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The Efficiency of Health Systems in Response to the COVID-19 Pandemic: Evidence from the EU Countries

Wydajność systemów opieki zdrowotnej w odpowiedzi na pandemię COVID-19: przykład krajów należących do UE

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Abstract

The COVID-19 pandemic has revealed the insufficient capacities and capabilities of countries around the world to deal with global infectious diseases and stressed the need to improve the international health security framework. An efficient and comprehensive health system that is able to cope with public health emergencies is an essential prerequisite for strengthening health security. The paper analyzes the efficiency of health systems in the European Union (EU) countries and their responsiveness to the COVID-19 pandemic. The research covers 27 EU countries and it is based on the secondary data contained in the 2019 Global Health Security Index Report. The aim of the paper is to identify key determinants for improving the efficiency of health systems in the EU, as well as to examine the interdependence between health expenditures and the efficiency of health system in this sample of countries. The research is conducted through descriptive statistics and correlation and regression analysis. The conclusions can be useful for the EU policy makers in formulating a strategy to improve the efficiency of Member States' health systems and preparedness for possible new pandemics.

Key words: efficiency, health system, health security, health expenditures, EU countries, COVID-19

Streszczenie

Pandemia COVID-19 ujawniła niewystarczające zasoby krajów na całym świecie do radzenia sobie z globalnymi chorobami zakaźnymi i podkreśliła potrzebę poprawy międzynarodowych ram bezpieczeństwa zdrowotnego. Wydajny i kompleksowy system opieki zdrowotnej, który jest w stanie poradzić sobie z sytuacjami kryzysowymi dotyczącymi zdrowia publicznego, jest niezbędnym warunkiem wzmocnienia bezpieczeństwa zdrowotnego. Artykuł analizuje efektywność systemów opieki zdrowotnej w krajach Unii Europejskiej (UE) i ich reakcję na pandemię COVID-19. Badanie obejmuje 27 krajów UE i opiera się na danych wtórnych zawartych w raporcie Global Health Security Index 2019. Celem artykułu jest identyfikacja kluczowych determinant poprawy efektywności systemów ochrony zdrowia w UE oraz zbadanie współzależności między wydatkami na zdrowie a efektywnością systemu ochrony zdrowia w tej grupie krajów. Badania uwzględniają statystyki opisowe oraz analizę korelacji i regresji. Wnioski mogą być przydatne dla decydentów UE przy formułowaniu strategii poprawy efektywności systemów opieki zdrowotnej państw członkowskich oraz gotowości na ewentualne nowe pandemie.

Słowa kluczowe: wydajność, system zdrowotny, bezpieczeństwo zdrowotne, wydatki na zdrowie, kraje UE, COVID-19

Introduction

Human health and ways to protect and improve it can be interpreted as the basic goals of humanity and as central issues in the research of theorists and practitioners in various fields. According to the World Health Organization, health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity. There is no doubt that humanity has significantly improved the quality of health in previous centuries. Today, most of the world's population has access to the water, sanitation, and hygiene. Numerous countries have built complex health care systems with the modern procedures and equipment that enable a healthy lifestyle of people. Global knowledge and experience in the field of health is expanding constantly and today is greater than ever before. However, health improvement is extremely unequal in a global perspective.

For example, a child born in Hong Kong can expect to live more than 84 years, while life expectancy of his peer in Ukraine is 72 years, and less than 54 years if child is born in Central African Republic (United Nations, 2020). Such huge inequalities in life expectancy across countries cannot be clarified through biology. Differences in health conditions between (and within) countries are a consequence of the economic and social policies that determine the environment in which people are born, grow, live, and work (Council of Europe, n.d.). Namely, the life expectancy and health care quality of population largely depend on the level of economic and social development.

The COVID-19 pandemic exposed the differences in the efficiency of health systems around the world, but also revealed the lack of global readiness to face public health emergencies. This pandemic has forced national economies across the globe to analyze their capacities and capabilities to prevent, detect, and quickly respond to the occurrence of infectious diseases and other acute forms of endangering the public health. Health systems that are able to respond effectively to such health threats have a significant advantage in reducing their negative health, social, and economic consequences.

The paper evaluates the efficiency of health systems in the 27 European Union (EU) countries in terms of prevention, detection, and rapid response to the pandemics on the example of COVID-19. The goal is to determine key factors in improving the efficiency of health systems in EU countries and, thus, enhance the health security of their citizens for possible new pandemics. Also, the paper considers the impact of health expenditures in EU countries on the efficiency of their health systems. The research findings can serve as guidelines for health policy makers in all EU countries.

The paper contains five separate segments. The first segment deals with the theoretical background and review of the literature on health security and effi-

ciency of the health system. The analysis of determinants of health system efficiency in the EU countries is presented in the second segment of the paper. Research methodology and hypotheses are defined in the third segment. The empirical results of the research are presented and discussed in the fourth segment. The last segment provides the concluding remarks and recommendations for improving the efficiency of health systems in the observed countries.

Theoretical background and literature review

Despite the fact that statistics show that the rate of infectious diseases in the EU countries has been declining in recent decades, sudden health shocks in the previous period have confirmed that threats to public health in the EU and the rest of the world exist permanently. Severe acute respiratory syndrome (SARS) in 2002, Swine flu pandemic (H1N1) in 2009, Escherichia Coli outbreak in Germany in 2011, Ebola virus disease in 2014, Zika in 2016, and, finally, COVID-19 in 2019 show that global threats through new infectious diseases can arise at any time and in any place.

Theoretical and empirical studies in the field of health system efficiency and health security of national economies demonstrate that this topic has attracted special attention of researchers at a time when the world was facing global challenges to public health. The occurrence of these studies in the last two decades can be attributed to efforts to explore and learn lessons from the consequences of the aforementioned infectious diseases. However, due to its global population coverage and duration, but also extremely pessimistic predictions about its social and economic consequences, it seems that the COVID-19 pandemic has caused the greatest attention of the professional and scientific public in recent history.

There is a broad consensus between researchers that the COVID-19 pandemic amplifies several problems of national economies and societies, which were serious and obvious even before (Anand et al., 2020; Ferrannini et al., 2021). A large number of studies published in the previous period (Jones et al., 2008; Morens et al., 2004; Morse et al., 2012; Webster, 1997) pointed to the catastrophic consequences that a possible global pandemic would have on international supply chains and cross-border economic cooperation, but also on individuals, welfare, and policies. Apparently, the COVID-19 pandemic threatens to exceed such predictions (Acemoglu et al., 2020; Albanesi & Kim, 2021; Alon et al., 2020; Glover et al., 2020; Boyce et al., 2021; Kandel et al., 2020; Kaplan et al., 2021; Stojanović-Jovanović et al., 2020). By the end of June 2021, more than 181 million confirmed cases of COVID-19 infection and more than 3.93 million deaths from the disease have been reported worldwide, while social and economic trends have completely shifted from their usual

Table 1. Health expenditure per capita in EU countries, PPP (current international \$), 2013-2018, source: World Bank (2021)

Country	Year						Average
	2013	2014	2015	2016	2017	2018	
Austria	4,945	5,083	5,206	5,476	5,674	5,879	5,377
Belgium	4,621	4,703	4,835	5,007	5,289	5,405	4,977
Bulgaria	1,186	1,349	1,355	1,468	1,575	1,634	1,428
Croatia	1,420	1,475	1,554	1,668	1,773	1,876	1,628
Cyprus	2,100	2,078	2,199	2,359	2,498	2,625	2,310
Czech Republic	2,380	2,472	2,442	2,522	2,753	3,041	2,602
Denmark	4,762	4,887	5,038	5,291	5,589	5,794	5,227
Estonia	1,650	1,770	1,866	2,009	2,230	2,428	1,992
Finland	4,069	4,084	4,099	4,212	4,340	4,457	4,210
France	4,547	4,659	4,692	4,943	5,110	5,250	4,867
Germany	4,953	5,193	5,355	5,574	5,931	6,098	5,517
Greece	2,163	2,100	2,149	2,239	2,274	2,340	2,211
Hungary	1,773	1,808	1,835	1,949	2,004	2,115	1,914
Ireland	4,949	4,962	5,079	5,365	5,617	5,897	5,311
Italy	3,216	3,210	3,266	3,417	3,572	3,624	3,384
Latvia	1,218	1,296	1,406	1,631	1,704	1,896	1,525
Lithuania	1,629	1,739	1,862	1,999	2,143	2,313	1,947
Luxembourg	5,346	5,574	5,547	5,675	5,870	6,048	5,677
Malta	2,767	3,157	3,374	3,541	3,891	3,897	3,438
Netherlands	5,219	5,214	5,205	5,280	5,499	5,635	5,342
Poland	1,575	1,627	1,717	1,851	1,979	2,015	1,794
Portugal	2,529	2,587	2,659	2,972	3,084	3,242	2,846
Romania	1,026	1,035	1,066	1,188	1,368	1,576	1,210
Slovak Republic	2,101	1,999	2,034	2,110	2,094	2,180	2,086
Slovenia	2,621	2,626	2,689	2,816	2,961	3,158	2,812
Spain	2,934	3,045	3,186	3,276	3,482	3,576	3,250
Sweden	5,073	5,193	5,331	5,396	5,636	5,828	5,410

flows. Also, according to Eurostat data on annual growth for 2020 (2021), GDP fell by 6.5% in the euro area and 6.1% in the EU.

Theoretical and empirical surveys that seek to explain the impact of the pandemic on economic and social developments in the world are constantly growing. Some of these studies explore the balance between minimizing adverse effects on human health and mitigating economic disruption in the global market (Alvarez et al., 2020; Jones et al., 2020). Others focus their research on measuring the impact of the pandemic on employment (Green & Loualiche, 2021), small and medium-sized enterprises (Bartik et al., 2020), financial markets (Ashraf, 2020; Mensi et al., 2020; Zhang et al., 2020), stock markets (Machmuddah, 2020; Ozkan, 2021), and public spending (Baker et al., 2020a; Baker et al., 2020b; Eichenbaum, 2020). The general conclusion of all mentioned studies is that the current health crisis will leave a deep mark in economic and social welfare on a global level, and that increasing the efficiency of health systems, which is reflected in the degree of resistance to such health shocks in the future, will be a necessary precondition for recovery and functioning in an international environment.

The concept of health system efficiency is quite controversial in practice and is very difficult to apply in a comparative analysis across countries (Cylus et al., 2017b; Reinhardt et al., 2002). There are not many attempts in the relevant literature to formulate

unique comparative measures (indicators) to be used in evaluating the effectiveness of national health systems. Furthermore, Cylus et al. (2017a) consider that all available studies have visible limitations, including a lack of a clear conceptual framework, limited data availability, and difficulties in selecting reliable and appropriate empirical techniques. Specifically, there is no consensus in the scientific community on the theoretical or statistical criteria that should be used to conduct such empirical analyses (Streetand & Hakkinen, 2009). Nonetheless, the health system efficiency is important as it *seeks to capture the extent to which the inputs to the health system, in the form of expenditures and other resources, are used to secure valued health system goals* (Cylus et al., 2017b: 7). It is the growing concern for policy makers and managers especially in the times of crises.

The analysis of determinants of health system efficiency in the EU countries

A) The analysis of financial support to the health system in the EU countries

Financial support to the health system is an important prerequisite for its building and development. The level of health expenditures in a national economy depends on numerous demographic, social, and economic factors, as well as the financial concept and organizational structure of the health sys-

tem itself. This clearly suggests that there are significant disparities in the level of health expenditures among countries in the EU. OECD and EU (2020) found that there is a strong correlation between national income and health expenditures, so high-income EU countries are typically those that spent the most on health. The same conclusion emerges from this paper through an analysis of health expenditures per capita in EU countries in the period 2014-2018 (Table 1).

According to the World Bank (2021) data, the average health expenditures per capita (adjusted for differences in countries' purchasing powers) of EU countries in the period 2013-2018 amounted to \$ 3,344. On average across EU member states, health expenditures have continuously increased from \$ 3,066 in 2013 to \$ 3,697 in 2018, which is an average growth of around 3.7% per year between 2013 and 2018. It is indicative that all EU countries achieved a positive growth of health expenditures in the observed period. However, Table 1 shows significant differences in the level of health expenditures in EU countries.

With average spending at \$ 5,677 per person, Luxembourg was the largest spending country in the EU, followed by Germany (\$ 5,517), Sweden (\$ 5,410), Austria (\$ 5,377), Netherlands (\$ 5,342), Ireland (\$ 5,311), and Denmark (\$ 5,227). Spending levels in the seven mentioned EU countries were at least 50% above the EU average (\$ 3,344). At the opposite end of the scale, Romania (\$ 1,210), Bulgaria (\$ 1,428), Latvia (\$ 1,525), and Croatia (\$ 1,628) were the lowest spenders in the EU region, with less than 50% of health expenditures compared to the EU average. Comparing the average annual investment in the health system of Luxembourg (as the leading EU country in terms of health expenditures) and Romania (as the country with the lowest health expenditures in the EU) shows a huge difference in financial support to health systems between EU member states. Namely, Luxembourg invested 4.7 times more in its health system in the observed period than Romania. Such large disparities in financial support to the health system over time necessarily lead to significant differences in health security conditions between countries.

B) The analysis of EU health systems responses to COVID-19

The COVID-19 pandemic is an unprecedented health, social, and economic shock that has surprised the world and the global economy. Countries across the EU region applied numerous and comprehensive responses to the virus, such as closing borders and total lockdown, but also providing masks, ventilators, and vaccines. However, coronavirus mortality and morbidity rates exist within the context of a national healthcare system and a population (World Bank, 2020). Table 2 presents data of John Hopkins

University (2021) on confirmed cases and deaths due to the COVID-19 virus in EU countries.

Table 2. Confirmed cases and deaths due to the COVID-19 in the EU countries, source: John Hopkins University 2021

Country	Cofirmed	Deaths	Deaths/ 100,000
Austria	649,576	10,680	120.31
Belgium	1,079,415	25,136	218.88
Bulgaria	421,032	17,990	257.89
Croatia	359,173	8,174	200.96
Cyprus	73,643	374	31.20
Czech Republic	1,666,025	30,280	283.79
Denmark	292,467	2,531	43.50
Estonia	130,806	1,268	95.58
Finland	94,334	967	17.52
France	5,819,088	110,900	165.37
Germany	3,730,126	90,400	108.74
Greece	418,342	12,542	117.04
Hungary	807,428	29,950	306.55
Ireland	269,037	4,979	100.76
Italy	4,252,976	127,270	211.07
Latvia	136,810	2,496	130.49
Lithuania	278,379	4,366	156.66
Luxembourg	70,516	818	131.96
Malta	30,589	420	83.56
Netherlands	1,706,611	18,007	103.89
Poland	2,878,767	74,828	197.07
Portugal	865,050	17,065	166.17
Romania	1,080,256	32,326	167.00
Slovak Republic	391,248	12,478	228.78
Slovenia	256,982	4,412	211.31
Spain	3,757,442	80,652	171.32
Sweden	1,084,636	14,574	141.70

According to John Hopkins University (2021) data presented in Table 2, a total of 32,600,754 confirmed cases of COVID-19 virus and 735,883 deaths from this infectious disease were registered in the EU region by June 22, 2021. Nevertheless, key parameters for evaluating the health system's readiness to identify, prevent, and respond to public health threats such as the COVID-19 pandemic lie in the mortality rate, i.e. in the number of deaths per 100,000 population.

With 306.55 deaths per 100,000 population, Hungary has the highest mortality in this population sample in the EU region, followed by Czech Republic (283.79 deaths), Bulgaria (257.89 deaths), Slovak Republic (228.78 deaths), Belgium (218.88 deaths), Slovenia (211.31 deaths), and Italy (211.07 deaths). Out of 180 countries in the world for which the above statistics are monitored, Hungary took the 2nd place, Czech Republic 4th place, Bulgaria 8th place, Slovak Republic 11th place, Belgium 12th, Slovenia 13th, and Italy 14th place in terms of deaths per 100,000 population. Therefore, even seven EU member states are in the top 14 countries in the world according to the number of deaths per 100,000 population. These data clearly confirm that the COVID-19 pandemic has exposed the insufficient

preparation and efficiency of some health systems in EU region to deal with major public health emergencies.

Methodology and hypotheses

The efficiency of health systems in the EU countries is observed through the prism of prevention, detection, and rapid response to pandemics and other forms of endangering public health. Capacities and capabilities for responding to pandemics are analyzed based on data presented in the Global Health Security Index Report, published by the Nuclear Threat Initiative and the Johns Hopkins Center for Health Security (2019). The Global Health Security Index is a comprehensive measure that shows the level of national preparedness to prevent and mitigate epidemics and pandemics (Ravi et al., 2020). The methodological framework for the Global Health Security Index calculation consists of 140 questions, grouped into 85 sub-indicators, 34 indicators and the following 6 categories: (1) Prevention; (2) Detection and reporting; (3) Rapid response; (4) Health system; (5) Compliance with international norms; and (6) Risk environment. Each of the above categories (as well as indicators, sub-indicators and questions) is scored on a scale from 0 to 100, where 0 represents the lowest and 100 the highest score in terms of national health security. Global Health Security Index Report 2019 covers 195 countries, including 27 EU national economies. Giving an answer to the defined aim implies testing the following hypotheses:

H1: Investments in health system have positive influence on the GHS Index.

H1.1. Health expenditure as % of GDP has positive impact on GHS Index.

H1.2. Health expenditure per capita has positive impact on GHS Index.

H2: Investments in health system have positive influence on the category Prevention of GHS index.

H2.1. Health expenditure as % of GDP has positive impact on the category Prevention of GHS index.

H2.2. Health expenditure per capita has positive impact on the category Prevention of GHS index.

H3: Investments in health system have positive influence on the category Health system of GHS Index.

H3.1. Health expenditure as % of GDP has positive impact on the category Health system of GHS Index.

H3.2. Health expenditure per capita has positive impact on the category Health system of GHS Index.

H4: The level of detection of health system increases the number of confirmed COVID-19 cases.

H5: The number of deaths from COVID-19 is influenced by the level of rapid response of health system and the number of confirmed COVID-19 cases.

For testing defined hypothesis regression and correlation analysis are performed. The list of used variables is presented in Table 3.

Table 3. List of used variables, source: authors' own work

Variable	Variable Type	Model
Global Health Security Index (GHSI)	Dependent	Model 1-2
Prevention (PREV)	Dependent	Model 3-4
Detection (DET)	Predictor	Model 7
Rapid Response (RESP)	Predictor	Model 8
Health System (HS)	Dependent	Model 5-6
Current health expenditure (% of GDP) (CHEgdp)	Predictor	Model 1-6
Current health expenditure per capita, PPP (current international \$) (CHEpc)	Predictor	Model 1-6
Confirmed cases (CONF)	Dependent	Model 7
	Predictor	Model 8
Deaths per 100,000 population (D100)	Dependent	Model 8

Empirical analysis and discussion

Data used in this study are from the Global Health Security Index (GHSI, PREVENT, DETECT, HS from 2019 Report), the Johns Hopkins University Coronavirus Resource Center (CONFIRMED, DEATHS from June 22, 2021) and the World Bank Development Indicators database (CHEgdp, CHEpc for the period 2013-2018). Our sample includes the 27 EU countries.

The descriptive statistics are presented in Table 4. The average current health expenditure as percent of GDP in the analyzed countries is 8.25 percent, while the least average value of 5.14 percent is recorded in Romania, and the highest average value of 11.44 percent is recorded in France. The average current health expenditure per capita in the analyzed countries is \$3,344.13 (PPP, current international \$), while the least average value of \$1,210.04 in 2013-2018 is recorded in Romania, and the highest value of \$5,676.73 is recorded in Luxembourg. The average number of confirmed COVID-19 cases is 1,207,435 and the minimum number of cases 30,589 is recorded on Malta, while the maximum is 5,849,088 in France. The average number of deaths per 100,000 population is 154.41 and the minimum number of deaths 17.52 is recorded in Finland, while the maximum is 306.55 in Hungary. As regards the GHSI the average value in the EU countries is 57.63, the minimum of 37.30 is recorded on Malta, and the maximum of 75.6 in Netherlands.

Correlation results are presented in Table 5. Results show that correlation between GHSI and current health expenditure as percent of GDP is positive, strong, and statistically significant (0.6455). Also, the correlation between GHSI and current health expenditure per capita is positive, moderate, and statis-

Table 4. Descriptive Statistics, source: Authors' calculations

Variable	Minimum	Maximum	Mean	Std. Dev.
GHSI	37.3	75.6	57.6259	9.8041
PREV	31.0	81.1	55.7852	12.2367
DET	32.9	97.3	67.3148	17.1563
RES	21.7	79.1	49.0593	15.6462
HS	21.9	70.2	45.4259	12.2922
CHEgdp	5.14	11.44	8.2493	1.8582
CHEpc	1,210.04	5,676.73	3,344.13	1,562.17
CONF	30,589	5,849,088	1,207,435	1,530,668
D	17.52	306.55	154.41	72.71

Table 5. Correlations, source: Authors' calculations

	GHSI	PREV	DET	RESP	HS	CHEgdp	CHEpc	CONF	D
GHSI	1								
PREV	0.8763*	1							
DET	0.7699*	0.5914*	1						
RESP	0.8514*	0.7015*	0.5468*	1					
HS	0.8431*	0.7131*	0.4831*	0.6551*	1				
CHEgdp	0.6455*	0.6774*	0.3565	0.4631**	0.5957*	1			
CHEpc	0.4958*	0.5001*	0.2524	0.2917	0.4674**	0.7214*	1		
CONF	0.3384	0.2339	0.2654	0.2876	0.3301	0.4373**	0.2226	1	
D	-0.1961	-0.1854	-0.1916	-0.1897	-0.0626	-0.2246	-0.4029**	0.2197	1

Note: * Correlation is significant at the 0.01 level (2-tailed), ** Correlation is significant at the 0.05 level (2-tailed)

Table 6. Regression results

Model 1	Constant	CHEgdp	R ²		Adjusted R ²
ln GHSI	3.5590 [27.98] (0.000)	0.00582 [3.87] (0.001)	0.3743		0.3493
			F statistics		
Model 2	Constant	ln CHEpc	R ²		Adjusted R ²
ln GHSI	2.7221 [5.38] (0.000)	0.1646 [2.61] (0.015)	0.2142		0.1827
			F statistics		
Model 3	Constant	CHEgdp	R ²		Adjusted R ²
ln PREV	3.3419 [20.74] (0.000)	0.0794 [4.16] (0.000)	0.4095		0.3859
			F statistics		
Model 4	Constant	ln CHEpc	R ²		Adjusted R ²
ln PREV	2.4709 [3.65] (0.001)	0.1907 [2.26] (0.033)	0.1691		0.1359
			F statistics		
Model 5	Constant	CHEgdp	R ²		Adjusted R ²
ln HS	3.0836 [14.05] (0.000)	0.0842 [3.24] (0.003)	0.2958		0.2676
			F statistics		
Model 6	Constant	ln CHEpc	R ²		Adjusted R ²
ln HS	1.8815 [2.22] (0.035)	0.2371 [2.25] (0.034)	0.1679		0.1346
			F statistics		
Model 7	Constant	ln DET	R ²		Adjusted R ²
ln CONF	5.4736 [1.43] (0.166)	1.8511 [2.02] (0.054)	0.1400		0.1056
			F statistics		
Model 8	Constant	ln RESP	Ln CONF	R ²	Adjusted R ²
ln D	3.7369 2.94] (0.007)	-0.8038 [-2.50] (0.020)	0.3205 [3.95] (0.001)	0.4087	0.3595
				F statistics	

Note: t values are given in [], p values are given in ()

tically significant (0.4958). Additionally, the positive strong statistically significant correlation exists between prevention and current health expenditure either as percent of GDP (0.6774) or per capita (0.5001). The correlation between Health System and current health expenditure as percent of GDP is positive, strong, and statistically significant (0.5957), while between Health System and current health expenditure per capita is positive, moderate, and statistically significant (0.4674). The correlation between current health expenditure as percent of GDP and confirmed cases is positive, moderate, and statistically significant (0.4373), while between current health expenditure per capita and deaths per 100,000 population exists negative, moderate, and statistically significant correlation (-0.4029).

The regression results are presented in Table 6. First two models explain the effects of current health expenditures on GHS index. Model 1 analyses the impact of current health expenditure as percent of GDP (CHEgdp) on GHS index in 27 EU countries and confirms the positive and statistically significant impact as we expected. If the current health expenditure as percent of GDP increases by 1 percent, the GHS index will increase by 0.58 percent. The estimated model explains 37.43 percent change in GHS index and this model is statistically significant as confirmed by the F test ($p < 0.01$). Model 2 explains the effects of current health expenditure per capita (CHEpc) on GHS index and also confirms the positive and statistically significant impact. If the current health expenditure per capita increases by 1 percent, the GHS index will increase by 0.16 percent. The estimated model explains 21.42 percent change in GHS index and this model is statistically significant as confirmed by the F test ($p < 0.05$). The results of these models suggest towards accepting the H1.1. and H1.2. hypotheses, and hence towards overall accepting the H1 hypothesis.

Following two models explain the effects of current health expenditures on Prevention. Model 3 analyses the impact of current health expenditure as percent of GDP (CHEgdp) on Prevention and confirms the positive and statistically significant impact as we expected. If the current health expenditure as percent of GDP increases by 1 percent, the Prevention will increase by 7.94 percent. The estimated model explains 40.95 percent change in Prevention and this model is statistically significant as confirmed by the F test ($p < 0.01$). Model 4 explains the effects of current health expenditure per capita (CHEpc) on Prevention and also confirms the positive and statistically significant impact. If the current health expenditure per capita increases by 1 percent, the Prevention will increase by 0.19 percent. The estimated model explains 16.91 percent change in Prevention and this model is statistically significant as confirmed by the F test ($p < 0.05$). Therefore, we can accept the hypotheses H2.1. and H2.2., and overall, the H2 hypothesis.

Next two models explain the effects of current health expenditures on Health System. Model 5 analyses the impact of current health expenditure as percent of GDP (CHEgdp) on Health System and confirms the positive and statistically significant impact as we expected. If the current health expenditure as percent of GDP increases by 1 percent, the Health System will increase by 8.42 percent. The estimated model explains 29.58 percent change in Health System and this model is statistically significant as confirmed by the F test ($p < 0.01$). Model 6 explains the effects of current health expenditure per capita (CHEpc) on Health System and also confirms the positive and statistically significant impact. If the current health expenditure per capita increases by 1 percent, the Health System will increase by 0.23 percent. The estimated model explains 16.79 percent change in Health System and this model is statistically significant as confirmed by the F test ($p < 0.05$). These results point towards acceptance of hypotheses H3.1. and H3.2. and hence, the H3 is confirmed as well.

Model 7 analyses the impact of Detection on Confirmed cases of COVID-19. The results confirm that 1 percent increase in Detection leads to the increase in Confirmed cases by 1.85%. The estimated model explains 14 percent change in Confirmed cases and it is statistically significant as confirmed by the F test ($p < 0.10$). Finally, Model 8 investigates the effects of Rapid Response and Confirmed cases on the Deaths per 100,000 population. The results show that 1 percent increase in Rapid Response leads to the 0.80 percent decrease in the Deaths per 100,000 population, while the 1 percent increase in Confirmed cases results in the increase of the Deaths per 100,000 population by 0.32 percent. The estimated model explains 40.89 percent change in Deaths per 100,000 population and this model is statistically significant as confirmed by the F test ($p < 0.01$). These results enable us to verify the hypotheses H4 and H5.

The results obtained in this study undoubtedly confirmed that investments in health systems are important in determining their overall efficiency and responsiveness to the pandemics. Higher investments in health systems improve the capacities and capabilities of the health systems to prevent, detect and rapidly response to the pandemics, thus strengthening the health security of all citizens and reducing the number of deaths. These results correspond to the conclusions drawn by Dyakova et al. (2017: x) that investments for health and well-being are priority for strengthening *public health systems, capacities and services to ensure national and global health security*. Furthermore, the OECD (2020) study stresses the need to pursue the health system strengthening in parallel with the health security efforts for prevention, detection, and rapid response to pandemics in order to develop resilient health systems. Health systems resilience implies the capacities of the health institutions and staff to effectively respond and manage crisis, without jeopardizing their core operations

(Lal et al., 2021). The COVID-19 pandemic more than ever raised the question of aligning all health system capacities and capabilities towards preventing pandemics, while continuing principal health services at satisfactory level.

Conclusion

Global COVID-19 pandemic has raised the question of the efficiency of health systems around the world and their preparedness to deal with unforeseen events and circumstances. These issues have become even more important for policy makers and managers due to the financial concerns regarding the continuing economic sustainability and resilience of health systems. The countries' responses to COVID-19 have been diverse, mainly dependent on the resilience of their health systems, and are still contextual and ongoing issues. Considering all this, our intention was to contribute to the existing discussion and give insights regarding efficiency of health systems. We investigated the efficiency of the health systems in the EU countries, as well as their responsiveness to the COVID-19 pandemic.

The efficiency of the health system is assessed based on the Global Health Security Index, as the overall measure, and its main categories – prevention, detection, rapid response, and health system, showing the countries' readiness for prevention and mitigation of pandemics and other health threats. The key determinants impacting the overall efficiency of the health system, as well as prevention and health system capacity are investments in health system. The correlation analysis results determined positive, statistically significant correlation between health expenditures, either as percent of GDP or per capita, and GHS index, Prevention and Health System. The results of the regression analysis revealed positive, statistically significant impact of health expenditures on these efficiency measures. Hence, the first three hypotheses of this study were confirmed.

Further, the results of the study determined the positive impact of detection capacity of health system on the confirmed cases of COVID-19 pandemics, as well as the impact of rapid response capability of the health system on reducing the number of deaths per 100,000 population. Thus, the last two hypotheses were also verified.

As the level of health expenditures in an economy depends on diverse demographic, social, economic, and organizational factors, there are significant disparities among countries regarding the level of health expenditure. The analysis revealed that, although the health expenditures exhibit positive trend at an average rate of 3.7% per year for the period 2013-2018, the high-income EU countries invest more in their health systems, than the low-income EU countries. The comparison between the leading EU country in terms of health expenditures (Luxembourg) and the country with the lowest health ex-

penditures (Romania) showed that investments in health system in Luxembourg are 4.7 times bigger than in Romania.

Based on all the above mention, it is evident that empirical findings in this study could be valuable for policy makers in the EU countries in drafting strategies and defining measures and activities aimed at increasing the efficiency and responsiveness of their health systems. Significant attention should be given to the health systems funding, as it is proven that investments in health systems lead to their increased efficiency and resilience. Therefore, it is clear that building comprehensive health systems, with stable public financing and embedded core capacities, will provide the stronger resilience and defense against the future unpredictable pandemics.

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Efficiency Assessment of Tax Measures in the European Countries Against the Effects of COVID-19

Ocena efektywności systemów podatkowych w Europie wobec skutków pandemii COVID-19

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Abstract

Ongoing global Covid-19 pandemic is not only health crisis but the economic challenge. The future of society depends on how successfully the authorities find a balance between imposition of stringent restrictions and economic development. Tax policies play a role in reducing losses caused by the Covid-19 lockdowns. All countries are taking tax measures to mitigate the impact of the effects of Covid-19 pandemic on society. While the Covid-19 pandemic has not yet been defeated, it is too early to draw conclusions about which tax measures against the effects of Covid-19 are efficient. On the other hand, correct trajectory of economic recovery can be missed if not to analyze the other countries experience. The object of this study is tax measures in the European countries against the effects of Covid-19. The subject of the study is the fuzzy set theory to assess the efficiency of tax measures in the European countries against the effects of Covid-19. The aim of the study is to find out which European countries have been more succeeded in tax measures implementing and type of their immediate crisis response. The analysis is carried out in 29 European countries. The result of the study allows to state that the number of tax measures against the effects of Covid-19 does not affect their efficiency and the most popular type of immediate crisis response has been the business cash-flow enhances.

Key words: Covid-19 (Coronavirus) pandemic, GDP per capita, type of tax, type of immediate crisis response, fuzzy set theory

Streszczenie

Trwająca globalna pandemia Covid-19 to nie tylko kryzys zdrowotny, ale także wyzwanie gospodarcze. Przyszłość społeczeństw zależy od tego, jak skutecznie władze osiągną równowagę między nakładaniem surowych ograniczeń a rozwojem gospodarczym. Polityka podatkowa odgrywa rolę w ograniczaniu strat spowodowanych przez ograniczenia związane z Covid-19. Wszystkie kraje podejmują inicjatywy podatkowe w celu złagodzenia wpływu pandemii Covid-19 na społeczeństwo. Chociaż pandemia Covid-19 nie została jeszcze pokonana, jest zbyt wcześnie, aby wyciągać wnioski na temat tego, które środki podatkowe przeciwko skutkom Covid-19 są skuteczne. Z drugiej strony można przeoczyć prawidłową trajektorię ożywienia gospodarczego. Przedmiotem tego badania są inicjatywy podatkowe podejmowane w krajach europejskich przeciwko skutkom Covid-19. Przedmiotem badania jest teoria zbiorów rozmytych wykorzystana do oceny skuteczności środków podatkowych w krajach europejskich wobec skutków Covid-19. Celem badania jest ustalenie, które kraje europejskie odniosły większe sukcesy we wdrażaniu środków podatkowych oraz rodzaju ich natychmiastowej reakcji na kryzys. Analiza prowadzona jest w 29 krajach europejskich. Wynik badania pozwala stwierdzić, że liczba inicjatyw podatkowych przeciwko skutkom Covid-19 nie wpływa na ich skuteczność, a najpopularniejszym rodzajem natychmiastowej reakcji na kryzys jest zwiększenie przepływów pieniężnych przedsiębiorstw.

Słowa kluczowe: pandemia Covid-19 (koronawirusa), GDP per capita, typ podatku, rodzaj natychmiastowej reakcji kryzysowej, teoria zbiorów rozmytych

Introduction

The Covid-19 pandemic has challenged the daily lives of all citizens of the world. To slow the Covid-19 spread, lockdown was introduced in the most countries of the world. All European countries had the lockdown for different periods of time both in 2020 and 2021. In the European countries the first lockdown started in Ireland on the 7th of March 2020, the next day Finland joined it. By mid-March, almost all European countries introduced pandemic restriction.

Only one full national lockdown was in Albania, Estonia, Finland, Hungary, Montenegro, Romania, Spain, and Ukraine. The longest one was in Albania (80 days) and the shortest in Finland (20 days). The second nationwide lockdown was at the end of December 2020 in Croatia, Czech Republic, Denmark, Lithuania Netherlands, Portugal, and Switzerland. By regions lockdown was in Germany and Greece and lasted 218 and 181 days respectively. About a year after the first lockdown, several European countries decided on the third lockdown, including Austria, Belgium, Bulgaria, France, Ireland, Italy, Poland, and United Kingdom. In France and United Kingdom lockdown was for regions only. The longest was in Wales for 345 days (statista).

In Europe the first full lockdowns implied not only significant restrictions in public life, but also the shutdown of business. During the second and third lockdowns some European countries have eased restrictions, opening shops and other businesses. Other European countries have switched on the curfew regime for some types of business.

For today the European countries have agreed on a coordinated approach to the movement between countries, vaccination, period of quarantine, but the crisis response for economic recovery was its own.

Among immediate crisis response the most popular has been corporate income tax regulation, value added tax regulation, and personal income tax regulation.

The largest number of measures for corporate income tax regulation was implemented in Poland, none of them in Estonia, Greece, Ireland, Latvia, Montenegro, Slovenia, Switzerland, and Ukraine. Measures to support health system through reducing value added tax and tax payment deferral for business were implemented in almost all European countries, excepting Albania, Denmark, Estonia, Lithuania, Montenegro, Romania, Slovak Republic, and Switzerland. Personal income tax was not regulated in Denmark, Estonia, Finland, Hungary, Moldova, Romania, Serbia, Slovenia, Switzerland, and Ukraine. Least of tax measures were taken in Ukraine (only extension of deadlines for filing income tax returns and asset tax returns) and Latvia (exemption from the advance payments for the taxation year 2020 and extending the rights of the tax administration to divide into time periods), and most of all in Poland (63 tax measures). (Overview of Country Tax Policy measures in response to Covid-19 crisis)

As the lockdown conditions and tax measures are different for European countries, the pandemic consequences are also different. To assess the tax measures efficiency in the European countries against the effects of Covid-19 should be used GDP per capita. Advantage of this index is that it is easy to compare across countries (world databank). The main markers that could indicate tax measures efficiency are presented in the figure 1.

It can be assumed that there should be a relationship between the duration of lockdown and the tax measures. Since the longer the full national lockdown, the higher the likelihood of business bankru-

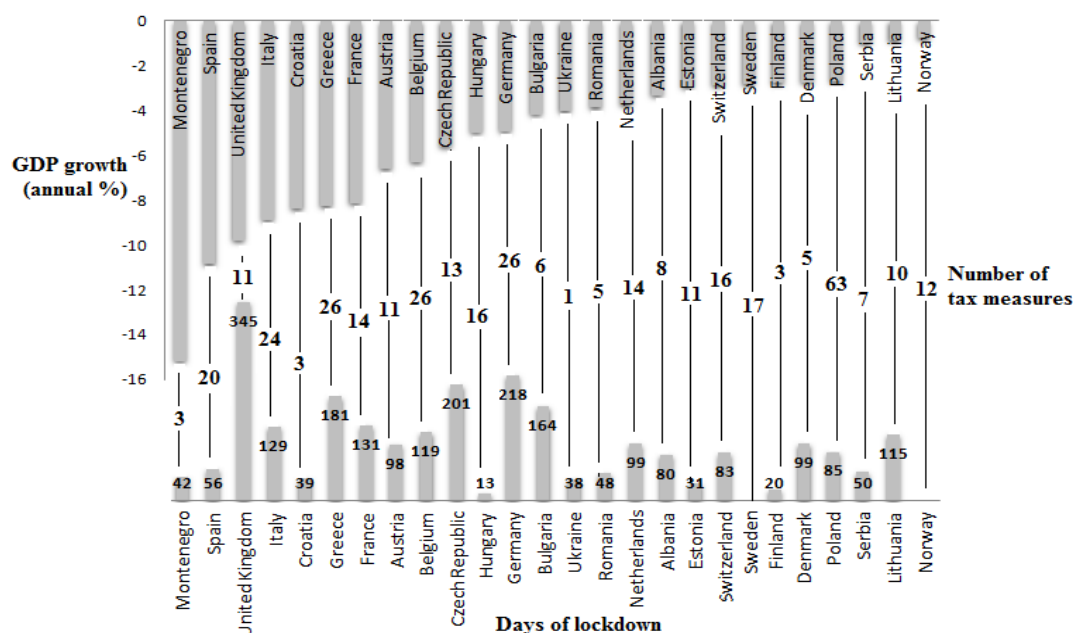


Figure 1. Annual GDP growth in 2020, duration of lockdown and tax measures the European countries (World Bank, 2021)

ptcy and a GDP decline. To prevent it government should take support measures. As it can be seen from Fig. 1, no such pattern is observed. For example, the highest GDP decline is in Montenegro, but there is no long duration of lockdown. Norway implemented 12 tax measures and has the lowest GDP decline. But the other side, Poland implemented 63 tax measures but its GDP decline is higher than in Norway.

The statistical data allow concluding that the key factor affected efficiency of tax measures against the effects of Covid-19 is its qualitative features but not quantitative estimates. Hence, it is of interest to identify those European countries that have succeeded in tax measures implementing.

Background

For today most international organizations have made the overviews of the tax measures introduced during the COVID-19 crisis.

The Organization for Economic Co-operation and Development (OECD) has developed guidance for policymakers. In it tax policy responses G20 countries and 21 additional members of the OECD/G20 are examined. The conclusions concerns that, on the one hand, strong and timely fiscal support has been key factor to incomes support and keeping businesses afloat and tax packages have focused on recovery-oriented measures, on the other hand, many countries have introduced new tax increases. To a great extent, it applies to developing countries that have a few opportunities to provide fiscal support to households and businesses (Tax policy during the COVID-19 pandemic, 2021).

The next step for OECD has been to develop targeted and temporary tax policy that governments could implement as part of their immediate Covid-19 response (Tax Policy Reforms, 2021).

The International Chamber of Commerce (ICC) in its statements provides expertise for coordinated global response to effectively contain the potential human and economic toll of the COVID-19 pandemic based on its broad network of 45 million businesses. As for tax measures ICC offers for tax administrations to provide an assurance of relief from penalties and interest and deferral or waive of tax payments during pandemic especially for small businesses (ICC statement on related tax measures in response to COVID-19, 2021).

Executive branch of the European Union European Commission (EC) in its communication considerate how to coordinate fiscal policy, taking to the next phase the concerted approach of addressing the pandemic, sustaining the economy, supporting a sustainable recovery and maintaining fiscal sustainability in the medium-term. EC forecasts that Real GDP would reach pre-crisis levels in the second quarter of 2022 but it could not return to its pre-crisis trend by the end of 2022. The recovery is not going to be the same across the European countries. The main national fiscal policy responses were cheap loans to Member States to help them to support workers. In 2020, the Council approved EUR 90 billion for 18 Member States supporting. For the Member States worst affected by the economic fallout of the Covid-19 pandemic EUR 312.5 billion of non-repayable support and would be provided (One year since the outbreak of COVID-19: fiscal policy response, 2021).

One of the largest multinational accounting firm PricewaterhouseCooper (PWC) have gathered and constantly updated tax relief measures that governments have implemented to help business and householders during the Covid-19 pandemic. Information concludes data about personal tax, corporate and other taxes, customs and trade, and compliance and labor (PWC, 2021).

On the one hand, analyzed overviews provides a general idea of taxation trends under Covid-19 pandemic conditions, but, on the other hand, they does not help find out the best way of addressing country's own specific tax challenges. This is due to the fact that, despite the extensive statistical base, methods of analysis and evaluation are not used. The wide range of measures implemented by governments poses a challenge to analysts to compare these policies over time or between countries. In scientific papers attempts to solve this problem have been made. Oxford University's Blavatnik School of Government has offered an approach to assess policy responses around the world. The data are tracked since 1 January 2020, cover more than 180 countries and are coded into 23 indicators. These indicators are recorded on a scale to reflect the extent of government action, and scores are aggregated into a set of policy indices (Blavatnik School of Government, 2021).

In paper (Morales, Rogers-Glabush, 2020) has been made an overview of the tax response of 47 European countries to the challenges imposed by the COVID-19 pandemic. Authors have grouped national measures into categories according to the purpose of each measure and analyzed next steps that should be taken to address the pandemic.

Despite the fact that the COVID-19 pandemic lasts just over a year tax measures in the European countries against the effects of Covid-19 have already been implemented. Relevant reviews of both international organizations and scientific communities have already been published. On the one hand, period of COVID-19 pandemic is too short to assess the efficiency of these tax measures. It means that it is too early to draw final conclusions. On the other hand, a methodological apparatus that would allow assess intermediate results of the tax measures efficiency has been developed.

From here the aim if this paper is to assess the efficiency of tax measures in the European countries against the effects of Covid-19.

Research methodology

The problem of efficiency assessment of tax measures against the effects of Covid-19 refers to decision-making under conditions of uncertainty. As a rule, to solve such problems the theory of probability is used. In the case of the Covid-19 pandemic, theory of probability is useless. The reason for this is the

lack of available data, which does not allow assessing with a sufficient degree of certainty the adequacy of the probabilistic model chosen to describe efficiency of tax measures in the European countries against the effects of Covid-19.

If there is no opportunity to use the statistical analysis methods assessing tax measures against the effects of Covid-19 (Kozlovskiy et. al., 2020), then the source of information is expert assessments. In such conditions, to assessing the existing uncertainty there is a need to use different from probabilistic approach. One of them is fuzzy set theory.

Fuzzy sets were introduced by Zadeh in 1965 as a apparatus for processing natural language utterances (Zadeh, 1965). This theory allows the expert assessment's phrases *the tax measures efficiency against the effects of Covid-19 is quite high* give a specific mathematical meaning. This makes possible to reduce qualitative expert assessments to quantitative. On the other hand, fuzzy sets provide an expert with great flexibility in evaluating numerical indicators. With regard to the problem of efficiency assessment of tax measures in the European countries against the effects of Covid-19 using the theory of fuzzy sets, it is necessary to solve the following problems:

- to define universal set;
- to construct membership functions;
- to make fuzzy decision where tax measures against the effects of Covid-19 were the most effective (Kozlovskiy et. al., 2019).

Practical use of the theory of fuzzy sets involves constructing membership functions. Its task is to describe in linguistic term the fuzzy set on a universal set $U=\{u_1, \dots, u_n\}$. The fuzzy set is Covid-19 crisis response tax measures. It is proposed to use the number of tax measures in the European countries against the effects of Covid-19 as a universal set.

The next step is to the construct membership function of a fuzzy set *Covid-19 crisis response measures* on the universal set (Kozlovskiy et. al., 2021).

There are two methods of constructing membership functions. The first one is based on statistical processing of the opinions of a group of experts. The second one is based on pairwise comparisons performed by one an expert (Zimmermann, 2010). Since it is not possible to involve many experts and the results of comparisons are obvious, pairwise comparisons should be used for the efficiency assessment of tax measures in the European countries against the effects of Covid-19. For each pair of elements of a universal set, the advantage of one element over the other is given. Pairwise comparisons are convenient to represent by the following matrix:

$$A = \begin{bmatrix} a_{11} & \dots & a_{1n} \\ \dots & \dots & \dots \\ a_{n1} & \dots & a_{nn} \end{bmatrix}. \quad (1)$$

where a_{ij} is the level of the element's advantage universal set's element u_i over u_j defined on the 9-point comparison scale by Saaty.

When comparisons are made, it is important to determine whether the more Covid-19 crisis response measures, the better. To determine it, it is necessary to find a relationship between the number of Covid-19 crisis response measures and the change in GDP per capita at the same period. The larger the GDP per capita, the more successful the Covid-19 crisis response measures are.

After determining all the elements of the matrix of pairwise comparisons, the degree fuzzy set membership is calculated by the formula:

$$\mu(u_i) = \frac{1}{a_{1i} + \dots + a_{ni}}. \quad (2)$$

After the membership function of a fuzzy set on the universal set is constructed, it is necessary to make a decision. To make fuzzy decision is to choose European countries where Covid-19 crisis response measures are the best under conditions of uncertainty and lack of information.

Results

To assess the effectiveness of tax measures in the European countries against the effects of Covid-19 using fuzzy set theory it is necessary to define universal set. As it was shown on Fig.1 the number of tax measures is from 1 in Ukraine to 63 in Poland. 3 out of 29 countries limited themselves to 26 measures, which is almost 2.5 times less than in Poland. From here the universal set is from 0 to 30 with a step of 6. Poland's experience is at the upper end of the universal set.

For constructing membership function of a fuzzy set *Covid-19 crisis response measures* on the universal set $U=\{0, 6, 12, 18, 24, 30\}$ expert pairwise comparisons should be formulated.

Since it is completely unclear whether more or fewer Covid-19 crisis response measures are better, then it is necessary to determine the minimum, maximum and average value of GDP per capita for each range of the universal set. The first diapason is from 0 to 5 Covid-19 crisis response measures. In it are Ukraine, Latvia, Croatia, Finland, Montenegro, Denmark, Moldova, and Romania. The second diapason is from 6 to 11 Covid-19 crisis response measures. In it are Bulgaria, Serbia, Albania, Slovak, Republic Lithuania, Austria, Estonia, and United Kingdom. In the diapason from 12 to 17 measures are Norway, Czech, Republic France, Netherlands, Hungary, Switzerland, and Sweden. There are no countries in diapason from 18 to 24 measures. The last diapason includes countries such as Spain, Italy, Belgium, Germany, Greece, and Poland. Data is taken from Fig. 1. Relationship between the number of Covid-19 crisis response measures and the change in GDP per capita in 2020 as the results of grouping by diapasons are presented in the table 1.

It can be seen from table 1 that diapasons $U=\{6, 17\}$ has the advantage. A weak advantage can be determined of diapasons $U=\{12, 17\}$ over diapasons

$U=\{6, 11\}$. From here such expert pairwise comparisons can be formulated:

- absolute advantage of $U=\{12, 17\}$ over $U=\{0, 5\}$;
- clear advantage of $U=\{18, 30\}$ over $U=\{0, 5\}$;
- significant advantage $U=\{12, 17\}$ over $U=\{18, 30\}$;
- weak advantage of $U=\{12, 17\}$ over $U=\{6, 11\}$.

These statements correspond to the following pairwise comparisons matrix:

$$A = \begin{bmatrix} 1 & 0,11 & 0,11 & 0,14 \\ 9 & 1 & 0,33 & 0,2 \\ 9 & 3 & 1 & 0,2 \\ 7 & 5 & 5 & 1 \end{bmatrix} \quad (3)$$

Applying formula (1), the grade of membership is determined. To normalize a fuzzy set, all the grades of membership should be divided by the maximum value. The graphs of the membership functions of the normal fuzzy set *Covid-19 crisis response measures* are shown in Fig. 2.

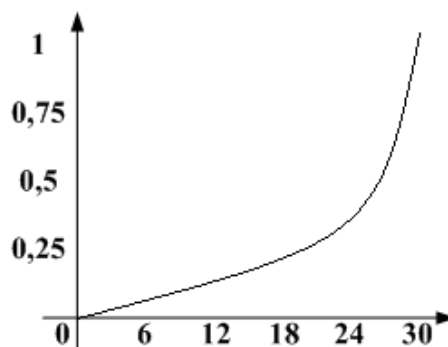


Figure 2. The graphs of the membership functions of the fuzzy set *Covid-19 crisis response measures*

As it can be seen, a large number of Covid-19 crisis response measures do not guarantee their effectiveness. European countries that are successfully recovering from Covid-19 pandemic have implemented from 6 to 18 measures. It is likely that the content of Covid-19 crisis response measures does not increase with their number. At the same time, the number of measures less than six does not allow to overcome the crisis consequences caused by the pandemic.

European countries can be roughly divided into 2 groups. In the first group there are countries that have focused on three main types of taxes, such as corporate income tax (CIT), corporate income tax (PIT), value-added tax (VAT). These countries are Albania, Austria, Bulgaria, Czech, Netherlands, Norway, Lithuania, and Slovak. In the first place among tax measures in these countries against the effects of Covid-19 is VAT and CIT. The second group includes countries that have introduced unique experiences based on their political traditions and economic realities. There are Estonia, Hungary, France, Serbia, Sweden, Switzerland, and United Kingdom. In all European countries where the tax measures against the effects of Covid-19 have been more suc-

Table 1. Relationship between the number of Covid-19 crisis response measures and the change in GDP per capita in 2020

The universal set $U=\{0, 6, 12, 18, 24, 30\}$	GDP per capita growth, annual %		
	minimal	average	maximum
Diapason $U=\{0, 5\}$	-15,16	-5,94	-2,73
Diapason $U=\{6, 11\}$	-9,79	-4,17	-0,87
Diapason $U=\{12, 17\}$	-8,11	-4,12	-0,76
Diapason $U=\{18, 30\}$	-10,84	-6,97	-2,70

Table 2. List of more successful tax measures in the European countries against the effects of Covid-19

	Type of tax				Type of immediate crisis response				
	CIT	PIT	VAT	Other	business cash-flow enhance	household cash-flow enhance	health system support	employment support	other
Albania	4	1	-	3	4	3	-	1	-
Austria	1	5	2	3	4	1	5	1	-
Bulgaria	1	1	1	3	2	1	1	1	1
Czech	3	3	9	2	5	2	1	-	9
Estonia	-	-	-	11	4	-	-	-	7
Hungary	2	-	1	13	4	1	5	-	3
Netherlands	3	1	3	7	12	-	2	-	-
Norway	2	2	2	6	10	-	-	-	2
France	1	1	1	11	9	-	1	-	4
Lithuania	3	1	6	-	3	-	1	1	5
Serbia	1	1	1	4	3	2	1	1	-
Slovak	4	1	-	2	6	1	-	-	-
Sweden	2	2	2	11	6	2	2	3	4
Switzerland	-	-	-	16	10	-	-	-	6
United Kingdom	2	1	2	6	5	1	1	1	3

successful the most popular type of immediate crisis response has been the business cash-flow enhances. Only Czech, Estonia, and Lithuania have preferred not typical than business cash-flow and household cash-flow enhance, health system and employment support types of immediate crisis response.

Discussion

Efficiency assessment of tax measures in the European countries against the effects of Covid-19 refers to multiobjective decision making. In this paper GDP per capita is used as the only criterion. On the one hand, this approach to efficiency assessment of tax measures against the effects of Covid-19 narrows the result. On the other hand, there are reliable and easy comparable statistics on GDP per capita. It makes results of efficiency assessment is more trustworthy.

The other point of discussion is the universal set division of diapasons. In this paper it was proposed to use step 6 for expert pairwise comparisons and membership functions construction. If the step were more or less, then the relationship between the number of Covid-19 crisis response measures and the change in GDP per capita could be different. If to sort the European countries by the number of tax measures, and plot the graph by GDP per capita, then the trend in the middle of the graph towards a decrease in the decline in GDP is seen. It means that the size of the diapason has no fundamental effect.

In addition, European countries were not initially in the same conditions when the Covid-19 pandemic had started. Less developed countries did not have sufficient safety margin to implement Covid-19 crisis response measures as developed countries could afford themselves. The political systems of European countries have their own features that affect the speed of decision-making. Different European countries, applying exactly the same experience, can get different results. That's why as a methodology, it is proposed to use the theory of fuzzy sets, which does not indicate the only correct solution, but suggests for study just list of more successful tax measures in the European countries against the effects of Covid-19.

Conclusion

Assessing the efficiency of tax measures in the European countries against the effects of Covid-19 using the fuzzy set theory let make such conclusions:

- the number of tax measures against the effects of Covid-19 does not affect their efficiency;
- the most advantageous number of tax measures against the effects of Covid-19 is from 6 to 18;
- European countries that have succeeded in tax measures implementing are Albania, Austria, Bulgaria, Czech, Estonia, France, Hungary, Lithuania, Netherlands, Norway, Serbia, Slovak, Sweden, Switzerland, and United Kingdom;

- European countries that have implemented from 6 to 18 tax measures equally either preferred value-added tax and corporate income tax regulation or have introduced their unique experience;
- the most popular type of immediate crisis response has been the business cash-flow enhances in European countries that have implemented from 6 to 18 tax measures.

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Formation of Sustainable Investment Attractiveness of Regions Under the Conditions of COVID-19

Kształtowanie zrównoważonej atrakcyjności inwestycyjnej regionów w warunkach pandemii COVID-19

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Abstract

The decline in the forecast indicators of the economy and production activity, the structural transformation of international production and consumer preferences, the reduction in income from bonds and world tourism, the massive layoffs of workers that led to an increase in unemployment and a decrease in household income, deferred investments and the reorientation of investment flows, both in economic sectors and in the regional context, are all the result of the impact of another challenge called Covid-19. The Covid-19 pandemic has changed and continues to change many characteristics of the economy and society. Together with the onset of the Fourth Industrial Revolution and the transition to the digital era, as well as taking into account completely new realities of the development of future generations, which are regulated by the concept of sustainable development, the formation of investment attractiveness is also taking place in a fundamentally different way. In this regard, the article substantiates the need to introduce the category *sustainable investment attractiveness* into everyday use. The author's vision of the interpretation of this concept is presented. A procedure for forming a stable investment attractiveness of regions in the conditions of Covid-19 has been developed.

Key words: investment risks, investment potential, sustainable investment attractiveness of regions, sustainable development, Covid-19

Streszczenie

Spadek prognozowanych wskaźników gospodarki i działalności produkcyjnej, strukturalne przekształcenia produkcji międzynarodowej i preferencji konsumentów, zmniejszenie dochodów z obligacji i światowej turystyki, masowe zwolnienia pracowników, które doprowadziły do wzrostu bezrobocia i spadku dochodów gospodarstw domowych, odroczone inwestycje i reorientacja przepływów inwestycyjnych, zarówno w sektorach gospodarki, jak i w kontekście regionalnym, są wynikiem wpływu wyzwań pandemii Covid-19. Zmieniła ona i nadal zmienia wiele cech gospodarki i społeczeństw. Wraz z nadejściem czwartej rewolucji przemysłowej i przejściem do ery

cyfrowej, a także uwzględniając zupełnie nowe realia rozwoju przyszłych pokoleń, które reguluje koncepcja zrównoważonego rozwoju, kształtowanie się atrakcyjności inwestycyjnej odbywa się również w zupełnie inny sposób. W tym zakresie artykuł uzasadnia potrzebę wprowadzenia do codziennego użytku kategorii zrównoważonej atrakcyjności inwestycyjnej. Została przedstawiona autorska wizja interpretacji tego pojęcia. Opracowano także procedurę kształtowania stabilnej atrakcyjności inwestycyjnej regionów w warunkach Covid-19.

Słowa kluczowe: ryzyka inwestycyjne, potencjał inwestycyjny, zrównoważona atrakcyjność inwestycyjna regionów, zrównoważony rozwój, Covid-19

1. Introduction

One of the key conditions for the development of any socio-economic system is the availability of investments as an important source of economic growth of the state. The global problems of humanity, which are primarily related to the political, environmental, economic and social crisis, including the global coronavirus pandemic, create significant obstacles in the processes of attracting investment.

Thus, according to the report on world investments 2020, prepared within the framework of the United Nations Conference on Trade and Development UNCTAD, 19% of projects involving foreign direct investment (FDI) in Europe were canceled, another 25% were frozen, half of the investors were going to reduce the investment volumes planned for 2020 by 10-15% (UN). In addition, the analysis presented in the report shows that in four of the ten key areas of sustainable development (SD), the inflow of international private sector investment has not increased significantly since the adoption of the goals in 2015. European countries, having a significant natural resource potential and high-quality human capital, are experiencing difficulties in attracting investment. The lever of changing this situation can be organizational and methodological support and practical stimulation of the investment attractiveness of regions, the success of which depends on the joint actions of science and practice.

Taking into account the fact that investment attractiveness is a characteristic that reflects the quality of the macroeconomic environment and its ability to meet the requirements of modern realities, the activation of investment activity of economic entities creates prerequisites for introducing innovations, optimizing production, increasing and updating production capacities, expanding existing and conquering new sales markets, fulfilling the strategic tasks aimed at the implementation of the SDGs. In this regard, there is a need to rethink the existing theoretical and methodological approaches and applied aspects of the formation of investment attractiveness of regions in the conditions of Covid-19, the implementation of which will bring us closer to sustainable development.

The purpose of the article is to develop theoretical, methodological foundations and practical recommendations for the formation of investment attractiveness of regions under the conditions of Covid-19.

2. Findings and Discussion

2.1. Formation of sustainable investment attractiveness of regions under the conditions of Covid-19: theoretical and analytical aspect

Successful implementation of regional investment activities is possible if there is a certain investment attractiveness of the territory. In modern science, the limits of the interpretation of the concept of *investment attractiveness* are not defined. They begin with its identification with the investment climate (L. Borshch, S. Herasymova 2007), and end with the solvency of the territory for investments (A. Nosova, Y. Krylov, 2003; K. Mamonova, 2008; S. Vdovin, 2014), which creates prerequisites for the formation of the author's vision regarding this category.

Analysis of the fundamental works of foreign authors Robert B. Stoby, A. (1969) Bevan, S. Estrin, K. Meyer (2000), J. Hellman, J. Johnson, D. Kaufman, M. Shankerman (2000), D. Holland (1998), J. Janssen (2001), allowed us to establish that scientists use the term *investment climate* only in the field of international financial markets.

The etymology of the concepts of *investment climate* and *investment attractiveness* indicates that they differ in content. The concept of *climate*, in a narrow sense, means the initial conditions (Geographical Encyclopedia), therefore, the climate is not a cause, but a consequence, which means that in order to attract investment, certain conditions must be met, as well as they must satisfy all parties (depositors, beneficiaries). Such a condition is the attractiveness of the territory (its capabilities), which determines the priority directions of the region's development. Thus, *investment climate* and *investment attractiveness* should be considered as separate categories.

A review of scientific research led to the conclusion that a number of authors, such as Y. Zadorozhna L. Diachenko (2007); T. Bezrukova, I. Shanin, Y. Ziborov (2015), consider the investment attractiveness at the macro and micro levels. Moreover, they refer to the investment climate (state and region) at the macro level, and the micro level is the investment attractiveness (industry, enterprise). When discussing this statement, it turns out that a state or a region cannot have investment attractiveness, but only an investment climate, and vice versa - the industry and the enterprise can be characterized only from the point of view of investment attractiveness. This approach does not allow us to display the full range of

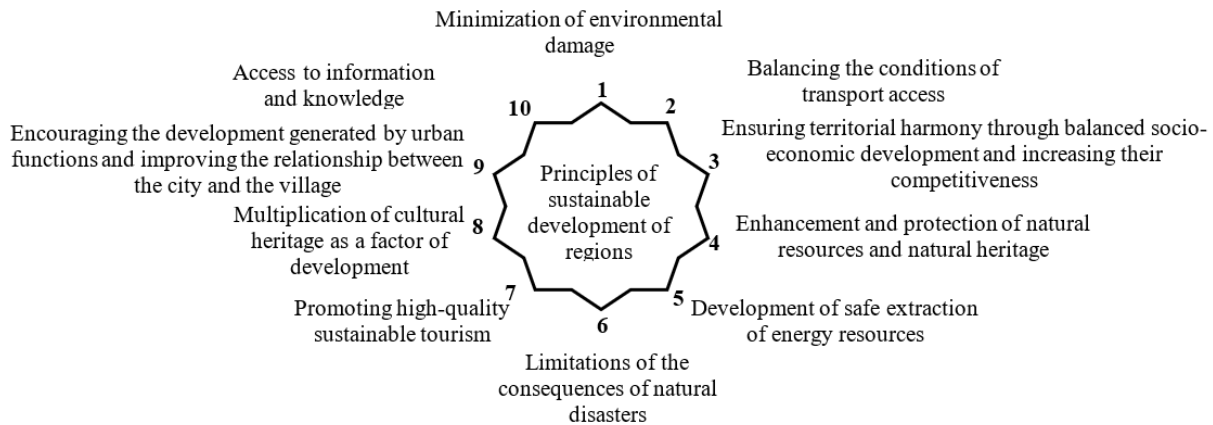


Figure 1. Fundamental principles of sustainable development of regions, compiled by the authors on the basis of Guiding Principles for Sustainable Development of the European Continent (2000)

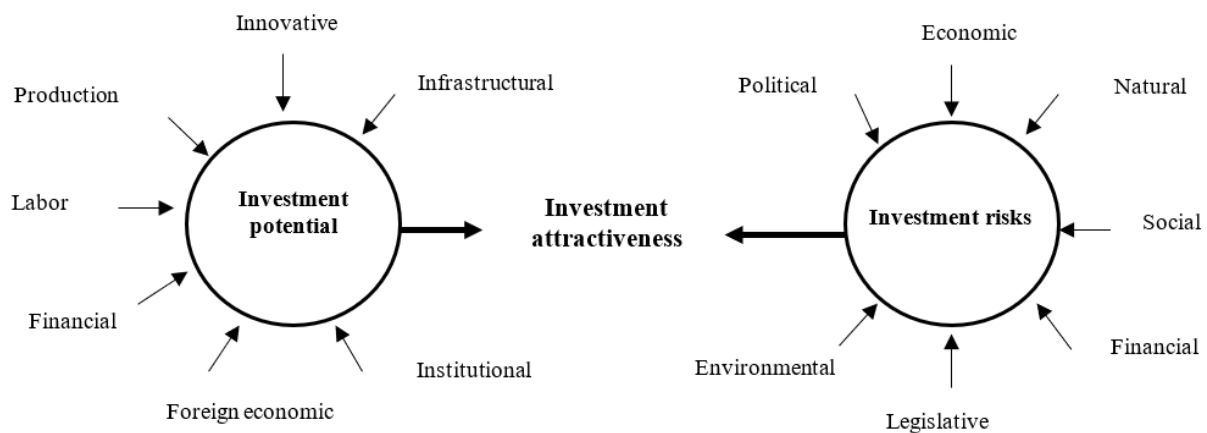


Figure 2. A figurative model of the formation of investment attractiveness of regions before the Covid-19 pandemic, compiled by the authors on the basis of Lavresh I., Myronov V., Smirnov A. (2011)

impact factors and narrows the set of indicators for evaluating capital investments, which in turn makes it difficult to practically rank regions by the degree of investment attractiveness.

Makarii N. calls the fair quantitative and qualitative characteristics of the external and internal environment of the object of potentially possible investment as investment attractiveness (Makarii, 2001). In the studies of I. Hryshyn, A. Shakhnozarov, I. Roizman (2001) investment attractiveness is considered through the combination of investment potential and investment risks. The investment attractiveness of the region determines the investment activity. At the same time, the authors understand investment activity as *the intensity of attracting investment in the fixed capital of the region*. Then the investment climate is a symbiosis of investment activity and attractiveness. A similar point of view is reflected in the studies of A. Asaul, I. Pasiada (2004), V. Kiriukhin (2006).

Thus, the presented generalization of scientific points of view allows us to conclude that investment attractiveness determines the vectors of investment movement. It is, on the one hand, factorial, and, on the other hand, resultant, i.e. it creates prerequisites for increasing investment activity. In this regard, the investment attractiveness of the region should be un-

derstood as a combination of investment potential (conditions and opportunities) and risks affecting the volume of attracted capital carried out on mutually beneficial terms with investors.

The investment potential in the article refers to the region's opportunities for sustainable development, that is, the investment potential allows us to form a vision regarding the region's readiness to receive investments with appropriate guarantees of capital preservation and profit for investors based on the principles of regional sustainable development (Fig. 1).

It should be noted that the investment potential of the region is represented by various types of resources: economic, foreign economic, production, labor, innovation, infrastructure, financial, institutional, etc. The formation of investment attractiveness of regions is carried out under the influence of various groups of risks: political, social, economic, environmental, and other risks that change over time as well as the strength of their impact changes (increases or decreases). Schematically, the formation of investment attractiveness can be represented as follows (Fig. 2).

The generalization of scientific points of view in the field of risks of forming the investment attractiveness of regions allowed us to establish the existence

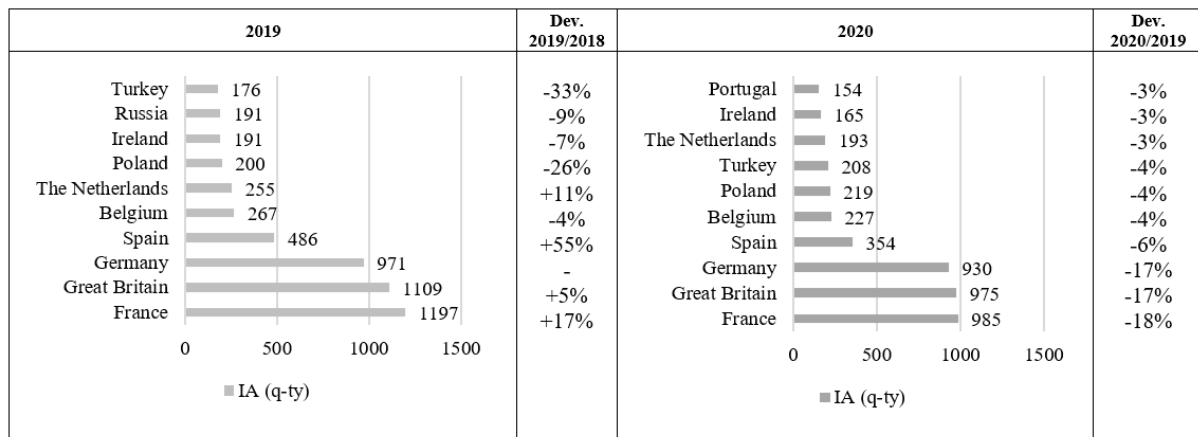


Figure 3. Dynamics of investment attractiveness in European regions before and during Covid-19, compiled by the authors on the basis of EY (2018, 2019, 2020)

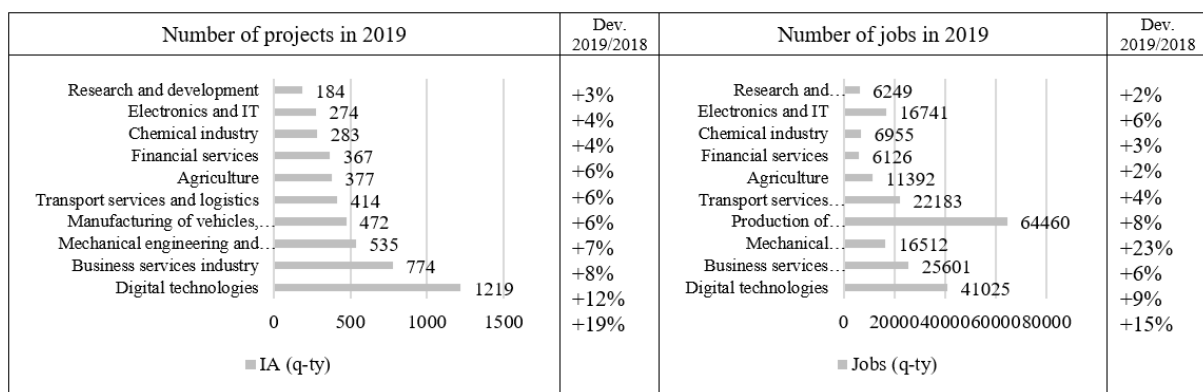


Figure 4. Investment attractiveness of industries during Covid-19, compiled by the authors on the basis of EY (2019, 2020)

of various classifications that were proposed by the authors taking into account their own scientific interests. Some people divide the entire set of risks according to two criteria: 1) according to the method of influencing the economic growth of investment attractiveness and 2) depending on the final goals of the regions (Nechytailo, 2011; Haidutskyi, 2004; Hukaliuk, Ivanovych, 2010; Kuzmyn, Komarnytskyi, 2002; Khusainov, 2015, etc.). Other authors consider the current order of income distribution between economic entities in society as the dominant risk of forming the investment attractiveness of the country (J. Janssen, 2001 P. Masset, 1971 Juha, 2017). Still others believe that risks in the formation of investment attractiveness of regions should be considered through competitive advantages (Mikashyn, 2014; Moghoiev, 2004; Lukianenko, Mozhovyi, Hubskeyi, 1998). Despite the differences in approaches, the vast majority of scientists identify the basic risks, which are presented in Fig. 2.

However, as practice has shown, there comes a period when one risk completely determines the development of further events, including the formation of the investment attractiveness of the regions. The UN World Investment Report 2020 notes that global flows of foreign direct investment (FDI) have been under great pressure as a result of the Covid-19 pan-

dem. Inflows in developing countries have been particularly hard hit. (UN World Investment Report, 2020).

The Covid-19 pandemic has undoubtedly changed and continues to change many characteristics of the economy and society. Together with the onset of the Fourth Industrial Revolution and the transition to the digital era, as well as taking into account completely new realities of the development of future generations, which are regulated by the concept of sustainable development, the formation of investment attractiveness is also taking place in a fundamentally different way. This fact was actively discussed at the 46th International Economic Forum (K. Schwab, S. Zahidi, 2016), and is also clearly visible in the empirical studies of the Association of Certified International Investment Analysts (ACIIA), Colliers International, European Investment Monitor.

For example, the empirical review of the European Investment Monitor for 2018-2020 notes a decrease in the inflow of foreign direct investment (FDI) to Europe, which in 2019 amounted to 6,412 projects, which is 0.9% more than in 2018. However, the Covid-19 pandemic contributed to the fact that only 4168 of them were implemented on time, a quarter of 1603 projects were postponed, and a tenth of 614 were canceled. In 2020, instability caused by the

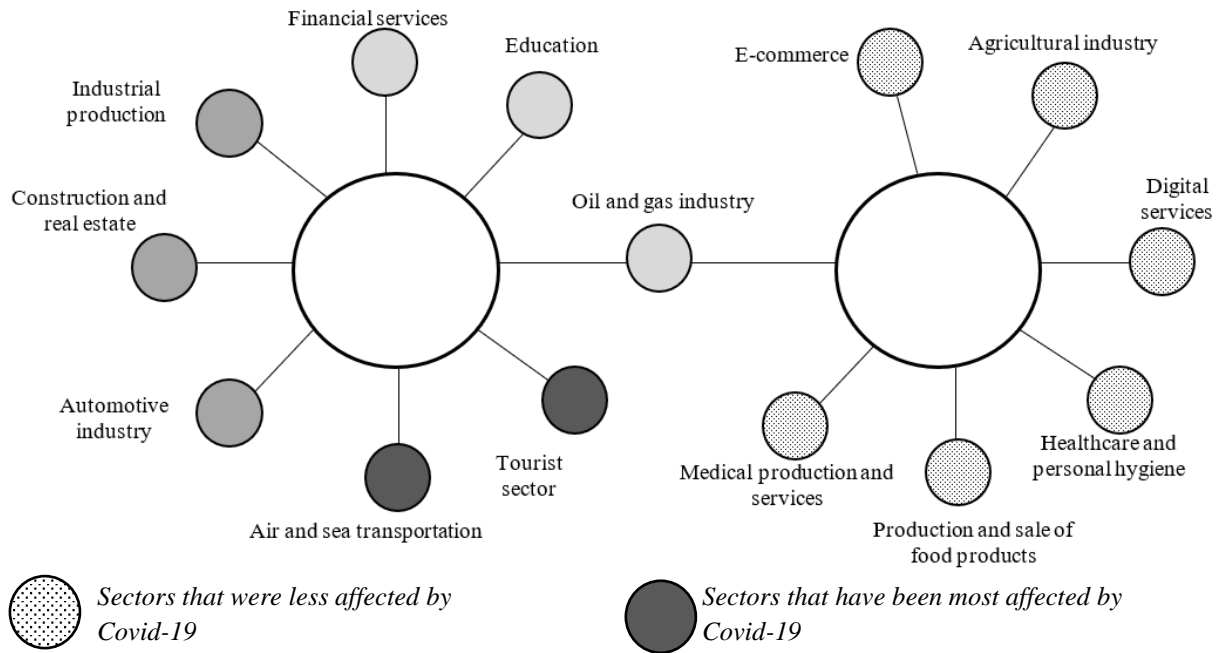


Fig. 5. Inversion of consumer preferences in economic sectors during Covid-19 (compiled by the authors on the basis of OECD, 2021)

spread of coronavirus infection led to another reduction in FDI inflows to Europe by another 13% (EY, 2019, 2020).

Despite the negative dynamics of FDI in 2019-2020, foreign companies continue to consider Europe as the most stable region with qualified, highly professional labor resources. The infographics of the European regions of the leaders in the number of investment projects in 2019-2020 are presented in (Fig. 3). It follows from the figure that a fifth of all European projects involving FDI account for France, which became the leader in terms of investment attractiveness and activity in 2019. During this period, 1,197 projects were announced in the region, which is 17% higher than in 2018. Thus, France has displaced the United Kingdom, which has had the highest investment attractiveness in Europe over the past decade. The change of leading positions is explained by the dominant impact of several risks caused by the Fourth Industrial Revolution (+/-), new realities of the development of future generations (+/-), Brexit in the UK (- for the UK/+ for France), the reform of labor legislation and corporate taxation initiated by Emmanuel Macron in 2017, which was highly appreciated by French and foreign investors (- for the UK/+ for France) and the Covid-19 pandemic, which negatively affected investment activity in the world as a whole, and also contributed to the structural transformation of international production. Thus, if in 2016-2017, according to official data from Eurostat, financial and insurance activities accounted for the highest share of both incoming and outgoing FDI flows of the EU-28 (Eurostat, 2016), in 2019-2020, projects in the digital technologies and business services sectors were the most attractive for foreign investors (The Global Risks Report, 2021). The com-

bined share of these sectors accounted for a third of all projects and a quarter of all new jobs. (Fig. 4). Despite the fact that the risk of Covid-19 is short-term (The Global Risks Report, 2021), its negative impact was felt by the whole world. Thus, according to the Global Risks Report -2021, Covid-19 has contributed to reducing the pace of development of the world economy, expanding existing differences within communities and between peoples, thereby complicating the path to achieving peace and the Sustainable Development Goals until 2030 (The Global Risks Report, 2021).

About the impact of the pandemic and the shift in consumer preference in the sectors of economy said in expert reviews of the Organisation for Economic cooperation and Development (OECD), Business confidence index (BCI), according to which Covid-19 increasingly negatively affect the tourism sector, the aviation and shipping, and helped enhance the development of e-Commerce, digital services, medical services and medical equipment manufacturing (Fig. 5). Changes in consumer preferences also affected the investment attractiveness of economic sectors. According to the presented image, there are more chances for the implementation of investment projects in those sectors where there is an increase in consumer demand due to the pandemic. It follows from the presented analysis that, despite its short-term nature (The Global Risks Report, 2021), Covid-19 contributed to a decrease in the investment attractiveness of some European regions (Great Britain, Spain, Russia), and the growth of others (France, Germany). The pandemic has led to a structural transformation of international production and consumer preferences, thereby ensuring the growth of capital in some sectors of the economy (medical pro-

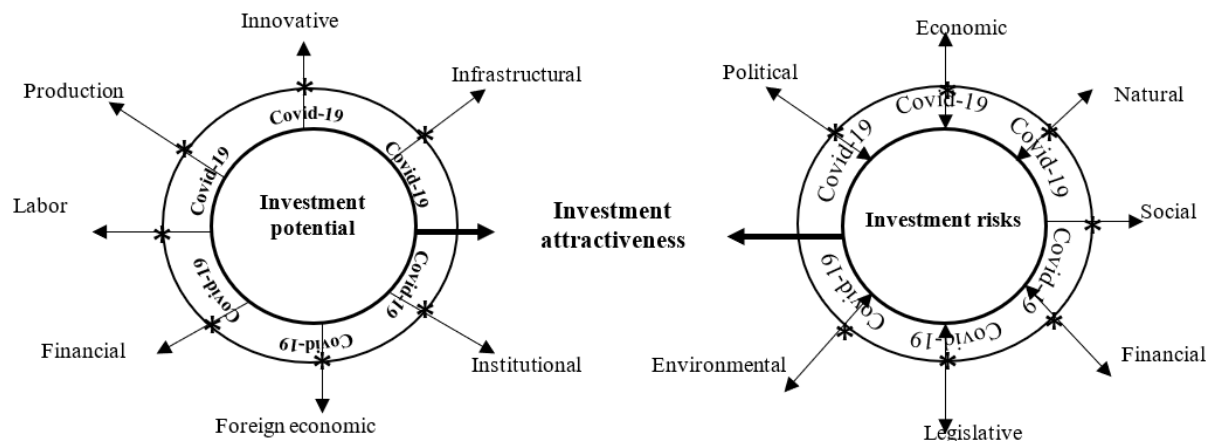


Figure 6. An imaginative model of the formation of investment attractiveness of regions during the Covid-19 pandemic, compiled by the authors

duction and services, digital services, e-commerce) and its reduction in others (tourism, air and sea transportation, the financial sector). In addition, there is still no clarity about the formation of the investment attractiveness of the regions after the Covid-19 pandemic.

The next strains of Delta, Epsilon, accelerated growth of investments in technology development, increased attention to issues of sustainable development and the fight against climate change, force investors to diversify IA. In this regard, some European regions may lose their investment attractiveness, while others, on the contrary, increase it due to the formation of resistance to Covid-19, therefore, the figurative model of the formation of investment attractiveness of regions during the Covid-19 pandemic will have a different look (Fig. 6).

The feature of the modified model of formation of investment attractiveness of the regions during the pandemic Covid-19 is that in addition to the key risks, there is an additional environment formed by the risk of Covid-19, which (Fig. 6) indicated by a circle, and the impact of this environment, formed by the intersection with other risks, weakening or strengthening the impact of each thereof.

2.2. Formation of sustainable investment attractiveness of regions in the conditions of Covid-19: methodological aspect

The analysis of the scientific and methodological basis in the context of the investment attractiveness of the regions allowed us to establish that the process of forming the investment attractiveness of the regions (IAR) in most cases is based on its assessment, by calculating ratings or points, on the basis of which conclusions are made. The most popular methods include the ratings of Euromoney, Forbes, Fitch, Moody's, Standard & Poor's, Barda's methods, 2003; Sivelkina, 2003; Smaglyukova, 2010; Khusnullina, 2009. As a rule, the listed methods offer the determination of the level of IAR through the amount of profit from investments, through expert assessments,

vertical and horizontal analysis of investments, approaches are widely used, within the framework of which an integral, aggregated indicator is derived. It should be noted that the existing methods are based on only two approaches. Therefore, these methods do not fully take into account the regional features of the formation of IA and the specifics of the development of the region, and they also do not take into account the risks affecting the level of IAR.

Thus, the investment ratings of the RA Expert agencies, the Agency for Strategic Initiatives, the National Rating Agency, Euromoney, Forbes, Fitch, Moody's, Standard & Poor's do not take into account such important characteristics of the IAR as the sectoral structure of the region's economy, and the real level of investment activity in the region does not always correspond to the assigned investment rating, which indicates its insufficient validity. Since the presented methods give preference to the scores set by experts, the results obtained will not be devoid of a certain degree of subjectivity.

The second approach to assessing the investment attractiveness of regions is based on the use of statistical scores, not expert ones. This approach is applied using the reduction of the values of statistical indicators to point indicators with reference to a scale, which also cannot fully reflect the level of difference in statistical indicators by region due to the limited intervals or a previously limited range of point estimates.

In addition, it is established that at this stage of the development of investment activity, in general, there is no methodology for forming a stable investment attractiveness of the regions. All this makes it necessary to develop special scientific and methodological tools for forming the investment attractiveness of regions in the conditions of Covid-19 on the basis of a set of relevant principles, methods and tools that ensure its calculation.

Scientific and methodological support for the formation of investment attractiveness of regions under the conditions of Covid-19 is a procedure for diag-

Table 1. Summary table of indicators of investment attractiveness of regions

Components of IA	Indicators
Natural and resource	Area of the territory, thousand km ² ; Structure of the territory, thousand km ² ; Population density, people per 1 km ² ; Cadastral value of land; Quantity and structure of natural resources
Economic	Gross regional product (in actual prices), billion US dollars; Volume of products sold, (goods, services), billion US dollars; Volume of industrial products sold (goods, services), billion US dollars; Volume of gross agricultural output, billion US dollars; Retail trade volume, billion US dollars; Capital investments (in actual prices), billion US dollars;
Foreign economic	Total volume of exports of goods, million US dollars; Total volume of exports of services, million US dollars; Total volume of imports of goods, million US dollars; Total volume of imports of services, million US dollars; Total volume of direct investments (share capital), million US dollars
Financial	Rate of inflation; Finance of business entities; Public finance; Insurance; Lending.
Ecological	Amount of industrial emissions into the atmosphere, tons per 1 sq. km; Amount of fresh water, cubic km per 1000 sq. m.; Amount of greenhouse gas emissions; Share of forest cover; Specific energy intensity of GDP; Amount of hazardous waste generated.
Production	Net financial result of enterprises before taxation, billion US dollars; Amount of profit that the enterprises received, billion US dollars; Number of small enterprises, units; Number of employed workers at small enterprises, thousand people; Volume of products (goods, services) sold by small enterprises, US dollars; Fixed assets, billion US dollars; Updates of fixed assets, billion US dollars;
Innovative	Number of scientific organizations, units; Number of issued patents, units; Number of employees involved in the implementation of scientific research, people; Expenses for the implementation of research and development, million US dollars; Expenditures on innovations of industrial enterprises, million US dollars; Volume of innovative products (goods, services) sold by industrial enterprises, million US dollars.
Labor	Number of permanent population, thousand people; Number of economically active population, thousand people; Number of the employed population, thousand people; Population of the pre-working age (0-15 years), thousand people; Population of working age (16-59 years), thousand people; Number of employed people with higher education, thousand people; Number of employees per 1000 workforce, thousand people.
Infrastructural	Number of localities, from; Volume of cargo transported by road, million tons; Operational length of railway tracks, thousand km; Length of public roads, thousand km; Number of mobile communication subscribers, thousand units; Number of Internet subscribers, thousand units.
Consumer	Volume and structure of consumption; Market demand; Real monetary income of the population; Real wages.
Social	Housing security, m ² . per 1 resident; Density of paved roads and public railway tracks, km per 1000 sq. km; Number of teachers and doctors per 1000 population, people; Number of stadiums with a capacity of more than 1500 people and flat sports facilities, pcs. per 1000 population.
Institutional	Structure of the legal system and the investment management system Quality of the institutional system Index of liberalization Corruption Perceptions Index

Note: the table does not contain an exhaustive number of indicators, but only the most commonly used ones when calculating the investment attractiveness of regions

nosing the investment potential of the region and investment risks (one of which is dominant in the short term, and determines the strengthening or weakening of the impact of others) that arise both at the state level and in each individual region, as well as the interpretation of the results based on a comparison of the data obtained (compiled by the author).

The authors understand the stable investment attractiveness of the regions as a set of investment potential (conditions and opportunities), focused on meeting the needs of future generations, and risks affecting the volume of attracted capital.

The basis of the author's methodology for forming the investment attractiveness of regions under the conditions of Covid-19 is based on the adapted development of N. Klimova 2003, which identified three dominant components of investment potential: resource (production + labor + financial resources), infrastructure and institutional ones, believing that they most systematically and fully reflect the components of social production, the subsystem of which is the investment sphere. However, taking into account the fact that modern trends have shifted towards qualitative indicators, in addition to the components of investment potential, the author's methodology identifies three dominants of sustainable development: economic, environmental, social and the dominant risk of Covid-19. Based on this, the procedure for assessing investment attractiveness becomes very cumbersome, since in each block (investment potential, investment risks, dominant risk of Covid-19, sustainable development, etc.) there is a certain set of indicators that are repeated in different blocks and make it difficult to deduce the total result (Table 1).

As follows from Table 1, the number of indicators is diverse and some of them are duplicated. Therefore, their systematization was carried out, as a result of which it was concluded that when developing a methodology for forming a sustainable investment attractiveness of regions under the conditions of Covid-19, it is advisable to be guided by an infrastructure approach.

The authors' understanding of infrastructure is reduced to the definition of the Austrian economist of Polish origin, Rosenstein-Rodan, who proposed to define it as *a set of conditions that ensure the favorable development of entrepreneurship in the main sectors of the economy and meet the needs of the entire population* (Rosenstein-Rodan P.N., 1969). Thus, the infrastructure approach can be considered as a set of management bodies and institutions that support the main market processes both in an organizational and material way, as well as the economic and financial activities of market structures. The infrastructure approach allows us to organize a large array of indicators without duplicating them, to determine the degree of investment attractiveness of regions, to form reasonable conclusions about the investment prospects for the development of regions.

The adherents of the infrastructure approach also include N. Vasilchuk, E. Kuzmenko (2015); O. Vasyliiev (2007); A. Hryshchenko, V. Soboliev (1998); A. Kuznetsova (2013). In particular, in the studies of N. Vasilchuk, E. Kuzmenko the authors distinguish production, non-production, market and institutional infrastructure (Vasilchuk, Kuzmenko, 2015). This idea is used when dividing the investment potential into groups, in order to avoid duplication of indicators, and simultaneously display the components of sustainable development and sustainable investment attractiveness in a comprehensive manner.

The higher the level of infrastructure development in the region, the more attractive it is for investors. Investment attractiveness provides new jobs and cash receipts in the form of taxes to the regional budget. Consequently, there is a steady improvement in the quality of life, which is the main indicator of the economic growth of the region and it ensures the implementation of the sustainable development goals. The procedure for forming a stable investment attractiveness of regions under the conditions of Covid-19 consists of the following blocks (Fig. 7).

As already noted, the procedure for forming a stable investment attractiveness of regions under the conditions of Covid-19 involves the diagnosis of key blocks according to various indicators. Generalization of research in the field of diagnostics made by V. Vasylenko, D. Vasilenko (2013), I. Blank (2004), E. Boichenko (2012), A. Barannikov (1999), B. Kollas (1997), E. Korotkova (2006), O. Hetman, V. Shapoval (2007), allowed us to come to the conclusion that its essence is determined through a triad of approaches, namely: 1) as a component of management activity (at the micro level – an enterprise, organization, institution; at the macro level – a state, region, industry), designed to control, in order to establish deviations in the development of an object from normative indicators and respond to them at the development stage; 2) as the ability to recognize the state of an object based on analysis in order to form reasonable conclusions about the identified trends, problems and causes that cause a negative development trend; 3) as scientific and methodological support, the use of which allows identifying, describing and determining problems in the processes of analysis, synthesis and evaluation.

Based on the above, the diagnosis of the formation of sustainable investment attractiveness of regions under the conditions of Covid-19 is understood by the authors as a complex of scientific, methodological and applied research aimed at identifying, describing and determining problems associated with changing conditions and opportunities for the development of individual elements of investment activity in this territory.

The basis for diagnosing the formation of sustainable investment attractiveness of regions under the conditions of Covid-19 is an infrastructure approach and a matrix method (Fig. 8),

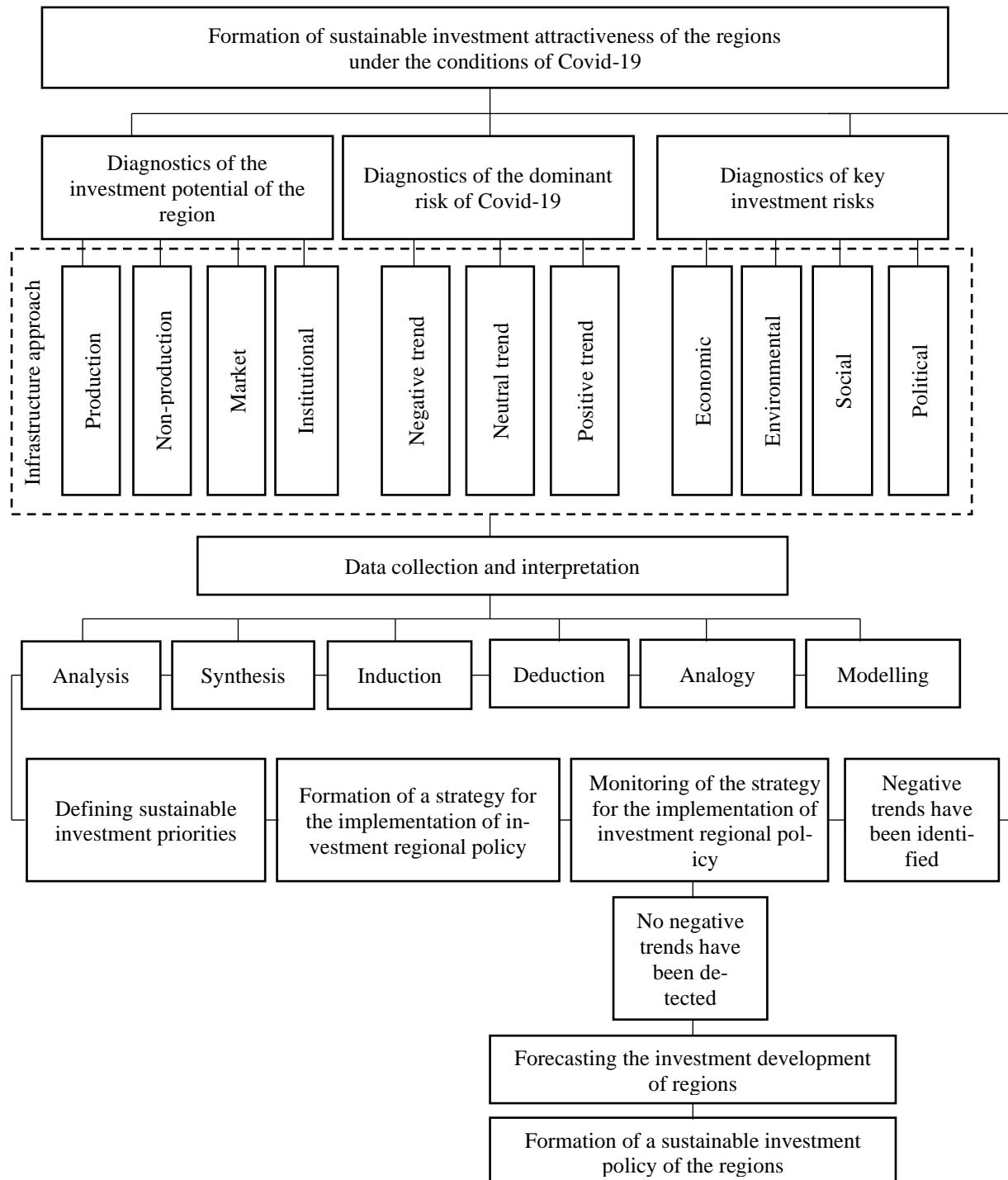


Figure 7. The procedure of formation of a stable investment attractiveness of regions under the conditions of Covid-19, compiled by the authors on the basis of N. Klimova (2003); N. Vasilchuk, E. Kuzmenko (2015)

where, KIR – key investment risks,
DIR – dominant investment risk.

This made it possible to systematize indicators for all blocks (diagnostics of the investment potential of the region, the dominant risk of Covid-19 and key investment risks) in order to avoid their duplication, as well as to clearly interpret the result.

The production component of the investment potential of the region reflects the main trends in the development of production activities in the region and

the opportunities associated with this activity. It is determined by the depreciation of fixed assets, roads and railways, the specific weight of paved roads and public railways, the share of unprofitable enterprises, the amount of damage resulting from the impact of Covid, etc.

The non-production component of the investment potential of the region includes social and management components and is determined on the basis of the following indicators: number of employed per

Risk diagnostics				
KIR				DIR
Economic	Environmental	Social	Political	Trends
1	2	3	4	5

Diagnostics of the investment potential of the region		
Production	P	1
Non-production	P^p	2
Market	M	3
Institutional	I	4

P_{11}	P_{12}	P_{13}	P_{14}	P_{15}
P^p_{21}	P^p_{22}	P^p_{23}	P^p_{24}	P^p_{25}
M_{31}	M_{32}	M_{33}	M_{34}	M_{35}
I_{41}	I_{42}	I_{43}	I_{44}	I_{45}

Figure 8. Matrix of aggregation of variables of sustainable investment attractiveness of regions under the conditions of Covid-19, compiled by the authors on the basis of Lagler (2021)

1000 workforce, proportion of the population with monetary incomes below the subsistence minimum, housing security per 1 inhabitant, area of emergency housing stock, number of teachers and doctors per 1000 population, etc. The management component in this case is determined through such characteristics as: insufficient volume of attracting investments for further economic development (the ratio of direct investment in GRP), errors in the development and management of regional budget programs; the inability of regional authorities to provide or partially limit the population with the necessary level of social services, as well as the level of corruption in public administration.

The market component of the investment potential of the region combines organizational, technical, financial, credit and research components, each of which performs certain functions (N. Vasilchuk, E. Kuzmenko, 2015) and has its own set of indicators. Thus, the function of the organizational and technical component is to coordinate the relationship between the market and society. The system of indicators of the market component, in turn, is divided into several groups. Taking into account the fact that this study is devoted to the formation of the investment attractiveness of the regions, the main indicators of the organizational and technical component include the provision of enterprises with raw products, materials, equipment and other goods and services and the organization of sales of manufactured products through various channels of the sphere of circulation, the number of enterprises engaged in the sale and storage of goods and their distribution by types and

kinds thereof, the size of trading enterprises, as well as throughput.

The main function of the financial and credit component is the accumulation of temporarily free monetary resources and their redistribution through lending. Based on this, it is advisable to present such indicators as the return on capital of enterprises in the basic sectors of the economy, the number of loans issued by banks by type of activity, the increase in assets of credit institutions, the volume of PI by economic sectors, and in the regional context.

The research component provides consulting services to entrepreneurs, investors, training of specialists in the investment field (conducting trainings, seminars, courses, etc.), research of market conditions and its dynamics, forecasting the state of markets, etc. The research component of the market component is characterized by such indicators as capacity, market saturation, production, import, export volumes, the number of specialists in the investment sphere, the number of types of educational activities and programs, the number of internationally accredited programs, expertise, etc.

In this case, the institutional component of the investment potential of the region is considered as a specific system of generally accepted, legally and traditionally established regulations, rules and restrictions, the organization, formation, regulation and use of which ensures the functioning of the market system in order to form a stable investment attractiveness of the regions under the conditions of Covid-19.

Table 2. Typology of trends in sustainable investment attractiveness of regions in the context of Covid-19, compiled by the authors based on Boichenko, Vasilchuk (2017)

Characteristics	Conclusions
Negative trend	
It indicates the presence of a problematic situation in the epidemiological situation, which negatively affects the formation of a stable investment attractiveness of the regions under the conditions of Covid-19.	The number of sick people is increasing; the number of those who have recovered is decreasing, as well as mortality is increasing.
Zero trend	
It gives an idea of the situation in which the dynamics of the main indicators characterizing the epidemiological situation did not change during the study period in practice.	There are no changes in the number of cases, recovered and deaths from Covid-19 during the study period.
Positive trend	
It indicates the presence of positive phenomena and processes in the epidemiological situation, which favorably affects the formation of a stable investment attractiveness of regions under the conditions of Covid-19.	The number of cases is decreasing (or there are no new cases); the number of recovered patients is increasing, mortality is decreasing (or there are no new cases).

Production, non-production, market and institutional components are formed under the influence of key investment risks (KIR), which include: economic, environmental, social and political risks, and the dominant investment risk of Covid-19 (DIR).

The risks, as well as the indicators of the investment attractiveness of the regions, were systematized, since there is a wide variety of classifications and types of risks in the modern scientific literature. In this study, the risks are divided into two groups: key and dominant ones. Under key investment risks, the authors understand those risks that are most dependent on external factors and that are most difficult to manage. The division of risks into two groups, among other things, is due to the concept of sustainable development, under the influence of which socio-economic processes are formed in the modern world (including the formation of the investment attractiveness of the region).

Diagnostics of economic risks in the context of sustainable development is based on the theory of maximum total income, which can be achieved through the optimal use of limited resources, saving technologies and cost reduction. The indicator of sustainability in this case is the independence of the region, which is ensured by the formation of a stable investment attractiveness.

Diagnostics of environmental risks implies that investment activities and processes associated with it should not violate the integrity of natural systems (natural systems should also be understood as the environment created by men, for example, cities). Environmental risks arise due to environmental pollution, man-made disasters caused by technical and technological features of human production and economic activity, as well as due to the accumulation of a large amount of industrial and household waste; emissions into the atmosphere, the use of mineral fertilizers and plant protection products in agriculture, etc. Environmental pollution leads to a decrease in the ability of natural systems to renew, which is an obstacle to sustainable development. Therefore, the main purpose of diagnosing environmental risks

is to form a sustainable investment attractiveness of regions based on the principles of regional sustainable development (see Fig. 1).

Diagnostics of social risks involves the identification (prevention) of destructive conflicts in society caused by investment processes and violating the stability of social and cultural systems. An indicator of sustainability in this case is an effective and fair decision-making system, a fair distribution of investment potential and investment benefits.

The diagnostics of political risks is aimed at ensuring consistency between the components of sustainable development; the investment attractiveness of the region; the components of sustainable development and investment attractiveness, as well as ensuring their integration from the fundamental to the applied plane. Political risks arise due to corruption, the lack of flexible legislative support for investment activities; the absence or imperfect territorial legislation coordinating privileged investment conditions that lead to social aggression (protests, strikes), military actions (revolution, external aggression). An indicator of sustainability in this case is an effective regulatory framework.

Diagnostics of the dominant risk of Covid-19 involves determining the strength of its impact by periods (establishing a trend for a month, quarter, half-year, year). It is worth noting that the dominant risk is the risk that has caused a significant undesirable impact on all spheres of life in a short period of time and has caused significant changes in the present and future periods. As indicators on the basis of which trends are formed (Table 2) it is proposed to use the population of the region, the number of cases of Covid-19, the number of recovered after Covid-19, the mortality from Covid-19.

Diagnostics of investment potential and investment risks is based on the collection and interpretation of data, using an integrated approach that includes such methods (Table 2).

Thus, the diagnostics of the sustainable investment attractiveness of regions under the conditions of Covid-19 allows us to form a comprehensive system

Table 3. Methods of diagnostics of stable investment attractiveness of regions under the conditions of Covid-19, compiled by the authors on the basis of Sheremet (2014)

Method	Characteristics	Result
Analysis	With the help of analysis, we establish the reality behind the totality of phenomena. The analysis allows us to reveal the essence of investment processes in the region, to understand the existing relations between investors, entrepreneurs, the state, intermediaries, etc., to find out the reasons for the emergence of these relations and the trends of their development.	The division of the total set of investment processes associated with the formation of the investment attractiveness of the region and the formation of conclusions for each component separately.
Synthesis	Using the synthesis, we combine the previously selected parts of the investment attractiveness of the region into a single whole. The synthesis allows us to determine how (with what force) the investment potential, investment risks, and dominant risk affect the formation of the investment attractiveness of the region.	Combining the data obtained as a result of the analysis. Justification of the strength (degree) of intensity and direction (tendency) of the influence of some processes and phenomena on others.
Induction	With the help of induction, we obtain general judgments, which are empirical and theoretical laws, hypotheses, generalizations. For example, we substantiate the dependence of the environmental and social components of sustainable development on the investment attractiveness of the region.	Building a general conclusion based on private conclusions
Deduction	It is the opposite of induction and represents a transition from the general to the particular. For example, based on the study of the investment attractiveness of the region, its impact on the amount of emissions into the atmosphere, the number of jobs and the level of income of the population, etc. is determined.	Construction of the further course of empirical research (new inductive generalizations).
Analogy	Using analogy, we draw conclusions by comparing different regions with each other, identifying similar features, and by comparing them we come to a specific conclusion. For example, the generalization of the experience of forming the investment attractiveness of Asian countries in order to implement it in European regions.	Forming conclusions about one object based on drawing an analogy with other objects.
Modelling	Conclusions by analogy, understood very broadly as the transfer of information about some objects to others, constitute the epistemological basis of modeling, which involves the study of investment attractiveness by creating and researching a copy (model) that replaces the original from certain sides of cognition.	Formation of conclusions based on the construction of the model.
Forecasting	With the help of forecasting, we obtain qualitative and quantitative characteristics of investment potential and investment risks.	Drawing conclusions about the prospects for the formation of a sustainable investment policy in the region.

for monitoring changes and determine sustainable investment priorities, which are further reflected in the strategy for implementing regional investment policy. Further, it is necessary to conduct a practical testing of the strategy in order to identify deviations based on monitoring. If a negative trend is determined, a repeated diagnosis is carried out, on the basis of which the reasons that negatively affect the formation of investment attractiveness are established.

3. Conclusion

In the article, based on the results of the conducted research, the theoretical and methodological foundations for the formation of sustainable investment attractiveness of regions under the conditions of Covid-19 are formed.

Based on the generalization of scientific points of view, it is established that investment attractiveness determines the vectors of investment movement and consists of investment potential and investment

risks. The formation of the investment attractiveness of regions is carried out under the influence of various groups of risks, the set of which changes over time, just as the strength of their influence either increases or decreases. 2019 has shown that a period is coming when one risk (Covid-19) completely predetermines the behavior of other risks and, in general, further socio-economic development. In this regard, there is a need to introduce such a term as sustainable investment attractiveness. It is proposed to understand the stable investment attractiveness of the regions as a set of investment potential (conditions and opportunities), focused on meeting the needs of future generations and risks affecting the volume of attracted capital.

Based on an analytical review of investment flows in European regions before and during Covid-19, it is proved that the pandemic has changed and continues to change many characteristics of the economy and society. It is proved that together with the onset of the Fourth Industrial Revolution and the transition to the digital era, as well as taking into account com-

pletely new realities of the development of future generations, which are regulated by the concept of sustainable development, the formation of investment attractiveness is also taking place in a fundamentally different way. In this regard, there is a need to develop organizational and methodological support for the formation of sustainable investment attractiveness of regions under the conditions of Covid-19. A figurative model of the formation of the investment attractiveness of regions during the Covid-19 pandemic is proposed, which, unlike the existing ones, in addition to the key risks, contains an additional environment formed by Covid-19.

Based on the analysis of the scientific and methodological basis in the context of the investment attractiveness of the regions, it is established that the process of its formation in most cases is based on an assessment, by calculating ratings or points, on the basis of which conclusions are made. It is proved that the existing approaches do not fully take into account the regional features of the formation of investment attractiveness, the specifics of their development, do not focus on risks, and the results obtained are devoid of a certain degree of objectivity. This led to the development of a clear procedure for the formation of a stable investment attractiveness of regions under the conditions of Covid-19, which, unlike the existing ones, allows us to form a comprehensive system for monitoring changes and determine sustainable investment priorities.

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Going Green Supply Chain Management During COVID-19, Assessing the Best Supplier Selection Criteria: A Triple Bottom Line (TBL) Approach

W kierunku zrównoważonego zarządzania łańcuchami dostaw podczas pandemii COVID-19, ocena kryteriów wyboru najlepszych dostawców: analiza Potrójnej Linii Przewodniej (TBL)

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Abstract

In the past ten years, sustainable supply chain management (SSCM) attach great importance due to consumers, for-profit and profitless organizations, laws and regulations to the social and corporate responsibilities of consumers, so it has been recognized by practitioners and scholars. Supplier selection, environmental effect like a lockdown, and social cooperation and other SSCM programs can play an important part in realizing the triple bottom line (TBL) of economic, environmental, social assistances. In supply chain management (SCM), the sustainable supplier selection (SSS) and firm performance plays an important role. Traditionally, when evaluating SSS performance, organizations will consider a new framework to obtain the overall criteria/sub-criteria of the sustainability index by encapsulating sustainability. In this paper 12 sub-criteria for 3 pillars of sustainability as economic, environment and social performance is collected. Although there are many articles on SSS and evaluation, so far, research on sustainability issues is very limited. This study endeavours to propose a fuzzy multi-criteria approach to discuss SSCM planning, and studies the issue of determining a current model for SSS in the supply chain during COVID-19 based on the TBL method. For express the linguistic value of the subjective preference of experts we use triangular fuzzy numbers. By using fuzzy numbers to find standard weights for qualitative performance evaluation, then fuzzy TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) is proposed to find the ranking of SSS. However, COVID-19 has a negative role in SSS and in firm performance. The situation of lockdown due to COVID-19 has a negative effect on the performance of the organizations. An example is given of the proposed method.

Key words: sustainable supply chain management (SSCM), triple bottom line (TBL), sustainable supplier selection (SSS), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), COVID-19

Streszczenie

Zrównoważone zarządzanie łańcuchem dostaw (SSCM) staje się coraz bardziej istotne w kontekście konsumentów, organizacji nastawionych na zysk i organizacji bez zysku oraz przepisy ustawowe i wykonawcze do społecznej i korporacyjnej odpowiedzialności konsumentów. Zostało docenione przez praktyków i naukowców. Wybór dostawcy, efekt środowiskowy, taki jak

blokada, oraz współpraca społeczna i inne programy SSCM mogą odgrywać ważną rolę w realizacji Potrójnej linii przewodniej (TBL) pomocy ekonomicznej, środowiskowej i społecznej. W zarządzaniu łańcuchem dostaw (SCM) zrównoważony wybór dostawców (SSS) i wydajność firmy odgrywają ważną rolę. Tradycyjnie, podczas oceny wyników SSS, organizacje będą rozważać nowe ramy w celu uzyskania ogólnych kryteriów/podkryteriów indeksu rozwoju, poprzez enkapsulację zrównoważonego rozwoju. W niniejszym artykule zebrano 12 kryteriów cząstkowych dla 3 filarów zrównoważonego rozwoju, takich jak wyniki gospodarcze, środowiskowe i społeczne. Chociaż istnieje wiele artykułów na temat SSS i ewaluacji, jak dotąd badania dotyczące kwestii zrównoważonego rozwoju są bardzo ograniczone. Niniejsze badanie ma na celu zaproponowanie rozmytego, wielokryterialnego podejścia do omówienia planowania SSCM i bada kwestię określenia obecnego modelu SSS w łańcuchu dostaw podczas COVID-19 w oparciu o metodę TBL. Aby wyrazić wartość językową subiektywnej preferencji ekspertów, używamy trójkątnych liczb rozmytych. Stosując liczby rozmyte do znalezienia standardowych wag do jakościowej oceny wydajności, proponuje się następnie rozmyte TOPSIS (Technika uporządkowania preferencji według podobieństwa do idealnego rozwiązania) w celu znalezienia rankingu SSS. Stwierdzono, że pandemia COVID-19 wywiera negatywny wpływ na SSS i wydajność firmy. Sytuacja zablokowania z powodu pandemii COVID-19 także ma negatywny wpływ na wyniki organizacji. Pomoc stanowi nowa metoda, analizowana w niniejszym artykule.

Słowa kluczowe: Zrównoważone zarządzanie łańcuchem dostaw, SSCM, Potrójna linia przewodnia (TBL), Zrównoważony wybór dostawcy (SSS), Technika uporządkowania preferencji według podobieństwa do rozwiązania idealnego (TOPSIS), COVID-19

1. Introduction

Over a period of time, significant changes have taken place in perceptions of enhancing the social and environmental performance of organizations (Zailani et al., 2012). In the past few periods, due to the rapid natural resource consumption and concerns about the gap between rich and poor and social responsibility, sustainability has become an important practice in professional research. This concern has been demonstrated in legislation to expand organizational responsibilities, while increasing emphasis on the training of sustainable managers and in theories development to support SSCM decisions (Zaid et al., 2018). In SCM, the SSS is the main problem faced by managers in maintaining the strategic competitive position of the organization. From the first purchase of the product to the service provider at the end of its service life, the SSS can be applied to various SSS throughout the product life cycle. As the research literature proves, it is always necessary to consider the tangible and intangible factors of SSS assessment, and the definition of these factors is not always clear (Mani et al., 2018).

Usually, at the time of evaluating SSS the organizations consider cost, delivery, quality, and price, technology, and flexibility criteria. Nowadays, logistics SCM solutions act as significant role in ensuring the competitiveness of the SCM, and the procurement process has become more complicated due to three pillars of sustainability pressures. But now, thanks to many organizations to consider and adoption of a SSCM plan for economic, environmental and social issues and evaluated the sustainability performance of their SSS (Önüt et al., 2009). However, several evaluation models in the literature for SSS. There are many methods for reviewing SSS, such as mixed integer programming, sustainability TBL criteria, weighted linear model method, fuzzy sustainable manufacturing company index (FSMCI), analytic hierarchy process and linear programming model, human judgment model, neural network/case-based reasoning method, statistical analysis, etc. Most of

the methods mentioned are based on multiple SSS attributes (Li et al., 2007).

On green SSS number of studies have been carried out. Yeh & Chuang (2011) studied a large number of papers on how to green principles applicable by environmental principles, which was evaluated by using multi-objective decision analysis. Hung (2011) discusses a fuzzy objective planning method for GSCM optimization based on activity cost accounting and value chain performance evaluation. You, Zhang, Xu, & Liu, (2020) applied a method of mixed fuzzy multi-criteria decision-making to evaluate the environmental performance of SSS. Govindan, Mina, Esmaili, & Gholami-Zanjani, (2020) integrated Hazardous Substance Management (HSM) into GSCM, and proposed a SSS model based on HSM using the ANP method. Liu, Eckert, Yannou-Le Bris, & Petit (2019) proposed a fuzzy TOPSIS method to evaluate the environmental performance of SSS. Govindan, Khodaverdi, & Jafarian, (2013) reviewed a new fuzzy multi-criteria decision-making framework, which is used for SSS with the incomplete information services. More and more authors solve SSS problems based on environmental aspects. The dual focus on environmental and economic standards in SSS must be further expanded to take in social sustainable criteria such as child labour, worker health, and social equity. Though these studies provide insights into the literature on sustainable/green SSS assessments, few people pay attention to SSS assessments that take all sustainability criteria into account. The main contributions of this paper include the SSS decision model in the SSCM based on the concept of TBL. Nicoletti Junior, de Oliveira, & Helleno (2018) are emphasized that the differences between the economic and social aspects of sustainability and the environmental aspects of sustainability have absorbed such differences.

In view of the past concerns and the multi-criteria nature of SSCM issues, we have proposed a multi-criteria framework to assess the sustainability performance of SSS. Multi-criteria decision-making methods (MCDM) in real-world systems usually deal

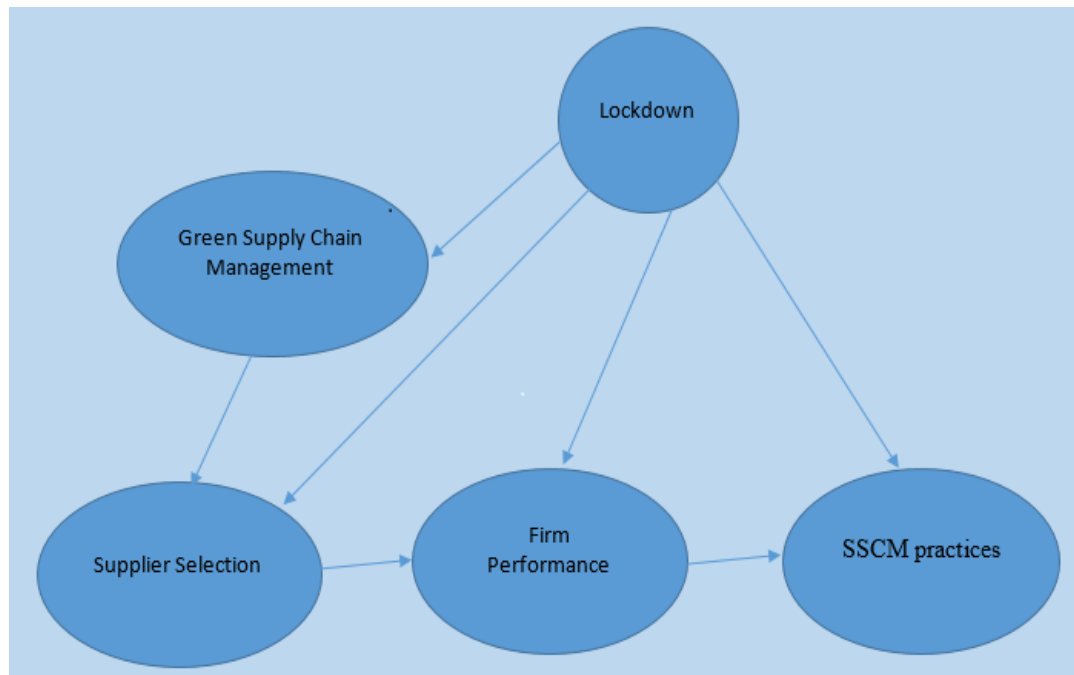


Figure 1. Theoretical framework of the study showing the relationship between green supply chain management, supplier selection, SSCM practices, lockdown, and firm performance

with personal human preferences. Because human judgments and preferences are usually vague and complicated, experts cannot use accurate scale language assessments to estimate their preferences, but can only give accurate language valuations. Therefore, the fuzzy set theory is introduced into the proposed MCDM framework, which aims to resolve such uncertainties (Hashemi et al., 2016). However, the situation of COVID-19 has a negative effect on the companies (Iqbal et al., 2021). COVID-19 affects negatively on all the businesses, which shows a negative impact on firm performance and on SSS. The performance of the supplier is decreased with high speed due to the lockdown. Therefore, the lockdown issue is continuously decreasing the performance of the Firms. Figure 1 shows the relationship between green supply chain management, supplier selection, lockdown, and firm performance.

The structure of this paper is organized as follows: First, principles of SSS by reviewing GSCM, social duty and determining sustainability standards that affect the company's purchasing decisions are reviewed (W. Iqbal et al., 2020). Second, introduce the principles of fuzzy set theory and fuzzy TOPSIS method to evaluate the environmental performance of SSS. Next, introduce the fuzzy TOPSIS and fuzzy set theory to evaluate the environmental performance of SSS. Then, apply and proposed method numerically, to perform sensitivity analysis on the results. Finally, a discussion and some concluding remarks are provided.

2. Literature Review

One of the main challenges of sustainable development is to put the definition of the World Commis-

sion on Environment and Development into practice and guide decision-making with its terms of reference. Another way to define sustainability is to provide some assistance in the design of human and industrial systems to ensure that use of natural resources and human recycling will not reducing the quality of life due to adverse conditions and the loss of future economic opportunities. The impact of social situations on human health and the atmosphere. This definition clearly shows that concert indicators are required to judge the sustainability and success of any decision (Veleva et al., 2001).

The three pillars of sustainability and SSCM practice include a series of strategies, all of which can make the supply chain more sustainable. Although much work on Green supply chain management (GSCM) has been done in the past, there is very little research on SSCM practices. To meet the needs of various stakeholder groups, increasing market pressure and stricter SSCM practices, organizations have begun to focus on their supply chains. Today, GSCM has become an important concern for companies that incorporate the three pillars of sustainability into their strategy (Rebitzer et al., 2004). The company is aware of the importance of partners taking responsibility for sustainable development in their own expansion, and without SSCM practices, it is impossible to solve the sustainability problems of any organization. (Roy et al., 2020).

The definition of SSCM is to manage the materials and information flow and the cooperation between organizations in the supply chain. As well as it integrates the triple bottom line selection issues including all three pillars of sustainable change (de Haan-Hoek et al., 2020). The TBL method suggests that in addition to economic performance, organizations

Table 1. Green supplier selection and evaluation criteria

Criteria	Subcriteria	Definition	Source
Economic criteria (C1)	Product cost, logistics cost (C11)	The manufacturing costs that determine the final amount of the product include maintenance costs, processing costs and warranty costs. The sum of the unit variable and the assigned fixed transportation cost.	Hvam, Hansen, Forza, Mortensen, & Haug, 2020, Absi & Kedad-sidhoum, 2003 and Ghodsypour & O'Brien, 2001.
	Delivery lead time(C12)	The time between order placement and arrival.	Chang, Chang, & Wu, 2011, Mafakheri, Breton, & Ghoniem, 2011.
	Quality assurance, Rejection Ratio (C13)	Obtain quality assurance, such as a certificate. The number of rejected incoming materials detected through quality control.	Kannan, Khodaverdi, Olfat, Jafarian, & Diabat, 2013, Ting & Cho, 2008.
	Technology Level of Capability of design, (C14)	The SP technological development can meet the company's current and future needs. The SP new product design capabilities can meet the company's current and future needs.	Zolfani, Chen, Rezaeiniya, & Tamošaitiene, 2012, Gupta & Barua, 2017), Choi & Hartley, 1996.
Environmental criteria (C2)	Pollution production (C21)	During the measurement period, the average amount of air pollutants, wastewater, and solid waste and hazardous substances discharged per day.	Nielsen, Banaeian, Golińska, Mobli, & Omid, 2014.
	Supply Consumption (C22)	The supply and demand relationship in units of raw materials, water and energy during the measurement period.	Lee, Kang, Hsu, & Hung, 2009.
	Eco-design(C23)	Design products to reduce material/energy consumption, design products for reuse, recycling, material recycling, design products to avoid or reduce the use of hazardous materials.	Govindan, Rajendran, Sarkis & Murugesan, 2015, Iqbal, Altalbe, et al., 2019.
	Environmental management system(C24)	Environmental certification, such as ISO 14000, environmental goal plan, environmental policy, environmental activity control and inspection.	Jabbour & Jabbour, 2009.
Social Criteria (C3)	Employment practices of internal social measures(C31)	Discipline and safety regulations, employee contracts, equal labor resources, diversity, discrimination, flexible work arrangements, work opportunities, employment compensation, career development.	Bai, Kusi-Sarpong, Badi Ahmadi, & Sarkis, 2019.
	Internal social measures health and safety(C32)	Health and safety incidents, health and safety practices.	Luthra, Govindan, Kannan, Mangla, & Garg, 2017.
	The impact of external social measures on local communities(C33)	Health, education, service infrastructure, housing, health and safety incidents, supervision and public services, support for educational institutions, safety, cultural property, economic welfare and growth, social pathology, grants and donations, and support for community projects.	Azadnia, Saman, & Wong, 2015, Irshad et al., 2019).
	The impact of external social measures on contract stakeholders(C34)	Procurement standards, partnership standards, consumer education, stakeholder authorization, stakeholder participation.	Reuter, Goebel, & Foerstl, 2012, Iqbal, Yumei, et al., 2019.

also need to participate in activities that have a positive impact on SSCM practices and business performance (Khokhar, Iqbal, et al., 2020). By adopting a TBL approach, organizations assume a responsible

position with regard to economic, environmental, social prosperity, quality, and justice respectively (Rashidi et al., 2020).

2.1. Green Supply Chain Management (GSCM) Selection Criteria

GSCM integrates natural environmental issues into SCM (Parveen et al., 2011). The main goal of GSCM is to remove all wastes inside the industrial development itself, such as water, air and land pollution and property waste, and to reduce hazardous substances. (M. W. Iqbal et al., 2020). The organization that implements a successful GSCM because it considers social criteria in the supply chain environment as well as economic and environmental criteria. Many researchers have used different terms to define a green chain in various ways. Uemura Reche, Canciglieri Junior, Estorilio, & Rudek (2020) described GSCM defines the procurement and selection of product design materials, from the manufacturing process to the consumer's final product delivery and product life cycle management, and also describes the combination of environmental thinking. The GSCM emphases on how companies use their SSS' process capabilities and technologies to integrate environmental issues, thereby enhancing their competitive advantage (Shahzad et al., 2020).

There are many activities that can be incorporated into GSCM plans and SSCM practices (Ali et al., 2020; Yu et al., 2020). SSS and environmental cooperation includes activities aimed at improving environmental performance and SSS capabilities to carry out joint projects to develop green products and innovation (Qiansong Zhang et al., 2020; Li et al., 2020). SSS in GSCM is clearly a key activity in procurement management, because the company's SSS can prove the company's environmental sustainability and ecological performance (Roehrich et al., 2017). The literature focusing on GSCM aims to obtain certification or introduce green practices through the three pillars of sustainability, so as to promote the SSS and improve SSCM's practices and business preferences (Chiou et al., 2011).

2.2. Selection criteria for social supply chain management (SCM)

Organizations are liable for social interests and social interests can also be found in the company's mission and value statement (Diers-Lawson et al., 2020). Although social duty has a long history, the concept of social duty (and sustainability) in the supply chain has only appeared in recent years (Osei-Kojo et Andrews, 2020). In order to implement the social responsibility system, stakeholders, consumer non-governmental organizations (NGOs) and local community regulations have put increasing pressure on organizations. In the SCM these systems are used to transfer social responsible behaviours, especially those that affect their business partners, and provide benchmarks for environmental principles that society must meet (Shafiq et al., 2020; Mani et al., 2020).

Social duty can be defined as the voluntary combination of environmental and social issues in the or-

ganization's business operations and relationships with stakeholders (Qingyu Zhang et al., 2020; Halim Perdana Kusuma et al., 2019). Organizations are increasingly aware that their behavior in procurement and SSCM will greatly regard their status and long-standing success (Baloch et al., 2020). Administrations are responsible for environmental health and safety regulations that promote and protect workers who produce their products, whether they are direct employees or working for SSS (Testa et al., 2020). Social duty has been the subject of many studies. Kelley, Hemphill, & Thams (2019); Papacharalampous, Papadimitriou, & Anagnostopoulos (2019) believe that social responsibility includes the economic legal ethics and charity expectations imposed by the society on the organization at a specific time. Teh et al., 2019; Zahid et al. (2020) following categories as important aspects of ethical diversity working conditions at the social level, human rights, security, philanthropy and communities. The practices and difficulties encountered by SMEs in transferring social responsibility behavior to SSS doing business in developing countries but Lock-down has a negative influence on firm performance (Yumei et al., 2021). (Zhang et al., 2019; Morsing, Spence, 2019). The concept of activity focuses on how the organization uses its technology and how to integrate sustainability issues to enhance competitive advantage (Suhi et al., 2019). Oliveira, Leiras, & Ceryno, (2019); Yazdani, Kahraman, Zarate, & Onar, (2019) have developed a framework for modelling and analysing complicated universal SCM networks with undertake social obligation through comprehensive risk management and environmental decision-making. Many methods of presenting social

Table 2. Membership functions of linguistic values

Level	Code	Fuzzy numbers
Very Low	VL	(0.1, 0.1, 0.3)
Low	L	(0.1, 0.3, 0.5)
Medium	M	(0.3, 0.5, 0.7)
High	H	(0.5, 0.7, 0.9)
Very High	VH	(0.7, 0.9, 0.9)
Very Poor	VP	(1, 1, 3)
Poor	P	(1, 3, 5)
Fair	F	(3, 5, 7)
Good	G	(5, 7, 9)
Very Good	VG	(7, 9, 9)

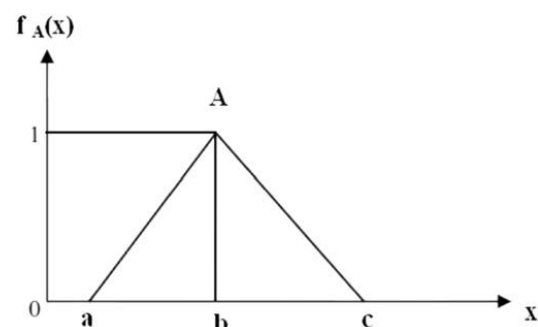


Figure 2. Membership function of triangular fuzzy number A

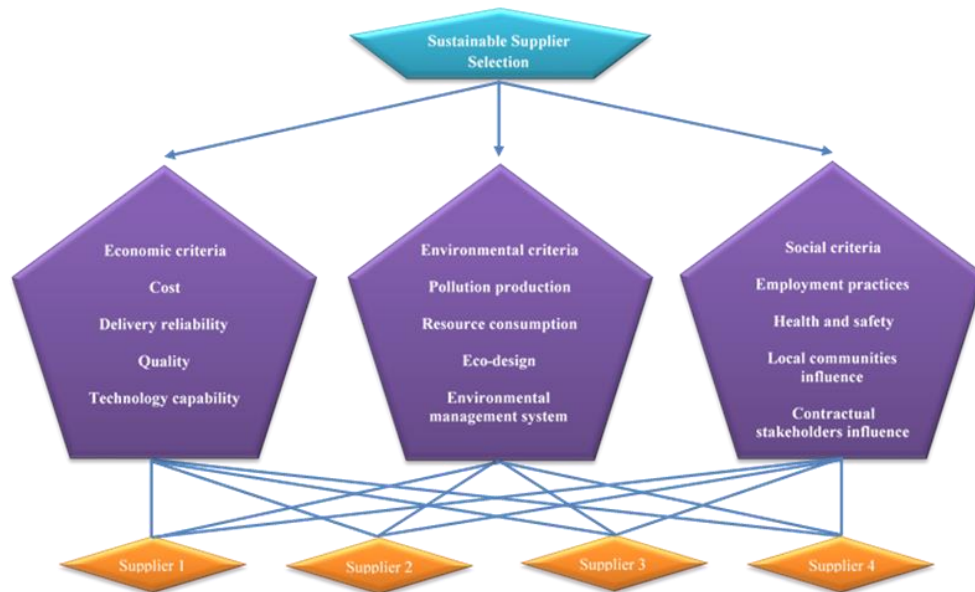


Figure 3. Hierarchical structure of decision problem

Table 3. The importance of the three weighting criteria from Experts

Economic criteria					Environmental criteria				Social criteria			
Experts	C11	C12	C13	C14	C21	C22	C23	C24	C31	C32	C33	C34
Expert1	H	H	VH	M	VH	H	H	M	H	H	M	M
Expert2	VH	H	H	M	H	VH	H	H	H	H	H	M
Expert3	H	H	VH	M	VH	H	H	M	VH	H	M	H

Table 4. Evaluation of suppliers (SP) on sustainability criteria by Experts

Experts		Economic criteria				Environmental criteria				Social criteria			
	Suppliers	C11	C12	C13	C14	C21	C22	C23	C24	C31	C32	C33	C34
Expert1	SP1	G	F	F	F	F	G	G	F	G	F	F	G
	SP2	F	F	G	F	F	G	G	VG	G	F	G	F
	SP3	VG	G	VG	G	F	F	G	G	VG	VG	G	F
	SP4	P	F	F	P	P	F	F	F	P	P	F	F
Expert2	SP1	G	F	F	F	G	G	G	F	F	VG	G	G
	SP2	F	G	G	F	F	F	G	G	G	F	F	G
	SP3	G	G	VG	F	G	G	VG	F	VG	F	G	G
	SP4	F	P	P	F	F	G	F	P	F	G	P	P
Expert3	SP1	G	F	F	F	G	G	F	VG	VG	G	G	G
	SP2	F	F	G	G	G	G	F	F	F	P	F	G
	SP3	G	G	G	F	G	VG	G	F	G	G	VG	F
	SP4	P	F	P	F	M	P	G	F	F	P	F	G

responsibility and SSCM issues to reverse logistics systems have been studied (Pakistan Bureau of Statistics, 2014; Nikolaou et al., 2013; Sarkis et al., 2010). Figure 2 shows the membership function of triangular fuzzy number A.

2.3. Sustainable Supplier Selection (SSS) Criteria and Methods

One of the most important activities to establish SSS decisions is to establish standards system. Since 1960s, many researchers have focused on the establishment of these criteria. Zafar, Zafar, Sarwar, Raza, & Khan (2019) were one of the first researchers in this field. The questionnaire papers sent to the administrators of Pakistani companies, he determined 33 different SSS criteria. These standards include

product quality, performance assurance, delivery and claims policy production facilities as well as production capacity net prices and technical capabilities. Zafar et al., (2019) concluded that quality delivery and performance history of SSS in Pakistan are the three most important criteria but the role of COVID-19 has remained most harmful to the world economy. The business is decreasing day by day due to the COVID-19 spread. Markets are close, and the revenue of the businesses is declined. In the situation of COVID-19, most of the countries are stopped working and restricted the people to remain inside the houses. Social distancing is one of the major precautions to prevent COVID-19. Therefore, in the organization the SSS and firm performance is also decreased due to the lockdown. However, the supply

Table 5. Fuzzy set decision matrix and fuzzy weight of criteria

Expert s	C1 1			C1 2			C1 3			C1 4			C2 1			C2 2		
We- ight	0.4	0.7 6	0.8	0.4	0.6	0.8	0.4	0.7 6	0.8	0.2	0.4	0.6	0.5	0.8 2	0.8	0.4	0.7 6	0.8
SP1	4	6	8	2	4	6	2	4	6	2	4	6	2	5.3	9	5	7	9
SP2	2	4	6	2	4.7	8	4	6	8	2	4.7	8	2	4.7	8	2	5.7	8
SP3	4	6.7	8	4	6	8	6	7.3	8	2	4.7	8	2	5.7	8	2	6	8
SP4	1	2.7	6	1	3.3	6	1	2.7	6	1	3.3	6	1	3.3	6	1	5	8
Expert s	C2 3			C2 4			C3 1			C3 2			C3 3			C3 4		
We- ight	0.4	0.6	0.8	0.2	0.4 7	0.6	0.4	0.6 6	0.8	0.2	0.4 7	0.8	0.2	6.7	0.8	0.2	0.6 7	0.8
SP1	2	5.7	8	2	5.7	8	2	6	8	2	6	8	2	6.7	8	4	6	8
SP2	4	6.7	8	2	6	8	2	5.7	8	1	3.3	6	2	4.7	8	2	5.7	8
SP3	4	6.7	8	2	4.7	8	4	7.3	8	2	6	8	4	6.7	8	2	4.7	8
SP4	2	4.7	8	1	3.3	6	1	3.3	6	1	4.7	8	1	3.3	6	1	4	8

Table 6. Normalized fuzzy decision matrix

Experts	C11			C21			C13			C14			C21			C22		
SP1	0.1	0.13	0.1	0.32	0.55	0.77	0.32	0.55	0.77	0.32	0.55	0.77	0.32	0.6	1	0.55	0.77	1
SP2	0.13	0.1	0.32	0.32	0.62	1	0.55	0.77	1	0.32	0.62	1	0.32	0.62	1	0.32	0.73	1
SP3	0.1	0.12	0.1	0.55	0.77	1	0.77	0.91	1	0.32	0.62	1	0.32	0.73	1	0.32	0.77	1
SP4	0.13	0.26	1	0.1	0.47	0.77	0.1	0.4	0.77	0.1	0.47	0.771	0.1	0.47	0.77	0.1	0.55	1
	C23			C24			C31			C32			C33			C34		
SP1	0.32	0.73	1	0.32	0.73	1	0.32	0.77	1	0.32	0.77	1	0.32	0.73	1	0.55	0.77	1
SP2	0.54	0.73	1	0.32	0.77	1	0.32	0.73	1	0.1	0.47	0.77	0.32	0.62	1	0.32	0.73	1
SP3	0.54	0.84	1	0.32	0.62	1	0.55	0.91	1	0.32	0.77	1	0.55	0.84	1	0.32	0.62	1
SP4	0.32	0.62	1	0.1	0.47	0.77	0.1	0.47	0.77	0.1	0.62	1	0.1	0.47	0.76	0.1	0.54	1

chain management is still working in lockdown because to manage the supplier selection and green supply chain management is the great importance for survival in the earth. However, it shows a negative role in the performance of the business. As discussed by the previous studies that the business is decreased due to lockdown (Sarkis, 2020). In this situation, the supplier selection and sustainable supply chain management is also facing performance-related issues. Due to the spread of COVID-19, the situation of lockdown is increasing, which causing to decrease in the firm performance (Alkahtani et al., 2021). Ikram, Zhou, Shah, & Liu (2019) studied that the most important criteria for SSS are product quality, delivery and performance in the past history of Pakistan. Muhammad et al., (2020) proposed the MCDM methods for SSS. Collect and analyse relevant articles that appeared in international journals from 2001 to 2010 to solve the most important criteria considered by experts for SSS. Dweiri, Kumar, Khan, & Jain (2016) summarized that Since 1960s, many researchers have focused on the establishment of these economic criteria. Figure 3 shows the hierarchical structure of decision problem.

The development of social and green SSS is also essential for effective SSCM, and consideration of environmental and social factors must go beyond the forefront of the organization's SSS agenda but Lockdown has a negative influence on firm performance (Khokhar, Hou, et al., 2020; Ageron et al., 2012). The organization has adopted various methods and activities of SSS decisions is establishing the criteria. In this study, we conclude some criteria that can be

applied in the SSS which defined them precisely (Hashemi et al., 2015). The selection criteria are not intended to fully describe the SSS performance, but only as an example of measures that can be formulated. We have summarized many standards and trials that can be measured in the literature in Table 1 from the regard of sustainability.

3. Fuzzy Numbers

Natural language expressing awareness or judgment is always personal, unclear or imprecise. The uncertainty and subjectivity of fuzzy numbers have been dealt with by probability and statistics for a long time. Since the accuracy of words is not as good as numbers, the concept of linguistic variables generally describes the definition of events (Chien et al., 2021). The definitions of these events are too poor to be described in predictable quantitative terms. In order to solve the perspicacity of human intelligence, Chou, Chang, & Shen (2008) introduced fuzzy set theory to precise the linguistic specifications in the process of experts. Fuzzy theory enables experts to deal with the ambiguity involved in data language evaluation. Wang & Lin (2003) were the first researchers to use fuzzy sets to investigate decision-making problems and initiated the FMCDM method. This article uses triangular fuzzy numbers to evaluate experts' preferences (Fu et al., 2021). The purpose for using triangular fuzzy numbers is that experts are instinctively easy to use and calculate.

There are various ways to define fuzzy numbers. A is a real fuzzy number which is described as fuzzy

subset of the real line \underline{R} with membership function $f_A(x)$, it is a constant mapping from x in X to the closed interval $[0, 1]$. If the membership level of an element is 1, it means that the element must be in the set. If the member level is 0, it means that the element is definitely not in the set. This article defines the perception of fuzzy numbers as follows (A˘ Enginoglu, 2011).

Definition 1. The membership function of the fuzzy number (as show in Fig. 1):

$$f_A(x) = \begin{cases} 0 & x < a \text{ or } x > c \\ \frac{x-a}{b-a} & a \leq x \leq b \\ \frac{c-x}{c-b} & b \leq x \leq c \end{cases} \quad (1)$$

Definition 2. Let $A = (a, b, c)$ and $B = (a_1, b_1, c_1)$ be two triangular fuzzy numbers. Then the operational laws of these two triangular fuzzy numbers are as follows:

$$A(+)B = (a, b, c)(+)(a_1, b_1, c_1) = (a + a_1, b + b_1, c + c_1) \quad (2)$$

$$A(-)B = (a, b, c)(-)(a_1, b_1, c_1) = (a - a_1, b - b_1, c - c_1) \quad (3)$$

$$A(*)B = (a, b, c)(*)(a_1, b_1, c_1) = (a * a_1, b * b_1, c * c_1) \quad (4)$$

$$(A(/)B = (a, b, c)(/)(a_1, b_1, c_1) = (a/a_1, b/b_1, c/c_1) \quad (5)$$

$$K * A = (k * a, k * b, k * c) \quad (6)$$

$$(A) - 1 = (1/c, 1/b, 1/a) \quad (7)$$

The distance between A, B fuzzy numbers is calculated as:

$$d(A, B) = \sqrt{1/3[(a - a_1)^2 + (b - b_1)^2 + (c - c_1)^2]} \quad (8)$$

Definition 3. Assume that an expert group has K expert, and the fuzzy rating of each expert ($k = 1, 2, \dots, K$) can be represented as a positive triangular fuzzy number R_k ($k = 1, 2, \dots, K$) with membership function $f_{Rk}(x)$. Then, the aggregated fuzzy number is defined as:

$$R = (a, b, c), k = 1, 2, \dots, K \quad (9)$$

where

$$a = \min_k \{a_k\}, b = 1/k \sum_{k=1}^K b_k, c = \max_k \{c_k\}$$

4. The fuzzy TOPSIS method

The multi-attribute decision-making (MADM) technology functionally related to the problem of discrete alternatives is a practical tool for resolving real-world problems. Since many MADM technologies are involved, (Gati, Krausz, & Osipow, 1996) provide taxonomies to classify these technologies into information types from experts, prominent information features, and main method categories. Classification does provide us with a clear direction for learning MADM technology (Bernroider et Stix, 2006). In these technologies, since there is a clearly expressed process, the attribute information category from the experts with the information is convenient

for decision-making. As in Table 7 and in Figure 4a & 4b show the weighted normalized fuzzy decision matrix. In this category of TOPSIS, the distance measurement concept as an alternative to the positive ideal solution (PIS) and negative ideal solution (NIS) is the most direct technique in MADM. Table 8 described the distances between suppliers (SP) and A^* , A^- with respect to each criterion.

Meanwhile, this study proposes a related technologies such as ELECTRE and AHP, the characteristics of the TOPSIS method make it a major MADM technology (Kalbar et al., 2012; Kahraman et al., 2007):

- First and for most take unlimited range of all three pillars of sustainability performance attributes and criteria.
- Then clear trade-offs and interactions between performance attributes. More precisely, the change of any one attribute can be compensated by other attributes in an opposite or direct way.
- The MADM technology (such as ELECTRE) method only determines the level of each alternative, and the priority ranking of alternatives with numerical values can better understand the differences and similarities between alternatives(Hou et al, 2019).
- AHP methods circumvents the pair-wise evaluation. This method is used when dealing with a large number of sustainability criteria/sub criteria.
- This is systematic simple calculation process.
- In general simulation comparison, when adding or deleting alternative methods in the MADM method, the rank inversion of TOPSIS is the smallest.
- The TOPSIS solution method includes the following steps (Yue, 2011; Memari et al., 2019; Opricovic,Tzeng, 2004):

Step 1. Compute the normalized decision matrix. The normalized fuzzy-decision matrix can be expressed as:

$$R = [r_{ij}]_{m \times n}$$

Where B and C are the sets of product cost criteria and benefit correspondingly:

$$r_{ij} = \left(\frac{a_{ij}}{c_j^*}, \frac{b_{ij}}{c_j^*}, \frac{c_{ij}}{c_j^*} \right), j \in B \quad (10)$$

$$r_{ij} = \left(\frac{a_j^-}{c_{ij}}, \frac{a_j^-}{b_{ij}}, \frac{a_j^-}{a_{ij}} \right), j \in C \quad (11)$$

The above normalization method aims to retain the standardized attributes of the element r_{ij} (normalized) triangular fuzzy number.

Step 2. Estimate the weighted normalized decision matrix. The weighted normalized value v_{ij} is considered as:

$$V = [v_{ij}]_{m \times n} \quad i = 1, 2, \dots, m \quad j = 1, 2, \dots, n \quad (12)$$

Where $v_{ij} = r_{ij} \cdot w_{ij}$ and w_{ij} are the weights of the j th attribute, or standard.

Table 7. Weighted normalized fuzzy decision matrix

Experts	C11			C12			C13			C14			C21			C22		
SP1	0.05	0.1	0.17	0.16	0.38	0.6	0.16	0.42	0.6	0.9	0.27	0.53	0.16	0.57	0.8	0.27	0.59	0.8
SP2	0.006	0.14	0.2	0.16	0.43	0.8	0.27	0.59	0.8	0.9	0.31	0.6	0.16	0.61	0.8	0.16	0.56	0.8
SP3	0.05	0.9	0.17	0.27	0.53	0.8	0.38	0.69	0.8	0.9	0.31	0.6	0.16	0.61	0.8	0.16	0.600.42	0.8
SP4	0.06	0.2	0.8	0.05	0.32	0.6	0.05	0.31	0.6	0.02	0.23	0.53	0.05	0.39	0.6	0.005	0.42	
	C23			C24			C31			C32			C33			C34		
SP1	0.16	0.51	0.8	0.9	0.41	0.6	0.16	0.58	0.8	0.16	0.53	0.8	0.9	0.41	0.8	0.16	0.43	0.9
SP2	0.27	0.51	0.8	0.9	0.43	0.6	0.16	0.56	0.8	0.05	0.32	0.7	0.9	0.35	0.8	0.9	0.41	0.8
SP3	0.27	0.59	0.8	0.9	0.35	0.6	0.28	0.69	0.8	0.16	0.53	0.8	0.16	0.48	0.8	0.9	0.35	0.9
SP4	0.16	0.43	0.8	0.002	0.26	0.53	0.05	0.35	0.6	0.005	0.43	0.8	0.02	0.26	0.6	0.02	0.31	0.8

Table 8. Distances between suppliers (SP) and A*, A with respect to each criterion

	C11	C12	C13	C14	C21	C22	C23	C24	C31	C32	C33	C34
d (SP1, A*)	0.52	0.51	0.42	0.45	0.39	0.78	0.47	0.37	0.46	0.46	0.53	0.49
d (SP2, A*)	0.49	0.39	0.4	0.44	0.45	0.78	0.39	0.39	0.37	0.46	0.48	0.55
d (SP3, A*)	0.4	0.3	0.4	0.44	0.45	0.78	0.39	0.39	0.37	0.46	0.48	0.55
d (SP 4, A*)	0.59	0.59	0.47	0.57	0.55	0.61	0.49	0.46	0.58	0.54	0.62	0.59
d (SP1, A-)	0.41	0.42	0.32	0.57	0.14	0.46	0.44	0.57	0.56	0.4	0.53	0.54
d (SP 2, A-)	0.53	0.58	0.41	0.55	0.57	0.14	0.46	0.44	0.56	0.4	0.53	0.54
d (SP3, A-)	0.57	0.64	0.41	0.58	0.57	0.07	0.49	0.42	0.62	0.56	0.56	0.52
d (SP 4, A-)	0.4	0.39	0.31	0.41	0.52	0.49	0.44	0.32	0.4	0.53	0.4	0.51

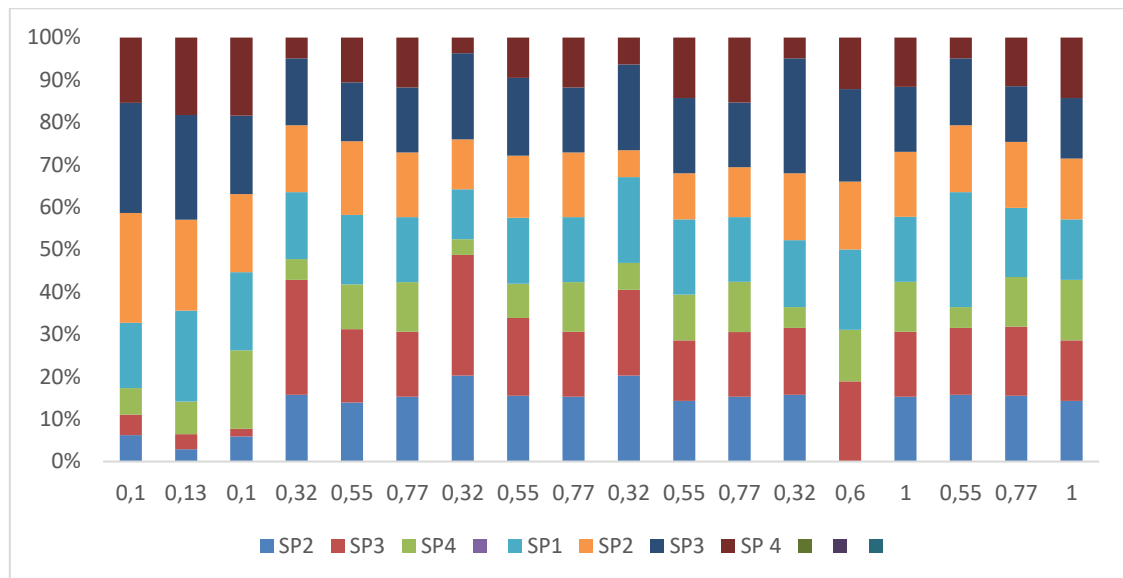


Figure 4a show the weighted normalized fuzzy decision matrix

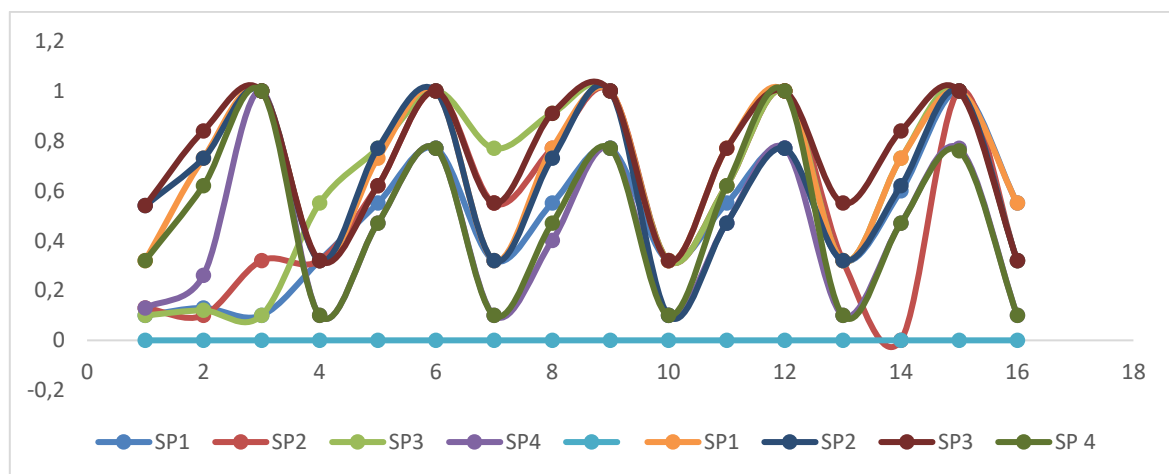


Figure 4b. show the weighted normalized fuzzy decision matrix

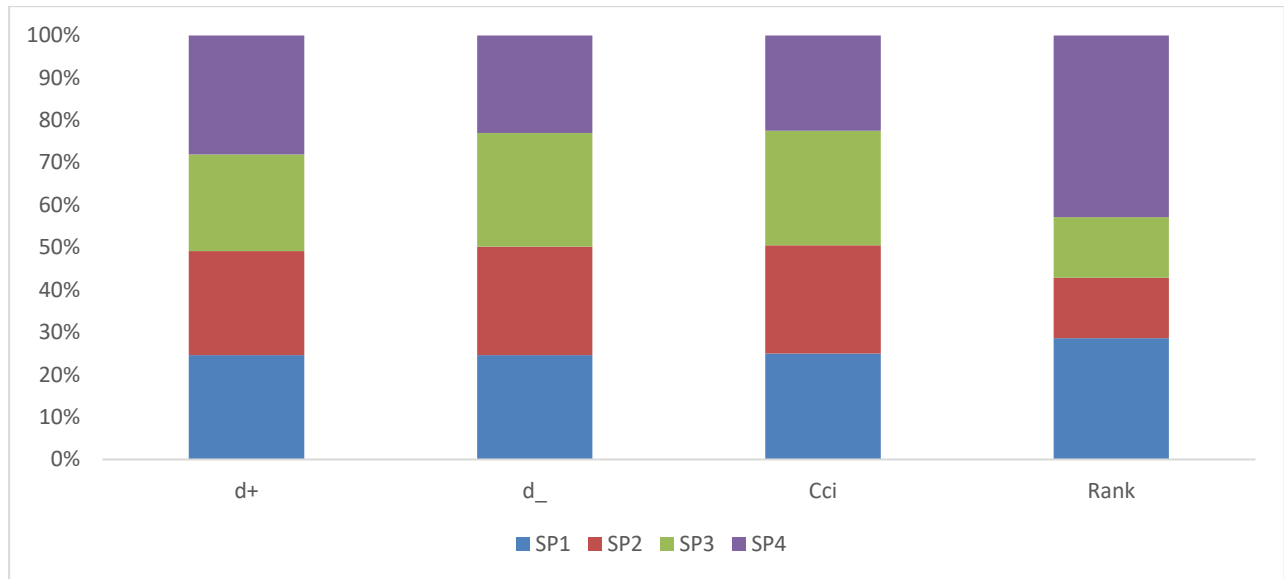


Figure 5. Calculations of d+, d- and cci from the Eq. 15 till Eq. 17

Table 9. Calculations of d+, d- and cci giving to Eq. 15 till Eq. 17

	d+	d-	Cci	Rank
SP1	5.94	5.61	0.485	2
SP2	5.92	5.83	0.495	1
SP3	5.52	6.11	0.524	1
SP4	6.77	5.23	0.435	3

Step 3. Determine positive and negative ideal solutions: Fuzzy positive ideal solution (FPIS, A^*) and fuzzy negative ideal of the solution (FNIS, A^-) can be defined as:

$$A^* = (v_1^*, v_2^*, \dots, v_n^*) \quad (13)$$

$$A^- = (v_1^-, v_2^-, \dots, v_n^-) \quad (14)$$

Where $v_j^* = \max_i \{v_{ij3}\}$ and $v_j^- = \min_i \{v_{ij1}\}$, $i = 1, 2, \dots, m$, $j = 1, 2, \dots, n$

Step 4. The distance of each alternative from the positive and the negative ideal solution A^* , A^- can be calculated as:

Where $v_j^* = \max_i \{v_{ij3}\}$ and $v_j^- = \min_i \{v_{ij1}\}$, $i = 1, 2, \dots, m$, $j = 1, 2, \dots, n$

$$d_i^+ = \sum_{j=1}^n d_v(v_{ij}, v_j^*), i = 1, 2, \dots, m \quad (15)$$

$$d_i^- = \sum_{j=1}^n d_v(v_{ij}, v_j^-), i = 1, 2, \dots, m \quad (16)$$

and $d_v(0,0)$ is the distance measurement among two fuzzy numbers.

Step 5. Estimate the virtual proximity to the ideal resolution. One define the tightness factor to determine all ranking orders possible SP after d_i^+ and d_i^- of each alternative A_i ($i = 1, 2, \dots, m$) has been calculated. The closeness coefficient (CC_i). The alternative calculation is:

$$CC_i = d_i^- / (d_i^+ + d_i^-), i = 1, 2, \dots, m \quad (17)$$

Step 6. Arrange the order of preferences. Alternative A_i is closer when cci approaches 1, FPIS (A^*) moves away from FNIS (A^-). According to the descending order of cci, we can determine sort all alternatives and choose one of the best possible alternatives.

5. Illustrative Case and Results

In order to test the practicability of the proposed SSS and evaluation methods, a case of evaluating is illustrated. Fig. 2 shown the hierarchy of the conclusion problem. We present the main criticisms identified in Table 1. Conduct surveys by distributing questionnaires to managers in the areas of business purchase and environment. The assessment consequences determined the comparative significance weights of several standards and grades. As described in Table 1, Figure 3 there are four economic, environmental and social criteria (C11, C12, C13 and C14), (C21, C22, C23 and C24), (C31, C32, C33 and C34) respectively. C11 is the product cost criteria. As Figure 6 described the Fuzzy TOPSIS results and sensitivity analysis of sustainable supplier (SP) selection.

Thus currently proposed method is used to solve this problem. Table 2 defines the relative importance weight and rank importance of the criteria described using linguistic variables. The three experts expressed their views on the importance weight of the 12 sub-criteria of 3 pillars and the rating of each SSS relative to these criteria/sub-criteria. Table 3 and 4 shows the original evaluation information provided by the three experts. Table 3-5 shows the fuzzy decision matrix and fuzzy weights of the standard normalized fuzzy decision matrix for the distance of each SSS to FPIS and FNIS and the proximity coefficient of each SSS for each criterion, respectively. According to the SSS choice, use Ms Excel to complete all calculations. Figure 7 shows the Sensitivity analysis result.

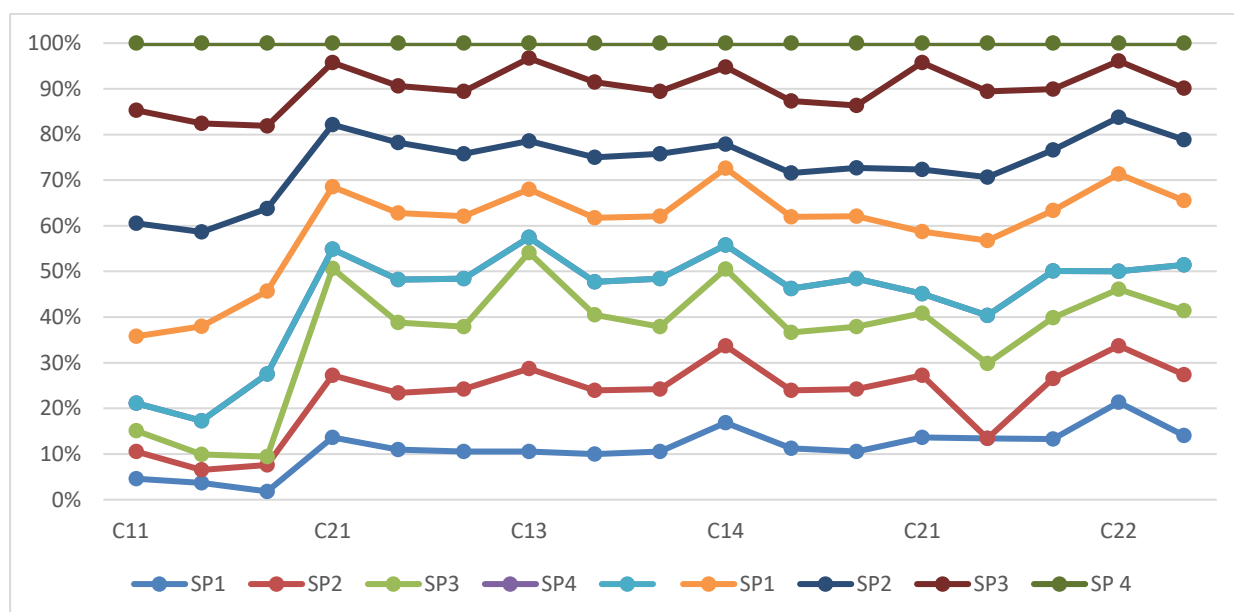


Figure 6. Fuzzy TOPSIS results and sensitivity analysis of sustainable supplier (SP) selection

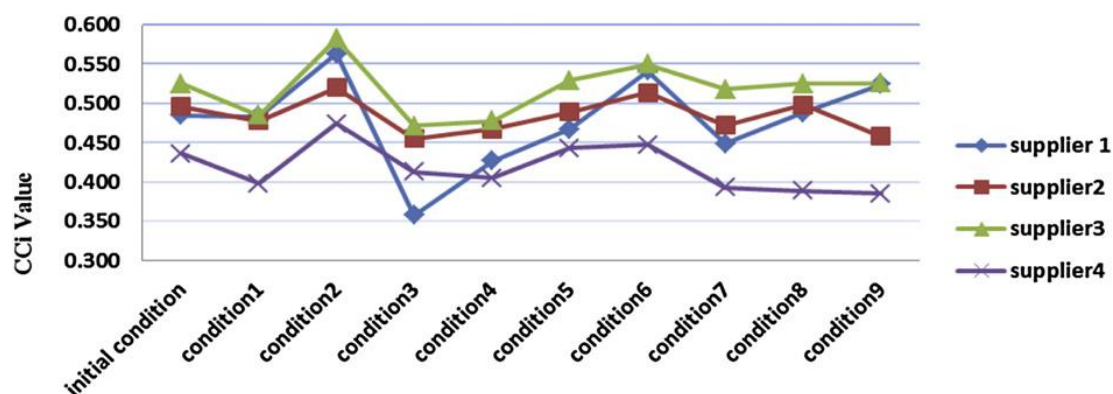


Fig. 7. Sensitivity analysis result

Table 10. Fuzzy TOPSIS method is the result of sensitivity analysis to sustainable supplier (SP) selection

Condition	Decision criteria	Experts	Suppliers (SP) ranking (Respectively)
Initial condition	C11, C12, C13, C14, C21, C22, C23, C24, C31, C32, C33, C34	Expert1, Expert2, Expert3	SP2, SP3, SP4, SP1
Condition1	C21, C22, C23, C24	Expert1, Expert2, Expert3	SP2, SP3, SP4, SP1
Condition2	C31, C32, C33, C34	Expert1, Expert2, Expert3	SP2, SP3, SP4, SP1
Condition3	C11, C21, C13, C14	Expert1, Expert2, Expert3	SP2, SP3, SP4, SP1
Condition4	C11, C21, C13, C14, C21, C22, C23, C24	Expert1, Expert2, Expert3	SP2, SP3, SP4, SP1
Condition5	C11, C21, C13, C14, C31, C32, C33, C34	Expert1, Expert2, Expert3	SP2, SP3, SP4, SP1
Condition6	C21, C22, C23, C24, C31, C32, C33, C34	Expert1, Expert2, Expert3	SP2, SP3, SP4, SP1
Condition7	C11, C21, C13, C14, C21, C22, C23, C24, C31, C32, C33, C34	Expert1	SP2, SP3, SP4, SP1
Condition8	C11, C21, C13, C14, C21, C22, C23, C24, C31, C32, C33, C34	Expert2	SP2, SP2, SP4, SP1
Condition9	C11, C12, C13, C14, C21, C22, C23, C24, C31, C32, C33, C34	Expert3	SP2, SP3, SP1, SP1

Table 9 Figure 5 summarizes the final results of fuzzy TOPSIS analysis. According to the value of proximity coefficient (CC_i), the rank order of the four SSS according to their sustainability performance is: SSS 2 > SSS 3 > SSS 4 > SSS 1. Therefore, from the perspective of experts, we can achieve that SSS 2 has the best sustainability performance. After considering all sustainability criteria, we have just shown the results of our analysis of SSS. After considering all sustainability criteria, we have just shown the results of our analysis of SSS.

5.1. Sensitivity analysis

The purpose of the sensitivity analysis is to deliberate the impact on SSS position when we select altered experts and criteria. This query is useful when there is uncertainty in the definition of the importance of different factors. Table 10 and figure 3 give detailed information on the other nine conditions. According to this sensitivity analysis, changing the fuzzy weight will change the order of SSS. Although the ranking of SSS varies depending on the basis of weights, usually from the all SSS the SSS 2 is the best. Since the decision-making process is a sensitive type of criteria, the expertise should be carefully considered when choosing this process.

6. Conclusion

SSCM edges such as SSS, environment and social cooperation can play an important part in accomplishing TBL benefits and promoting sustainable social development. This article emphasizes on the economic, environmental and social criteria of SSS based on the TBL concept. An inclusive study of sustainable supply chain operations should study all three sustainability features instantaneously. In this article, we introduce a fuzzy MCDM method based on sustainability criteria for SSS decisions. First, determine the criteria for SSS based on the literature. Second, experts implement language scores for standards and alternatives, and then use fuzzy TOPSIS to aggregate scores and generate overall performance scores to measure the SSCM practices and business performance. Finally, we conduct a sensitivity analysis to determine the standard weights by the decision-making process. The results instructed the company to choose the best SSS among the candidates in four ways to continue to cooperate with the SSS team, and suggested that certain SSS improve some defects or stop cooperation with certain SSS. In general, the selection of SSS is one of the most critical factors. This is also based on expert decisions. Through the company's decision-making and implementation, opportunities for improving its sustainability performance can be discovered and prioritized, which can reduce its negative impact of the activity on the environment and society. However, COVID-19 has a negative effect on company performance. Due to the use of COVID-19, countries

are under lockdown and business operations seem to be paralyzed. Therefore, the lock-in situation due to COVID-19 has a negative impact on the company's performance.

7. Limitation

Though, above discussing article has few limitations. More than 10 SSCM practices have been identified. No other SSCM practices and problems have been discovered, so actual issues regarding the accuracy of these experts' decision-making needs to be investigated to ensure the feasibility of this method. Because, this study conducted in the situation of lockdown, therefore, the companies were not in complete operation that is the reason, there could be weakness in data collection. The situation of COVID-19 is not similar in each country, therefore, future studies should be examined on the other countries to scrutinize the effect green supply chain management, SSCM practices on firm performance. The information and data required to apply this method is one of the limitations of the feasibility of this operation. Supply chain managers should not only adopt this approach, but also maintain such data for future organizational management. Due to the SSS evaluation process, experts face time pressure and lack of expertise on issues related to GSCM and SSCM practices. Although the preferences are not complete, we recommend that you consider SSS. May be this research subject of future research. In addition, various technologies and dynamic evaluation models can be used to integrate the SSS phase with continuous examination. Moreover, the allocation of demand after positioning all SSS is another imperative issue, in future which may become a new trend.

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Empowering Theory of Poverty Reduction for Sustainable Development: Does the Welfare of Descendants Matter?

Wspieranie teorii ograniczania ubóstwa dla zrównoważonego rozwoju: czy dobro przyszłych pokoleń ma znaczenie?

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Abstract

The first Sustainable Development Goal expresses the global concern in poverty eradication. We looked at the theory of poverty reduction with a long-term perspective in mind to confirm the congruence of modern approaches and their compliance with the principles of sustainable development. Despite clear signs of targeting Sustainable development goals to the future, we have found that future poverty needs deep discussion. We researched legal acts, policies and scientific sources to prove the possibility and suitability of recognising future poverty as a valid form of poverty. We considered the main possible difficulties that will challenge initiatives of future poverty exhausting. Finally, we proposed several perspective directions of further research to include the future poverty concept into the agenda of governments and supranational organisations.

Keywords: future poverty, Sustainable development goals, forms of poverty, poverty reduction policy

Streszczenie

Pierwszy Cel Zrównoważonego Rozwoju wyraża globalną troskę o eliminację ubóstwa. W tej pracy przyjrzelśmy się teorii ograniczania ubóstwa w perspektywie długoterminowej, aby potwierdzić zgodność nowoczesnych podejść i ich zgodność z zasadami zrównoważonego rozwoju. Pomimo wyraźnych oznak ukierunkowania Celów zrównoważonego rozwoju na przyszłość, stwierdziliśmy, że kwestia przyszłego ubóstwa wymaga dodatkowej uwagi. Przeanalizowaliśmy akty prawne, polityki i źródła naukowe, aby udowodnić możliwość i stosowność uznania przyszłego ubóstwa za ważną formę ubóstwa. Zastanowiliśmy się nad głównymi możliwymi trudnościami, które będą wyzwaniem dla przyszłych inicjatyw ograniczających ubóstwo. W końcu zaproponowaliśmy kilka perspektywicznych kierunków dalszych badań, aby włączyć koncepcję przyszłego ubóstwa do programu rządów i organizacji ponadnarodowych.

Słowa kluczowe: przyszłe ubóstwo, Cele zrównoważonego rozwoju, typy ubóstwa, polityka zmniejszania ubóstwa

1. Introduction

Overcoming poverty is at the top of the list of sustainable development goals set out in *Transforming our world: the 2030 Agenda for Sustainable Development*. In addition, the UN General Assembly recognises that *eradicating poverty in all its forms and dimensions, including extreme poverty, is the greatest global challenge and an indispensable requirement for sustainable development* (General Assembly of the United Nations, 2015).

Public welfare is essential for the peace and prosperity of every state. In the long run, the wealth of the state will not matter if the people are unhappy. Cicero said: *Salus populi – suprema lex* (The welfare of the people shall be the supreme law). Poverty has always existed in social systems (Atkins, 2006). Historically, poverty has been criticised and glorified (Jones, 2010). Before the rise of the social economy theory, poverty was usually an individual or family problem. Until the emergence of sustainable development theory, it remained a problem of region or state. Nowadays, due to the deepening globalisation processes, poverty has acquired the status of a global problem determining the direction of future development for the whole human civilisation.

The problem of poverty in the global dimension has remained relevant in recent decades. In 2019 A. Banerjee, E. Duflo and M. Kremer won The Nobel Prize in Economic Sciences *for their experimental approach to alleviating global poverty* (Nobel Foundation, 2019). However, the *only* theory of poverty is still far from complete.

The apparent reason for the absence of a general poverty reduction theory is states' individualism, differences in their political models and mechanisms, in the level of economic development, income, opportunities, and culture. The General Assembly recognises the freedom of each state to develop and implement its different instruments to overcome poverty (General Assembly of the United Nations, 2015). However, this freedom is a two-sided blade. On the one hand, states can respond flexibly to the needs of citizens and address economic insecurity. However, on the other hand, states can adopt declarative acts that speak loudly about poverty but do not contain tangible steps to overcome it.

Understanding poverty in the dimension of sustainable development requires two questions that we can ask any citizen worldwide: *What is poverty?*, *Why the money is in the first place, after all?*. Of course, the answer to the first question can include concepts like *restriction, lack, unsatisfied needs*, perhaps even *situation*. However, in modern society, access to goods is limited mainly by price, and the perception of poverty as a money deficiency has been ingrained in mass mindsets. The second question aims to clarify the differences in access to privileges separating the poor and other groups. These issues are central to sustainable poverty reduction policies. Unfortunately,

the data show that there is no straightforward solution at the global level.

According to The United Nations (UN) standards (PPP \$1.90 a day), in 2020, from 0.8% to 45.7% of certain regions' populations were below the poverty line. The worst situation was in Sub-Saharan Africa (43.4% and 45.7%) and South Asia (22.9% and 18.2%). The anti-leaders in the ranking (according to the UN standard) were Madagascar (77.6%), Congo (76.6%), Burundi (71.8%), Malawi (70.3%), Central African Republic (66.3%), Mozambique (62.9%).

However, some countries reported complete or almost complete eradication of critical poverty - Kyrgyzstan (0.9%), Sri Lanka (0.8%), Mongolia (0.5%), and the Dominican Republic (0.4%), Tunisia (0.2%), Jordan (0.1%), Kazakhstan (0%), Maldives (0%), Thailand (0%), Ukraine (0%) and others (UNDP, 2020). Maybe then our research does not meet the needs of time? Should governments simply use the experience of countries that have successfully overcome acute poverty? Unfortunately, this is a dead-end.

Poverty has been, and probably will be, one of humanity's unresolved problems for decades to come. The UN successively includes poverty on the global agenda, but unfortunately, that is not enough. As Schleicher, J., Schaafsma, M., & Vira, B. (2018) rightly point out, sustainable development goals are the basis for a holistic perception of poverty, but their weakness is differences in interpretation. From the standpoint of a sustainable approach, we can see a crucial weakness of current anti-poverty policies - the almost complete absence of sight on the future. Nobel laureates Banerjee, A. V., & Duflo, E. (2011) called for a rethinking of poverty in the spatial dimension. Today, the spatial dimension is a popular area of research on poverty and ways to overcome it (Fan, 2021). However, researchers and governments often unnoticed the temporal dimension of poverty, although UNDP (2020) emphasises the importance of eradicating poverty in all its forms and preserving the results achieved in a changing world.

In 2012, Ukraine reported almost complete eradication of poverty, 0% according to the UN standard and 1.3% according to the national standard. However, in 2019 State Statistical Service of Ukraine reported negative changes. Absolute poverty (according to the national standard, about \$ 2.2 a day) was 1.1%, relative poverty (at a poverty line of about \$ 3.6 a day) was 24.4% (State Statistical Service of Ukraine, 2019). Thus, the pre-2012 policies were impactful for poverty reduction but did not affect results preservation.

Governments are glad to report on poverty alleviation, but they do not consider sustainability principles and do not care about results preservation in the long term due to different reasons.

We wish to advance views on poverty reduction as a long-term process, not a one-time activity or short-term phenomenon. Long-term planning has limita-

tions. The longer the term, the higher are the uncertainty and risks associated with predictive difficulties and changes in the influence of known or new factors. There are currently limited global plans to tackle poverty for more than a decade. The time frame of Global Sustainable Development Goals is about 15 years. However, the transition of persons to the status of *adults* occurs according to various criteria at 18, 21, and even 27 years. Should we take into account the change of generations that will occur during the implementation of a plan? Does a sustainable approach require assurances that our descendants will not live in poverty?

We rely on the idea of sustainable development and believe that the world should be better for posterity. We do not want to leave poverty to posterity, just as we do not want to leave hunger, global warming, and inequality to them. Thus, we will explore the theory of overcoming poverty from the standpoint of sustainable development, with a view to the distant future, when children born in the year of approval of the Sustainable Development Goals will become adults.

2. Literature review: spatial and temporal approaches to poverty

The Sustainable Development Goals (SDGs) are global and address the universal problems of humanity. Schleicher, J., Schaafsma, M., & Vira, B. (2018) pointed to the significant potential of SDG in solving complex problems related to development, society, and the environment. At the same time, Sopilnyk, R., & Piwowarski, J. (2021) emphasised the dynamic nature of SDG, which germinating need for continuous enrichment of their content and interpretation. Overcoming poverty in all its forms is the first of the SDGs. We explore the importance of sustainable development goals for the future and, therefore, we must note the lack of a time label in the formulation of the first goal. The first goal is mainly about the widespread eradication of poverty and let us call this approach *spatial*.

As we will see further, the spatial approach is now dominant in poverty studies. Current empirical research is mainly based on data provided by supranational institutions like the UN, the World Bank, et cetera, or by national statistical services. The data allows identifying the link between poverty reduction policies and changes in this area, clarifying the factors that affect the growth or reduction of the poor people share in the population. These data are the basis of short-term states strategies and also it is used to assess the success of reforms.

We understand the spatial approach as focused on overcoming poverty today (or in the imminent future), in isolation from the sustainable development principles. Considered space can be geographical, social or economic, real or virtual (for ex. data or

draft space). However, this approach is strictly limited to the present and past. The primary tool of the spatial approach is retrospective and comparative analysis.

The spatial approach we observed, for example, in the article by Fan, S., & Cho, E. E. (2021), who explored policies to stimulate farming, migration to cities, and the creation of social protection networks for rural residents. Alternatively, Alkire, S., Oldiges, C., & Kanagaratnam, U. (2021) proposed a significant extension of the Multidimensional Poverty Index to assess the resilience of people falling out of poverty. Chen, S., & Ravallion, M. (2007) described the development of approaches to poverty assessment during 1981-2004. They found that the approach to estimating household income remained dominant but had shortcomings. Thorbecke, E. (2013) made a relatively straightforward critique of income-based approaches to poverty assessment. Finally, Deaton, A. (2005) pointed to bottlenecks in the methodology for assessing the links between economic growth and poverty reduction.

The above and other studies are significant, as they form the basis for planning policies and measures to timely overcome poverty, especially critical. Nevertheless, something in human nature (or in the world economic model) does not allow us to overcome poverty in a short time and preserve results. Therefore, to find the answer to the problem of total poverty eradication, we should consider a spatial-temporal approach.

Going beyond the spatial approach means the transition to a Spatio-temporal coordinate system. The problem of poverty is much more profound if we look at it in the space-time dimension. Sutter, C., Bruton, G. D., & Chen, J. (2019) partially covered this issue, emphasising the long-term nature of business reforms to reduce poverty. Ding, J., Wang, Z., Liu, Y., & Yu, F. (2020) noted the importance of a long-term synergy effect in the *people – industry – land* system for sustainable poverty alleviation.

Similar links between poverty and sustainable development, as described by Fan, S., & Cho, EE (2021), were investigated by Tonn, B., Hawkins, B., Rose, E., & Marincic, M. (2021). Their work shows a clear focus on the future. In particular, the researchers pointed to the expected increase in the number of poor and health problems in the United States. In addition, they described factors (such as climate change, ageing, housing, automation of production) that will remain relevant in the coming decades.

We can partially explain the need for approach change through the requirement of parallel implementation of the altruistic model that underlies the theory of sustainable development and the intergenerational sustainability dilemma. This problem extends to all areas of research and policy concerning the prospects of human civilisation. For example, in philosophical work on the Anthropocene, Bai, X. et

al. (2016) state: *Much of the debate about the Anthropocene has focused on interpreting past and present changes while saying little about the future.*

However, sustainable development researchers are gradually strengthening and expanding their future vision. The transition from spatial to spatial-temporal perception of sustainable development is associated with changes in politics, society, and the psychology of people. The study results by Vainio, A., Pulkka, A., Paloniemi, R., Varho, V., & Tapio, P. (2020) indicate the existence of a political need to include assessment of the near and distant future into socio-psychological models of people's sustainable behaviour.

Psychological aspects of sustainable development combine into the concept of intergenerational equity, which denotes care for future generations (Golub, 2013). Researchers of sustainable development are actively developing this concept and gathering convincing empirical evidence. For example, Pandit, A., Nakagawa, Y., Timilsina, R. R., Kotani, K., & Saijo, T. (2021) conducted a field experiment to study the sustainable management of solid waste and proved that the needs of imaginary future generations affect the population's perception of sustainability policy. Meanwhile, the results of an empirical study by Timilsina, R. R., Kotani, K., Nakagawa, Y., & Saijo, T. (2021) indicate that the current generation acts primarily for their benefit and virtually ignores the interests of future generations. Researchers have pointed out that the urban population is less interested in sustainability. In contrast, the rural population have cohesion and the potential to solve the intergenerational equity problem. According to a study of an overlapping generations model, Dao, N. T., & Edenhofer, O. (2018) proved that the economy could fall into the trap of poverty, fragile ecology and low life expectancy due to imperfect altruism between generations in a competitive economy.

How distant should the future be that we have to take it into account? Iwaniec, D. M. et al. (2020) investigated sustainable future scenarios in urban planning and identified three types, depending on the implementation period - short (up to five years), medium-term (up to twenty years) and long-term (from forty to eighty years). Each type has its characteristics and benefits that are important for sustainable development. For example, Browning, M. H. E. M., & Rigolon, A. (2019) found that the unexpected links between poverty, the environment, and politics can emerge in the long run.

The primary tool to look into the future from the standpoint of sustainable development is scenario modelling and planning. For example, Iwaniec, D. M. et al. (2020) proposed a system of Sustainable Future Scenarios to develop plausible, consistent representations of the future. Their work shows the time-spatial approach in the recommendations for improving scenario planning, decision-making, and

building research capacity for long-term sustainability planning.

We do not consider it possible and appropriate to abandon the spatial approach because it would mean a departure from a sustainability paradigm in favour of abstract futurology.

Using the spatial-time approach, we should note the role of state and civil institutions. Koskimaa, V., Rapeli, L., & Hiedanpää, J. (2021) pointed out that international commitments, semi-autonomous governance, and stakeholder participation are factors in the effectiveness of a sustainability policy with a view to the future. Similarly, Golub, A., Mahoney, M., & Harlow, J. (2013) noted the importance of restorative justice to address sustainability issues in the light of intergenerational equity. Researchers have shown that restorative justice promotes social cohesion and improved resource management. To solve the problem of intergenerational equity, Dao, N. T., & Edenhofer, O. (2018) noted the importance of ensuring a sustainable state of the social planner.

Regarding the spatial-time approach, poverty reduction policies must back up the future vision for sustainable development. For example, Edward, P., & Sumner, A. (2014) noted significant differences in the methods and outcomes of assessing global poverty's future extent and spread. Thus, researchers have proposed a specific model for obtaining a consistent set of long-term global poverty estimates. On the other hand, Iwaniec, D., Childers, D., VanLehn, K., & Wiek, A. (2014) insisted on the expediency of *visionary modelling*, which means the development of viable and sustainable visions in compliance with the principles of sustainability and differs from normative scenario planning. This method combines temporal (visions of desired states) and spatial (modelling based on governments, experts and stakeholders participation) elements.

After all, current research relies on policymakers' demand, which rarely goes beyond retrospective analysis and short-term forecasts. Therefore, based on a literature review, we formulated the following research questions:

RQ₁: Is the modern concept of poverty sufficiently future-oriented?

RQ₂: Is it possible to identify a future-oriented form of poverty?

RQ₃: What problems arise if we consider the policy of overcoming poverty with a view to the future?

Addressing these issues will strengthen the theory of overcoming poverty and focus its development on the long term.

3. Results

3. 1. Is the current concept of poverty future-oriented?

We begin our research by analysing the meaning and content of the poverty concept. The first goal of sus-

tainable development points to poverty and all its forms that we must overcome together. However, the very definition of poverty is debatable.

Many factors influence the classification of a person as poor, and it is challenging to unify them at the global level. Therefore, governments do not pay attention to the definition of poverty because it can complicate the policy of its reduction. The anti-poverty policies and reforms based on the poverty threshold concept confirm the above assumption.

Despite criticism regarding the unsuitability for long-term planning (Edward, 2014), the poverty threshold is quite common at the global and national levels because of its clarity and simplicity. There are two groups of people – poor and not needy, divided here and now by income. Everyone can compare their income with the poverty threshold standard and find out about their belonging to the poor. Each government can assess the number of poor citizens. Simplicity lies in the method of evaluation and availability of data and the ways of governmental response. Supposing poverty is related to income makes the slight raising of minimal wages an obvious answer. On this background, the idea of overcoming poverty *in all its forms* breaks, and descendants receive future poverty provoked by ineffective short-term policies.

Despite the apparent limitations, the idea and instrument of the poverty threshold play an integral role in stimulating government action to contend poverty. For example, the US Global Poverty Act of 2007 defines extreme global poverty and the US role in its eradication. In addition, the US Recognizing Poverty Act provides the basics of reforms to overcome poverty by shifting the poverty line. A similar trend is present in European legislation.

In Article 208 of the Treaty on the Functioning of the European Union (2016), the key objective of the Union development cooperation policy is to reduce and, finally, eradicate poverty. Accordingly, the European Commission (2010) included the poverty threshold concept in the Europe 2020 strategy. However, specifying the targets for 2020, the European Commission drew attention to the interrelation between the movement of European citizens above the poverty line, employment, education, science and the environment.

The expanded interpretation of poverty as a phenomenon that concerns more than just income is the *multidimensional approach*. This approach became widespread in the late 1990s. In 2001, the United Nations Committee on Economic, Social and Cultural Rights (UN Committee) stressed the gradual abandonment of past views on poverty as a lack of income. Instead, the UN Committee proposed that poverty be considered a lack of essential opportunities to meet people's needs, including food, education, dignity, social protection and inclusion.

In The Poverty Reduction Strategy for Asia and the Pacific, the Asian Development Bank (ADB) (1999) defined poverty as a condition in which a person is deprived of the primary means and opportunities to which he or she is entitled. ADB relates the state of poverty to the violation of human rights to work and remuneration, to be protected from external shocks, to participate in decision-making.

Transforming the concept of poverty to cover human rights is an essential step towards sustainable development. However, such a transformation must be careful because it can provoke a methodological shift. The interdisciplinary basis of the theory of sustainable development determines the probability of methodological pluralism. Studying poverty from the standpoint of human rights limits the coverage of the economic basis of related processes and vice versa – economic research is impossible without transforming abstract rights into specific economic concepts.

Haughton, J. H., & Khandker, S. R. (2009) work is an excellent example to support our reasoning. They interpreted poverty as *deprivation in well-being*, which aligns with *human rights violations*. Scientists then considered two approaches to assessing such deprivation, its sources and characteristics: a) limitations in income and consumption and b) limitations in opportunities associated with the functioning of the entire society. UNDP also argues that poverty means not just *making ends meet or paying the bills for basic services on time* but is multidimensional (United Nations Development Program, 2018). We saw the development of this thesis in the UNDP report (2020), where the goal of calculating the Multidimensional Poverty Index sounds as *to shift our attention from traditional income-based poverty measures towards a more holistic view of lived poverty*.

Modern approaches to the interpretation of poverty have their supporters and opponents, are evolving and overgrown with new details, but, unfortunately, do not contain a time perspective. We can imagine extrapolating the approaches described above to the future, but in this case, they will contain too many unpredictable variables. The income of future generations depends not only on poverty reduction policies but also on many economic, social and behavioural factors. Similarly, the elimination of future restrictions on rights and opportunities must consider the future development of public relations and equality policies.

Unfortunately, we must recognise that the modern concept of poverty, which has recently undergone a multidimensional transformation, is still not sufficiently future-oriented. Thus, the injection of time perspective into the concept of overcoming poverty must be gradual. Nevertheless, the time perspective needs to acquire some form at the present stage, which has led us to the following question: is it possible that future poverty is a form of poverty?

3.2. Forms of poverty and future poverty

A valid question about poverty, its forms and approaches to assessment was voiced by Pritchett, L. (2006): *When the World Bank dreams of 'a world free of poverty', what should it be dreaming?* Fighting abstract poverty is like fighting the world's oceans. Concretising efforts to overcome poverty requires a clear goal – a flow that can be blocked or diverted. Forms of poverty are becoming such a flow in relevant policies.

Generally, poverty is a complicated phenomenon to assess. Nevertheless, the concretisation of its forms allows governments to develop and justify sufficiently clear plans to overcome. Absolute and relative poverty are the primary forms government and supranational organisations operating with. Such a classification is the most universal and, at the same time, quite abstract.

The Council of Europe (2021) defines absolute poverty as the lack of sufficient resources to meet vital needs. It is this idea that underlies the poverty line. This form of poverty has a monetary expression enshrined in global documents. Globally, the Agenda for Sustainable Development contains the criterion of extreme poverty – to live on less than \$1.25 a day. In 2015, this criterion increased to \$1.90 (United Nations Development Program, 2018).

In 2018, the World Bank raised its absolute poverty lines, which are more flexible. Their values were \$3.20 in lower-middle-income countries and \$5.50 a day in upper-middle-income countries. In addition, the World Bank followed global trends and implemented the Multidimensional poverty measure. This tool aims to assess consumption, education, access to water, sanitation and electricity (World Bank, 2020-a). Delimitation of the object of assessment according to the criterion of absolute poverty lines is the first step to abandon this concept. Just as the World Bank calculates absolute poverty lines for lower-middle-income and upper-middle-income countries, we may require a separate calculation for agricultural or technological countries or countries with older populations. Ultimately, the differentiation of the evaluation base leads to the transformation of the absolute approach into a relative one. The Council of Europe (2021) points out that in Europe, poverty is usually understood as relative poverty, the availability of lower resources and opportunities for households than are considered adequate in a particular society.

It may be convenient for individual states to formulate a national strategy for overcoming poverty based on the poverty threshold concept (International Monetary Fund, 2016). However, the most clumsy method is artificially raising incomes (for example, by raising the minimum wage) without considering inflation. As a result, real incomes will remain the same, and may even decline, while the state will report a reduction in absolute poverty. Building a strategy to combat relative poverty can also suffer from

manipulation. In 2013, the United Nations Economic and Social Commission for Asia and the Pacific found that economic growth in the region led to higher incomes for the poor, but the rich became even more wealthy. Income inequality has exacerbated the problems of the poor in various dimensions (United Nations Economic and Social Commission for Asia and the Pacific, 2013).

Thus, the notion of globalised relative poverty enters the arena, and we can treat it as the third known form of poverty – multidimensional poverty. The Council of Europe (2021) sees a new stage in developing approaches to poverty reduction in the emergence of the Human Development Index and other tools for assessing multidimensional poverty. In Banerjee, A. V., & Duflo, E. (2011), multidimensional poverty is a holistic model based on the systemic theory of poverty. Liu, Y., & Xu, Y. (2016) noted the importance of a multidimensional approach to developing poverty-based poverty reduction programs.

The needs and deprivations of the poor are fundamental concepts of the multidimensional approach (UNDP, 2020). The link between poverty and need is illustrated to some extent by the archetype of Diogenes, who refused the cup when he saw a child drinking from the palms (Kardas, E. P., 2010). However, not everyone shares Diogenes' views.

There is an infinite number of combinations and variations of needs, and there are many approaches to their classification. Despite some difficulties in data collection, it is relatively easy to assess and compare people's needs. Everyone already needs food, shelter, security, and communication (Maslow, A. H., 1943). If we supplement this list with education, medicine, and transport infrastructure, we will have a ready framework for a multidimensional approach. Maybe it is worth focusing on three forms? Nevertheless, there is still no answer about integrating future poverty into the poverty reduction policy system.

The problem of the multidimensional approach is the disproportionate needs of individuals in the global, which creates requirements for simplification of the method of their evaluation and comparison, as written by Lanjouw, J., & Lanjouw, P. (2001) and Ravallion, M. (1996). Also, what about forecasting the needs of future generations? This question is a little bit philosophical. Twenty years ago, it was difficult to predict that one of the most critical needs for posterity today would be access to the Internet or the availability of the COVID-19 vaccine. Today, the lack of Internet access and vaccines is an indicator of poverty.

The multidimensional approach complicates the formation of public policy. Under this approach, states have to provide a certain income level and ensure that the *formally non-poor* have all they need. This issue connects with income and non-income inequality, as the United Nations Economic and Social Commission found analysing the Millennium Devel-

opment Goals implementation (Asia-Pacific aspirations: Perspectives for a post-2015 development agenda, 2013).

Finally, why should governments take poverty into account in the long run? The simple answer is because they are obliged by law. Such an obligation brings us to the fourth form of poverty, which we will call the *poverty-in-rights*. We will look at this form under an interdisciplinary approach, considering law, economics, and cultural aspects. The beauty of law is its stability allowing researchers to predict the future better than using mathematical instruments. However, we should take into account the role of economics and cultural factors in legal doctrine evolution.

In 2001, the United Nations Committee on Economic, Social, and Cultural Rights declared a human rights approach to poverty, designed to increase the effectiveness of poverty reduction policies. The Office of the United Nations High Commissioner for Human Rights (2004) noted that non-fulfilment of any human rights is a fairly complete and straightforward definition of poverty. This approach developed in parallel with the multidimensional and has similar features. Like the multidimensional, a human rights approach promotes a much broader interpretation of poverty than lack of income.

The second article of the Universal Declaration of Human Rights states that everyone has fundamental rights regardless of property status (United Nations, 1948). The Islamic Development Bank links poverty overcoming to the right of all people to live in dignity and prosperity (IsDB GROUP, 2021).

The UN Global Compact links poverty to a lack of freedom of speech and choice, access to social protection, the power to negotiate, decent work, and points to it as the root cause of many human and labour rights violations (UN Global Compact, n.d.). The United Nations Development Program (2018) also points to a clear link between poverty and human rights abuses.

The Office of the United Nations High Commissioner for Human Rights (2004) argued in favour of a human rights approach, arguing that any poverty reduction policy is basing on the norms and values established by international human rights law. However, a human rights approach has obvious limitations associated with law enforcement. Sometimes, there is an impregnable wall between the enshrined right and the opportunities for the poor to exercise it. This statement applies primarily to countries with a low level of economic development and/or a high level of corruption, where the state budget cannot cover all the items of expenditure necessary to ensure human rights. As a result, poor people forcedly suffer from poor nutrition and drug shortages, receive education in unfavourable conditions (Khilukha et al., 2020), and, finally, accept lower-paid work, which closes the circle of poverty for these people and their descendants. Nevertheless, even

countries with the most robust economies have the same problems. For example, the Federal Safety Net (founded by Robert S. Pfeiffer) says that while federal programs have helped improve the lives of millions of Americans, many people are left behind because of poor education, disability, mental illness, or addiction to alcohol or drugs (Federal Safety Net, n.d.).

Thus, overcoming the poverty-in-rights form can have good results, but it is also difficult for states and governments. Is the concept of this form of poverty future-oriented? With some limitations, definitely yes. Establishing the rule of law and the dictates of human rights in the state will mean preserving these rights for posterity. The reliability of this method is commensurate with its complexity and can be challenged only as a result of the revolution, war, or global crisis.

The most important feature of the human rights approach is its potential in overcoming intergenerational conflict and achieving sustainability in this way. Uniform rules of the game, equality, and justice for all, guarantees from the state and international organisations - this is what we can achieve by using the human rights approach to poverty alleviation. Moreover, as Golub, A., Mahoney, M., & Harlow, J. (2013) pointed out, a strong sense of justice between generations is the mainstay of sustainability.

Thus, we explored four forms of poverty (absolute, relative, multidimensional, and poverty-in-rights) that can be addressed through anti-poverty policies. Due to different countries' economic and cultural factors, some forms are wider described in policies, and others have only cognitive value. However, all discussed forms have one thing in common - they are an abstraction. As follows from the first SDG, poverty must be exterminated in all its forms. The conditional forms of poverty we have been talking about serving as guidelines for governments and supranational associations. Future poverty can be a similar higher-order abstraction with the same significance for sustainable development.

In order to adhere to the principle of *Entia non sunt multiplicanda* (*Entities should not be multiplied unnecessarily*), we can point to the mandatory nature of future poverty as property or component of each form of poverty or its consequence. We may require governments to include a calculation of the future effect of poverty alleviation measures in short-term policies or insist on in-depth calculations of the impact of education reforms on the educational deprivation of the poor in twenty years. But let us be honest, it will not change anything. We have already said that the needs of future generations are a mystery to us behind seven locks. Changing the culture and worldview of people can shake even the legal basis for overcoming poverty, the breakdown of which we have seen in the example of market transformations in post-socialist countries after the fall of the Soviet Union (Yankovska, 2021). Therefore, from the

standpoint of sustainable development theory, we do not consider future poverty a *tail* of modern forms of poverty.

One way or another, any honest policy of overcoming poverty impacts all forms of poverty, including future poverty. Policies to increase the minimum income help to reduce inequality (relative poverty), increase the ability to receive education and maintain health (multidimensional poverty), enable living in dignity (poverty-in-rights), and, finally, create the conditions for prosperity in the future. Reducing relative poverty means balancing the minimum income at the higher level, equal access to quality health and education services, justice, and better prospects for descendants. Efforts to overcome multidimensional poverty give impetus to higher incomes, the inclusion of the poor, and the actual realisation of human rights. Reducing poverty-in-rights means that today and in the future, every right will be protected by state and society, including the right to decent work and earnings, welfare, education, health and personal development, and more.

If there is such a connection, why do poverty reduction policies ignore the poverty of future generations (Lavallée, 2010)? After all, in order for our descendants to live in prosperity, decisive action by governments is needed today to raise the population above the poverty line, ensure equality and access to social services, ensure the rule of law, and equal access to legal services. Let us find the guilty one.

3.3. Future poverty and comfort of governments

Poverty reduction targeting and timing have a solid link to governance and policies (Wang, 2020; Nguyen, 2021). Cobbinah, P. B., Erdiaw-Kwasie, M. O., & Amoateng, P. (2015) emphasised the crucial role of governments in tackling poverty for sustainable development. Haughton, J. H., & Khandker, S. R. (2009) noted that keeping poverty on the agenda is one of the crucial reasons measuring poverty is essential.

We do not have data on future poverty, so we must look for an alternative tool to stimulate progress in this direction. Moreover, we must never forget that a simplified interpretation of poverty is beneficial for political purposes. This view corresponds to the thesis of Koskimaa, V., Rapeli, L., & Hiedanpää, J. (2021) regarding democracies that have difficulty in solving long-term problems. In addition, weak institutions generate reproduction patterns that lead to poverty (Ramos-Mejía, 2018).

Comfort of governments means a policy that can show good results in the short term. Short-term policies aimed at immediate positive results create a *warm bath* for the population – an imaginary feeling of positive change in the state. In turn, politicians receive widespread support. However, worrying about future poverty means breaking out of the comfort zone for politicians and the government. Schleicher, J., Schaafsma, M., & Vira, B. (2018) pointed out that

a broad interpretation of sustainable development goals can risk *picking cherries* – neglecting some of the challenging goals.

For sustainable development, governments must define poverty as broadly as possible. Instead, the lack of a single theory of poverty allows governments to pursue one of two types of policy: *against poverty as a lack of money* and *against poverty as a lack of opportunity*. Unfortunately, rare politicians will take on the burden and responsibility of the third type – *against poverty as a threat to future generations*.

It is challenging to expect promotions of the third type of policy in countries experiencing economic problems. The source of such doubts is the eternal confrontation between short-term political interests and the long-term development strategy of the state. Fair and regular elections are a fundamental principle of democracy. However, the short tenure of most public positions raises politicians' desire to promise a lot but to fulfil only the simplest promises. The regression of the political system or national economic model (for example, the transition from democracy to tyranny or from capitalism to autocratic socialism) does not help because it exacerbates poverty-in-rights.

Let us consider some of the challenges of including future poverty on the agenda related to governments' desire for political comfort.

1. *Instability of sustainable policy.* Fritzen, S. (2002) noted that the previous poverty alleviation policies in Vietnam were not focused on achieving equal growth in the long term. Thus, the sustainability of Vietnam's achievements in poverty reduction was not guaranteed. Sustainable development policies can *wear a mask*, but not be such. It is not necessary to make policy truly sustainable to achieve specific policy goals and create the appearance of reforms. Unstable sustainable development policies are unsuitable for overcoming future poverty, involves insignificant measures, and cannot be adequately integrated into the country's economic, social and cultural space. Moreover, such policies may distort or conceal current poverty data and ignore glaring cases of acute poverty.
2. *Governments may accidentally or intentionally exclude key elements from policies to address future poverty.* Deng, Q., Li, E., & Zhang, P. (2020) developed the concept of *forces* to overcome poverty, followed by *starting force*, *driving force* and *support force*, (*the basis of existence*, *acceleration* and *environment* respectively) which must be balanced and supportive of each other; otherwise, sustainable development is impossible. Similarly, the exclusion from politics of one of the crucial elements of poverty alleviation will save budget funds but not endorse sustainability.
3. *Funding to address future poverty does not yield immediate results.* Abstractly, after helping sev-

eral families below the poverty line, the government can report on poverty reduction based on concrete data. The clear consequences of the fight against future poverty may become available in decades. Thus, the current government should reconcile that benefits from progress in overcoming future poverty will get future governments.

4. *Corruption, embezzlement, and waste are harbingers of the demise of any best poverty reduction policy.* Before undertaking future poverty, governments need to ensure that policy effectiveness is not affected by *shadow factors*. Otherwise, any measures to overcome future poverty can become a source of corruption.
5. *Overcoming the 'selfishness of generations' requires governments to be highly professional, flexible, and active in organising and financing events and changing the culture and outlook of the population for sustainable development.* In addition, according to Iwaniec, D., Childers, D., VanLehn, K., & Wiek, A. (2014), governments need to become visionaries for overcoming future poverty, which will put forward transformational goals and a clear focus on the desirable future state.

Thus, to empower the theory of poverty reduction for sustainable development, we propose considering future poverty as one of the forms of poverty mentioned in the first SDG. Such a simple step, we believe, will help consolidate the efforts of poverty theorists and practitioners to strengthen relevant policies. According to Bai, X. et al. (2016), the scientific community needs to negotiate interdisciplinary *questioning* and joint resolution with stakeholders. We believe that the broader discussion of future poverty will inspire governments and, finally, improve the lives of our descendants, which is the main idea of sustainable development.

As our research is theoretical, we do not undertake to formulate recommendations for governments, but we can suggest further directions for research.

Joint efforts can lay the foundations for overcoming the poverty of future generations and harmonise the approaches of different governments, supranational entities, and institutions:

- lawyers could examine whether it is time to include the *right not to be poor* in their countries' constitutional rights,
- behaviourists should try to describe the behaviour of future generations and what we can do now to ensure that our descendants do not inherit patterns of poverty.
- economists can suggest ways to create opportunities for future generations by implementing long-term and long-term development projects, such as creating an international fund to combat future poverty.

- political, sociological and cultural researchers can seek new ways of promoting equality and social justice between generations.

Limitation

This study is theoretical and philosophical. We relied on the previous researches, legal acts, our own experience and observations to describe the desired interpretation of the first goal of sustainable development with a view to the future. Therefore, before implementing the above recommendations, they should be tested using empirical methods.

Conclusions

This study found that future poverty needs to be more widely represented in policies and discussed in the scientific community. We have proven the possibility and expediency of interpreting future poverty as a form of poverty like an absolute, relative, multi-dimensional and poverty-in-rights, which must be annihilated to achieve the first SDG. We also briefly noted the challenges governments and peoples might face in developing and implementing policies to address future poverty. As a result, we have outlined the critical directions for further research, strengthening policies to contend poverty with a view to the future.

This study is partly idealistic. We understand that the lack of food, clothing and shelter for modern people means much more than the illusory happiness of descendants. Nevertheless, we believe that the golden grain of sustainable development is growing in such a contradiction. By ignoring the poverty of future generations, society and governments doing the same as previous generations, which conducted nuclear tests, saturated the atmosphere with carbon, and polluted the oceans. It did not look like a problem in the past; technological progress was considered a boon for posterity. Now we have the consequences - global warming, chronic diseases, and extinction. Therefore, we should not hope that the descendants will cope with poverty on their own. We believe that governments and international organisations should look at the first SDG through this approach.

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Natural Resources in Function of Sustainable and Competitive Tourism Development of the EU Countries

Zasoby naturalne a zrównoważony i konkurencyjny rozwój turystyki w krajach UE

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Abstract

Natural resources are the base of tourism development and competitive position in the tourism market of many tourist destinations. At the same time, the issue of their use in the function of tourism development is very complex and must be based on the idea of sustainability. The paper examines the importance of natural resources for the competitiveness of tourism in the European Union (EU). The aim of this paper is to consider the relationship of natural resources and tourism competitiveness in the EU countries, as well as to identify countries of good practice, but also countries that require improvement of natural tourism attractions and their activation in function of competitive and sustainable tourism development. In accordance with the defined aim of the research, correlation and cluster analysis are applied in the paper. The results of the research can benefit the creators of tourism development policy, because they enable the selection of indicators of availability and attractiveness of natural resources that can be improved, as well as countries in which special attention should be paid to more successful tourism valorization of natural resources.

Key words: natural resources, tourism, competitiveness, sustainability, EU countries

Streszczenie

Zasoby naturalne są podstawą rozwoju turystyki i pozycji konkurencyjnej na rynku turystycznym wielu destynacji turystycznych. Jednocześnie kwestia ich wykorzystania w funkcji rozwoju turystyki jest bardzo złożona i musi zgodna z ideą zrównoważonego rozwoju. Artykuł analizuje znaczenie zasobów naturalnych dla konkurencyjności turystyki w krajach Unii Europejskiej (UE). Celem niniejszego artykułu jest rozważenie relacji zasobów naturalnych i konkurencyjności turystycznej w krajach UE, a także wskazanie krajów dobrych praktyk, ale także krajów, które wymagają zmian w traktowaniu przyrodniczych atrakcji turystycznych i ich aktywizacji w funkcji konkurencyjnej i zrównoważonej rozwój turystyki. Zgodnie z wyznaczonym celem badań w pracy zastosowano analizę korelacji i skupień. Wyniki badań mogą przynieść korzyści twórcom polityki rozwoju turystyki, ponieważ pozwalają na dobór wskaźników dostępności i atrakcyjności zasobów przyrodniczych, które można poprawić, a także krajów, w których należy zwrócić szczególną uwagę na skuteczniejszą waloryzację turystyczną zasobów naturalnych.

Słowa kluczowe: zasoby naturalne, turystyka, konkurencyjność, zrównoważoność, kraje UE

Introduction

In order for a tourist destination to be successful in a market, it is necessary to have two basic characteristics, its competitiveness and sustainability. It is not enough only one parameter to be satisfied, but both and they must support each other. The competitiveness of a destination refers to its ability to compete efficiently and profitably with other destinations in the tourism market. Sustainability refers to a destination's ability to maintain the quality of its natural, social, cultural, and environmental resources while competing in the market (Goeldner and Ritchie, 2012). Sustainability plays the most important role in the long-term competitiveness of a tourist destination (Goffi et al., 2019). In other words, sustainability is a central element of a tourist destination's competitiveness. The idea of sustainable development are applicable to all types of tourist destinations, i.e. in all types of tourism, including mass tourism development and specific forms of tourism (UNEP and WTO, 2005; OECD, 2016). According to Dugulan et al., (2010) competitiveness is one of the common concepts used to present the sustainable development of tourism.

Natural resources play a huge role in achieving competitive and sustainable tourism development. If used in a sustainable way, they are the basis of the competitive advantages of many tourist destinations. In this paper, the authors focus on the analysis of indicators of availability and attractiveness of natural resources of the EU countries as a basis for competitive tourism development. Namely, in the literature there are certain researches of the connection and impact of natural resources on the competitiveness of tourism of certain groups of developing countries. A comprehensive understanding of this relationship at the level of EU countries was lacking, so the authors perform the analysis on a sample of EU 27 countries. The research was realized through two stages. Firstly, the interdependence between the availability and attractiveness of natural resources and the competitiveness of tourism in a sample of EU countries was examined by applying a correlation analysis. Subsequently, a cluster analysis was applied to examine the homogeneity of EU countries according to available natural resources and their use for tourism purposes. The analysis and discussion of the obtained results enabled the selection of key indicators of tourism development, but also the countries in which the use of natural resources for tourism purposes requires improvement, and the formulation of appropriate recommendations on that basis.

1. Literature Review

In order to understand the concept of destination competitiveness, many authors point out that it is necessary to get acquainted with the concepts of comparative advantage and competitive advantage,

which are essential elements of competitiveness (Hassan, 2000; Michael et al., 2019). Comparative advantage includes all resources possessed by one destination, and competitive advantage implies the ability of the destination to allocate them efficiently and effectively, i.e. uses these resources over an extended period of time (Crouch, 2011). According to Porter (1990), resources can be divided into five basic categories: human resources, natural resources, knowledge resources, capital, and infrastructure. Ritchie and Crouch (2003) believe that when considering competitiveness in tourism, it is necessary to add a new category of resources, the historical and cultural resources of the destination, and to expand the category of infrastructure with a tourism supra-structure.

Tourism, as a global phenomenon today, owes its success to the wealth of natural resources. Quality and preserved natural resources are a key value of a tourist destination and can create the comparative advantages for tourism development (Krstić et al., 2016). Climatic and geographical factors, flora and fauna, are the determining factors when tourists choose a destination (Milićević and Štetić, 2017). Due to the growing interest of tourists in nature-based tourism, protected natural areas, such as national parks or special nature reserves, are becoming very attractive tourist destinations, where tourists can enjoy untouched nature, see landscapes, study flora and fauna, etc. (Krejić et al., 2019; Trišić, 2020) and, at the same time, learn about the protection and sustainable use of natural resources in the area (Esfandiar et al., 2019).

The basis for the development of nature-based tourism are natural resources, such as forests, rivers, waterfalls, mountains, lakes, which represent the primary attraction (Lundberg and Fredman, 2012; Taczanowska et al., 2019). However, the expansive development of tourism affects the greater utilization of natural resources, and poses a major threat to the natural environment (Podhorodecka and Dudek, 2019). The negative consequences of tourism on the natural environment are reflected in land degradation, endangering biodiversity, disturbing the landscape, polluting water resources and air. Authors Asghari (2011) and Marković et al. (2020) state that the tourism industry, investors and tourists still do not have a clear awareness of how to use natural resources in a sustainable way, because uncontrolled use often leads to their destruction.

Numerous authors agree that natural resources are a very important determinant of modern tourism development and an integral part of a country's tourism competitiveness model (Mihalič, 2013; Gios et al., 2006). Countries with preserved natural resources have a significant competitive advantage in attracting tourists (WEF, 2019). The quality of natural resources in the destination must be maintained in order to maintain the level of tourist demand. If the high level of quality of these resources is not main-

Table 1. Descriptive statistics of the observed indicators, source: Authors' calculation

	N	Minimum	Maximum	Mean	Std. Deviation	Variation Coefficient
Number of World Heritage natural sites	27	0.00	5.00	1.52	1.53474	101.07
Total known species	27	232.00	538.00	383.85	76.92389	20.04
Total protected areas	27	1.69	55.07	22.56	12.19683	54.07
Natural tourism digital demand	27	1.23	91.95	29.08	27.70110	95.24
Attractiveness of natural assets, 1-7	27	3.02	6.46	5.24	0.82766	15.80
TTCI	27	3.97	5.44	4.53	0.42872	9.46
Valid N (listwise)	27					

tained, the demand for tourists will inevitably decrease (Goeldner and Ritchie, 2012). Aguiló et al. (2005) conducted research in the Balearic Islands, which proved that tourists have become increasingly demanding in terms of the natural environment and its quality. Du Toit et al. (2010) showed in their study that there is a strong link between the natural environment and the competitiveness of a tourist destination. The authors used a number of indicators of the natural environment in the analysis, such as natural heritage (with the number of UNESCO World Heritage natural sites), coast, thermomineral spring, land area, etc. They concluded that the wealth of natural resources significantly increases the competitiveness of the tourist destination.

Jovanović and Janković Milić (2013) also state that the quality of natural resources can provide a significant competitive advantage in a country's tourism. Therefore, according to them, it is extremely important to measure the contribution of this indicator to the overall tourist competitiveness. The authors analyzed the impact of the quality of natural resources on the tourism competitiveness of South Eastern European countries in the period from 2009 to 2013. The results of their research showed that there is a positive and statistically significant impact of the quality of natural resources on the tourism competitiveness of these countries. Dugulan et al. (2010) analyzed the competitiveness of Central and Eastern European countries, from the aspect of the impact of natural resources. However, their results showed that natural resources are not a significant factor in the competitiveness of these countries as tourist destinations. Namely, the authors conclude that a larger number of World Heritage natural sites, known species and protected natural areas, as well as the overall higher quality of the natural environment, should contribute to these countries becoming more attractive destinations for international tourists, which will affect their larger competitiveness in the tourism market in the future.

2. Information Basis of Research, Methods and Hypotheses

The aim of this paper is to consider the relationship between the quality of natural resources and the competitiveness of tourism in the EU countries, as well as the homogeneity of the EU countries when it

comes to natural resources as a basis for tourism development. In order to realize the defined aim of the research, the paper starts from the following assumptions: 1) There is a positive correlation between the specificity and attractiveness of natural resources and the competitiveness of tourism in the EU countries; 2) the EU countries differ significantly in the specificity and attractiveness of natural resources.

The information basis of the research is the report of the World Economic Forum on the competitiveness of tourism and travel for 2019. In addition to the Travel & Tourism Competitiveness Index (TTCI) values for the EU member states, the analysis also includes data for indicators within the pillar Natural Resources. The quality, i.e. specificity and attractiveness of natural resources of the EU countries is measured by the values of the following indicators: Number of World Heritage natural sites, Total known species, Total protected areas, Natural tourism digital demand and Attractiveness of natural assets (WEF, 2019). Descriptive statistics of the data included in the analysis are given in Table 1.

The value of the indicator Number of World Heritage natural sites in the EU countries ranges from 0 to 5. Countries with a value of 0 are: Cyprus, Czech Republic, Estonia, Ireland, Malta, Lithuania. Luxembourg and Latvia, while the value of 5 is recorded in Italy and Spain. The minimum value of the indicator Total known species which measures the total known species of mammals, birds and amphibians was recorded in Malta, and the maximum in Spain. The minimum value of the indicator Total protected areas which represent total square kilometers of terrestrial and marine areas under protection as a share of the country's total territorial area (WEF, 2019) was recorded in Cyprus, and the maximum in Slovenia. The minimum value of the indicator Natural tourism digital demand, which measures online search for natural based forms of tourism on a scale from 0 to 100, was recorded in Lithuania, and the maximum in Italy. Attractiveness of natural assets was rated best in Austria and weakest in Belgium (Annex 1). In addition to the minimum, maximum and mean values of the analyzed indicators, Table 1 also shows the values of the standard deviation and the coefficient of variation for each of the observed indicators for the sample of the EU countries. It can be concluded that the greatest variability among the EU countries was recorded when it comes to the

Table 2. Correlation matrix, source: Authors' calculation

	Number of World Heritage natural sites	Total known species	Total protected areas	Natural tourism digital demand	Attractiveness of natural assets	TTCI
Number of World Heritage natural sites	1					
Total known species	0.813 (0.000)**	1				
Total protected areas	0.209 (0.294)	0.215 (0.282)	1			
Natural tourism digital demand	0.483 (0.011)*	0.518 (0.006)**	-0.230 (0.249)	1		
Attractiveness of natural assets, 1-7	0.287 (0.146)	0.322 (0.101)	-0.195 (0.329)	0.578 (0.002)**	1	
TTCI	0.631 (0.000)**	0.521 (0.005)**	0.035 (0.864)	0.638 (0.000)**	0.336 (9.086)	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 3. Final Cluster Centers, source: Authors' calculation

	Cluster		
	1	2	3
Number of World Heritage natural sites	1.63	0.13	3.88
Total known species	397.13	296.38	509.00
Total protected areas	27.64	15.24	18.15
Natural tourism digital demand	26.64	15.36	65.70
Attractiveness of natural assets, 1-7	5.04	5.27	5.93

value of the indicator Number of World Heritage natural sites, followed by the Natural tourism digital demand indicator.

In order to provide answers to the research questions, i.e. hypotheses, correlation and cluster analysis were applied in the paper. Correlation analysis was applied in order to determine the interdependence between the quality of natural resources and the competitiveness of tourism in the EU countries. Cluster analysis was applied in order to determine the homogeneity of the EU countries according to the quality of natural resources. The membership of countries by selected clusters is shown in Table 4. It can be concluded that 4 out of 27 analysed countries (France, Greece, Italy and Spain) belong to the cluster of best performance (cluster 3). This group of countries records the leading values of four of the five analysed indicators of availability and attractiveness of natural resources. A total of 8 countries (Cyprus, Estonia, Finland, Ireland, Latvia, Malta, Luxembourg, Lithuania) belongs to the cluster with the lowest performance (cluster 2). This group of countries records the weakest results in all analysed indicators. This can be a guideline for tourism policy makers at the EU level, given the pronounced interdependence between the availability and attractiveness of natural resources and the competitiveness of tourism, to pay more attention to the protection and promotion of natural resources in these countries. The largest number of countries, 15 in total, i.e. all remaining EU countries belong to the cluster with medium performance (cluster 1). e Post Hoc Test was applied in order to test the significance of the

difference between the defined clusters, after grouping the EU countries according to the analyzed indicators.

3. Research Results and Discussions

The first part of the analysis is dedicated to testing the relationship between the availability and attractiveness of natural resources and the competitiveness of tourism in the EU countries. To this end, the values of the Pearson correlation coefficients between the observed indicators are calculated. The values of the correlation coefficients (r) and the corresponding p - values (p) are shown in Table 2.

The results shown in Table 2 indicate that there is the highest correlation level between the TTCI and Natural tourism digital demand indicator ($r = 0.638$, $p = 0.000$). This is followed by the values of Pearson's correlation coefficient between TTCI and Number of World Heritage natural sites ($r = 0.631$, $p = 0.000$) and TTCI and Total known species ($r = 0.521$, $p = 0.005$). There is a moderate statistically significant positive correlation between these indicators and the TTCI values. A positive correlation also exists between the TTCI values and the other two indicators, Total protected areas and Attractiveness of natural assets, however the values of Pearson's correlation coefficient are not statistically significant. This interdependence between the TTCI value and all observed indicators speaks in favor of confirming the first initial assumption of the research. Namely, there is a positive correlation between the specificity and

Table 4. Clusters of the EU countries according to the indicators within the pillar *Natural Resources*, source: Authors' calculation

Country	Cluster	Distance	Country	Cluster	Distance
Austria	1	39.448	Italy	3	26.711
Belgium	1	48.844	Latvia	2	46.794
Bulgaria	1	49.440	Lithuania	2	25.134
Croatia	1	64.491	Luxembourg	2	50.774
Cyprus	2	21.849	Malta	2	74.026
Czech Republic	1	20.749	Netherlands	1	34.847
Denmark	1	44.898	Poland	1	17.700
Estonia	2	29.319	Portugal	1	59.440
Finland	2	33.740	Romania	1	45.151
France	3	17.928	Slovak Republic	1	24.926
Germany	1	35.858	Slovenia	1	28.564
Greece	3	39.796	Spain	3	29.531
Hungary	1	27.308	Sweden	1	39.249
Ireland	2	37.398			

Table 5. Multiple Comparisons (Post Hoc Test), source: Authors' calculation

Indicators	(I) Cluster	(J) Cluster	Mean Difference (I-J)	Std. Error	Sig.
Number of World Heritage natural sites	1	2	1.50833(*)	0.43133	0.005
		3	-2.24167(*)	0.55441	0.001
	2	1	-1.50833(*)	0.43133	0.005
		3	-3.75000(*)	0.60332	0.000
	3	1	2.24167(*)	0.55441	0.001
		2	3.75000(*)	0.60332	0.000
Total known species	1	2	100.75833(*)	14.77570	0.000
		3	-111.86667(*)	18.99222	0.000
	2	1	-100.75833(*)	14.77570	0.000
		3	-212.62500(*)	20.66761	0.000
	3	1	111.86667(*)	18.99222	0.000
		2	212.62500(*)	20.66761	0.000
Total protected areas	1	2	12.39292(*)	4.87433	0.045
		3	9.49167	6.26531	0.302
	2	1	-12.39292(*)	4.87433	0.045
		3	-2.90125	6.81800	0.905
	3	1	-9.49167	6.26531	0.302
		2	2.90125	6.81800	0.905
Natural tourism digital demand	1	2	11.28450	10.18639	0.519
		3	-39.05300(*)	13.09327	0.017
	2	1	-11.28450	10.18639	0.519
		3	-50.33750(*)	14.24829	0.005
	3	1	39.05300(*)	13.09327	0.017
		2	50.33750(*)	14.24829	0.005
Attractiveness of natural assets	1	2	-0.22808	0.34975	0.793
		3	-0.88683	0.44956	0.141
	2	1	0.22808	0.34975	0.793
		3	-0.65875	0.48922	0.384
	3	1	0.88683	0.44956	0.141
		2	0.65875	0.48922	0.384

* The mean difference is significant at the 0.05 level

attractiveness of natural resources and the competitiveness of tourism in the EU countries.

Given that the existence of a positive correlation between the competitiveness of tourism in the EU countries and the availability and attractiveness of natural resources has been confirmed, the second

part of the analysis is dedicated to examining the homogeneity of the EU countries according to available natural resources that can be in function of tourism development. First, three clusters of the EU countries are singled out according to the observed indicators of natural resources (Table 3). Cluster 3 is

identified as the cluster with the best performance, followed by cluster 1, then cluster 2.

In order to determine between which clusters of countries and for which indicators within the pillar Natural Resources there is a statistically significant difference in the values of the indicators, a Post Hoc Test is conducted. The results are shown in Table 5. Based on the results presented in Table 5, it can be concluded that there is a statistically significant difference between clusters in a number of analysed indicators. This result is the basis for confirming the second initial assumption of the research. Namely, the EU countries differ significantly in terms of specificity and attractiveness of natural resources. It should be noted that a statistically significant difference between clusters is not observed when it comes to the Attractiveness of natural assets indicator, between the third cluster compared to the first and second when it comes to Total protected areas indicator and between the first and second cluster according to Natural tourism digital demand indicator.

Conclusion

The huge role and importance of natural resources for the tourism development of countries imposes the need for a more detailed examination of their connection and impact on the tourism competitiveness. The results of previous research on this topic differ depending on the selected sample of countries. While some authors find a significant impact of natural resources on the competitiveness of tourism (Jovanović and Janković Milić, 2013), others talk about the lack of any significant link between natural resources and tourism competitiveness in certain groups of countries and about the possibility of more successful use of natural resources (Dugulan et al., 2010). Unlike previous researches, which took into account a relatively smaller sample of countries, the research in this paper was conducted on a sample of 27 EU countries. The results of the research confirmed the existence of a positive correlation between the indicators of availability and attractiveness of natural resources and the competitiveness of tourism in the EU countries. At the same time, the highest level of positive correlation was recorded between the values of the indicator Natural tourism digital demand and TTCI. This fact can be significant, because it is an indicator that does not represent a given state of affairs, but can be further improved by implementing the achievements of modern technologies in the process of tourism development. Since the first part of the research confirmed the existence of a positive correlation between natural resources and tourism competitiveness of the EU countries, the second part examined their homogeneity according to the availability and attractiveness of natural resources. The research showed that the EU countries differ significantly according to the values of the analysed indicators, as well as that there are

certain countries (Cyprus, Estonia, Finland, Ireland, Latvia, Malta, Luxembourg, Lithuania) where it is necessary to make additional efforts to more successfully valorise natural resources for the purpose of tourism development. Of course, this valorisation must be based on the sustainability, with the maximum possible preservation of available natural resources for future generations and future tourism development.

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Annex.

Table A1. Values of the TTCI and indicators within the pillar *Natural Resources*, Source: WEF, 2019

Countries	Number of World Heritage natural sites	Total known species	Total protected areas	Natural tourism digital demand	Attractiveness of natural assets, 1-7	TTCI
Austria	1.00	412.00	28.40	63.14	6.46	4.95
Belgium	1.00	351.00	24.65	11.02	3.02	4.55
Bulgaria	3.00	446.00	28.30	19.29	5.00	4.21
Croatia	2.00	424.00	23.58	85.12	6.04	4.53
Cyprus	0.00	312.00	1.69	22.36	5.97	4.22
Czech Republic	0.00	384.00	22.16	11.65	4.25	4.33
Denmark	3.00	355.00	17.93	14.62	5.08	4.58
Estonia	0.00	322.00	19.51	1.77	4.89	4.20
Finland	1.00	330.00	14.16	13.09	6.10	4.52
France	4.50	516.00	33.21	58.99	5.57	5.40
Germany	3.00	431.00	38.79	23.11	5.35	5.39
Greece	1.00	473.00	11.03	50.57	6.18	4.55
Hungary	1.00	383.00	22.60	3.84	4.52	4.19
Ireland	0.00	263.00	4.04	27.96	5.89	4.54
Italy	5.00	509.00	13.37	91.95	5.65	5.09
Latvia	0.00	341.00	17.51	1.46	5.09	4.04
Lithuania	0.00	317.00	17.76	1.23	4.64	3.98
Luxembourg	0.00	254.00	40.87	4.17	4.60	4.56
Malta	0.00	232.00	6.41	50.82	4.97	4.36
Netherlands	1.00	364.00	21.21	18.09	3.75	4.79
Poland	1.00	392.00	38.06	13.32	4.40	4.23
Portugal	1.00	424.00	16.89	78.55	6.00	4.89
Romania	2.00	438.00	24.31	7.74	5.08	3.99
Slovak Republic	2.00	397.00	37.63	3.81	5.09	3.97
Slovenia	2.00	396.00	55.07	18.82	5.90	4.35
Spain	5.00	538.00	14.97	61.27	6.31	5.44
Sweden	1.50	360.00	14.97	27.51	5.67	4.56

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Suitability of Rural Living & Work Facilities, Spatial Behavior Patterns of Farmers and Family Income

Zrównoważoność ułatwiania życia i pracy na wsi, przestrzenne wzorce zachowań rolników i dochody ich rodzin

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Abstract

In recent years, China has put forward policies to improve rural infrastructure and promote the development of rural industries causing to dramatic transition in the living and employment conditions. Moreover, under the pressure of the high expenditure of living and the difficulty of finding jobs, new changes have taken place in the spatial behavior pattern of farmers' residence and employment. Based on a field survey of 839 observations in 123 villages in Poyang Lake basin, China, we developed indicators to evaluate the suitability of rural living facilities (SLF) and work facilities (SWF). Multinomial logit regression model was used to measure the relationship between SWF, SLF and the spatial behavior patterns of farmers. The results show that: (1) SWF development in rural areas lags behind SLF; (2) Higher SLF is most distributed in suburban areas ; (3) Higher SWF is mostly distributed in suburban towns and characteristic towns; (4) The effects of SLF and SWF on the spatial behavior patterns of farmers are significantly positive; (5) Farmers in the urban-rural amphibious pattern usually obtain a higher income level, and also bring vitality to the countryside.

Keywords: suitability of living facilities, suitability of work facilities, spatial behavior pattern, multinomial logit model, rural development, family income

Streszczenie

W ostatnich latach Chiny przedstawiły politykę poprawy infrastruktury wiejskiej i promowania rozwoju przemysłu wiejskiego, powodując istotne zmiany w warunkach życia i zatrudnienia. Ponadto, pod presją wysokich wydatków na życie i występujących trudności ze znalezieniem pracy, nastąpiły nowe zmiany w przestrzennym wzorcu zachowań rolników w miejscu zamieszkania i pracy. Na podstawie ankiety terenowej obejmującej 839 obserwacji w 123 wioskach w dorzeczu jeziora Poyang w Chinach, opracowaliśmy wskaźniki do oceny przydatności ułatwiania życia na wsi (SLF) i ułatwiania pracy (SWF). Do pomiaru związku między SWF, SLF a przestrzennymi wzorcami zachowań rolników zastosowano wielomianowy model regresji logitowej. Wyniki pokazują, że: (1) rozwój SWF na obszarach wiejskich pozostaje w tyle za SLF; (2) SLF jest najbardziej rozpowszechniony na obszarach podmiejskich, podczas gdy; (3) Wyższe SWF są rozprowadzane głównie w miejscowościach podmiejskich i miejscowościach charakterystycznych; (4) Wpływ SLF i SWF na przestrzenne wzorce zachowań rolników jest znacząco pozytywny; (5) Rolnicy funkcjonujący w układzie miejsko-wiejskim zwykle uzyskują wyższy poziom dochodów, a także wnoszą vitalność wsi.

Słowa kluczowe: zrównoważoność ułatwiania życia, zrównoważoność ułatwiania pracy, przestrzenny wzorec zachowań, wielomianowy model logitowy, rozwój obszarów wiejskich, dochody rodzin

1. Introduction

At present China, rural areas are weak spots in economic development. Rural development is vital to the stable development of the whole country. The problems resulted in the abandonment of rural areas include mobility, poverty, biased policies and inadequate land management (Liu and Li, 2017). In order to solve these problems, the Chinese government first proposed *Rural Revitalization Strategy* in 2017. In 2019, a package of policies has further released following the report of *No 1 central document* of Chinese government, which charts the roadmap for rural vitalization. Among them, the government put forward the guidelines of rural revitalization strategy, including thriving businesses, pleasant living environment, social etiquette and civility, effective governance, prosperity and out of poverty. In order to improve rural infrastructure and promote the development of rural industries, China has issued many policies. For example, to help disadvantage households to fight poverty, the targeted poverty alleviation policy was designed to taking targeted measures in different regions (Zhou et al., 2018). At the same time, the implementation of land transfer policy aims at achieving farmland scale management, attracting investment, promoting the invigoration of rural land resources and labor, improving the economic efficiency of land and increasing farmers' income (Yuan et al., 2018). Driven by these policies, rural areas in China have experienced a significant transformation through population, employment, and industrial restructuring. Living conditions in the countryside have been greatly improved. Great changes have taken place in the living facilities in the countryside. Brand-new roads have been built to every front door. Every household had clean tap water to drink. Colorful cultural facilities such as activity rooms and libraries have also entered the countryside. Not only that, with the acceleration of rural land circulation, the scale of industrialization is also constantly improving urban-rural integration and industry integration, injecting new vitality to the countryside. China has made great achievements in rural poverty eradication. By the end of 2019, more than 11.09 million rural people in China were lifted out of poverty, contributing to 66.8% of poverty reduction compared with the previous year. Developments in rural industry also have been a major contributor to China's remarkable GDP and export growth, and absorbing more than 30% employment of the rural labor force (Long and Woods, 2011). China also has witnessed a big increase in off-farm employment (Li et al., 2021). In 2020, the per capita disposable income of rural residents in the city reached 17131 yuan, an increase of 14170 yuan compared with 2,946 yuan in 2000.

Despite the tremendous development in rural areas, there is still a serious outflow of people from rural

areas, causing a series of problems affecting sustainable development, such as the rapid loss of rural labor force, the weakening of rural population, the idle and waste of rural resources and the hollowing out of villages (Liu, 2018). Population stability is critical to sustainable rural development. Hence, the strategy for retaining labor force has become the key for rural development. Residence and employment are important elements of regional spatial structure (Zheng et al., 2006). Rural households' residential and employment location choice therefore becomes the most important spatial behavior. Farmers, as rational human being, tend to improve the economic efficiency of their families by changing their residence and working place. Rural revitalization has received extensive attention in recent years, but the human behavior embedded in this process is rarely considered. Scholars have long proposed that the development of rural industries will reduce the mobility of farmers to the city (Liang et al., 2002). However, little research has been done on rural residential and employment decisions. It is not clear how the objective living and employment conditions of farmers affect their subjective spatial behavior patterns of residential and employment choice.

A rural settlement is a type of rural locality where rural residents live and engage in producing (Yang et al., 2015). Developing local advantageous industries, providing well equipped electric power and other infrastructure, increasing the rural highways supply, as well as constructing supporting policies and systems are help to increase farmers' income and narrow the its gap (Weng et al., 2021). Symbiotic development of housing and industry can effectively resolve the problem of unemployment in rural areas and strengthen the social and economic fabric of these areas, providing a foundation for sustainable rural development and revitalization (Cheng et al., 2019). Holmes argued that multifunctionality is the central dynamic driving rural changes, not only in Australia but more generally in affluent societies (Holmes, 2006). However, the objective living and work conditions in rural areas have undergone great changes, but few scholars have taken it seriously, especially the working conditions in rural areas. It is of great significance for the sustainable development of rural areas and the formulation of government policies to clarify the influence of rural objective environment on the subjective behavior pattern of farmers.

Indicators to measure the objective suitability of living facilities (SLF) and the objective suitability of work facilities (SWF) are not unified. Thus, this article intends to sort out the concept and connotation of rural SLF and SWF, through putting forward theoretical framework and indicator system for the evaluation of SLF and SWF. These studies can help develop strategies to attract the young and educated to rural areas and to tailor local and regional devel-

opment strategies more effectively. Through the analysis of coupling coordination degree, we comprehensively evaluated the comprehensive development of rural areas in our study area. In general, the paper may have three contributions. Firstly, we put forward a theoretical framework and indicator systems to evaluate the rural development status and explore the spatial characteristics of SLF and SWF at the village level. Second, we combined the objective conditions of rural areas and the subjective choices of farmers to explore the internal logic between them. Finally, we deeply analyzed the income of farmers under different spatial behavior patterns, so as to recognize the incentives to attract labor force to stay in the countryside for the achievement of rural revitalization and sustainable development.

2. Literature review and theoretical framework

2.1. SLF and SWF

Livable level is an important indicator for measuring regional sustainable development. Many scholars put forward it to measure SLF since directly reflects people's quality of life in a given area (Yi et al., 2021). In general, livability consists of two core concepts: one is the high quality of life in terms of opportunities and achievements; the other is the good external and internal environments that influence the resident's life directly (Li et al., 2020).

In recent decades, sustainability and livability are pursued in urban context throughout the world. Onnom et al. (2018) used the analytic hierarchy process method in establishing a livable city index for medium-class cities of a developing country and generated a map based on multiple factors that showcased the livable ones. In addition to using the AHP to develop an importance-based hierarchy of criteria, mathematical analysis was applied to derive the livability index (Mushtaha et al., 2020). Liu et al. (2020) proposed a combined subjective-objective way to establish an evaluation index system evaluate urban livability supported by traditional Geo-data and social media data. Based on large-scale questionnaire surveys conducted in 2015 in 40 major cities in China, Zhan et al. (2018) explored the characteristics of satisfaction with urban livability and the effect magnitude of its determinants using the geographical detector model.

All of the above literatures are about urban SLF research. However, the research on rural SLF is still relatively rare. Compared with the widespread concerns about urban livability, the concept of livability was introduced in rural studies during the 1950s against modernization and urbanization. Recently, Wang et al. (2019) evaluate the characteristics of the satisfaction levels of rural livability

based on field questionnaire survey results, as well as examine the intensity effects of the related determinants, using a structural equation model (SEM). Overall, further studies are needed to provide theoretical support and practical reference for the rural human settlement environment improvement and rural revitalization in the new era.

The objective employment conditions in rural areas have attracted few attentions. Some of the above-mentioned scholars have integrated the rural production function into the study of rural livability. Nevertheless, the multifunctional attributes of rural settlements and rural land use has attracted the attention of some scholars. Qu established an index system to evaluate the multifunction of rural settlements and identified the spatial distribution of ecological function, living function and production function in study area (Qu et al., 2017). Yang explored the spatial-temporal characteristics of both the coupling and coordinating relationship of the rural production-living-ecological function from 2000 to 2015 in Beijing-Tianjin-Hebei region (Yang et al., 2020).

In general, the research on rural SLF and SWF in China is still in progress, and further research is needed to provide theoretical support and practical reference for the improvement of rural living environment and rural revitalization strategy in the new era. In order to reflect the real expectations of rural residents for their living environment, a scientific rural SLF and SWF evaluation framework is needed.

2.2. Households' spatial behavior patterns

In the past four decades, the gap between urban and rural areas has gradually widened due to China's long-term implementation of the strategy of giving priority to industry and cities (Li et al., 2020). While urbanization and industrialization is associated with larger urban-rural income gap (Yuan et al., 2020), the rural labor force is moving to the cities in large numbers, especially in first-tier cities, such as Beijing, Shanghai, Shenzhen and Guangzhou (Zhou, 2014). In the process of citizenization, migrant workers begin to divide, while different sub-groups of migrant workers have great differences in terms of their economic activities, social integration, so do their demands and evolve progress for citizenization. As they move into cities, more and more rural residents are making trade-offs between cities and the rural areas in terms of residence and employment. The concept of *semi-urbanization* was put forward to analyze the unbalanced integration of rural floating population in cities. According to different choices of residence and employment, rural-urban migrants can be differentiated into four types, which we call new citizens, entrepreneurs, floating population and swing group respectively (Figure 1).

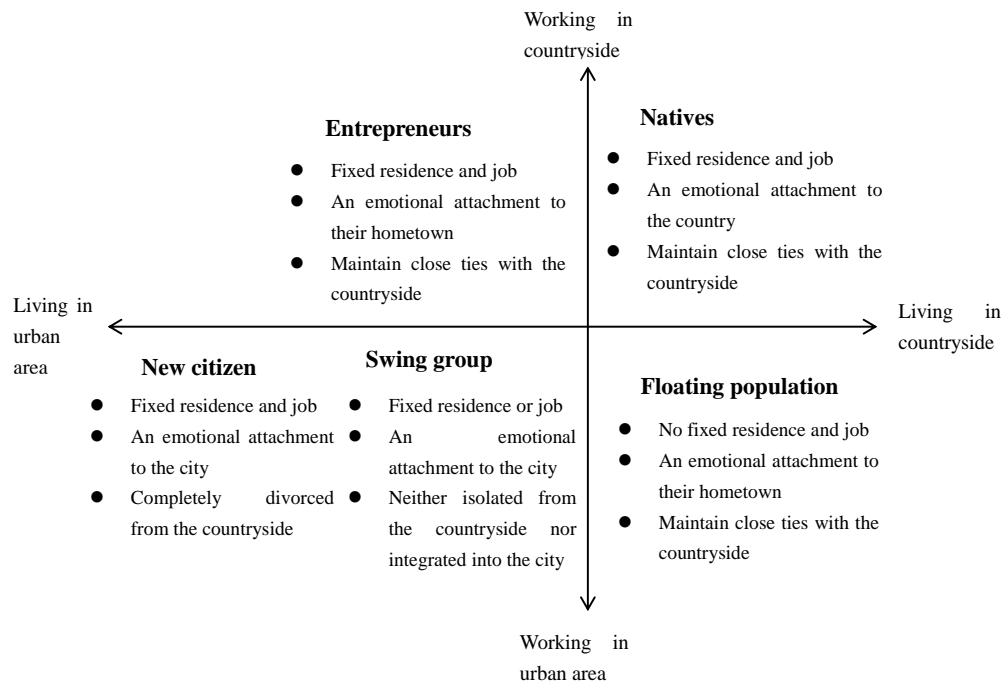


Figure 1. Household classification and its characteristics

First of all, the first type of migrant workers (new citizens) refers to those who have entirely completed the transformation from farmers to citizens, leaving the countryside and merging into the cities. Specifically, new citizens have been acquired higher levels of education and job skills, stable jobs and higher wages, higher labor market status and better economic opportunities and achievements (Tan et al., 2017). Their family has been reunited in the city and has gained equal access to social opportunities such as housing, social security, and health care, as well as their children's education. At the same time, They have extensive social networks and social connections in the city (Cao et al., 2014), showing attachment to urban society and sociocultural attachment (Chen and Liu, 2016). They also have culturally accepted the urban industrial lifestyle and psychologically consider themselves as members of cities.

The second group of migrant workers (Entrepreneurs) also settle down in cities and becomes new citizens. Different from the first group, because of the connection with the countryside, they tend to use their accumulated capital and technology to start their own business back home. Compared with traditional farmers, their human capital level is more advanced: more abundant knowledge stock, more advanced ideas and more innovative management ability. Entrepreneurs have become particularly promising for the rural population, bringing new thought to the rural lifestyle (Mattsson and Cassel, 2020).

The third type of migrant workers (Floating population) just goes to the cities to find jobs, leaving their families in the countryside. As for the temporary

residents, some of them migrate only to earn enough money to accumulate capital for investment in their hometown or supplement their family budgets (Owusu, 1998). They go to cities for work but not end up settling down in cities (Tao et al., 2015). For unskilled migrant workers, the majority of which has no formal qualifications required for city residency, leaving them largely without access to social security and health benefits (Wu et al., 2019). Most migrant workers cannot afford the high housing prices in cities. They still maintain an emotional attachment to countryside and a social rejection of the city (Li and Rose, 2017).

The fourth category of migrant workers (Swing group) is a transitional group, lying between the first and the third. The swing group comes from the process that migrant workers increasingly break away from the countryside and fail to integrate into the city. Unlike new citizens and floating population, they may have stable residences or jobs, but they have been lost the attachment and belonging of migrant workers to their hometown, they have not obtained the household registration status of settling down in the cities as migrant workers.

In this paper, we regarded Natives as the rural residence-employment pattern. Since Swing Group, Floating Population and Entrepreneurs have inconsistent choices of in terms of residence and employment place, we classified them as urban-rural amphibious pattern. New citizens have already out of the countryside, so we regarded them as the urban residence-employment pattern.

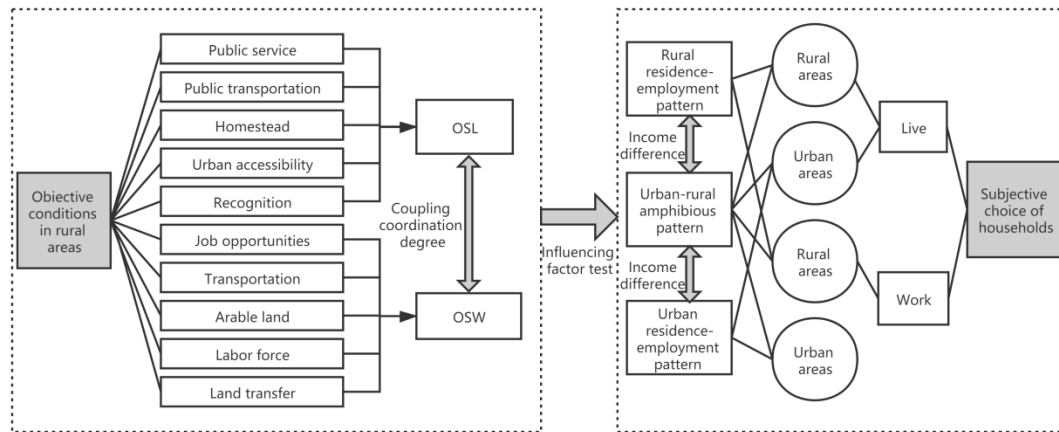


Figure 2. Research frame diagram

2.3. Theoretical framework

Villages are the basic economic and social elements in rural areas of China, and also the carrier of rural residents' production and living space. However, the suitability of villages has not received widespread attention. There is currently still no unified definition and measurement strategy for SLF and SWF in the available literature. It was considered that livable

countryside areas which would be suitable for residents to live would include a unity of graceful villages, beautiful environments, pleasant lifestyles, and harmonious societies (Liu et al., 2016). This paper established the evaluation system of SLF based on the national standards of *Evaluation for the construction of beautiful villages (GB/T 37072-2018)*, the guidelines of rural revitalization strategy, as well as previous research findings regarding livability or the assessment of rural living conditions (Huang and Du, 2015; Wang et al., 2017). Since there are few studies on the evaluation of SWF, we select indicators according to the actual situation of the study area and study on land use multifunctional (Zhou et al., 2017; Zou et al., 2021). SLF and SWF are objective measures of the countryside. In fact, farmers have a variety of choices when choosing a place of residence and employment. The diversity of employment and residence leads to spatial mismatch. The concept of jobs-housing balance was developed by scholars in urban studies (Li and Liu, 2016). Although the choices of residence and employment are independent, the two choices interact with each other, and considering one aspect in isolation may lead to bias. While existing theories and intuitions support bi-directional interactions between employment and residence, Steinnes (1978) uses two-stage least square method (TSLS) to build the residential location model and the employment location model respectively. Studies have concluded that the location of population and the location of work were determined simultaneously (Kimaro et al., 2015). Therefore, we comprehensively considered the

housing and employment choices of farmers and divide them into three spatial behavior patterns.

Modern push-pull theory holds that in addition to income, migration is pushed and pulled by infrastructure conditions, such as medical facilities, educational facilities and environmental conditions (Hare, 1999). This study is based on the theory of farmers' behavior of the school of rational peasants. First, economic rationality is the basic starting point for farmers' decision-making behavior. In addition, the new migration economic theory proposes that *family decision-making is not completely determined by individuals, but more by families*. Therefore, in this paper, we explore whether there are differences in household income under different spatial behavior patterns.

3. Materials and Methods

3.1. Study area

Poyang Lake basin (113°34'36"-118°28'58"E, 24°29'14"-30°04'41"N) is located in the Jiangxi province, southeast of China. With Ganjiang River running through the whole Poyang Lake basin, it has abundant agricultural resources and obvious ecological advantages, with 3,082.21 thousand hectares arable area at the end of 2016. There also have a large agricultural population, a large rural area and a relatively high proportion of agriculture. The urbanization rate of resident population is 57.4%, which is lower than the national average rate 60.60%. In 2019, Poyang Lake basin's GDP was 2.47575 trillion yuan. The outflow of massive labor force in the rural areas of Poyang Lake basin has become a serious problem. There were 12.066 million urban employees, accounting for 45.8% of the total labor force in study area. Meanwhile, there were 9.086 million rural migrant workers. Among them, 5.990 million were went outside the province, increased by 1.5 percent compared to the previous year, while 3.096 million stayed in Poyang Lake basin, increased by 3.4 percent. With large rural areas, ample arable land and massive migrate

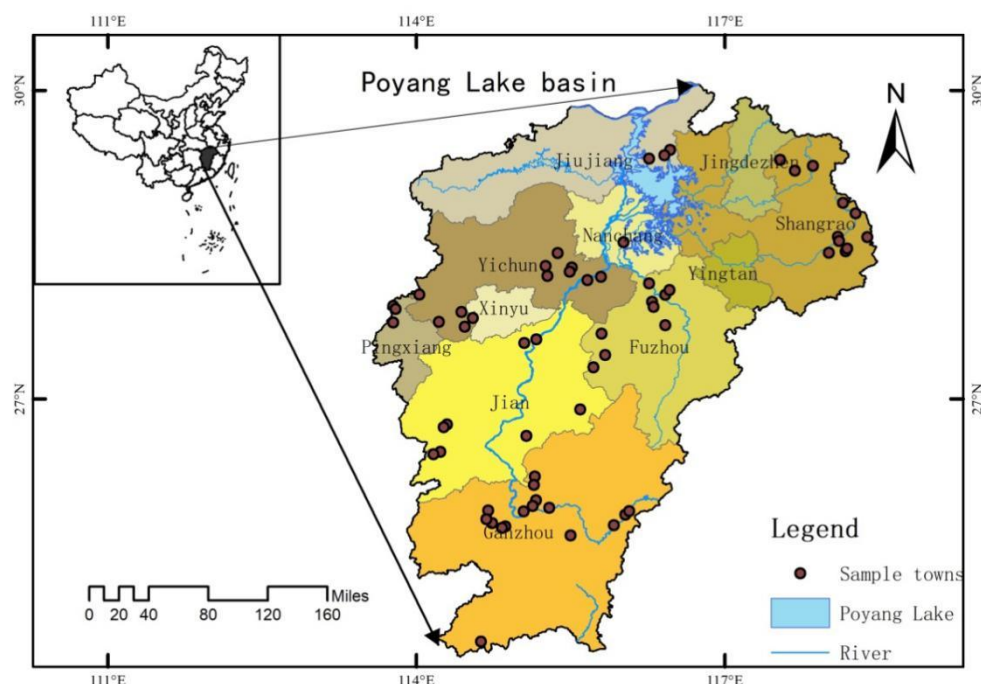


Figure 3. Study area

Table 1. Indices for the evaluation of SLF and SWF

Index		Explanation	Weight	Attribute
SLF	Public service	Basic education, medical facilities and sanitation were added with the equal weight after standardization	0.147	+
	Public transportation	Does the village have public transport	0.395	+
	Homestead	Homestead area per capita	0.130	+
	Urban accessibility	The distance from the village to the nearest town center	0.155	-
	Recognition	The average recognition degree of villagers to the development prospect of the village	0.173	+
SWF	Job opportunities	The number of primary, secondary and tertiary industries were added with the equal weight after standardization	0.166	+
	Transportation	Accessibility to roads	0.234	+
	Arable land	Arable land per capita	0.090	+
	Labor force	Proportion of migrant workers in village	0.245	-
	Land transfer	Proportion of land circulation in villages	0.265	+

workers, Poyang Lake basin is typically to analysis the rural basic situation and spatial behavior pattern of farmers. There are a total of 100 county-level administrative regions in the Poyang Lake basin, of which 24 were surveyed by us.

3.2. Data

The data used in this study are from a field survey in Poyang Lake basin of China, January 2020. It's a cross-sectional survey, covering 24 counties, districts and prefecture-level cities with a simple random sampling. The objects of our survey are rural population over 18 years old with working capability who have a rural residence. For each county, three levels of sampling towns were defined according to their feature: suburban town, remote town and characteristic town. After dealing with the

outliers, 839 valid questionnaires from 123 villages were obtained. For each village, we conducted field research on its location, economic and industrial conditions and the configuration of the infrastructure. For each respondent, information was gathered on their characteristics such as age, gender, employment and residential choice, perception of policy and so on.

3.3. Methods

Because the measurement units and orders of magnitude of the indicators that measure rural SLF and SWF are different, and each indicator has a positive or negative impact on the system. Therefore, each indicator needs to be standardized before all calculations. x_i represent the indicators in Table 1. The standardized calculation formula of positive indica-

tors x_i^+ and negative indicators x_i^- we adopted is as follows:

$$x_i^+ = \frac{x_i - \min(x_i)}{\max(x_i) - \min(x_i)} \quad (1)$$

$$x_i^- = \frac{\max(x_i) - x_i}{\max(x_i) - \min(x_i)} \quad (2)$$

3.3.1. CRITIC method

CRITIC method, first proposed by Diakoulaki et al. (1995), is an objective weighting method that determines the weight according to the contrast intensity and conflict of indicators. Among them, contrast intensity refers to the value difference in evaluation index, which is measured by standard deviation e_j . The conflict between the indicator j and other indicators is calculated as $\sum_{i=1}^n (1 - r_{ij})$, and r_{ij} is the correlation coefficient between indicator i and j . The information contained in index j is determined by the product of the standard deviation of the evaluation indicator and the degree of conflict, shows as Eq. (3).

$$I_j = e_j \sum_{i=1}^n (1 - r_{ij}) \quad (3)$$

$$w_j = \frac{I_j}{\sum_{j=1}^m I_j} \quad (4)$$

w_j is the objective weight of the indicator j , which can be obtained from Eq. (4).

3.3.2. Coupling coordination degree model

Based on the evaluation of SLF and SWF, the coupling coordination degree model is used to calculate the coupling coordination degree of living and employment conditions of each village.

$$C = \left(\frac{SLF \cdot SWF}{SLF + SWF} \right)^{1/2} \quad (5)$$

C is the coupling degree reflecting the interaction and influence between SLF and SWF of villages. T is the comprehensive coordination index between SLF and SWF (see Eq. (7)). Both α and β are constants which $\alpha + \beta = 1$. In this study, both α and β are set as 0.5. The coupling coordination degree D can comprehensively reflect the interaction and coordination degree between systems, which can be obtained from Eq. (6).

$$D = \sqrt{C \cdot T} \quad (6)$$

$$T = \alpha U_1 + \beta U_2 \quad (7)$$

3.3.3. Multinomial logit model (MNL)

We divided the behavior pattern into three types according to the different combination of employment place and residence place of peasant households. One is to live and work in the countryside, and the second is to live and work in the city. Both of these two patterns reflect the integration of household and employment. The third is the urban-rural amphibious pattern, which reflects the semi-urbanization of peasant households, including urban residence-rural employment and rural residence-urban employment.

In the ordered model, the influence of variables increases the probability of the most severe re-

sponse type and decreases the probability of the least severe response type (Geedipally et al., 2011). Therefore, ordered logit can be empirically biased. The multinomial logit model is an extension of the binary logit model, which is used when the dependent variable has several categories that are unordered. The MNL model used in this study is as follows.

$$Y_i = \alpha_m + \sum_{k=1}^K \beta_{mk} X_{ik} + u_i \quad (8)$$

Y_i is multi-classification variable of household spatial behavior pattern. X is a vector of individual characteristics of farmers and SLF and SWF that affect spatial behavior pattern. β_{mk} is the parameter to be estimated and K is the error term. In this paper, the reference is set as M , and the value of other types of spatial behavior pattern is $m=1, \dots, M-1$. Therefore, the Logit model can be expressed as:

$$\ln \frac{\text{prob}(Y_i=m)}{\text{prob}(Y_i=M)} = \alpha_m + \sum_{k=1}^K \beta_{mk} X_{ik} = Z_{mi} \quad (9)$$

Where, $Y_i = M$ represents the reference and $Y_i = m$ represents the other items. For reference, the multinomial logit model is estimated according to Eq. 10. For other items, the multinomial logit model is estimated according to Eq. 11.

$$\text{prob}(Y_i = M) = \frac{1}{1 + \sum_{h=1}^{m-1} \exp(Z_{hi})} \quad (10)$$

$$\text{prob}(Y_i = m) = \frac{\exp(Z_{mi})}{1 + \sum_{h=1}^{m-1} \exp(Z_{hi})} \quad (11)$$

3.3.4. Quantile regression

Classical OLS regression model, through the conditional expectation $E(y|x)$, calculate the influence of the independent variable x on the dependent variable y . Classical OLS regression is represented by the following formula:

$$y = \beta x + \varepsilon \quad (12)$$

Among them, β is the regression coefficient, and ε is the error term. The classical OLS regression only pays attention to the conditional mean of the dependent variable but does not fully consider the complete characteristics and skewed distribution of the conditional distribution of the dependent variable. Therefore, it may lead to errors in estimation results. The quantile regression method can be used to get regression of explanatory variables with explained variables under different quantiles to obtain the influence of the explanatory variables on the whole conditional distribution. The general form of quantile regression model is represented as follows:

$$y_i = x_i' \beta_\theta + \mu_{\theta i}, 0 < \theta < 1 \quad (13)$$

$$\text{Quant}_\theta(y_i|x_i) = x_i' \beta_\theta \quad (14)$$

where x is the vector of independent variables and y is the explained variable. θ represents the quantile point, and μ is the random disturbance term. β_θ indicates the θ quantile regression coefficient to be estimated. The estimator $\hat{\beta}$ is obtained by the following minimization objective function:

$$\min \sum_{y_i \geq x_i' \beta} \theta |y_i - x_i' \beta| + \sum_{y_i < x_i' \beta} (1 - \theta) |y_i - x_i' \beta| \quad (15)$$

Table 2. Variable definition and data description of sample villages and interviewees

Index	Explanation	Mean	S.D.
Village characteristics			
Basic educational facilities	The actual number of schools	2.29	1.66
Medical facilities	The actual number of clinics or pharmacies	2.99	4.05
Environmental sanitation	The actual number of cleaners	3.49	3.97
Public transportation	Does the village have public transport: No=0, Yes=1	0.23	.42
Homestead	Homestead area per capita (m^2)	28.79	10.31
Urban accessibility	The distance from the village to the nearest town center (m)	5.67	6.52
Recognition	The average recognition degree of villagers to the development prospect of the village: poor =1, general =2, promising =3	2.67	0.34
The primary industry	The number of enterprises in the primary industry: 0=1; 1-2=2; more than 2	1.35	0.55
The secondary industry	The number of secondary enterprises in the secondary industry: 0=1; 1-2=2; more than 2	1.49	0.74
The tertiary industry	The number of tertiary enterprises in the secondary industry: 0=1; 1-2=2; more than 2=3	1.25	0.50
Transportation	The type of road closest to the village: none=0, county highway=1; provincial highway=2; national highway=3; expressway=4	2.10	1.38
Arable land	Arable land per capita (m^2)	451.43	33.63
Individual characteristics			
Labor force	Proportion of migrant workers in village: 70% above=1, 30%-70%=2, more than 30% =3	1.85	0.72
Land transfer	Proportion of land circulation in villages: 0-30%=1, 30%-60%=2, more than 60% =3	1.56	0.78
Gender	Female = 0, Male = 1	0.71	0.46
Age	Actual age	46.79	12.90
Household income	Family's income in 2019 (Ten thousand Yuan)	10.71	14.80
Educational level	Junior high school or below=0; High School or Junior college=1; College or above=2	0.37	0.58
Labor force	The ratio of the labor force to the total number of family	0.61	0.21

Table 3. Distribution of SLF and SWF

Proportion (%)	lower-level	low-level	middle-level	high-level	higher-level
SLF	14.63	56.09	6.50	4.89	17.89
SWF	20.33	36.59	32.52	9.76	0.81

4. Results and discussions

4.1. Descriptive analysis

4.1.1. Descriptive analysis of sample villages

Table 2 presents the basic profiles of sample villages. As can be seen from the standard deviations of rural infrastructure, there is a large degree of dispersion of medical facilities and environmental sanitation among the sample villages. In addition, only 23% of villages have access to public transport. The average population of migrant workers in sample villages exceeds 70%, which fully shows the current situation of hollowing out and aging weakening of rural areas. Although most of the labor force has chosen to leave the countryside to work in the cities, a majority of villages are considered to have a promising development prospect. The proportion of rural land transfer is low, which indicates that the high idle rate of rural land and the low utilization rate. The per capita homestead area is $28.84m^2$ and the per capita cultivated land area is $446.67m^2$.

4.1.2. Descriptive analysis of interviewees

Table 2 also shows the basic profiles of respondents. It shows that the majority of respondents were men with a junior high school degree or below. The average age is 46.76 years old and the average family income of the entire sample is 17100 yuan. On average, the labor force in the households of respondents was 60 percent of the total population.

4.2. Characteristics of SLF and SWF

4.2.1. Evaluation of SLF and SWF

Taking the administrative village as the evaluation unit, we estimated the SLF and SWF values of 123 villages in Poyang Lake basin by using CRITIC method based on the indexes in Table 1. The calculation results were again normalized so that the final results fell within the range [0–1]. We used an equal interval method to further classify the SLF and SWF of villages into five categories: lower-level [0-0.2), low-level [0.2-0.4), middle-level [0.4-0.6), high level [0.6-0.8), higher-level [0.8-1].

Table 4. Distribution of coupling coordination degree

Classes	Range	Proportion (%)
Low-level coupling	[0-0.3)	3.25
Antagonism stage	[0.3-0.5)	22.76
Adaptive stage	[0.5-0.7)	52.85
High-level coupling	[0.7-1]	21.14

Table 5. Regional heterogeneity analysis

Regional types	Remote towns		Sub-urban towns		Characteristic towns	
	Remote villages	Sub-urban villages	Remote villages	Sub-urban villages	Remote villages	Sub-urban villages
SLF	1.85	2.11	2.91	3.17	1.78	2.68
SWF	2.23	2.11	2.36	2.38	3.00	2.36
Coupling coordination degree	2.62	2.79	2.91	3.14	2.89	3.00

Table 6. Results of the multinomial logit regression

Explanatory variable	Rural residence-employment pattern	Urban-rural amphibious pattern
	Coefficient	Coefficient
Gender	−0.542**	0.188
Age	0.085***	0.042***
Education	−0.222	−0.750**
Annual household income	−1.083***	0.003
Household labor ratio	0.068	0.146
SLF	0.733*	1.649***
SWF	0.077	1.282*
Constant	−1.152*	−3.739***
Pseudo R^2	0.1855	
Prob>chi2	0.000	

Note: * $p < 0.05$; ** $p < 0.01$, *** $p < 0.001$.

As shown in Table 3, majority of villages in Poyang lake basin attained a low-level SLF, accounting for 56.1% of all sample villages. The lower-level SLF and higher-level SLF of villages had similar proportions, 14.6 percent and 17.9 percent respectively. In addition, the proportion of villages at the middle-level SLF and high-level SLF was just 6.5% and 4.95%. Overall, the SLF of villages in Poyang lake basin was not high. As for SWF, the low-level of SWF of villages has the maximal proportion 36.6%, while the higher-level SWF only accounts for 0.8%. The mean difference between SLF and SWF was not significant. However, there is a large gap between SLF and SWF at a higher level. In general, rural SWF lags behind SLF.

4.2.2. Coupling coordination degree

We put SLF and SWF into the coupling coordination degree model, and obtained the coupling coordination degree of 123 villages. There is no unified standard for the classification of coupling coordination degree, and we divided the coupling coordination degree into four levels (Table 4). More than half of the villages are in the stage of adaptation. The villages with high level of coupling accounted for 21.1%. Overall, the level of coordination between SLF and SWF is high, but still needs to be improved.

However, the majority of rural areas are in the adaptation stage, which makes the average level of coupling coordination degree reflect limited infor-

mation. SLF and SWF of different levels were set as 1 to 5 and coupling coordination degree of different levels was set as 1 to 4 to further analyze their regional heterogeneity (Table 5). SLF in suburban towns are higher than other towns, both in remote and suburban rural areas. And suburban villages generally have better SLF than remote villages. As for SWF, it shows completely different characteristics from SLF. It is apparent from this result that higher SWF values appeared in characteristic towns and sub-urban towns. On the one hand, the strong support of the government to the characteristic towns provides a lot of funds and employment opportunities, which improves the SWF. On the other hand, due to the expansion of urbanization, a large number of suburban farmland has been occupied, which is conducive to the development of industry. For different types of rural areas, the level of coupling coordination degree in suburban rural areas is always higher than that in remote rural areas. This indicates that SWF and SLF are more coordinated in suburban rural areas. The regions with higher coupling coordination degree are basically consistent with the regions with higher SLF.

4.3. Determinants to households' spatial behavior pattern

Through the field survey questionnaire, we obtained a total of 839 valid questionnaires from 123 villages after removing the outliers, showing the

Table 7. Results of the quantile regression of family income

Explanatory variable	OLS	Quantile regression				
		10th	25th	50th	75th	90th
Gender	0.029	−0.183	−0.119	0.160	0.019	0.142
Age	−0.001	−0.001	0.007*	0.004	0.009**	0.012**
Education	0.239**	0.212*	0.260**	0.158***	0.189*	0.205***
Household labor ratio	0.763***	0.400	0.178**	0.667***	0.729***	0.827***
Spatial behavior pattern						
Rural residence-employment pattern	−0.443***	−0.100***	−0.572****	−0.428***	−0.458***	0.560***
Urban-rural amphibious pattern	0.196	0.198	−0.150	−0.029	−0.081	−0.116
Urban residence-employment pattern (=ref.)						
Constant	1.429***	0.550	0.688***	1.205***	1.292***	1.363***
R ²		0.888				
F		13.40***				

Note: *p < 0.05; **p < 0.01, ***p < 0.001.

respondents' objective preferences for residence and employment. In order to explore the impact of objective housing and employment environment on farmers' subjective housing and employment behavior, we used the multinomial logit model. Tables 6 show the results.

Since we focused on the relationship and sustainable development between SLF and SWF in rural areas, we used urban residence-employment pattern as a reference. First of all, compared with the urban residential-employment pattern, people with rural residence-employment pattern are characterized by male and a higher age, which is the same as the previous conclusion. This is also consistent with the current situation that a large number of young and middle-aged rural labor forces migrate leading to the formation of hollowed villages. The income of farmers in the rural residence-employment pattern is significantly less than that in the urban residence-employment pattern. In addition, higher SLF is beneficial for farmers to choose rural residence-employment pattern, while SWF was not statistically significant. Higher SLF in rural areas is conducive to attracting farmers to stay and work in rural areas. It's worth emphasizing that the regression result was obtained by removing two outliers of extremely high income. They account for only 0.36% of the total sample, but 65 times the average income of the total sample, and 91 times that of farmers who also belong to the rural residence-employment pattern. They are in the highest income brackets among respondents engaged in non-farm activities. This shows that the vast, cheap and promising land of the countryside has made their careers and brought them great wealth. Besides, both of them started businesses in rural areas with higher SWF. As for farmers with rural-urban amphibious pattern, they also have higher ages and lower levels of education. Annual household income is not statistically significant. This indicates that the income gap between rural-urban amphibious pattern and urban residence-employment pattern is not large. As expected, the SLF and SWF are significantly positive, which means higher SLF and SWF can encourage people to choose urban-rural amphibious pattern.

For farmers living in the suburban areas and working in the city, better objective living conditions provide them with low housing costs. They can not only save living expenses, but also get a higher salary by working in the city with convenient transportation.

4.4. The family income gap of farmers under different spatial behavior patterns

In order to further explore the relationship between household income and farmers' spatial behavior pattern, we used quantile regression method to further explore the influence of spatial behavior pattern on different income groups of farmers. The empirical results of OLS and quantile regression are reported in Table 7.

OLS method estimates the mean impact of peasant households' spatial behavior patterns on income, so it is not suitable to compare the income differences of households under different patterns. In order to further analyze rural household income differences under different patterns, quantile regression method used to compare the results for the 10th, 25th, 50th, 75th and 90th quantiles. The results of OLS estimation show that the coefficients of education, household labor ratio and urban residence-employment pattern are significant. Education level and household labor ratio would have a positive effect on household income. As for spatial behavior pattern, rural households with the urban residence-employment pattern have a higher income than those follow rural residence-employment pattern. However, the coefficient of urban-rural amphibious pattern is not statistically significant.

Empirical results show that there are differences between the parameters obtained by OLS and quantile regression. At the 10th, 75th and 90th quantiles, the low and high income percentile, age has significant positive effects on family income. Although there is still a positive correlation between education level and income in each quantiles, it is not difficult to find that the influence of education level on different income groups fluctuates. With the increase of farmers' income quantile, the promoting

effect of education level on income rises, falls and rises again. With the increase of income quantile, the positive influence of household labor ratio on household income is greater.

However, rural residence-employment pattern has a significant positive effect on household income in each quantile, but the urban-rural amphibious pattern is not statically significant. It proved that there is no significant difference in the family income between urban-rural amphibious pattern and urban residence-employment pattern in each quantile. However, the rural residence-employment pattern effects were slighter in the lower quantiles than in the upper quantiles. The large income gap between urban and rural areas is a major problem in China's economic development.

5. Conclusions

Although regional livability in China has attracted more and more attention from the public and the government in recent years, previous studies have mainly focused on the evaluation of urban livability. Despite the large amount, low cost of land and labor in the countryside, the productive function in the countryside is always neglected, and the work facilities in the countryside are rarely evaluated in the existing literature. Based on the field survey of 123 villages in Poyang Lake basin, we evaluated the objective conditions of the sample villages, SLF and SWF, based on village level data. Then, we verify the effect of objective environment on farmers' subjective spatial behavior patterns of residence and employment. Finally, the quartile regression method is used to further examine the income differences of farmers under different spatial behavior patterns. The main conclusions are as follows.

The average SLF and SWF were 2.55 and 2.34 respectively. Although the mean values of SLF and SWF are similar, SLF is mostly distributed at a higher level. Specifically, 17.89% of the villages had a higher-level of SLF, while only 0.81% of the sample villages had a higher-level of SWF. Therefore, more attention should be paid to taking measures to promote the development of rural industries to change the situation of the lagging development level of rural industries. In addition, we divided villages into six categories according to different township types and the distance from village to town center, so as to identify the heterogeneity of SLF and SWF. The key findings from the analyses show that there has a higher SLF in suburban towns and suburban villages. However, the higher SWF is mostly distributed in suburban towns and characteristic towns.

SLF and SWF only evaluated the objective conditions of individual villages. The results obtained from the multinomial logit model had confirmed that the objective conditions in rural areas affect the choice of farmers' subjective spatial behavior pat-

tern of residence and employment. Compared with the urban residence-employment pattern, people with rural residence-employment pattern are characterized by male, higher age and lower income. In addition, higher SLF is beneficial for farmers to choose rural residence-employment pattern, while SWF was not statistically significant. In the survey, we noticed that a small part of the rural residence-employment model of farmers have a very high income, account for only 0.36% of the total sample, but their income is 65 times the average of the total sample, and 91 times that of farmers who also belong to the rural residence-employment pattern. Furthermore, they are all located in the higher areas of SWF. This finding was unexpected and suggests that although SWF in rural areas is not significant for the overall sample, it creates good conditions for a small number of people, which showing the huge potential for people to create wealth in the countryside. In contrast, compared with the urban residence-employment model, the rural-urban amphibious model shows higher age and lower education level, but the income was not significant. Besides, both SLF and SWF have significant promoting effects on farmers' choice of rural-urban amphibious pattern.

Rural households with the rural residence-employment pattern have a 19.6% lower income than those follow urban residence-employment pattern. The results of quantile regression allowed us to understand that, no matter in what quantiles, the income of farmers with urban-rural amphibious pattern and urban residence-employment pattern is higher than that of rural residence-employment. The urban-rural amphibious pattern is the optimal spatial behavior pattern for both rural development and famer individuals. On the one hand, farmers can get higher income in this pattern; on the other hand, farmers in the urban-rural amphibious pattern can bring population and vitality to the countryside.

6. Policy implication

First, governments should be committed to improving the current serious outflow of rural labor force, pay attention to the housing and employment problems in rural areas, and improve objective living and employment conditions. In particular, the employment environment in rural areas needs to be improved.

Second, governments should make overall plans to revitalize the countryside and tailor policies to local conditions according to their advantages. Priority of development of industries should be given to suburban towns and characteristic towns and the objective living conditions in remote villages should also be further improved. Suburbs and characteristic towns can be used as rural growth poles for industrial development. Suburban towns with distinctive features should be built into rural growth poles for

industrial development, and become the gathering points of employment in nearby rural areas. Characteristic towns should rely on their natural advantages, firstly realize urban-rural integration, and then drive the development of rural enterprises in nearby towns with characteristic towns. Make characteristic town become the engine that improves rural appearance, accelerate rural economy grows. Third, governments should further reform the rural land system and investment system and further liberalize the rural market to create a better policy environment for rural entrepreneurship. The government should encourage farmers to adopt the urban-rural amphibious spatial behavior pattern to further increase the income of farmers.

Finally, the aging of the rural population is a serious problem. As the enthusiasm of young people and farmers with higher education level to participate in agriculture is not high, governments should promote the cooperation between universities and rural areas, and set up a university student cooperation base in rural areas. For college students who want to start a business in rural areas, governments should actively provide land transfer coordination, financial support and technical services.

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Sustainable Development and Religion. A European Perspective

Rozwój zrównoważony i religia. Perspektywa europejska

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Abstract

Religion is an important factor associated with sustainable development. Based on the data from the International Social Survey Programme (ISSP) – Religion IV, we analysed religiosity in 20 European countries, taking into account declarations of religiosity, frequency of religious practices, religious beliefs, and attitudes towards members of other religious groups and non-believers. We have also examined how declarations of religiosity have changed since 1991 and compared the results with the ones from the European Social Survey.

Key words: sustainable development, religion, religious practices, beliefs, Europe, International Social Survey Programme

Streszczenie

Religia jest istotnym czynnikiem powiązaniem ze zrównoważonym rozwojem. Wykorzystując dane International Social Survey Programme (ISSP) Religion IV przeprowadzono analizę religijności w 20 krajach Europy. Uwzględniono deklaracje religijności, częstość praktyk religijnych, przekonania religijne oraz stosunek do przedstawicieli innych religii i niewierzących. W zakresie deklaracji religijności prześledzono jej zmiany od 1991 roku oraz porównano z wynikami European Social Survey.

Słowa kluczowe: rozwój zrównoważony, religia, praktyki religijne, przekonania, Europa, International Social Survey Programme

Introduction

Sustainable development aims at achieving physical, mental and social well-being in harmony with economic development and environmental protection. Religion is an important factor in shaping this well-being.

Researchers from the German Institute of Global and Area Studies (GIGA) analysed the causal mechanisms for different dimensions of religiosity – from the perspective of sustainable development. The results of empirical research confirm that different dimensions of religion exert an influence on 12 elements of the economic pillar of sustainable development, 4 elements of the environmental pillar, and as many as 40 elements of the social pillar of sustainable development (e.g., in the area of health and well-

being, education, social capital, and social conflicts) (Basedau, Gobien, Prediger, 2017).

Religion plays a fundamental role in shaping societies, not only through its direct influence on human behaviour but above all, through its effects on formal and informal norms and values, as well as public discourses. Research on the social dimension of sustainable development has shown that a number of religious dimensions exert a positive influence on physical and mental health as well as on the general well-being, while a significant religious diversity is negatively correlated with well-being. Regarding physical health, the risk of cancer and sexually transmitted diseases is lower for religious people, for example. Many studies have shown that religiosity can prevent harmful behaviour such as drug abuse. Studies on democracy have provided evidence that Christian

and Hindu countries are, on average, more democratic and better governed than Muslim or Orthodox Christian countries (it remains unclear, though, whether this is due to the predominant religious tradition, the level of secularization or some other factors). As far as conflict is concerned, most researchers agree that the dominance of one religious group and parallel ethnic and religious cleavages increase the risk of conflict (Basedau, Gobien, Prediger, 2017). Moreover, religion is often perceived as the main cause of conflict, both within societies and internationally. On the other hand, the influence of religion on promoting peace-building is also emphasized (Silvestri, Mayall, 2015).

For these reasons, it is crucial to study religiosity- in this case the religiosity of Europeans. The article attempts to examine religiosity in contemporary Europe based on the International Social Survey Programme (ISSP) research carried out as part of the Religion IV module. The aim is to answer the following research questions: (1) how often do Europeans declare that they are religious and have these declarations changed over time? (2) how often do Europeans engage in religious practices? (3) how common are religious beliefs? (4) how frequent are negative attitudes towards members of other religions? These questions are asked in the context of international comparisons. The surveys were conducted in: Austria, Bulgaria, Croatia, Czech Republic, Denmark, Finland, France, Spain, Iceland, Lithuania, Germany, Norway, Russia, Slovakia, Slovenia, Switzerland, Sweden, Hungary, Great Britain, and Italy. Although the study does not cover all European countries, almost all areas of Europe are represented¹.

Methodology

The International Social Survey Programme is an international research programme aimed at regular measurement of variables covering a broad scope of social life throughout the world. The ISSP surveys are repeated every couple of years (starting from 1985), which allows for observing changes in the measured phenomena. The ISSP has a modular structure, with each module devoted to a particular topic (e.g., religion, environment, social networks, perception of the role of government, etc.). Currently, it includes 11 modules, within which 34 studies have been carried out (another 4 are still being developed)².

The ISSP Religion IV survey (2018)³ was conducted in 33 countries around the world, including 20 countries in Europe. Overall, the European sample consisted of 27,284 respondents (around 1,350 from

each country, on average). The samples were selected randomly (simple random sampling, systematic sampling and proportionate stratified sampling). Various research techniques were used to collect the data: face-to-face interviews (computer-assisted and traditional questionnaire interviews), indirect (telephone) interviews and survey questionnaires (both paper and online)⁴.

The issue of religion and religiosity was also addressed in other surveys that covered all or most European countries. These include in particular: the Euro-barometer Survey (2010 and 2019) and the Pew Research Poll (2015). Single variables concerning religion were also used in the Gallup Survey (2007, 2008, 2009) and in the European Social Survey (2019/2020 and earlier).

However, the Euro-barometer Survey included only 4 questions about religion (affiliation to a religion or faith, self-declaration of religiosity, frequency of religious practices and frequency of praying). Consequently, these data are not sufficient for conducting more in-depth analyses, although they can be useful for observing major trends. When it comes to the Pew Research Poll, only one survey dealt with religiosity in Europe. Since it contained many variables, it could potentially enable conducting an in-depth analysis. However, this study covered only Central and Eastern Europe. The Gallup Survey contained only one question on religiosity. Hence, the International Social Survey Programme (ISSP) with its module on religion seems to be the most promising research programme for cross-European comparative studies that would include many variables. What is more, the ISSP surveys on religion were carried out four times (in 1991, 1998, 2008 and 2018), which enables us to observe some trends in religiosity. The drawback is that different countries participated in the surveys in different years (for details, see Table 1).

It is pointed out that pan-European research should take into account the religious map of Europe. The European continent can be divided into four main areas of religious influence: (1) the Catholic Church is the main religious influence in central and southern parts of Europe (Portugal, Spain, France, Belgium, central and southern part of Ireland, Italy, Malta, South Switzerland, Germany, Austria, Hungary, Croatia, Slovenia, Czech Republic, Slovakia, Poland, Lithuania, part of the Netherlands, Latvia, and Ukraine); (2) Protestantism is the main religious influence in central and northern areas (Iceland, England and Northern Ireland, Central and Northern Switzerland, Germany, Denmark, Norway, Sweden, Finland, Estonia, Latvia, part of Hungary, the Netherlands, and Belarus); (3) the Greek and Russian Or-

¹Data from the 2018 surveys released in autumn 2020.

²More information on the ISSP can be found at: <http://w.issp.org/menu-top/home/>.

³ISSP Research Group. International Social Survey Programme: Religion IV – ISSP 2018. *GESIS Data Archive, ZA7570 Data file Version 2.0.0*, Cologne 2020.

⁴For more details, see: https://search.gesis.org/research_data/ZA7570.

Table 1. Declarations of religiosity by country and survey year

			ISSP 1991	ISSP 1998	ISSP 2008	ISSP 2018	ESS 2018	ISSP 2008- 2018
Country	Austria	n	613	591	477	506	892	
		%	61.2%	60.1%	46.8%	42.7%	35.7%	-4.1%
	Bulgaria	n	557			537	516	
		%	50.5%			55.5%	23.5%	
	Croatia	n			926	627	644	
		%			77.1%	63.7%	35.6%	-13.4%
	Czech Republic	n	296		283	368	405	
		%	24.2%		18.7%	27.5%	16.9%	+ 8.8%
	Denmark	n	313		435	244		
		%	28.1%		21.7%	15.2%		-6.5%
	Finland	n			445	396	791	
		%			39.2%	34.0%	45.1%	-5.2%
	France	n	319		698	247	664	
		%	28.2%		28.4%	27.5%	33.0%	-0.9%
	Spain	n	1401		1021	615	479	
		%	56.3%		43.1%	36.9%	28.7%	-6.2%
	Iceland	n				465		
		%				40.7%		
	Lithuania	n				520	786	
		%				52.6%	42.8%	
	Germany	n	413 ⁵	614 ⁶	653	552	763	
		%	41.3%	45.6%	38.3%	32.9%	32.4%	-5.4%
	Norway	n	581	511	375	387	279	
		%	37.9%	33.9%	35.0%	31.7%	19.8%	-3.3%
	Russia	n	747	295	585	801		
		%	43.9%	10.0%	57.6%	52.0%		-5.6%
	Slovakia	n			683	598	510	
		%			60.0%	45.2%	47.1%	-14.8%
	Slovenia	n	371	766	401	613	408	
		%	36.9%	36.8%	37.7%	58.2%	31.0%	+ 20.5%
	Switzerland	n	447		529	713	573	
		%	37.1%		43.0%	31.0%	37.2%	-12.0%
	Sweden	n	188		222	239	307	
		%	15.8%		18.0%	14.0%	19.9%	-4.0%
	Hungary	n	453		351	387	436	
		%	45.3%		34.8%	38.7%	26.2%	3.9%
	Great Britain	n	312	529	1354	474	556	
		%	38.8%	42.1%	44.0%	32.5%	25.2%	-11.5%
	Italy	n	648	665	712	640	1340	
		%	64.3%	67.7%	66.0%	53.7%	48.8%	-12.3%

thodox Churches are dominant in south-eastern areas (Greece and part of Cyprus and Macedonia, Serbia, Bulgaria, Romania, Ukraine, Moldova, Georgia, Armenia, Russia, parts of Bosnia and Herzegovina, Kazakhstan, Estonia, Latvia, and Belarus); (4) Islam is influential over the eastern part of Europe (Turkey, Azerbaijan, Albania and parts of Macedonia, Kazakhstan, Georgia, Bulgaria, and Bosnia and Herzegovina) (Barrett, 2001).

Religious diversity in contemporary Europe has received much attention of researchers, who in their studies focus on one or several European countries or on a particular region of Europe: Eastern Europe

(e.g., Pickel, Sammet, 2012; Tomka, 2011; Saghal, Cooperman, Schiller, 2017), Western Europe (e.g., Halman, 2004; Nicolet, Tresch, 2009), or the entire Europe (e.g., Coutinho, 2016; Cipriani, 2010; Liedhegener, Odermatt, 2013).

Self-declarations of religiosity

For self-declarations of religiosity, the responses *extremely religious*, *very religious* and *somewhat religious* were added together to create one variable value (*religious*), which was then counted. The same procedure was used for the data sets collected in

⁵West Germany

⁶West Germany.

1991, 1998, 2008 and in 2018, i.e., when the ISSP included the module on religion. Table 1 displays the distribution of this variable, with the last column showing the differences in results for the last decade (from 2008 to 2018). Table 1 also includes data collected in the 2018 European Social Survey, which allows for comparing the ISSP data and the ESS data collected in the same year.

As can be seen, the differences between these two are significant in almost every case. While in the ISSP survey, religiosity was measured with a word scale, which was an ordinal scale (obviously after the response *I don't know* was excluded), in the ESS the analogous variable was measured with an interval scale consisting of 10 points (from 0 to 9) – with only the most extreme values described. Thus, it was the researcher's task to decide which points on the scale should be included in the category *religious*. Unavoidably, such decisions tend to be arbitrary. I decided to take a *broad* approach and to include points 6, 7, 8 and 9 in the category *religious*. Nevertheless, the differences between the ESS and ISSP results are very noticeable (and would be even bigger if points 7, 8 and 9 were combined). How can these discrepancies be explained? They may result from using structurally different measurement tools: questions that contain an ordinal variable (with all values described), and questions that contain an interval variable (with only extreme values described and numbers for the remaining values). The following conclusion can be drawn: when measuring the level of religiosity based on self-declarations, the questions to which answers are given in the form of a number scale that does not contain descriptions of the intensity of a given feature, except for extreme points (for example, *very religious* vs. *definitely non-religious*) are more likely to generate more negative choices, as compared to questions with all possible answers described (e.g., *very religious*, *rather religious*, *definitely non-religious*, etc.)⁷.

Examining declarations of religiosity over time, we can observe a general downward trend: Europeans see themselves as becoming less and less religious. Obviously, this thesis requires further research to be confirmed. In this analysis, we rely on fragmentary data and moreover, the surveys that would allow for a complete, or even cursory description of changes in religiosity were not conducted in all countries. Nevertheless, the overall trend is clearly visible.

Countries for which we have relatively complete data and which show a clear downward trend in declared religiosity include: Croatia (a decrease of more than 13% in the percentage of people who consider themselves religious over the last 10 years), Slovakia (a decrease of nearly 15% over the same period), Switzerland (a decrease of 12%), Great Brit-

ain (a decrease of almost 12%), and Italy (a decrease of over 12%). In all these countries, decreases amount to over 10%. An interesting trend can be observed in Great Britain and Italy. These countries saw a slight increase in the number of people who consider themselves religious between 1991 and 2008, to be followed by a decrease in 2018.

In Austria, Denmark, Finland, Spain, Germany, Norway, Russia and Sweden, the number of respondents who consider themselves to be religious fell by about 3-6% between in 2008 and 2018. In Bulgaria, this decrease amounted to 5%, but in the period from 1991 to 2018. If we take into account a longer perspective (from 1991 to 2018), then in many countries the decreases in declared religiosity are even greater (obviously, this comparison can be made only if the data for 1991 is available). An even sharper decline can be observed in Austria (18.5%), Denmark (12.9%), Spain (19.4%), and Germany (12.7%).

An increase in declared religiosity is observed in 3 countries, all of which are former *people's democracies*. These are: Slovenia (an increase of over 20% between 2008 and 2018), the Czech Republic (an increase of approx. 9%), and Hungary (an increase of approx. 4%). France, with the percentage of declared religiosity remaining basically at the same level (difference below 1%) throughout the observation period (1991-2018), is a special case here. It was already some years ago that researchers concluded that: *traditional religious beliefs and involvement in institutionalized religion vary considerably from one country to another; and they have steadily declined throughout Western Europe, particularly since the 1960s. Studies have often reported that many Western Europeans have ceased to be regular church-goers today outside of special occasions such as Christmas and Easter, weddings and funerals, a pattern especially evident among the young* (Norris, Inglehart, 2004).

After analysing changing trends in religiosity, let us look at differences in declared religiosity between inhabitants of individual countries in 2018. The following countries have the highest percentage of respondents who consider themselves religious: Croatia (63.7%), Slovenia (58.2%), Bulgaria (55.5%), Italy (53.7%), Lithuania (52.6%), and Russia (52%) – except for Italy, these are all countries of the former Eastern Bloc. On the other hand, the percentage of respondents who consider themselves religious is the lowest in Sweden (14%) and Denmark (15.2%), as well as in the Czech Republic and France (27.5%). The Czech Republic is an interesting case here. This country is usually considered to the most secularized in Europe. However, the percentage of people who consider themselves religious in the Czech Republic is by no means the lowest in the group of countries under study. It stands at 27.5% and it shows a clear

⁷Obviously, after removing responses *I don't know*, *hard to tell*, etc., which reduce the level of measurement to the nominal one.

Table 2. Self-declarations of religiosity by country

			Very religious	Somewhat religious	Neither religious nor non-religious	Somewhat non-religious	Definitely non-religious
Country	Austria	n	158	348	180	163	336
		%	13.3%	29.4%	15.2%	13.8%	28.4%
	Bulgaria	n	117	420	184	85	162
		%	12.1%	43.4%	19.0%	8.8%	16.7%
	Croatia	n	275	352	149	48	160
		%	27.9%	35.8%	15.1%	4.9%	16.3%
	Czech Republic	n	74	294	378	259	332
		%	5.5%	22.0%	28.3%	19.4%	24.8%
	Denmark	n	58	186	570	222	562
		%	3.6%	11.6%	35.7%	13.9%	35.2%
	Finland	n	89	307	267	126	375
		%	7.6%	26.4%	22.9%	10.8%	32.2%
	France	n	42	205	222	149	283
		%	4.7%	22.8%	24.6%	16.5%	31.4%
	Spain	n	116	499	388	316	395
		%	6.8%	29.1%	22.6%	18.4%	23.0%
	Iceland	n	86	379	273	145	260
		%	7.5%	33.2%	23.9%	12.7%	22.7%
	Lithuania	n	257	263	270	32	162
		%	26.1%	26.7%	27.4%	3.3%	16.5%
	Germany	n	138	414	209	191	725
		%	8.2%	24.7%	12.5%	11.4%	43.2%
	Norway	n	103	284	343	116	375
		%	8.4%	23.3%	28.1%	9.5%	30.7%
	Russia	n	263	538	164	144	431
		%	17.1%	34.9%	10.6%	9.4%	28.0%
	Slovakia	n	192	406	267	226	230
		%	14.5%	30.7%	20.2%	17.1%	17.4%
	Slovenia	n	144	469	136	79	226
		%	13.7%	44.5%	12.9%	7.5%	21.4%
	Switzerland	n	320	393	489	252	849
		%	13.9%	17.1%	21.2%	10.9%	36.9%
	Sweden	n	63	176	552	348	572
		%	3.7%	10.3%	32.3%	20.3%	33.4%
	Hungary	n	70	317	172	208	232
		%	7.0%	31.7%	17.2%	20.8%	23.2%
	Great Britain	n	114	360	315	168	502
		%	7.8%	24.7%	21.6%	11.5%	34.4%
	Italy	n	179	461	176	152	223
		%	15.0%	38.7%	14.8%	12.8%	18.7%
Total	n	2858	7071	5704	3429	7392	
	%	10.8%	26.7%	21.6%	13.0%	27.9%	

increase (of nearly 9% between 2008 and 2018, after a fall of approx. 6% between 1991 and 1998).

Let us take a closer look at self-declarations of religiosity in individual countries (Table 2). Those who consider themselves to be very religious most often live in Croatia (27.9%) and Lithuania (26.1%), followed by Russia (17.1%), Italy (15%), Slovakia (14.5%), Switzerland (13.9%), Slovenia (13.7%), Austria (13.3%), and Bulgaria (12.1%). On the other hand, people who declare themselves definitely non-religious most often live in Germany (43.2%), Switzerland (36.9%), Denmark (35.2%), Great Britain (34.4%), Sweden (33.4%), Finland (32.2%), France (31.4%), and Norway (30.7%). The respondents who are the least likely to declare themselves non-religious

come from Croatia (16.3%), Lithuania (16.5%), Bulgaria (16.7%), Slovakia (17.4%), and Italy (18.7%).

The data shows that countries of the former Eastern Bloc along with Italy are the *mainstay* of religiosity in Europe. On the other hand, non-religious attitudes are predominant in the Scandinavian countries as well as in Germany, France and Great Britain.

Religious practices

Another common indicator of religiosity is the frequency of religious practices. The original variable in the ISSP surveys had the following values: (1) several times a week or more often, (2) once a week,

Table 3. Frequency of religious practices by country

			At least once a month	At least once a year	Less than once a year or never
Country	Austria	N	236	420	536
		%	19.8%	35.2%	45.0%
	Bulgaria	N	105	396	436
		%	11.2%	42.3%	46.5%
	Croatia	N	346	342	291
		%	35.3%	34.9%	29.7%
	Czech Republic	N	152	248	993
		%	10.9%	17.8%	71.3%
	Denmark	N	91	465	1075
		%	5.6%	28.5%	65.9%
	Finland	N	93	339	778
		%	7.7%	28.0%	64.3%
	France	N	99	205	622
		%	10.7%	22.1%	67.2%
	Spain	N	398	302	1020
		%	23.1%	17.6%	59.3%
	Iceland	N	88	354	693
		%	7.8%	31.2%	61.1%
	Lithuania	N	280	364	329
		%	28.8%	37.4%	33.8%
	Germany	N	227	323	1173
		%	13.2%	18.7%	68.1%
	Norway	N	102	347	789
		%	8.2%	28.0%	63.7%
	Russia	N	186	434	926
		%	12.0%	28.1%	59.9%
	Slovakia	N	470	201	650
		%	35.6%	15.2%	49.2%
	Slovenia	N	228	400	442
		%	21.3%	37.4%	41.3%
	Switzerland	N	288	633	1298
		%	13.0%	28.5%	58.5%
	Sweden	N	113	386	1256
		%	6.4%	22.0%	71.6%
	Hungary	N	147	248	605
		%	14.7%	24.8%	60.5%
	Great Britain	N	271	151	807
		%	22.1%	12.3%	65.7%
	Italy	N	446	338	405
		%	37.5%	28.4%	34.1%
Total		N	4366	6896	15124
		%	16.5%	26.1%	57.3%

(3) two or three times a month, (4) once a month, (5) several times a year, (6) about once a year, (7) less than once a year, (8) never. For the purposes of the study, these values were grouped as follows: *at least once a month* (responses from 1 to 4), *at least once a year* (responses 5 and 6), *less than once a year or never* (responses 7 and 8). Frequent religious practices (at least once a month) are most common among inhabitants of Italy (37.5%), Slovakia (35.6%), Croatia (35.3%) and Lithuania (28.8%), and to some extent also Spain (23.1%), Slovenia (21.3%) and Austria (19.8%) (Table 3). On the other hand, very rare religious practices (or lack of religious practices) are declared mainly by inhabitants

of Sweden (71.6%), Czech Republic (71.3%), Germany (68.1%), France (67.2%), Denmark (65.9%), Great Britain (65.7%), Finland (64.3%), Norway (63.7%), Iceland (61.1%), and Hungary (60.5%). As it was the case with self-declarations of religiosity, religious practices are more frequent in some former Eastern Bloc countries and in Italy (to some extent also in Spain), while inhabitants of the Scandinavian countries, Germany, France and the United Kingdom (to some extent also Hungary and the Czech Republic) do not engage in religious practices or do it very rarely. It can be concluded that the declared frequency of religious practices is consistent with self-declarations of religiosity.

Table 4. Religious beliefs by country

			Believe in afterlife	Believe in heaven	Believe in hell	Believes in religious miracles	Believe in the super-natural powers of deceased ancestors
Country	Austria	N	619	460	329	722	435
		%	71.9%	53.4%	38.2%	83.9%	50.5%
	Bulgaria	N	274	265	248	264	214
		%	75.7%	73.2%	68.5%	72.9%	59.1%
	Croatia	N	553	572	519	523	286
		%	82.3%	85.1%	77.2%	77.8%	42.6%
	Czech Republic	N	484	377	293	385	421
		%	70.0%	54.6%	42.4%	55.7%	60.9%
	Denmark	N	511	357	154	286	260
		%	77.0%	53.8%	23.2%	43.1%	39.2%
	Finland	N	501	385	229	332	219
		%	81.6%	62.7%	37.3%	54.1%	35.7%
	France	N	364	233	166	309	187
		%	75.1%	48.0%	34.2%	63.7%	38.6%
	Spain	N	710	641	467	551	434
		%	72.6%	65.5%	47.8%	56.3%	44.4%
	Iceland	N	641	383	140	401	324
		%	85.6%	51.1%	18.7%	53.5%	43.3%
	Lithuania	N	457	374	355	433	377
		%	79.8%	65.3%	62.0%	75.6%	65.8%
	Germany	N	628	501	262	890	338
		%	58.7%	46.8%	24.5%	83.2%	31.6%
	Norway	N	418	315	174	311	218
		%	75.7%	57.1%	31.5%	56.3%	39.5%
	Russia	N	647	609	596	698	582
		%	67.9%	63.9%	62.5%	73.2%	61.1%
	Slovakia	N	669	545	486	579	496
		%	85.3%	69.5%	62.0%	73.9%	63.3%
	Slovenia	N	457	377	326	631	289
		%	63.8%	52.7%	45.5%	88.1%	40.4%
	Switzerland	N	1178	910	483	1032	756
		%	77.4%	59.8%	31.7%	67.8%	49.7%
	Sweden	N	546	352	144	304	310
		%	81.0%	52.2%	21.4%	45.1%	46.0%
	Hungary	N	356	396	326	299	230
		%	70.8%	78.7%	64.8%	59.4%	45.7%
	Great Britain	N	621	556	352	386	238
		%	78.6%	70.4%	44.6%	48.9%	30.1%
	Italy	N	739	617	537	714	398
		%	83.7%	69.9%	60.8%	80.9%	45.1%
Total		N	11373	9225	6586	10050	7012

Religious beliefs

The ISSP questionnaire included a number of questions concerning what can be generally referred to as *religious beliefs*. The article does not examine these variables separately, instead we use summary statistics (*multiple responses* procedure). The procedure for defining multiple responses combines the variables into dichotomy sets for which tables are created. Table 4 contains the results for questions about belief in life after death, belief in heaven, belief in hell, belief in religious miracles, and belief in the supernatural powers of deceased ancestors. Only positive responses (*definitely yes* and *probably yes*) were

counted. Since each respondent could give a positive answer to any number of statements (maximum 5, as 5 variables were taken into account), the response percentages exceed 100⁸.

Religious beliefs are much more common than one would expect from self-declarations of religiosity and the frequency of religious practices. Over 80% of inhabitants of Croatia, Finland, Iceland, Slovakia, Sweden and Italy, and over 70% of inhabitants of Austria, Bulgaria, Czech Republic, Denmark, France, Spain, Lithuania, Norway, Switzerland, Hungary, and Great Britain believe in life after death. Germans are the least likely to believe in life after death (approx. 59%). Approximately 85% of

⁸Respondents could also select: *probably not*, *definitely not* and *I don't know*.

Table 5. Belief in God by country

			Does not believe and never has	Does not believe, but used to	Believes, but did not use to	Believes and always has
Country	Austria	N	185	221	71	536
		%	18.3%	21.8%	7.0%	52.9%
	Bulgaria	N	198	58	82	482
		%	24.1%	7.1%	10.0%	58.8%
	Croatia	N	137	52	61	627
		%	15.6%	5.9%	7.0%	71.5%
	Czech Republic	N	664	165	115	276
		%	54.4%	13.5%	9.4%	22.6%
	Denmark	N	578	258	52	437
		%	43.6%	19.5%	3.9%	33.0%
	Finland	N	268	212	53	368
		%	29.7%	23.5%	5.9%	40.8%
	France	N	248	169	70	277
		%	32.5%	22.1%	9.2%	36.3%
	Spain	N	247	313	43	1009
		%	15.3%	19.4%	2.7%	62.6%
	Iceland	N	174	260	93	450
		%	17.8%	26.6%	9.5%	46.1%
	Lithuania	N	91	52	176	425
		%	12.2%	7.0%	23.7%	57.1%
	Germany	N	459	294	103	627
		%	31.0%	19.8%	6.9%	42.3%
	Norway	N	444	218	48	332
		%	42.6%	20.9%	4.6%	31.9%
	Russia	N	277	86	335	562
		%	22.0%	6.8%	26.6%	44.6%
	Slovakia	N	295	213	278	476
		%	23.4%	16.9%	22.0%	37.7%
	Slovenia	N	253	153	47	478
		%	27.2%	16.4%	5.0%	51.3%
	Switzerland	N	469	480	163	859
		%	23.8%	24.4%	8.3%	43.6%
	Sweden	N	751	219	68	360
		%	53.7%	15.7%	4.9%	25.8%
	Hungary	N	286	85	111	402
		%	32.4%	9.6%	12.6%	45.5%
	Great Britain	N	377	271	56	526
		%	30.7%	22.0%	4.6%	42.8%
	Italy	N	94	167	62	787
		%	8.5%	15.0%	5.6%	70.9%
Total		N	6495	3946	2087	10296
		%	28.5%	17.3%	9.1%	45.1%

the Croatian population and approx. 79% of the population of Hungary believe in heaven. In almost all other countries included in the survey, the percentage of those who believe in heaven exceeds 50% (except for France - 48% and Germany - approx. 47%). The percentage of respondents who believe in hell is markedly lower. Inhabitants of Croatia (approx. 77%), Bulgaria (approx. 69%), Hungary (approx. 65%) as well as Russia, Lithuania and Slovakia (approx. 62%) are the most likely to believe in hell; whereas respondents from Iceland (approx. 19%), Sweden (approx. 21%) and Germany (approx. 25%) are the least likely to believe in hell. Inhabitants of Slovenia (approx. 88%), Austria (approx. 84%), Germany (approx. 83%) and Italy (approx. 81%) are

the most likely to believe in religious miracles, whereas those living in Denmark (approx. 43%), Sweden (approx. 45%) and Great Britain (approx. 49%) are the least likely to believe in religious miracles. Beliefs in the supernatural powers of deceased ancestors were also examined. Such beliefs are most common among inhabitants of Lithuania (approx. 66%), Slovakia (approx. 63%), Czech Republic and Russia (approx. 61%), and the least common in Great Britain (approx. 30%) and Germany (approx. 32%).

When compared with self-declarations of religiosity and religious practices, religious beliefs are surprise-

Table 6. Negative attitudes towards members of various religions and non-believers by country

			Christians	Muslims	Buddhists	Jews	Non-believers and atheists
Country	Austria	N	52	436	133	171	130
		%	9.9%	83.2%	25.4%	32.6%	24.8%
	Bulgaria	N	8	146	61	80	101
		%	3.9%	71.9%	30.0%	39.4%	49.8%
	Croatia	N	24	117	119	68	136
		%	9.6%	46.6%	47.4%	27.1%	54.2%
	Czech Republic	N	97	836	247	181	93
		%	10.9%	94.3%	27.8%	20.4%	10.5%
	Denmark	N	58	581	64	124	55
		%	9.4%	93.7%	10.3%	20.0%	8.9%
	Finland	N	48	681	136	166	184
		%	6.4%	90.9%	18.2%	22.2%	24.6%
	France	N	38	257	35	73	33
		%	13.2%	89.5%	12.2%	25.4%	11.5%
	Spain	N	36	445	108	157	139
		%	7.1%	88.1%	21.4%	31.1%	27.5%
	Iceland	N	50	325	60	134	90
		%	12.8%	82.9%	15.3%	34.2%	23.0%
	Lithuania	N	16	363	176	178	135
		%	3.5%	79.8%	38.7%	39.1%	29.7%
	Germany	N	17	455	97	108	91
		%	3.3%	87.8%	18.7%	20.8%	17.6%
	Norway	N	64	395	70	105	60
		%	14.4%	88.8%	15.7%	23.6%	13.5%
	Russia	N	20	206	133	148	114
		%	6.2%	64.0%	41.3%	46.0%	35.4%
	Slovakia	N	35	840	235	280	100
		%	4.0%	96.4%	27.0%	32.1%	11.5%
	Slovenia	N	19	172	45	91	63
		%	8.2%	73.8%	19.3%	39.1%	27.0%
	Switzerland	N	85	654	69	284	100
		%	10.3%	79.5%	8.4%	34.5%	12.2%
	Sweden	N	77	668	102	132	75
		%	10.4%	90.5%	13.8%	17.9%	10.2%
	Hungary	N	22	442	145	252	101
		%	4.1%	82.8%	27.2%	47.2%	18.9%
	Great Britain	N	50	282	63	91	74
		%	14.7%	82.7%	18.5%	26.7%	21.7%
	Italy	N	39	375	124	124	178
		%	8.3%	80.1%	26.5%	26.5%	38.0%
Total		N	855	8676	2222	2947	2052

ingly much more common. This may suggest that in many European countries, religious beliefs are more stable than declining declared religiosity and religious practices. It seems that for some Europeans these beliefs have somehow got separated from institutionalized religion, and now these two function independently – at least to some extent.

Some researchers believe that religion regains ground in many parts of the world, including Europe. There is talk of a striking religious revival in former Socialist countries – but also in the Catholic south of the continent, religion appears to erode much less than in the Protestant regions. While in North-Western Europe, the mainline churches may have become more grey and empty, evangelical movements and smaller, conservative religious communities are flourishing there at the same time (Hart, Dekker, Halman, 2013).

Belief in God is undoubtedly the most important religious belief. In the surveys under study, the question about believing in God was formulated in such a way as to take into account how this belief has changed. The respondents were asked to choose from the following statements: *I do not believe in God now and I never have; I do not believe in God now, but I used to; I believe in God now, but I didn't use to; I believe in God now and I always have*. First, let us examine the responses that indicate belief in God, regardless of when it occurred (responses 3 and 4). In 13 countries (out of 20 under study), over 50% of respondents believe in God. Belief in God is most often declared in Lithuania (approx. 80%), Croatia (approx. 78%), Italy (approx. 77%), Russia (approx. 71%), Hungary (approx. 71%), Bulgaria (approx. 69%), and Spain (approx. 65%). On the other hand, respondents in Sweden (approx. 31%) and the Czech Republic (approx. 32%), as well as in Denmark and

Norway (about 37% each) are the least likely to declare that they believe in God. Once again it can be noted that there are more respondents who declare that they believe in God than those who consider themselves religious. By way of example, in Germany approx. 32% of respondents declare themselves religious, while about 56% believe in God. God-believers most often declare that they have always believed in God; they are less likely to declare that they believe in God now, but they did not use to in the past. If the latter is the case, such religious conversions are reported most often in Russia (approx. 27%), Lithuania (approx. 24%) and Slovakia (approx. 22%), whereas they are the least common in Spain (approx. 3%) and in Denmark, Finland, Norway, Sweden, Slovenia, Great Britain and Italy (approx. 4- 6%). Inhabitants of Iceland, Switzerland, Finland, Great Britain, France and Austria are the most likely to lose their faith in God (approx. 22-27%), while those living in Croatia, Russia, Lithuania and Bulgaria are the least likely to report loss of faith in God (approx. 6-7%). The Czech Republic and Sweden, along with Denmark and Norway have the highest percentage of those who have never believed in God (approx. 54% and 43-44%, respectively). The lowest percentage of non-believers is noted in Italy (approx. 9%) and Lithuania (approx. 12%). Table 5 shows the results concerning belief in God.

Attitudes towards members of other religious groups and non-believers

Attitudes towards members of other religious groups and non-believers are also related to religious issues. When asked about their attitude towards these people, respondents indicated very positive, somewhat positive, somewhat negative and very negative attitudes. Since social problems arise as a result of spreading negative attitudes rather than positive ones, I would like to take a closer look at the former. Table 6 shows the frequency of negative attitudes (negative and somewhat negative attitudes combined) by country. Based on Table 6, we may conclude that negative attitudes towards Muslims are overwhelmingly dominant in all 20 countries under study. Such attitudes are most often (over 90%) displayed in Slovakia (approx. 96%), Czech Republic, Denmark (approx. 94%) as well as in Sweden and Finland (approx. 91%) and France (approx. 90%). Inhabitants of Norway and Spain are also very likely to declare negative attitudes towards Muslims (approx. 88-89%). Likewise, such attitudes are common in Austria, Iceland, Lithuania, Germany, Switzerland, Hungary, Great Britain, and Italy (approx. 80-89%). Inhabitants of Croatia are the least likely to display negative attitudes towards Muslims (approx. 47%). By contrast, negative attitudes toward Buddhists are much rarer. Most often they are declared

in Croatia (approx. 47%) and Russia (approx. 41%), while in Switzerland they are the most unlikely (approx. 8%). Negative attitudes towards Jews are most often manifested by inhabitants of Hungary (approx. 47%), Russia (46%) and Bulgaria (approx. 40%), and the least often by respondents in Sweden (approx. 18%). Negative attitudes towards Christians are declared most rarely; relatively most often in Norway (approx. 14%), France and Iceland (approx. 13%), and the least often – in Germany (approx. 3%), Lithuania, Slovakia, Hungary and in Bulgaria (approx. 4%). Another issue worth considering is the attitude towards non-believers and atheists. A negative attitude towards such people is most likely to be expressed by respondents in Croatia (approx. 54%) and Bulgaria (approx. 50%); less likely by inhabitants of Italy (38%) and Russia (approx. 35%), and the least likely by those living in Denmark, Czech Republic, Sweden, Switzerland, France, Norway, and Slovakia (approx. 11-14%).

Factors differentiating religiosity

Our analyses so far have been based on the frequency distributions by country. A question may be asked, however: is differentiation by country the most important in Europe (or at least in the 20 countries under study)? What about such factors as gender, age, education, etc? Perhaps socio-demographic variables differentiate the most important dimensions of religiosity more strongly than the fact of living in a given country? Since the ISSP data is obtained from random samples, statistical inference may be applied. Table 7 contains regression results for qualitative data (CATREG optimal scaling) – separately for 3 main dependent variables: self-declaration of religiosity, frequency of religious practices and belief in God now and in the past.

All three regression models turned out to be significant, with coefficients of determination (fit) (R^2) of similar values, which indicates the value of explained variance ranging between 13 and 15%. Standardized beta coefficients allow us to determine the hierarchy of the influence of most important independent variables on the 3 dependent variables. In each case, the influence of a country of residence turns out to be stronger than that of any other socio-demographic variable included in the model (i.e., age, gender, size of the place of residence and level of education). Considering Europe as a whole (or more precisely, 20 countries under study), it can be stated that nationality is a key factor differentiating the examined dimensions of religiosity, and its influence is markedly stronger than that of socio-demographic factors.

Having answered the main question, let us briefly examine how much independent variables (shown in the rows of Table 7) influence the three main dependent variables (shown in the columns of Table 7).

Table 7. Regression results for qualitative data

	Self-declaration of religiosity	Belief in God now and in the past	Frequency of religious practices
Model significance	<0.0005	<0.0005	<0.0005
Significance of independent variables	<0.0005	<0.0005	<0.0005 ⁹
Model Fit (R ²)	0.134	0.151	0.131
Beta standardized coefficients			
Country	.265	.294	.302
Age	-.174	.161	-.152
Gender	.139	.146	.101
Size of the place of residence	-.046	.057	-.056
Level of education	.070	-.063	.017

This hierarchy of influence is almost identical for each dependent variable: (1) country, (2) age, (3) gender, (4) level of education, (5) size of the place of residence (only in the case of religious practices, the size of the place of residence exerts more influence than the level of education)¹⁰. Age increases religiosity in all three dimensions, while education and the size of the place of residence decrease religiosity – also in all three dimensions. Taking into account gender, women are more religious than men¹¹.

Conclusions

A general trend that can be observed based on the ISSP results is that Europeans are becoming less likely to declare themselves as religious. This is different in some countries of the former Eastern Bloc, mainly in Slovenia but also in the Czech Republic and Hungary, where an increase in declared religiosity has been noted. The findings demonstrate that countries of the former Eastern Bloc along with Italy are the *mainstay* of religiosity in Europe. On the other hand, non-religious attitudes are predominant in the Scandinavian countries as well as in Germany, France, and Great Britain.

Likewise, religious practices are more frequent in some former Eastern Bloc countries and in Italy, while inhabitants of the Scandinavian countries, Germany, France, and the United Kingdom (to some extent also Hungary) do not engage in religious practices at all or do it very rarely. It can be concluded that the declared frequency of religious practices is consistent with the declared religiosity. Religious beliefs are expressed much more often than it might be expected from the frequency of religious declarations and practices. Over 80% of Europeans believe in afterlife and in religious miracles. The belief in the supernatural powers of deceased ancestors, which is the least common, is declared by almost 50% of Europeans. The frequency of belief in God corresponds with this to some extent. In 13

countries (out of 20 under study), over 50% of respondents believe in God.

The attitude of Europeans towards members of other religious groups and non-believers varies from country to country. Negative attitudes towards Christians and non-believers and atheists are relatively rare (ranging from a few to a dozen or so percent). Negative opinions about Buddhists and Jews are more common, but by far most respondents (from approx. 70% to over 90%) express hostile attitudes towards Muslims.

The regression results show that living in a given country is the most important factor that influences key dimensions of religiosity and it is markedly stronger than age, gender, education level, and size of the place of residence.

The survey results described in the article cover the time before the COVID-19 pandemic. We will have to wait for the results of similar studies that will deal with the post-pandemic period. Can we expect significant changes here? Such changes may be expected in relation to issues connected with sustainable development (Pawłowski, 2020). What about religiosity? History shows that epidemics have usually resulted in increased religious involvement – though in a short-term perspective. Time will show what will happen this time.

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⁹Only the variable *education level* had a lower significance = 0.005.

¹⁰In the case of variables: *self-declaration of religiosity* and *frequency of religious practices* (Table 2 and Table 3), higher values indicate weaker religiosity; while for the variable *belief in God now and in the past* (Table 5), higher value indicates stronger religiosity. This is the system of variable values originally used in the ISSP Religion IV.

¹¹Gender is coded as follows: 1 - male, 2 - female.

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Role of Religion in Environmental Sustainability: An Indian Perspective

Rola religii w kształtowaniu zrównoważoności środowiskowej: perspektywa Indyjska

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Abstract

Environmental trepidations are global issues, environment sustainability is conceivable with the noble motive, which takes real shapes with the insights and perspectives from different religions. In the process of learning and teaching laid down by religion help to expand our understanding and develop our behavior towards nature. Role of religion to shape our attitudes to the natural world is significant, because its domination in human personality is always recognizable.

The paper would like to find out different prospect to achieve environment sustainability with the help of imperatives given by Indian religion. This imparts many valuable imperatives which unify nature as an inseparable part of human life and vice versa. Three major religions originating from India were explored in this paper: Hinduism, Buddhism and Jainism. The paper tries to show the human affiliation with nature is well expressed in every aspect of Indian religious life.

Key words: Nature, Religion, Hinduism, Jainism, Buddhism

Streszczenie

Gdy degradacja środowiska stała się problemem globalnym, zrównoważony rozwój środowiska można sobie wyobrazić dzięki szlachetnemu motywowi, który przybiera realne kształty dzięki wglądom i perspektywom z różnych religii. W procesie uczenia się i nauczania nakreślonego przez religię pomagamy poszerzyć nasze rozumienie i rozwijać nasze zachowanie wobec natury. Rola religii w kształtowaniu naszego stosunku do świata przyrody jest znacząca, ponieważ jej dominacja w osobowości człowieka jest zawsze rozpoznawalna.

Artykuł podejmuje próbę rozpoznania perspektywy osiągnięcia zrównoważenia środowiska za pomocą imperatywów podanych przez religię indyjską. Daje to wiele cennych imperatywów, które jednoczą przyrodę jako nieodłączną część ludzkiego życia i vice versa. W artykule tym omówiono trzy główne religie wywodzące się z Indii: hinduizm, buddyzm i dżinizm. Artykuł stara się pokazać, że związek człowieka z naturą jest dobrze wyrażony w każdym aspekcie indyjskiego życia religijnego.

Słowa kluczowe: natura, religia, hinduizm, dżinizm, buddyzm

Introduction

The Indian religious tradition are entangled with various cultural, social, philosophical as well as ethical values which has developed with history of many years, which embraces multiple movements, external interventions, and internal revolutions. The philosophical traditions of India are rich and numerous,

offer many theoretical and practical perspectives on the human living and imparts many value laden imperatives to improve human conditions, and its environment. The philosophical ideas and ethical teachings have a significant impact not only within Indian scenario but it can help the conditions and problems of all parts of the globe. This paper is trying to trace certain significant points as well as imperatives

given by different religious directives of India towards nature. This paper revitalize those thoughts to get a new outlook for solving any practical problems faced by our environment.

Human Civilization is currently facing many ecological complications, i.e. climate change, natural disasters, pollution, and related health issues (IPCC, 2007; IEEP, 2006; ILO, 2018; The Lancet Commissions, 2009). All the above concerns are connected to nature's ability to sustain life. Even human society stand with glitches to endure themselves with a limited resources available in the globe. The ability to maintain and sustain in this scenario is called sustainability. The challenges of sustainability can be imagined with the allegory of shrinking capacity of Earth: although environmental burdens are intensifying, available extent of natural resources are dwindling. Precaution must be taken from all perspective. Specific complication as opposed to looking at the challenge from a global perspective is not splendid (Karl-Henrik, 2000).

When thinking of making a real effort towards sustainability, it must be recognized that development and technology made a significant impact (negative) on environment and its availability (IPCC, 2007). It demands a new geographical era named Anthropogenic (Zalasiewicz et al., 2008) or it can be defined as a *new human* period. Other than the efforts made by governmental policies and regulations to control the impact of climate change, but research shows that the progress expected is very dawdling (Lenton, 2012; Cook, 2009). Literature guides a significant change in human behavior and attitude towards sustainability is vital.

Role of Religion in stimulating pro-environmental behavior

From primitive mind to contemporary thought religion was of paramount significance. In order to recognize the human life style and thinking, one had to study their values that they had adopted from the religion they belonged. Since ages, it would have been difficult to find any human being who did not belong to any religion. As religion is a universal manifestation, it expresses with values and stands (Lowie, 1963). Although immense variations found in the outward observance, inner structure and the purpose of religion are identical. They are alike in their sense of inner conviction, strong faith and their dependence upon some force outside themselves. The primitive, religion might have made human life supersititious, rigid in many way, but the values and ethical standards passed on to human life through religion, made human being conscious and virtuous. Religion made them men of faith and faith in goodness insight them to be good and virtuous. So, religion has an encouraging place in human life and in human society, understanding and consciousness towards the need of present.

This universal appeal of religion has almost vanished from contemporary life of different parts of the world, but Rober H. Lowie, mentioned during his field work he found it alive in India and it still influenced the virtues of life and people in India to solve contemporary problems (Lowie, 1963).

The charisma of religion in the human life has immense. A faith in religion give confidence to face crises. Ethics recognize its foundation in religion. It has a vital place in everything an individual does, from believe to judgment he possess, the vision he carry forward. Although religion is not only the sole source of integration but there are sources like art, culture, education, which influence human life. For most of the individuals, religion is still the most available source of amalgamation of views. This point not only justifies its presence but also explains its universal allure. Now it is the time to take a momentary look to the present situations that have deliberately set about eradicating religion and facing present disasters.

Role of Religion in Environmental Sustainability

Role of religions are vital in motivating the behavior of their admirers from the very beginning. It has a significant effect on their food habits, customs and the way they live their daily lives. Human civilization is constantly evolving with religion from the earliest days of their existence. Religion has not only changed the life of primitive human society but it has a vigorous impact on today's life and the behavior of human beings (Palmer and Finlay, 2003). The CIA's World Fact book consider that religions are the primary foundation to shape the daily living style of more than 75% world's population. (CIA World Fact Book, 2009). Literature shows religious imperatives have a larger impact on the human believe and its subsequent work. So Religion plays an authentic role at changing behaviors in light of the sustainability challenges (Hulme, 2009; Slimak & Dietz, 2006).

Religion can act as dominant potency to change the human attitude towards more sustainable way of life. There are many example which indicates the inspiration of religion in bringing sustainability, i.e. *experiment in Tanzania that is emerging as an Islamic model for spreading environmental ideals* (Barclay, 2007). Even the United Religions Initiative (URI) is a global prevalent interfaith network that supports peace and justice through its interfaith network. URI also persuades the project of sustainability. It works with a mission and aim *to create cultures of peace, justice and healing for the Earth and all living beings* (URI, 1996).

A conclusion can be drawn from above evidences that religions have a remarkable influence on changing attitude towards sustainability (Palmer and Finlay, 2003). The gist of sustainability is present in all the religion of the world and in their supporting scriptures. Although the word sustainability was not

explicitly used before but its essence was felt and advocated by all religion throughout history. Religious Association like ARC (Alliance for Religion and Conservation, UK) is focusing on the urgent requirement of approaches from each religion to preserve sustainability. Each major religion is trying to treasure their own religious imperatives to solve the sustainability challenges (ARC, 1995). Mary Evelyn Tucker recommends that religion will be a key adherent for the environmental emergency calls and the different religions of the world have to return to their ethical imperatives for sustaining environment as a voice of global community (Tucker, 2004).

Religion to awaken Environmental Sustainability: An Indian Perspective

The Indian religion is knotted with different cultural, social, philosophical systems that have recognized over a history, compounded with movement of peoples, foreign interventions, and internal transformations in structures and identities experienced over time. Three major religion originating from India are: Hinduism, Buddhism and Jainism. Mostly these three comprise the oldest religious traditions of the Indian subcontinent. Indian Religion and Philosophy has a remarkable work in this field, but it needs to rejuvenate those thoughts to get a solution to our environmental problems and finding a way to achieve environmental sustainability. The ethical teaching, principles found in Indian religion, are transferred from generation to generation and become a way of human life. Those eco-friendly ethical standards influenced human life and become a virtue of their life and subsequently gets passed on to different generation.

Hinduism: Divinity in Nature

The most fundamental philosophical tradition in India has tried to formulate the philosophical thoughts with three concepts of God, Nature and Man – the Supreme Being, the Universe, and the Individual Self. Indian Philosophy never tries to make any demarcation between these three concepts, in its philosophical sense it is very much interrelated. The Hindu concept of the natural world is the belief in the Ultimate Absolute Reality, the Supreme Self, which described as Existence-Consciousness-Bliss (Swami Ranganathananda, 1980). The Hindu scriptures identify God with the Universe, the natural world of multiplicity and differences; it widely accepted views among Hindu scriptures that Brahman transforms Himself into the ever blossoming and developing form of the external world. Even the individual souls of men are thought of as identical with highest soul. The Supreme Being is the whole universe, animate and inanimate. He is the origin of it, the place of its preservation and of its dissolution at the end of the long cycle of existence. Moreover, in the concept of *Lila in Hindu Philosophy*, the creative

play of the Gods, described as the world as a creative manifestation of the divine (Tucker and Chapple, 2000). Therefore Hindus always see themselves in everything and everything in Him, and worship Him as abiding in all kinds of created things (McKenzie, 1971). This reflect the love and respect for all the creation of Hindus, they respect all the living beings of the universe, in the extreme they never tries to separate their life in any way from any inanimate creation, they conceptualize all the existence as manifestation of the same Supreme Being (Callcott, 1987). Accepting the words of Bhagvad Gita, *I stand pervading this whole universe with a single fragment of myself* (Basak, 1953), almost all Hindus believe and acknowledge the immanence of Ultimate Reality in all objects of nature; they never fail to reflect on His transcendence of the created world. The Vedic traditions of Hinduism offer metaphors that value the power of the natural world. Scholars of the Vedas have held forth various texts and rituals that extol the earth (*bhu*), the atmosphere (*bhuvah*), and sky (*sva*), as well as the goddess associated with the earth (*Prthivi*), and the gods associated with water (*Ap*), with fire and heat (*Agni*), and the wind (*Vayu*). They have noted that the centrality of these gods and goddesses suggests an underlying ecological sensitivity within the Hindu tradition (McKenzie, 1971).

Jainism: Liberation with Nature

Jains of India have always been very much philanthropic to all types of lives; they have practically been talking about the modern topic ecology throughout the centuries. Lives of all types have always been very precious in their philosophy- *na hanyet na ghatayet*, it means one should not kill and should not cause to kill. This is the basic motto of their philosophy (Chapple, 2006).

It developed a path of renunciation and purification designed to liberate one from the shackles of karma, allowing one to enter into a state of eternal liberation from rebirth, or *kevala*. The primary method of attaining this ultimate state requires a careful observance of nonviolent behavior. Jainism emphasizes nonviolence, or Ahimsa, as the only true path that leads to liberation and prescribes following rigorous rules for the protection of life in all forms. Jainism has a system of ethics that places non-violence at the top of its principle of morality. Abstaining from any kind of injury, in thought, word, and deed, to any kind of living being, immobile or mobile is *ahimsa* (Jain, 2011).

The common concerns between Jainism and environmentalism can be found in a mutual sensitivity toward living things, recognition of the interconnectedness of life forms. For the Jains, this approach is anchored in a cosmology that views the world in terms of a cosmic woman whose body contains countless life souls (*jiva*) that reincarnate repeatedly until the rare attainment of spiritual liberation (*kev-*

ala). The primary means to attain freedom requires the active non-harming of living beings, which disperses the karmas that keep one bound. Jains adhere to the vows of non-violence to purify their karma and advance toward the higher states of spiritual attainment. For Jaina laypeople, this means the need to avoid doing harm to all forms of life, including bugs and microorganisms. Our ecosystem becomes impoverished, humans take notice and respond. Similarly, according to the Acaranga Sutra, Mahavir was moved when he observed nature at close range, noticing that even the simplest piece of a meadow teems with life (Chapple, 2002). The goal within Jainism is to ascend to the *Siddha Loka*, a world beyond heaven and earth, where all the liberated souls dwell eternally in a state of energy, consciousness, and bliss. Hence, from the aspect of practice, Jainism holds some interesting potential for ecological thinking, though its final goal transcends earthly concerns (Chapple, 2001).

You are the one whom you intended to kill, you are the one you intended to tyrannize, you are the one whom you intended to torment, and you are the one you intended to punish. The enlighten one who lives up to this dictum neither kills nor causes other to kill thus, Bondage and emancipation are within yourself (Tatia, 2006) Therefore, the worldview of the Jainas might be characterized as a bio-cosmology. Due to their perception of the *livingness* of the world, they hold an affinity for the ideals of the environmental movement (Holmes, 1987).

Buddhism: Life with Nature is Sacred

In Buddhist religion, nature was considered sacred. Nature had been very close to the Buddha in all the important occasions of his life, he was born in a garden, he attained Buddha-hood and passed away from this world under the trees, and he preached his first sermon in a deer park and from then on always he stayed outdoors in the shade of trees. (Ariyaratne, Macy, 1992). The word Dharma means religion in Buddhist philosophy. For Buddhist, it is the sacred law, morality and the teachings of the Buddha. It is also all things in nature. All creatures including inanimate creation are all dharma. So at its very essence, Buddhism can be described as an ecological religion or a religious ecology. Buddhist philosophy begins with the principles of love, compassion and respect for all life. The very heart of Buddhist thought it procures the ecological sensitivity. This thought expresses that our birth and existence is dependent on causes outside us, inextricably linking us with the world and denying us any autonomous existence. We and all nature are inseparable, entwined, all one.

Two of the most important qualities are developed by Buddhists are loving-kindness and compassion. Loving-kindness is understood as the wish for others to be happy, and compassion as the wish to alleviate

suffering. Both starts with ourselves, by recognizing the fact of our own suffering and seeking to uproot its causes. Before turning to the plight of others, it is necessary to understand deeply the origins of suffering within ourselves. Such insight can then lead to a genuine capacity to show others the way to freedom from their inner pain. Ultimately loving-kindness and compassion extend to all living things: people, animals, plants, the earth itself. The root of compassion is wisdom. Wisdom is not an introverted *intellectual* quality but, Buddha explains it can only be give rise through a spontaneous concern for life. According to him, the four great elements of earth of earth, water, fire and air are the components of both our own and others' bodies. For these reasons, we should give life to others by setting them free (Batchelor, 1992). According to the Nobel Peace Prize Lecture of the Dalai Lama, we all share this small planet earth, so we should learn to live in harmony and peace with each other and nature. He explains staying together as family is not just an impressive idea, but a necessity. We are dependent on each other in so many ways that we can no longer live in isolated communities and ignore what is happening outside those communities (Burford, 1992; Gross, 1997). We need to help each other when we have difficulties, and we must share the good fortune that we enjoy (Dalai Lama, 1992).

Conclusion

The contemporary problems are due to our alienated form of life from religious influence in our life. When science started unveiling the secrets of nature one by one, humanity gradually lost faith in theistic religions. Consequently moral and spiritual values were also discarded. Since the Industrial Revolution and the consequent acquisition of wealth through technological exploitation of nature, humanity has become more and more materialistic. It promised us a comfortable life with moral deterioration, which is a double-edged weapon; it has adverse effects on humanity's mental and physical well-being as well as on nature. In the present eco-crisis humanity has to look for radical solutions and that can be determined only through our values, priorities and choices. The human beings should reappraise its value system. So all the religion teaches us that mind is the forerunner of all things. If we act with an impure mind, a mind with greed, hatred and delusion, suffering is the inevitable result. The action follows by pure mind, with the qualities like contentment, compassion and wisdom, happiness will follow like a shadow.

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Analysis of Child Marriage and Related Policies in Indonesia: Sustainable Development Issue

Analiza uwarunkowań małżeństw zawieranych przez dzieci i powiązanych polityk w Indonezji: kwestia zrównoważonego rozwoju

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Abstract

Child marriage is a prevalent social problem in developing countries, including Indonesia, and its implementation has been prohibited in all regions of Indonesia. The revision of the marriage law that lifts up the minimum age limit for child marriage and the implementation of the child protection policy does not inevitably guarantee that the practice of child marriage can be avoided. The research objective of this study was to analyze the success of the factors and the effectiveness of the implementation of policies on handling the practice of child marriage in achieving sustainable goals in Indonesia. Data collection was performed using a profile approach utilizing data from the National Development Planning Agency of 2016-2019, desk review of the literature, and stock-taking of relevant research studies. Moreover, the effectiveness of policy implementation is assessed using a contingency analysis of the factors of policy commitment and government capacity. The results showed that the effectiveness of policy implementation from the factor of policy commitment was performed through the integration of the goals of SDGs into the national strategy for preventing child marriage, enforcement of main policy changes, mapping of regional-based issue trends and root causes, mapping of regional-level derivative policies issued before main policy revision changes, harmonization and synchronization of various policies through derivative policies, planning and development at the regional and village levels. Adjustment in the factor of implementation capacity of policy is indicated by institutional convergence and synergy of various parties, including learning from various good practices in the regions. The contingency matrix-based policy application model for handling the practice of child marriage will be effective if it utilizes a progressive model.

Key words: child marriage, changes in policy implementation, SDGs, elimination of harmful practices for children, Indonesian territory

Streszczenie

Małżeństwa zawierane przez dzieci są powszechnym problemem społecznym w krajach rozwijających się, w tym w Indonezji, choć ich wprowadzanie zostało zakazane we wszystkich regionach kraju. Zmiana prawa małżeńskiego, która podnosi dolną granicę wieku dla małżeństw dzieci, oraz wdrożenie polityki ochrony dzieci nie gwarantuje uniknięcia praktyki małżeństw dzieci. Celem badawczym niniejszego opracowania jest analiza sukcesu czynników i skuteczności wdrażania polityk dotyczących postępowania z praktyką małżeństw dzieci w kontekście osiągnięcia zrównoważonych celów w Indonezji. Zbieranie danych przeprowadzono z zastosowaniem podejścia profilowego, wykorzystując dane z Narodowej Agencji Planowania Rozwoju z lat 2016-2019, przegląd literatury i inwentaryzację badań naukowych. Ponadto skuteczność realizacji polityki oceniono za pomocą analizy czynni-

ków zaangażowania politycznego i zdolności rządu. Wyniki pokazały, że skuteczność wdrażania polityki na podstawie czynnika zaangażowania politycznego została dokonana poprzez integrację celów SDGs z krajową strategią zapobiegania małżeństwom dzieci, egzekwowanie głównych zmian polityki, mapowania regionalnych trendów problemowych i przyczyn źródłowych, mapowania polityk pochodnych na poziomie regionalnym wydanych przed zmianami głównej rewizji polityki, harmonizacja i synchronizacja różnych polityk poprzez polityki dotyczące instrumentów pochodnych oraz planowanie i rozwój na poziomie regionalnym i wsi. Na dopasowanie czynnika zdolności wdrożeniowej polityki wskazuje zbieżność instytucjonalna i synergia różnych stron, w tym uczenie się na bazie różnych dobrych praktykach w regionach. Oparty na matrycy kontyngencji model stosowania polityki w odniesieniu do praktyki zawierania małżeństw dzieci będzie skuteczny, jeśli będzie wykorzystywał model progresywny.

Słowa kluczowe: małżeństwa dzieci, zmiany we wprowadzaniu polityki, SDGs, eliminacja praktyk szkodliwych dla dzieci, Indonezja

Introduction

Child marriage is a precarious practice and a global problem. By 2030, every country, including Indonesia, will make child marriage a target for achieving the fifth goal of SDG, which is achieving gender equality and empowering all women and girls where one of its targets is to abolish the practice of child marriage (Dahal, 2016). The Convention on the Rights of the Child stated that child marriage is a marriage that is done through civil, religious, or customary law, and with or without official registration or consent in which one or both couples are children under the age of 18 (Widiantara and Yuhan, 2019; Simon et al., 2020). Dewi (2018) stated that the practice of child marriage is related to the fact that it violates children's human rights, limits their choices and opportunities, and makes them prone to violence, exploitation, and abuse. Child marriage also marks the culmination of adolescence for both girls and boys, which should be a period of physical, emotional, and social development before entering adulthood (Erulkar, 2013).

The issue of the practice of child marriage is crucial to study as it has developed into a common social problem that not only occurs in Indonesia but also in several countries such as Bangladesh, India, Pakistan (South Asia), Malawi, Chad, Mozambique, and Niger (Africa) (Khana et al., 2013; Walker et al., 2013). This problem arises at the intersection of two hierarchies: gender and age. Women are always in the position of the least power; at worst, they are powerless and customarily have to surrender to men. Conversely, in the age hierarchy as adolescents, they must obey their parents and family or older members of the community (Grijns and Horii, 2018; Bartels et al., 2018; Mirzaee et al., 2021).

The Indonesian government has prohibited the practice of child marriage in all regions. It is regulated through three main policies, including: Law Number 35 of 2014 concerning Child Protection, Law Number 16 of 2019 concerning Amendments to Law Number 1 of 1974 concerning Marriage, and Supreme Court Regulation (Perma) Number 1 of 2019 concerning Guidelines for Adjudicating Application for Marriage Dispensation. Those three policies are

related to child protection, which is by limiting the age of marriage and granting child marriage dispensation (Hizbullah, 2019; Tresiana and Duadji, 2020). The three of them serve as the foundation for adjusting the implementation of various policies related to this matter.

Studies on the practice of child marriage are highly varied, in which they are related to multi-dimensional social issues and have a chain impact on the success of the country's national development (Fadlyana and Larasaty, 2016; Baysak et al., 2020). One of the studies also connects the poverty factor with the continuity of sustainable development. The 2030 Agenda emphasizes the strong linkages between the 17 goals and 169 targets by considering the social, economic, and environmental aspects of development. Poverty (goal 1 of SDG) is not only a risk factor for the practice of child marriage (goal 5 of SDG) but also a risk factor for child development and contributes to results below average in terms of food and nutrition (goal 2 of SDG), health (goal 3 of SDG), education (goal 4 of SDG), proper water and sanitation (goal 6 of SDG), and birth registration (goal 16 of SDG) (Girls Not Brides, 2019; Parson and Edmeades, 2015).

Studies in Indonesia and three countries in South Asia including India, Bangladesh, and Pakistan illustrate how children, particularly girls from poor and marginalized families, confront the highest risk of child marriage. Furthermore, child pregnancy is more prevalent among those with low education who come from low-income households. Child marriage is a family strategy to escape poverty, involving economic defense as a result of tribal hostilities in Pakistan and clan development and cultural traditions in India (Khanna et al., 2013; Paul, 2019; Bartels et al., 2018). A study conducted by Paul (2019) found that child marriage because of poverty does not make children better off, but passes the burden of poverty on to the next generation.

Besides poverty, contributing factors include geography (Johnson et al., 2019), lack of access to education (Mim, 2017), gender inequality (Sarfo et al., 2020) social conflict and disaster (Dzimiri et al., 2017; Dewi and Dartanto, 2018; Mazurana et al., 2019), lack access to comprehensive reproductive

health services and information (UNICEF, 2018; Salam et al., 2016), social norms that reinforce particular gender stereotypes (for instance, women should marry at a young age) (Gemignani and Wodon, 2015), culture (interpretation of local religions and traditions) (Karam, 2015; Saskara, 2018). Other aspects like matchmaking and society's acceptance of child marriage become the driving factors for the practice of child marriage (Yusha, 2020).

Several recent studies and research in Indonesia showed that the most powerful relevance is not only to poverty but also to disasters and geography. In certain conditions such as natural disasters and humanitarian crises, child marriage has increased threefold. The reasons, among others, are that parents intend to get rid of economic burdens, safety factors, and fear of unwanted pregnancy. Natural disasters and humanitarian crises commonly give families a feeling of insecurity. This condition is oftentimes a reason for families to marry off their daughters as a form of protection (Pettay et al., 2020; Dewi and Dartanto, 2018; Haryanto, 2012). Moreover, living in a rural geographic area also becomes a risk factor for child marriage (Yulanda, 2019; Bappenas, 2018).

The practice of child marriage involved complicated implications relating to how children can develop their health and nutrition, welfare and education, and the environment where they grow. It is highly related to the continuity of the nation's generation. Recognition of the SDGs that children are agents of change and torch-bearers for sustainable development clarify the relationship between the practice of child marriage and the development of future human resources of a nation (Sheehan et al., 2017). Five challenges due to the practice of child marriage that can adversely affect human resource development in the future include: the potential for failure to continue education; the potential for increased maternal mortality; the potential for increased infant mortality (IMR); the potential for increased domestic violence and divorce; and finally the potential for economic loss with an estimated of at least 1.7% of gross domestic income (GDP) (Rabi et al., 2015).

Diverse problems and challenges in achieving the goals and targets of the SDGs require not only social adjustment but also the way to change the implementation of specific policies based on regional development. (Bappenas, 2018; Febryano et al., 2021). This case attracts attention not only from scholars but also policymakers. Children must grow optimally and become excellent and competitive human resources with the guaranteed risk of the practice of child marriage. Several studies have observed that child marriage is only related to factors such as family resilience, (Baumont et al., 2020), mentoring model (Astrid, 2019), and optimizing children's capacity (Lo Forte et al., 2019). However, researchers rarely disclose how the contingency analysis model (commitment factor and policy implementation capacity)

should see the success of these factors and the effectiveness of implementing policies in handling the practice of child marriage.

The research objective of this study was to analyze the success of the factors and the effectiveness of the implementation of policies in handling the practice of child marriage in achieving sustainable goals in Indonesia. The resulting policy recommendations will be useful for related policymakers and stakeholders to realize a just, equitable, inclusive, and sustainable management of handling detrimental practices, as well as consider local ideas and initiatives.

Methods

This study mapped child marriage using a profile approach based on the development of the main areas of development planning in Indonesia (Ministry of National Development Planning, 2018). It aims at determining the characteristics of child marriage in each area of development planning so that policy recommendations will be specific and sustainable for each region.

Data sources on child marriage in Indonesia in the last four years were collected from the Ministry of National Development Planning. Data obtained from 34 provinces in Indonesia were divided into four regions based on the main areas of development. Region A consists of five provinces, including Aceh, North Sumatra, West Sumatra, Riau, and Riau Islands; region B consists of 11 provinces, including Jambi, South Sumatra, Bengkulu, Bangka Belitung Islands, Lampung, Banten, Jakarta, West Java, Central Java, Yogyakarta, and West Kalimantan; region C covers six provinces, including East Java, Bali, Central Kalimantan, North Kalimantan, East Kalimantan, and South Kalimantan; and region D consists of 12 provinces including West Nusa Tenggara, East Nusa Tenggara, West Sulawesi, South Sulawesi, Southeast Sulawesi, Central Sulawesi, Gorontalo, North Sulawesi, Maluku, North Maluku, Papua, and West Papua. The population of underage married children was divided into 4 groups: year 1 (2016), year 2 (2017), year 3 (2018), and year 4 (2019).

Profile analysis was performed using multivariate variance (MANOVA) and SAS 9.4 application (Huberty and Olenjnik, 2005; Da Silva et al., 2015). The procedures and steps taken included: First, using Box's M test to check the assumption of homogeneity of the variance-covariance matrix Box (1949). The null hypothesis is rejected if the data from all groups have the same variant-covariance matrix, which is called heterogeneous. The next step was to check the data distribution from which the multivariate data should be distributed normally for each group. We used the Shapiro-Wilk test for univariate normality test and skewness and Mardia kurtosis for the multivariate normality test. Subsequently, deepening the profile analysis was carried out through

several tests. We reject the null hypothesis if the values of all those tests are less than an alpha level of 5%, or if the F statistic exceeds the critical value. If only the first hypothesis is the area of rejection, then the last two hypothetical tests are not performed as they are deemed meaningful (Usman, et al, 2013; Sabbag, 2019; Khattree and Naik, 2005).

This study also used desk review and stock-taking for data collection. Desk reviews were conducted to map policy commitments, government capacity, social literature, economics, child marriage politics, and sustainable development. It aimed to enrich the concept of implementing specific policies, in line with sustainable development. The stocktaking was seen from the results of research and recent publications on policy implementation, policy changes, development strategies, planning and budgeting in international/global, national, and local, and some lessons learned/local initiatives.

Data collected through profile analysis, desk review, and stock taking was reviewed using contingency analysis (Lester, 1994). The contingency matrix was used to see support for strategic policy implementation models for governance in handling the practice of child marriage. The contingency model in realizing fair, equitable, inclusive, and sustainable governance was considerably influenced by two factors, including the commitment and capacity of the government. The government's commitment was observed when it provides support through data recognition and policy strengthening. Government capacity was observed when it has a good coordination mechanism and the ability to bridge the interests of various stakeholders. Based on these two factors, the government's ability to implement policies was divided into 4 categories (Figure 1), including: (a) Progressive is implementation with high policy commitment and government capacity characterized by the utilization and recognition of specific data/evidence, enforcement of main policies, harmonization, synchronization of main and derivative policies, central and regional institutions, coordination and synergy in central, regional, and village levels; (b) Delayer is low policy commitment and high capacity; (c) Struggler is high commitment, but with inadequate capacity (d) Regressive is insufficient commitment and capacity.

Government Commitment	Government Capacity	
	High	Low
High	Progressive	Struggler
Low	Delayer	Regressive

Figure 1. Contingency Matrix, source: Lester (1994)

All publications were read by a team of writers who then performed thematic categorization of the findings in the publication. The results of the categorization were then analyzed by considering the profile analysis. Then, the analysis of changes in policy implementation was triangulated by the research team

and subsequently elaborated in the discussion section.

Results and discussion

Results

Profile of Child Marriage in Indonesia

The profile of child marriage is an overview of the current trends in the practice of child marriage in particular areas, which illustrates the root of the problem and the basis for recommendation proposals. It becomes one of the ways the government can achieve successful implementation of policies and programs. Mapping child marriage trends was performed by using MANOVA profile analysis with SAS 9.4 software as shown in Figure 2. It shows that each region has different characteristics in the four main development areas (Region A, B, C, and D).

Figure 2 shows the order of cases of child marriage based on the four main area divisions in Indonesia as follows: region C (East Java, Bali, Central Kalimantan, North Kalimantan, East Kalimantan, and South Kalimantan) has the highest number of cases of child marriage, followed by region B (Jambi, South Sumatra, Bengkulu, Bangka Belitung Islands, Lampung, Banten, Jakarta, West Java, Central Java, Yogyakarta, and West Kalimantan), region D (West Nusa Tenggara, East Nusa Tenggara, West Sulawesi, South Sulawesi, Southeast Sulawesi, Central Sulawesi, Gorontalo, North Sulawesi, Maluku, North Maluku, Papua, and West Papua), and finally region A (Aceh, North Sumatra, West Sumatra, Riau, and Riau Islands). The trend of cases in each region seems remarkable. This trend fluctuated in region C over the years. Meanwhile, in regions B and D, this trend only converged in the second year; however, for the following years, the trend was similar to the initial year of data. In region A, the trend shows that the cases occurring every year have an average relative value equal to the highest number of child marriage cases.

The suspected root cause is used as an evidence base of policy to deal with the practice of child marriage. Akoglu, et al. (2015) argued that mapping with presumptions would lead to an anomaly of accuracy in the analysis of results. In region C, the suspected root cause for a large number of child marriages is low access to education services, especially, education services that support knowledge of sexual and reproductive health. It is because coverage of quality education services is also essential in children's growth. The suspected root cause in region B is a high poverty rate. The proposed policy solution for region B is to improve the capacity of primary caregivers for children. In addition, attempts to strengthen the child welfare system are also significant, for instance, social assistance and protection programs. The impact of child marriage will be ex-

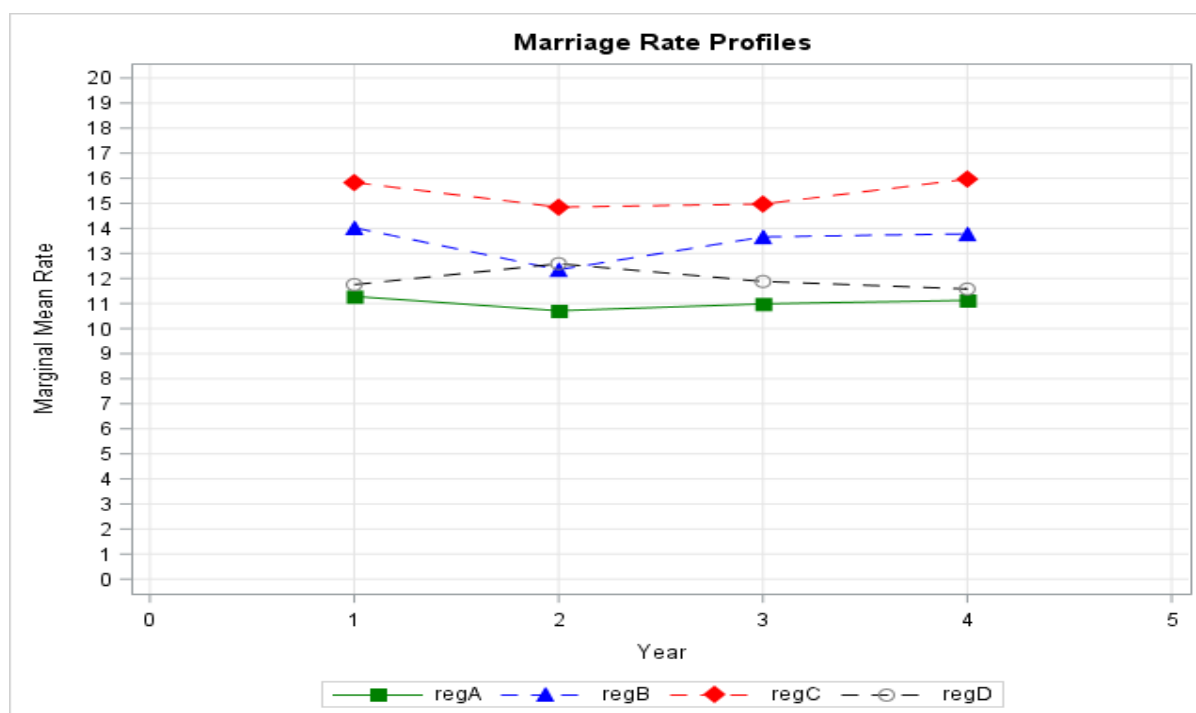


Figure 2. Region Group Profiles for Marriage Rate Profiles

perienched not only by children who marry early but also by those born from such marriages, and it has the potential to establish intergenerational poverty. In region D, the possible root cause is a low level of health awareness. The proposed recommendation is to apply a social participation model (Duadji and Tresiana, 2018a) for all ages through community forums in order to strengthen awareness of health and prevent child marriages in the coming years. Lastly, in region A, the number of cases tends to be stable each year, and thus strengthening statutory policies is highly recommended. An empirical study conducted by Duadji dan Tresiana (2018b) pointed out that collaborative governance-based city programs can be implemented as a proper policy of each district government that can be established holistically, interactively, and sustainably.

In general, this study identified several interrelated factors that are considered related to the practice of child marriage, including education, health, psychology, poverty (economy), geographical conditions, disasters, and state failure. Several factors simultaneously act as a driving force and a defense to avoid the practice of child marriage as long as it is implemented using the right approach.

The damaging impact of child marriage, particularly for girls, is a pregnancy that occurs at an early age and vulnerability to maternal and child mortality. Pregnancy and childbirth complications are recorded to be the second leading cause of death for women aged 15-19 years with diverse health risks being faced. The high number of marriages before the age of 15-18 years is potential to increase the maternal mortality rate (359/100,000 births), infant mortality rate (32/1000 births), and malnourished babies (4.5

million/year) leading to generation loss in the future (Duadji and Tresiana, 2020). Irani and Roudsari (2019) and Efevbera et al. (2017) linked reproductive organs that are not ready for intercourse and pregnancy with an increased risk of cervical cancer. The risk of children being born due to the physical condition of pregnant women at an early age, who are still growing and need nutritional intake, results in insufficient nutritional intake for the baby in the womb, impact the fetus's body, and improper brain growth. The fetus will be born in malnutrition such as low body weight and height. Imperfect brain growth while in the womb leads to lower intelligence for babies and children compared to those born to women over the age of 21. It shows the need to provide quality education and inclusive sexual and reproductive health rights (SRHR) services. Comprehensive sexual education programs in Pakistan, Peru, and Kenya indicate that they have a significant role in reducing early pregnancy and child marriage. It can be a solution to prevent child marriage, particularly in region C.

Psychologically, child marriage has a damaging effect because the children are not emotionally stable (Aulia and Darmansyah, 2020). This condition increases the vulnerability to domestic violence (KDRT), in which 44% of girls who marry early experience domestic violence with high frequency and 56% with low frequency. Cases of marriage at a young age (12-21 years) three times more end in unilateral divorce, victims of sexual violence and pedophilia, which cuts off access to education and the world of work.

Another impact of child marriage is impoverishment (Dewi and Dartanto, 2018). Children from families

with a low-income economic quintile are most at risk of child marriage. Poverty becomes the major driver of marriage, particularly for girls in developing countries. The impoverishment encountered by these children has the potential to develop new impoverishment and strengthen the poverty chain.

Other driving factors include geography and disaster. The data show that girls in rural areas are twice as likely to marry at a young age compared to girls in urban areas. Rumble et al., (2018) stated that the factor of living in rural areas has a high risk for children to marry early. Marshan, et al. (2013) found that girls living in urban areas are more likely to have opportunities outside of marriage and childcare than those living in rural areas. It may indicate the need to intervene at the regional level, particularly in rural areas, to prevent or respond to the practice of child marriage. Increasing the involvement of the village government also serves as one of the strategies that can be performed, such as the practice that occurred in several villages by forming a child-friendly village child protection group (KPAD) (Duadji and Tresiana, 2020). The literature study also found that the risk of girls who are married off is higher in situations following a natural disaster. A study conducted by Dewi and Dartanto (2018) showed that in Indonesia, India, and Sri Lanka, child marriage has increased due to the force to marry a widower after the tsunami. In some cases, marriages occur to receive government assistance specifically given to those who get married and start a family.

Finally, child marriage affects the failure of the state to implement programs and attempts to improve the quality of human resources (HR). It resulted in the country losing economic and political opportunities in international relations (Al Mamun, 2019). A poverty alleviation policy is not enough, in which a child protection system, child welfare in social assistance and protection programs, and child care are needed to be strengthened.

Government Commitment: Strengthening Policies on Handling the Practice of Child Marriage

The government's commitment is a factor in the effectiveness of declining the number of the practice of child marriage. Its success can be observed from the integration of the SDGs into national, regional, and village planning, enforcement of key policies and mapping, as well as synchronization and harmonization of various related derivative policies.

The government has determined a vision to protect children's rights and human resource development for future generations of the nation. Three major national policies as a fundamental aspect of the prevention of child marriage include: *First*, Sustainable Development Goals (SDGs). Child marriage is included in goal 5: achieving gender equality and empowering all women and girls, in which one of the targets is the abolishment of child marriage. It has become the

foundation for various national policies; *Second*, integrating the target of Sustainable Development Goals (SDGs) related to reducing the number of the practice of child marriage into the National-Medium Term Development Plan (RPJMN) of 2020-2024 as stated in Presidential Regulation Number 18 of 2020. The number of the practice of child marriage is targeted to decline from 11.2% in 2018 to 8.74% in 2024; *Third*, implementing the RPJMN of 2020-2024 policy direction and strategy into the National Strategy for the Prevention of Child Marriage (STRANAS PPA).

The government's attempts in implementing the National Strategy for the Prevention of Child Marriage (Stranas PPA) are performed through enforcement of key policies, mapping, harmonizing, and synchronizing policies. Some of which are carried out as follows:

- a. Strengthening the implementation of three main policies associated with child protection and policies for regulating the age of child marriage.
- b. Integrating the national strategy for preventing child marriage which is led by the national planning agency.
- c. Integrating the issue of child marriage into the indicators of the Child-Friendly City Program and initiating a national campaign to end child marriage which is led by The Ministry of Women's Empowerment and Child Protection.
- d. Mapping and harmonizing various forms of existing policy is carried out by the government to achieve the target of reducing the number of the practice of child marriage. 17 Regional Regulations in Cities and Regencies, 12 regulations at the village level, 20 Circular at the Village/Sub-District level were issued before the new marriage law was passed. Therefore, it is necessary to observe and adjust to the development of existing policies. The regulation of child marriage in regional regulations remains an appeal and notification if the practice of child marriage becomes a matter that must be watched out together. Harmonization is required so that various regulations at the central and regional levels can be harmonized, mutually supportive, and effective in their implementation in the field.
- e. Synchronization between laws is also extremely urgent. The synchronization among them: *first*, synchronization of Law Number 16 of 2019 concerning Marriage that still needs to be synchronized with the Supreme Court Regulation (Perma) Number 1 of 2019 concerning Guidelines for Adjudicating Application for Marriage Dispensation. This attempt is made to the consistency and firmness of judges in deciding dispensation cases in line with the spirit of preventing or rejecting child marriage. *Second*, the synchronization between Law Number 7 of 2017 concerning General Elections and Law Number

16 of 2019 is performed to create consistency regarding the provisions of voters who still use the age limit of 17 years or are married or have already been married. Third, Law Number 24 of 2013 concerning Population Administration that still uses the age limit of 17 years or is married or has been married for citizens who are required to have an electronic identity card. The government strives so that the two regulations do not have the potential to open up gaps of tolerance or loosening of the practice of child marriage. Synchronization ensures the integration of the main policies in the derived policies.

Various supports in the form of rules and regulations at different kinds of levels of government have the potential to prevent child marriage. It aims to improve, strengthen, and formulate derivative policies that do not conflict with the main policies and establish synergies of development plans and programs at all levels of government, including central, regional, and village. Duadji and Tresiana (2020) and Febryano (2021) stated that although the practice does not disappear suddenly, rules and regulations can be a considerable political statement against child marriage, particularly for areas where child marriage remains a culture. Upstream approaches like the formation of regulations and norms take a long time, and their effectiveness needs to be reviewed. Study support is required to understand regulations or sanctions that have a positive impact on the prevention of child marriage.

Government Capacity as Policy Executor

Government capacity is a factor in the effectiveness of policy implementation. Its success is observed from the existence of institutional convergence and synergy among various stakeholders, including at the central, regional, and village levels in taking lessons from various good practices in the regions. The implementation of each strategy at all levels is escorted by the ministries/agencies, sectors, and related stakeholders, including:

- a. At the national level, it will be escorted by Bappenas, KPPPA, Ministry of Religion, Ministry of Education and Culture, BKKBN, Ministry of Health, Ministry of Youth and Sports, and the Regional Representative Council (DPD).
- b. At the regional level, it will be escorted by Regional Government Organizations (OPD) related to women's affairs and child protection, such as the PPPA and KB Service, the Education Office, the Health Service, the Social Service, P2TP2A, youth organizations (OSIS, Mosque Youth Forum), children's forums in various levels, etc.
- c. At the village level, it will be escorted by the village head, children's forum,

PATBM, Mosque Youth Forum, OSIS, teachers, GenRE, etc.

The synergy, commitment, and active role of local governments in implementing policy are reflected in their integration in regional development planning at the provincial, district, and city levels through several policy instruments including: Law Number 23 of 2014 concerning Regional Government. The regional government synergizes, harmonizes, and integrates into Regional-Medium Term Development Plan (RPJMD) and Regional Government Work Plan (RKPD); Ministry of Internal Affairs Regulation Number 64 of 2020 concerning Guidelines for the Preparation of Regional Revenue and Expenditure Budget (APBD) for children's programs. Besides, the local government developed the Institutional Formation of Regional Technical Implementation Unit (UPTD) for the Protection of Women and Children to strengthen the institutional aspect.

A study by Plan Indonesia and Coram International (2015) illustrated the synergy of various parties including taking lessons from various good practices in the regions as efforts made to abolish child marriage in Indonesia. Some of the programs include programs to improve access to education and information on the reproductive health of adolescents in Rembang, Sukabumi, and West Lombok; programs to strengthen the environment to enable the fulfillment of the sexual and reproductive health rights of children in Mataram City and North Lombok District; Programs to provide life skills education to face the world of work in Sikka, Nagekeo, and Lembata Districts. All of them are local initiatives that can leverage success at the community level. Stakeholder coordination is a great potential to support efforts to prevent child marriage.

Discussion

The development process adopting the paradigm of pursuing growth, is centralized, focuses on infrastructure, and ignores environmental conservation affect the abandonment of some vulnerable groups of the community, including children. Watson (2021) stated that children must bear multiple vulnerabilities, not only double vulnerabilities but also triple vulnerabilities. Various risks must be confronted by children in remote villages, those in indigenous communities, those with disabilities, those in refugee camps, and those from minority groups (religion/belief, ethnicity/custom, gender identity, and sexual orientation). One of the forms of vulnerability confronted by them is marriage, and this vulnerability is further increased by a *regressive model of policy implementation*, marked by the absence of policy commitment and government capacity (Lester, 1994). This condition is likely to fail in achieving the Sustainable Development Goals. Girls Not Brides (2019) mentioned that one of the principles in the Sustainable Development Goals is

No One is Left Behind. This principle of inclusiveness is beyond the male-female category and includes vulnerable groups of children who have been marginalized and forgotten in development. Some of the emphasis of the Sustainable Development Goals (SDG) for children include justice and equality, children as agents of change, and children as torch-bearers for sustainable development. It indicates that the government's capacity is directed at the welfare of children. The basic rights of children in a region/country are an essential marker of progress in the process of realizing the SDGs.

Child marriage is not a mono-factor problem. The socio-cultural system, particularly government policies, becomes one of the issues that must be faced by several countries, especially Indonesia (Sunaryanto, 2019). Bappenas (2018) recorded data from international organizations including United Nation Development Economic and Social Affairs (UNDESA) which placed Indonesia in second place in the number of child marriages following Cambodia; The Council of Foreign Relationship (CRF) said that Indonesia is one of the ten countries with the highest number of child brides/grooms. One in five girls in Indonesia are married under the age of 18; research conducted by the United Nations organization that focuses on protecting the rights of children and young people, the United Nation Children Fund (UNICEF), revealed that that one in six girls in Indonesia is married before the age of 18 or as many as 340.00 people. Meanwhile, 50,000 girls are married under the age of 15 each year.

Two factors that contribute to the high practice of child marriage are socio-cultural (Ahonsi et al, 2019) and government policy factors, which include government capacity (Lester, 1994). The socio-cultural factor is reflected in the perspective in seeing children. Today's children are adults in the future so that the growth and development throughout the child's lifespan will affect their chances and quality of life. A study by Duadji and Tresiana (2020) described children, particularly the female sex, for example, that the loss of opportunities to grow and develop at the age of the child will result in adult women losing the opportunity to gain access to decent and legal work. The low capacity of women's leadership results in low participation of women in policy formulation and decision making, the more vulnerable to violence and discrimination, the downturn in women's health status and quality of life.

Studies in several countries in India, Pakistan, Bangladesh, Zimbabwe, Syria, Kenya, including Indonesia, have a socio-cultural perspective of the interconnected value of children, influencing the high rate of child marriage (Seth et al., 2018; Dahal, 2016; Khanna et al., 2013; Bartels et al., 2018; Mirzaee, 2021; Dewi, 2018). Girls remain placed as subordinates because of the patriarchal culture and client patrons such as in Indonesia, conflict conditions and family resilience in Syria, Pakistan, and Bangladesh,

and traditions and clan development in India. These countries show that their viewpoint and perspectives on the value of girls are not considered in terms of age, but physically, affecting the opportunity to access formal education so that the dropout rate experienced by girls is higher than that of boys. This state makes women more vulnerable to poverty. The poverty chain has implications for the perception of girls as a burden on the family. Therefore, there is an idea that the sooner the marriage is done, the faster the burden on the family will be reduced. The number of the practice of child marriage occurs mostly in low-income families. The lack of information related to sexual education contributes to the emergence of unwanted pregnancy conditions. In this state, the major choice that is often taken is to marry off the child.

The factors of policy and government capacity also contribute to the widespread practice of child marriage (Simon et al, 2020). It affects how the process of making, improving, and enforcing policies becomes a problem that occurs in many countries, including Indonesia (Nugroho, 2012). Indonesia has ratified several international conventions associated with girl protection from the practice of child marriage, including the Convention on the Rights of the Child which was ratified by Presidential Regulation No. 36 of 1990, Convention of the Elimination of All Forms of Discrimination Against Women (CEDAW) which was ratified through Law Number 7 of 1984, the International Convention on Civil and Political Rights (ICCPR) which was ratified through Law Number 12 of 2005, and the International Convention on 10 Economic Social and Cultural Rights (ICESCR) which was ratified by Law Number 11 of 2005.

In Indonesia, the practice of child marriage is considerably related to the dualism of the prevailing regulations, which is Law Number 1 of 1974 concerning Marriage and Law Number 35 of 2014 concerning Child Protection. There is a clash in Indonesian government policies regarding the recognition of the age of marriage of the age of 16 years (in the Marriage Law) and the recognition of the age category of children of the age of 18 years (in the Child Protection Law). Revision of the marriage law through Law no. 16 of 2019, which raises the minimum age limit for marriage for boys and girls to 19 years does not necessarily guarantee that the practice of child marriage can be avoided. Marriage regulations allow submission of marriage dispensation if the bride and groom do not meet the minimum age requirement for marriage through a judge. A study conducted by Hizbulloh (2019), described several related issues associated with marriage dispensation that has further expanded the practice of child marriage, including: an increase in application for marriage dispensation, granting of dispensation by judges, unwanted pregnancies, and premarital sex proposed by families. Granting by the judges is concerned with subjectivity involving considerations of values, norms, and

culture by adopting parental concerns. Likewise, the Child Protection regulation states that parents and the community are obliged and responsible for preventing child marriage. However, in reality, many children are still forced to marry at an early age and this is socially legitimized by families and society (Duadji and Tresiana, 2020; Rumble et al., 2018; Saskara, 2018; Pettay et al., 2020).

Based on this illustration, it can be seen that the challenges and potential for minimizing the practice of child marriage, particularly in Indonesia, are quite complicated. Challenges include not only the need for attempts to strengthen children to be resilient and as agents of change in line with the SDGs targets but also support for policies and capacity for implementing child protection that has not guaranteed that children are protected from the practice of child marriage.

The developed contingency analysis by Lester (1994) shows the effectiveness of its implementation. The effectiveness of the implementation of policies on the handling of the practice of child marriage is performed with two adjustments, including the factors of the government commitment and capacity. **The first change** relates to the factor of government commitment through the utilization of data/evidence and strengthening policies. Mapping of data and specific evidence-based on areas, as the root of the problem and the foundation for program design performed by the government, demonstrates a shift in the understanding of children. Children are no longer merely objects of development, but become the subject of various existing programs (Ahonsi et al., 2019). Evidence-based policy model (Cairney, 2017) and experience-based studies in Australia from 2007 to 2017 (Solebury, 2001; Hanrahan, 2017) illustrates the evolution of evidence-based policy adjustment that has contributed to the role of data/evidence in determining the success of policy decisions and the support of reliable models. Accurate information can improve the basis for decision-making, avoid mistakes, and set the political environment by providing evidence that results in a balance. It can improve targeting performance and sharpen the determination of priority areas, resulting in the design and implementation of area-based targeting methods. This process with multiple effects has a further effect on the successful implementation of public policy. The failure of a country to minimize the practice of child marriage is associated with a failure to understand the key issues and root causes of each region, not leaving local needs, negating local wisdom and particularity. The mapping of root causes according to a grouping of uniform/contiguous regions connect with essential policies in a country.

Strengthening regulations and strategies for implementing measurable and systematic national strategic policies in harmony among stakeholders at cen-

tral, regional, and village levels is one form of government commitment. Determining the direction of the national development policy for child protection is performed by strengthening the child protection system that is responsive to the diversity and characteristics of the child's living space. Mapping, harmonization, synchronization, enforcement of regulations, and filling in regulatory gaps are performed to achieve the target of minimizing the number of the practice of child marriage, harmonizing various regulations at the central and regional levels, mutually supporting and effective in their implementation in the field. It is crucial as a tool for policy review and to improve the quality of policies so that they are right on target (Lo Forte, 2019; Febryano, 2021). The actions are done for a collective movement to eliminate the gap of tolerance or to loosen up the practice of child marriage. The encouragement for a new marriage policy change, besides being able to pave the way for all stakeholders to protect all girls from child marriage, will also require socialization regarding the changed regulations. Excellent implementation needs to be done for the Child Protection Law which stipulates that parents are obliged to prevent child marriage. Integrated attempts to prevent child marriage from non-governmental organizations and local governments are necessary to be developed. Several grassroots initiatives ranging from local assistance, the involvement of traditional leaders and local leaders can support the accomplishment of the successful implementation of the policy (Aceituno et al., 2020; Ajide et al., 2017).

The second change, is related to the factor of government capacity to implement policies through good coordination among stakeholders. Aligica (2006) stated that stakeholder analysis shows the extent of power/influence and the extent of the importance of each stakeholder in determining the implementation of the next coordination. Three findings of the analysis include: **the first finding**, that BAPPENAS, KPPPA, Ministry of Health, BKKBN, Ministry of Religion, and local governments have high interest and influence. The influence is obtained from the indicators in the strategic plan, in which the importance is indicated by the existence of programs that are directly oriented to prevention efforts. **The second finding**, all programs associated with the issue of child marriage prevention are present at ministries/agencies that have targeted interventions for reproductive health, adolescents, families, and women, including KPPPA, Ministry of Religion, BKKBN, Ministry of Education and Culture, and Ministry of Health. **The third finding**, power/influence is high, but the importance remains low because the programs have not been oriented towards preventing child marriage, including the Ministry of Home Affairs; Ministry of Education and Culture; Ministry of Villages, Development of Disadvantaged Areas, and Transmigration; Ministry of Youth

and Sports; Ministry of Social Affairs; and the Ministry of Communication and Information. These ministries have direct programs concerning adolescents and youth at the regional level (Ministry of Villages and Ministry of Home Affairs) that have the potential to prevent child marriage; BPS in providing accurate data; Independent research institutes and universities, along with community organizations in conducting research also play an important role in providing data and information.

Conducting a stakeholder analysis is a huge potential for supporting attempts to prevent child marriage. Strengthening is performed through coordination and convergence by strengthening the National Secretariat as a liaison in implementation strategies, using exploratory studies, and assessing child marriage, including forming a communication strategy referring to the characteristics of the target group, socio-cultural conditions, and educational background in stages, and have specific targets in the particular time frame at the national level (Bappenas, 2018).

At the regional level, Regional Integrated Service Units were formed at the provincial, district, and city levels to strengthen the implementation of coordination and synergy of programs and activities (Duadji and Tresiana, 2020). The perspective of the approach of the social change systems theory formulates outcomes and possible strategies to accomplish the goals. Emerson et al. (2012) stated that a multi-sector approach is also recommended. The argument that supports this proposal is the presence of a variety of regional contexts, so it is important to accommodate the diversity of contexts through a variety of strategies. The drive for adjustments requires coordination forums integrating child marriage prevention at various levels of government with an excellent reporting and documentation model.

Policies for handling the practice of child marriage following major policy changes require an adjustment in the right model and have relevance to the policy, which gives advantages for stakeholders in realizing a fair, equitable, inclusive, and sustainable handling of detrimental practices for children. The previous policy model had a high risk of failure. The root causes and the recommendations are not based on evidence/data (Cairney, 2017), incorrect way of seeing children in development (Watson, 2021; Dahal, 2016), policy advocacy which is a weak political commitment (Febryano et al., 2021), and unintegrated implementation capacity (Emerson et al., 2012). Howlett (2017) observed the importance of the choice of policy instrument to obtain effective implementation policy design. Contingency analysis in policy implementation requires a focus on changing the conditions performed on targets by establishing data support, policies, and government capacity, at the central, regional, and village levels, including the adoption of local initiatives (Nguyen and Rieger, 2019). The choice of regressive implementation

needs to be fixed with more appropriate and sustainable options.

By using Lestern's (1994) analysis, the choice of policy implementation will be successful by employing the progressive model choices. The relevance of progressive policy implementation is based on the integration of goals of SDGs into national and local development policy and planning adjustments, convergence institutions as a coordination forum between central stakeholders, development of an integrated service unit at the local level, and the adoption of support from local initiatives in strengthening prevention models at the level of society. The results are expected to be effective in implementing a just, equitable, and sustainable management policy.

Cocclusions

The implementation of policies on handling the practice of child marriage following adjustments in policies on marriage and child protection requires changing the right model and policy support. Previously, the implementation of the policy model had a high risk of failure, including the absence of evidence support, weak policy advocacy, weak synergy, and coordination among stakeholders. The contingency matrix-based policy application model for handling the practice of child marriage will be effective if it utilizes a progressive model.

Several levels for the effectiveness of policy implementation in handling the practice of child marriage include: (a) *Collaboration of the government*, non-governmental organizations, local governments, and village governments to integrate encouraging the enforcement of main policies and synchronization on derivative policies on the practice of child marriage. Several community-based integrated child protection model initiatives; arrangements of village regulations, knowledge sharing programs, and public awareness campaigns in collaboration with the media, community activists, children, youth, and local governments; smart practices from local initiatives can be considered as *a reference role model for effective programs and activities*. (b) *The central government (Bappenas)* is necessary to lead the development of joint innovative action plans or co-design innovative solutions in a cross-stakeholder framework and perform the division of tasks and specific roles. (c) The government along with elements of the media, activists, local, and village governments, including children, establish innovative socialization and educational activities so that the practice of child marriage does not become the norm. (d) Capacity building of children through decision-making programs, area-based child protection, strengthening of children's forums. (e) Cooperation with research centers and NGOs in building data and documentation of good practices at the local level.

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Inclusive Education as a Tool For Implementing the Sustainable Development Goals on the Basis of Humanization of Society

Edukacja inkluzywna jako narzędzie realizacji Celów zrównoważonego rozwoju w kontekście humanizacji społeczeństwa

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Abstract

The technogenic civilization, despite significant scientific and technical achievements, unfortunately, continues to face problems that entail irreparable consequences. Human activity based on the principle of immeasurable consumption produces an increase in inequality, poverty, hunger, diseases, armed conflicts, and global environmental changes. Weapons of mass destruction pose a global socio-environmental threat. All these trends indicate the need to move to a new level of progress based on sustainability, which in turn requires the formation of a new personality focused on the system of environmental values, and not on the values of the consumer society. Only a society consisting of people with a new worldview will be able to develop sustainably. In this regard, the author's vision of inclusive education is formed in the study, which is understood as a system with a high integration ability, the role of which is reduced to creating a sustainable society with rational moral foundations. A doctrinal model of the implementation of the Sustainable Development Goals is proposed, the core of which is the humanization of society, contributing to moral, economic, social, cultural changes and influencing the life of society, while becoming the driving force of the economic, social and environmental aspects of sustainable development. The author's approach allows us to expand the scientific vision of the essence and content of inclusive education, to determine the role of humanization in ensuring the implementation of the Sustainable Development Goals. The conceptual provisions of the article can be used as the basic foundations of a sustainable development strategy.

Key words: sustainable development, Sustainable Development Goals, inclusion, integration, inclusive education, humanism, humanization

Streszczenie

Cywilizacja technogeniczna, mimo znaczących osiągnięć naukowo-technicznych, niestety nadal boryka się z problemami, które niosą za sobą nieodwracalne konsekwencje. Działalność ludzka oparta na zasadzie nieograniczonej konsumpcji powoduje wzrost nierówności, ubóstwa, głodu, chorób, konfliktów zbrojnych i globalnych zmian środowiskowych. Broń masowego rażenia stanowi globalne zagrożenie. Wszystkie te trendy wskazują na potrzebę przejścia na nowy poziom postępu oparty na zrównoważonym rozwoju, co z kolei wymaga ukształtowania nowej

osobowości skupionej na systemie wartości środowiskowych, a nie na wartościach społeczeństwa konsumpcyjnego. Tylko społeczeństwo składające się z ludzi o nowym światopoglądzie będzie w stanie rozwijać się w sposób zrównoważony. W związku z tym zaproponowano autorską wizję edukacji inkluzywnej, rozumianej jako system o wysokiej zdolności integracyjnej, którego rolą jest tworzenie zrównoważonego społeczeństwa o racjonalnych podstawach moralnych. Proponowany jest doktrynalny model realizacji Celów zrównoważonego rozwoju, którego istotą jest humanizacja społeczeństwa, przyczynianie się do zmian moralnych, ekonomicznych, społecznych, kulturowych oraz wpływanie na życie społeczeństwa, jednocześnie będący siłą napędową ekonomicznych, społecznych i środowiskowych filarów zrównoważonego rozwoju. Podejście autorów pozwala poszerzyć naukową wizję istoty i treści edukacji inkluzywnej oraz określić rolę humanizacji w zapewnieniu realizacji Celów zrównoważonego rozwoju. Ramy koncepcyjne artykułu można wykorzystać jako podstawowe fundamenty strategii zrównoważonego rozwoju.

Słowa kluczowe: zrównoważony rozwój, Cele zrównoważonego rozwoju, inkluzja, integracja, edukacja inkluzyjna, humanizm, humanizacja

1. Introduction

Global economic progress contributed to the formation of a number of negative trends that have become a threat to all living things with times. As a result of human activity, nature began to lose the ability to reproduce. The struggle for resources has become tougher. The gap in the income of the population has increased. The number of poor people has increased. All this made it necessary to form a new model of the development of civilization, which could withstand the impending global social, economic and environmental crisis. In this regard, inclusive education becomes particularly relevant as a tool for humanizing society, since it is not only an innovative process that allows training and education of individuals with different basic capabilities at different levels of the educational vertical, but also has a powerful impact on the development of the educational process itself, significantly changing the relations between its participants, as well as the general approach to the existence of future generations, which in turn allows building a careful rational attitude to the environment. All this ensures the further implementation of the Sustainable Development Goals.

The purpose of the study is to substantiate the theoretical and applied aspects of inclusive education as a tool for implementing the Sustainable Development Goals and humanization of society. Based on the goal, the study sets the following tasks: to form the author's vision of the category of *inclusive education* in the context of sustainable development; to prove that inclusive education is a tool for achieving the Sustainable Development Goals; to define the role of humanization in society and conceptualize the content of the theory of humanism of the XXI century; to form a doctrinal model for the implementation of the Sustainable Development Goals through the humanization of society on the basis of inclusive education.

2. Methodology

The theoretical and methodological basis of the study was the fundamental and applied provisions in the field of philosophy and sociology by K.O. Appel, W. Barret, F. Bacon, I. Goethe, I. Herder, G. Endrueit, I. Kant, A. Camus, T. Campanella, G. Marseille, T. Mor, T. Parson, J. J. Rousseau, G. Trommsdorff, L. Feuerbach, F. Schiller, Y. Habermas, M. Heidegger, K. Jaspers, J.-P. Sartre; pedagogics of H. Davydenko, J. Korczak, A. Kresta, J. Blaze, O. Krasnyukova, N. Skok, O. Ferapontova, V. Yarska et al.; scientific works of Ukrainian and foreign scientists concerning the sustainable development by D. Albert, T. Czerwinski, B. Baker, J. Bog-nar, Don. Meadows and D. Meadows, R. Jorgen, B. William, A. Pawłowski, V. Udo.

The information base of the study was encyclopedic, normative, statistical data, official reports of the US Census Bureau, the World Bank, reports of the United Nations on the human environment, the Club of Rome on Human Problems, previously conducted studies in the field of rationing inclusive education, Sustainable Development Goals and humanization of society.

In particular, the idea of presenting inclusive education as a tool for implementing the Sustainable Development Goals was based on philosophical studies of V. Udo, A. Pawłowski, in which the authors note that *to move to a new level of progress based on renewable sustainability, a breakthrough of the crisis is required, primarily in education and transformative actions on the part of all stakeholders of the nation, the family – every person* (Udo, Pawłowski, 2010).

The key conclusions regarding the global humanization of society through the establishment of general and individual trends and patterns, taking into account spiritual, cultural, national, socio-economic characteristics, were formulated thanks to the studies of I. Bakhov, E. Boichenko, N. Martynovych et al., whose article presents the scientific and methodological support for the assessment of cause-and-effect relationships between the existing system of cultural

and educational institutions and the cultural development of society (Bakhov, Boichenko, Martynovych, Nych, Okolnych, 2020).

In the course of the study, the following scientific methods were used: historical and logical (in defining the essence of the concepts of *humanism*, *humanization*, *inclusive education*, *sustainable development*, as well as in the formation of the idea of humanization of the XXI century); general scientific method (for conceptualizing the doctrinal model for the implementation of the Sustainable Development Goals through the humanization of society on the basis of inclusive education); systematic approach (in determining the place of inclusive education and humanization in society and sustainable development, in determining the levels, connections, principles of the doctrinal model for the implementation of the Sustainable Development Goals through the humanization of society on the basis of inclusive education); comparative, statistical analysis (to substantiate key findings) and graphical analysis (to visualize the main results obtained).

3. Findings and Discussion

Inclusive education

The current stage of development of inclusive education in European countries is associated with various contradictions both in the categorical apparatus and in practical application. Some authors reduce the concept of inclusive education (hereinafter referred to as IE) to the educational problems of disabled children. Others identify inclusion with integration. The types of inclusion are not sufficiently structured. In addition, in modern pedagogical science, such concepts as *exclusion*, *adaptation*, *habilitation*, *segregation*, and others are used as complementary antonyms of inclusion. The generalization of the positive and negative experience of the implementation and development of inclusive education in a number of European countries also made it possible to make sure that the tools and results are dissimilar. Based on the above, there is a need to systematize existing approaches to the consideration of inclusive education.

The analysis of scientific publications allowed us to establish that the history of the emergence of inclusive education goes back to the XVII century. It is connected with the introduction of the mathematical term *integral*, which was transformed under the influence of various factors, and by the XX century it began to be used in philosophy, psychology, sociology, and then in pedagogy to describe various system processes. The widespread use of the concept of *integration* in the humanities is due to its semantic load. So according to the explanatory dictionary of foreign words *integration* from the French *intégration* – Lat. *integratio* – means the replenishment, res-

toration, unification into a whole of some parts, elements (Chervinsky, Nadel-Chervinska, 2012).

In his research, T. Parson considers the philosophical concept of integration from two positions: as a process of adaptation of the system to the environment and as a process of balancing the components of the system (Parsons, 2002).

Over time, the concept of integration was supplemented and expanded by the Stuttgart specialists G. Endruweit and G. Trommsdorff, whose studies are similar to T. Parson's methods and were based on a structural and functional concept. The authors argued that, in a sociological sense, integration is the inclusion of new elements in a system, after which they acquire the properties of this system and no longer differ from others (Endruweit, Trommsdorff, 2002). At the same time, the term *social integration* appeared in pedagogy, which was originally used in the United States to refer to racial and ethnic minorities, later it began to be applied to the children of immigrants, and only in recent decades (since the 60s of the XX century) the term entered the speech turnover on the European continent and began to be used in the context of the problems of persons with disabilities (disabled people).

An analysis of previous studies shows that in modern Europe, the concept of *inclusion* is directly related to the emergence of a new model of human rights, which arose after the adoption of the Universal Declaration by the United Nations in 1948, which served to intensify the development of new terminology, among other things.

Literally, inclusion means (from the English *inclusion* – addition, attraction) – the process of increasing the degree of participation of all citizens in society (Short dictionary of the system of concepts of inclusive education: a terminological dictionary, 2015). Therefore, it can be concluded that the etymology of inclusion is based on the concept of *integration*, as well as philosophical arguments about the social integration of an individual in a democratic society, which created the prerequisites for the emergence of a number of new categories explaining the identification of the concepts of *inclusion/ integration*.

A similar point of view is reflected in the studies of V. Yarska, N. Davydenko. According to the definition of social inclusion by V. Yarska, this term clearly indicates the formation of a democratic society, where an individual or a group of individuals is included in a broad society (Yarska, 2008).

H. Davydenko notes that the concept of '*inclusion*' is directly related to the formation of the democratic way of life in Western Europe in the field of sociology, which contributed to the change of key paradigms (Davydenko, 2014).

At the same time, the arguments presented above allow us to assert that inclusion is a narrower concept in comparison to integration: *integration* is

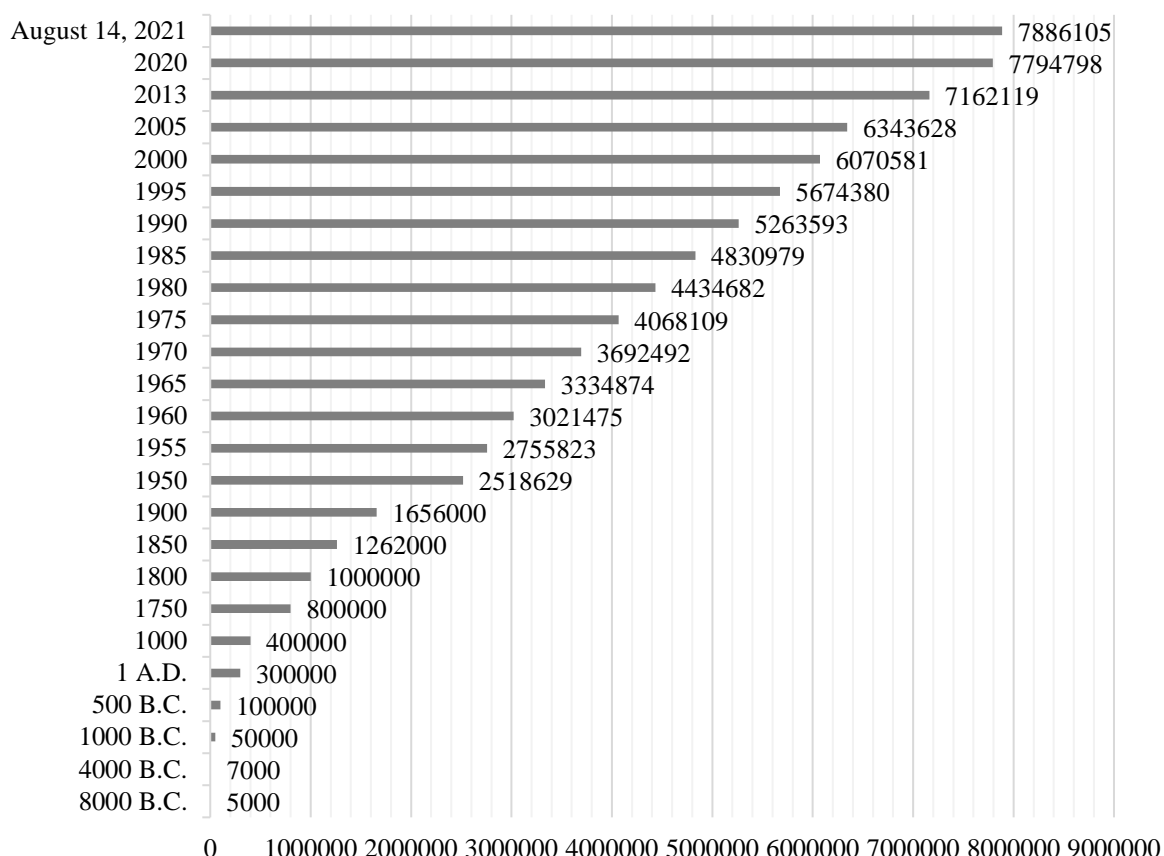


Figure 1. Dynamics of the earth's population in various historical epochs, compiled by the authors according to (US Census Bureau, 2021) 2020-2021 (World meter, 2021)

the process of combining the elements of the system (Chervynskiy, Nadel-Chervynska, 2012), while *inclusion* refers only to the individual. Inclusive education is just a reflection of the result that can be obtained from the symbiosis of these categories. On the one hand, education, being an open system, allows reflecting system aspects, on the other hand, inclusion determines the individual's place in this system and the final result from the process of interaction of its elements.

The result of the interaction is also reflected in the definition of the United Nations Educational, Scientific and Cultural Organization (UNESCO), which interprets inclusive education as a positive reaction to the diversity of students and the perception of their individual differences not as a problem, but as an opportunity to enrich learning (UNESCO).

In a sociological studies of N. Skok inclusive education is also considered through the integration, by way of inclusion, with the aim of obtaining a particular result in the process of interaction: inclusive education is the process of integration of individuals in the educational process, regardless of gender, ethnicity, religious affiliation, previous achievements, health status, level of development, socio-economic status of the parents and other differences (Skok, 2005).

In the studies conducted by O. Ferapontova, it is noted that inclusive education contributes to ensuring equal access to education for the whole society, taking into account the diversity of special needs and individual opportunities (Ferapontova, 2007).

Summarizing the above, it should be noted that the authors understand the philosophy of modern education by inclusion. Inclusive education is primarily a system with a high integration ability. The main goal of inclusive education is to ensure the full participation of all members of society, regardless of opportunities, by including them in any processes. The high integration ability of the inclusive education system allows us to assert that it is an instrument for the implementation of the Sustainable Development Goals and the humanization of society.

From inclusive education to sustainable development

The XX century in modern science was marked by a century of changes. Indeed, during this period there were significant scientific, technical, economic, political, demographic and other changes that determined the future. A breakthrough in medicine contributed to an increase in life expectancy, and modern technologies provided an increase in the quality

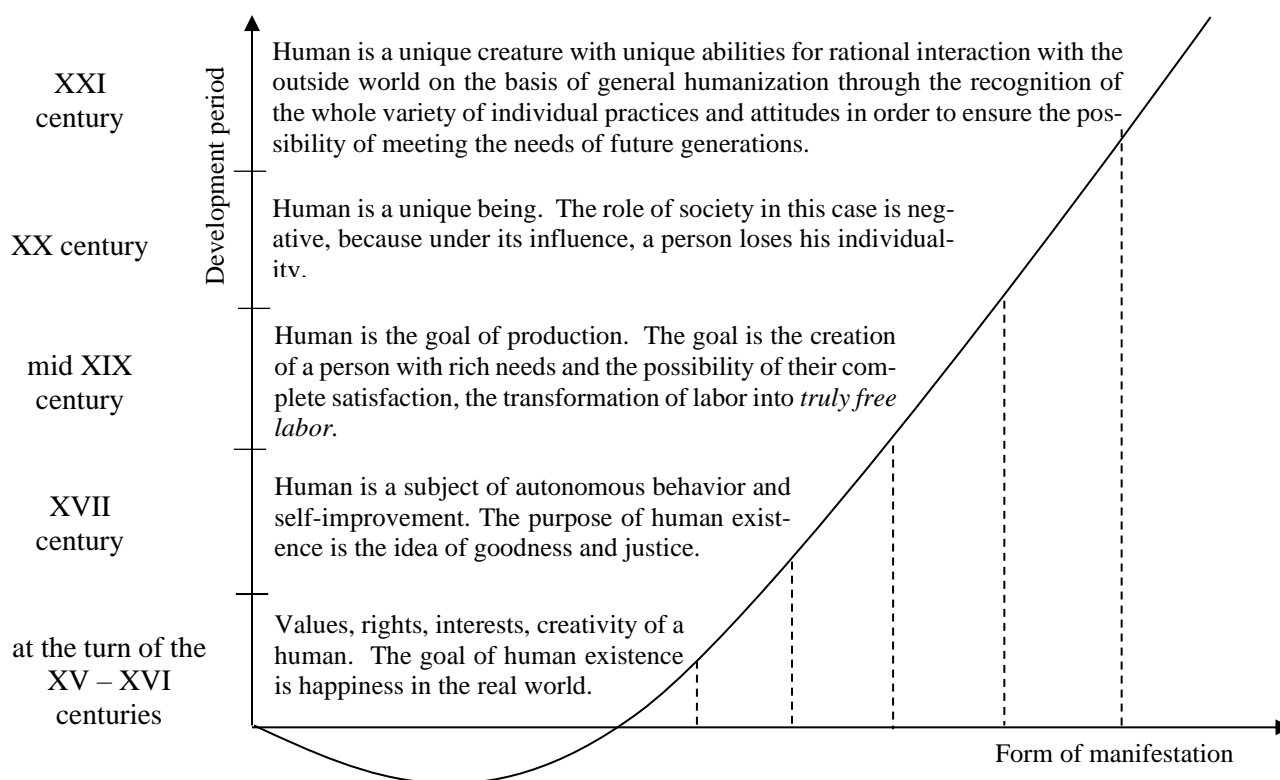


Figure 2. Periodization of the concepts of humanism, compiled by the authors on the basis of a generalization of the works of K. Levi-Strauss (1994), P. Kristeller (1956), E. Garen (1986), Y. Burckhardt (1996).

of life of the population, as a result of which by the end of the 70s of the XX century there was a demographic explosion – a sharp increase in the population as a result of a steady and significant excess of birth rate over mortality (Ehrlich, 1975). More clearly, the dynamics of population growth on earth in various historical epochs is shown in (Fig. 1).

It should be noted that to date, there is a steady trend of population growth in the world. Thus, according to the World Bank, as of July 2021, the world's population increased by another 226 million and amounted to 7.9 billion people (World Bank).

The overpopulation of the planet, combined with vital human activity, increased the burden on the environment and contributed to the emergence of a conflict with nature, which led to an acceleration of global changes in all environments and the practical termination of the restoration of renewable natural resources – air, water, soil, flora and fauna. Of course, global environmental changes have affected the economy and people's health. They showed that humanity has crossed any acceptable boundaries in its development. Thus, the period of *independence of mankind* from the laws of nature has come to a logical conclusion. As a result, it became necessary to rethink the further development of civilization.

The debate about sustainability has a long tradition. Back in 1969, negative trends in ecology, economics and social development were mentioned. In the declaration of the first UN conference on the environment (Stockholm, 1972), the relationship of econo-

mic and social development with environmental problems was noted (Declaration of the United Nations Conference on the Human Environment, 1972). A significant contribution to understanding further development was made by the scientific reports of the Club of Rome (Limits to Growth, 1972), which proposed the ideas of the transition of civilization to a state of *global dynamic equilibrium*, to *organic growth* (Meadows, Donella; Meadows, Dennis; Randers, Jorgen; Behrens III, William, 1972).

In 1987, the report *Our Common Future* was published. In which, as a path to the future, sustainable development is proposed that connects the needs of the present and future generations. The document was prepared by the United Nations International Commission on Environment and Development under the leadership of Brundtland. It noted that sustainable development represents *development that meets the needs of present generations without compromising the ability of future generations to meet their own needs* (WCED, 1987). At the same time, the analysis of various scientific points of view regarding the interpretation of the concept of sustainable development gives grounds to assert that the majority of scientists consider the classic definition of sustainable development not to the interpretation of the UN International Commission on Environment and Development, but to the definition presented in the UN Framework Document Agenda XXI: *Sustainable development is a model for the movement of humanity forward, in which the needs of the present*

generation of people are met without depriving future generations of such an opportunity (Agenda XXI, 1992).

Agreeing with the overwhelming majority of scientists, we consider it expedient in this study to consider sustainable development as a qualitatively new model of human movement into the future based on the humanization of the individual and society. In this regard, inclusive education is assigned with the role of an institution for creating a sustainable society with rational moral foundations. This need arises from the life of the consumer society, which consumes about 86% of all global resources and produces 75% of waste from economic activities (Global Footprint Network, 2021), as well as from the presence of conflicts, poverty, hunger, inequality, pandemics, degradation of society and the environment.

Discussion about the humanization of society

Speaking about humanism, it should be noted that it has always played an important role both in the life of an individual and society as a whole and occupied a key place in the system of universal values. The ideas of humanism determine the attitude of a person to various phenomena associated with his existence, motivate, direct and substantiate his actions. Therefore, the problem of the content of the ideas of humanism is not only academic in nature, but directly addressed to practice. Analysis of scientific literature indicates that humanism is a historically changing system of views (Fig. 2).

It follows from the figure that with each subsequent period in the development of philosophical thought, the forms of manifestation of humanism also become more diverse and complex. So, initially, the formation of a new worldview – humanism (from the Latin *humanus* – human), which later became the ideology of the European Renaissance was reduced only to opposing the church's view of man as an insignificant and sinful being.

In the classic sense, which was generated by the Renaissance in Italy, humanism is already seen as a form of asserting universal human values in society, aimed at the cultural and moral development of human abilities. (Social Pedagogy Concise Dictionary of Concepts and Terms, 2016). Such an approach made it possible to further expand the forms of manifestation of humanism and to consider it not in a narrow, but in a broad sense, as a benevolent attitude towards a person, affirming his freedom and dignity, regardless of any social functions and roles he performs, seeing in him an independent source of creative forces (Electronic library of the Institute of Philosophy of the Russian Academy of Sciences, 2015). Unlike the ancient and medieval approaches, modern European humanism defends an anthropocentric picture of the world in which a person is a free being, capable of creating himself, giving himself any na-

ture that he himself desires, as a subject of knowledge and activity, relying in his actions on his own mind and creative potential. This was the main discovery of humanism, which was developed in the rationalistic thought of modern times, which affirmed the decisive importance of the human mind both in the knowledge of the world and in the creation of socio-political forms of social life. This tradition had the greatest influence on the development of social and philosophical thought – the humanistic ideal of an individual as a free personality, capable of self-creation and creativity, gave rise to the dream of a society in which this ability would be fully realized in life, which led to the emergence of the first communist utopias (Kviatkovskiy, 2018).

Doctrinal model of the implementation of sustainable development goals through the humanization of society based on inclusive education

World globalization, which began in the second half of the XX century, testifies to the need to search for an ideological model of current social and economic development, ways to renew sociocultural life that would contribute to the mass humanization of society through the recognition of the whole variety of individual practices and attitudes, and the basis of the model should be based on the formation of a person of moral consciousness, the basis of which is personal responsibility.

Scientists from various fields and areas of scientific interests declare the need to change the consciousness of a *modern human*. In particular, in the work of A. Pawłowski *How to Teach on Sustainable Development Issues?* the author uses poetry to combine feeling and technology, hoping that such an approach can cause positive changes in the awareness and behavior of readers (Pawłowski, 2015).

Appealing to personal responsibility, it is important to note that the concepts of practical discursive ethics of K.O. Appel (1999) and Y. Habermas (1999) are taken as a basis, which are based on the humanistic ideals of justice and solidarity. The humanistic principle of justice *postulates the same respect and equal rights for each individual, the basis of solidarity is compassion (empathy) and concern for the well-being of others* (Appel, 1999; Habermas, 1999).

Thus, humanization is the core of inclusive education (Fig. 3).

Internal humanization, forming the personal responsibility of the individual, contributes to the renewal of socio-cultural life (external harmonization), thereby ensuring the massive humanization of society. Internal humanization is understood as the process of formation of spiritual (religion, confession) and mental (inner world of a person) qualities, which are based on the principles of justice, solidarity, moderation, rationality, sustainability. External humanization is the projection of the individual's internal attitudes onto the social, cultural environment

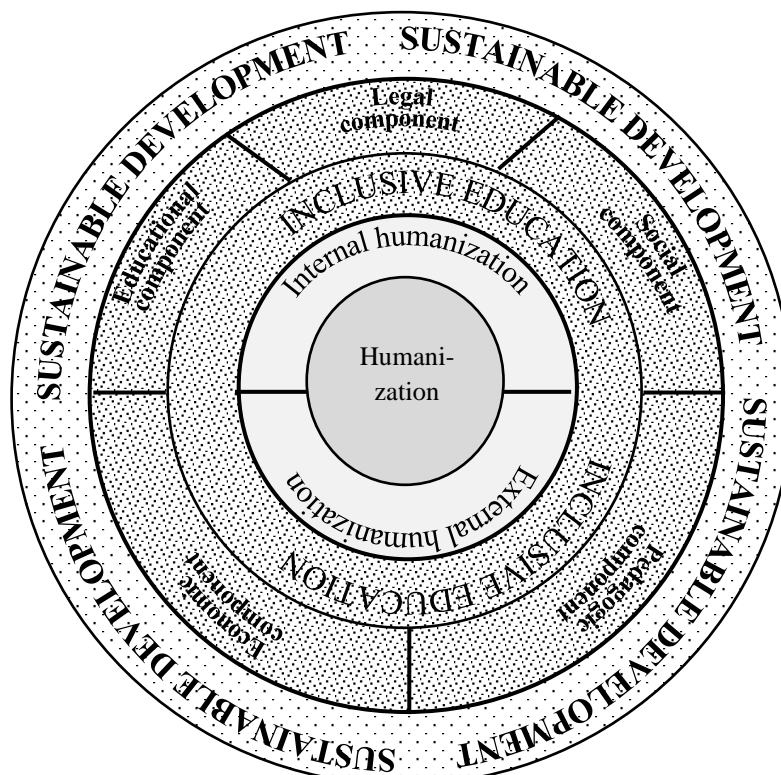


Figure 3. Doctrinal model of the implementation of sustainable development goals through the humanization of society based on inclusive education, compiled by the authors

under the influence of which the identification of the society (region, country) occurs.

It is important to note that in this case, inclusive education is assigned not only the role of ensuring the full participation of all members of society, regardless of opportunities, by including them in any processes, but also a communicative one, which is defined as any exchange of information between the elements of the system. The elements of inclusive education are individuals or groups, as well as legal, social, pedagogical, economic and educational components. In other words, we are pushing the boundaries of understanding inclusion and inclusive education beyond disability.

As has been noted more than once, education is an open system. Taking into account the fact that the concepts of *inclusion* and *integration* in the study correlate as partial and general, inclusive education in this case is also considered as a form of integration. This approach, according to the authors, allows to reflect the interaction not only within the system, but also outside it, providing both moral and economic, social, cultural changes, which in turn affect the life of society, becoming a necessary condition and driving force of economic, social and environmental aspects of sustainable development. Sustainable development in relation to inclusive education constitutes a global environment. It is of importance that each component of the presented model is in constant dynamics.

Thus, the Doctrinal model for the implementation of the Sustainable Development Goals created by the authors makes it possible to link the concept of sustainable development with the formation of spiritual and mental values that focus on the survival of all mankind, and inclusive education ensures the implementation of the Millennium Goals through the legal, social, pedagogical, economic and educational components.

The legal component of inclusive education focuses on ensuring equal rights in education, preventing and combating exclusion in education, identifying and eliminating factors that hinder the realization of an individual's right to education on the basis of equality and accessibility. In this way, the legal framework contributes to the provision of inclusive and equitable quality education and the promotion of lifelong learning opportunities for all (Goal 4); promotes peaceful and inclusive societies for sustainable development, by ensuring access to justice for all (Goal 16), strengthens the means of implementation and revitalizes the Global Partnership for Sustainable Development (Goal 17), as well as reduces inequalities in all of its manifestations (Goal 10).

The social component of inclusive education is aimed at the formation and assimilation by an individual of a wide range of values (healthy way of life, respect for nature, moderate consumption, etc.), social roles and expectations, on the basis of which the daily life of people is formed, as well as the for-

mation of *stable personality* on the basis of mastering the acquisition of knowledge, skills, values of cultural heritage accumulated by society. Through interaction, individuals influence each other, thereby forming strong beliefs about the need to eradicate poverty (Goal 1), hunger (Goal 2), ensure equal rights of rich and poor, men and women (Goal 5), promote availability and rational water use and sanitation for all (Goal 6).

The pedagogical component of inclusive education ensures the implementation of all 17 goals of the Millennium, since this component, in particular, contributes to the formation of internal and external beliefs of the individual, which are subsequently accepted / not accepted, spread or become obsolete through the social component. This is due to the fact that the formation of internal and external beliefs is influenced by the family, teachers and society, which are able to change the worldview of an individual to a global understanding of the idea of sustainable development as a universal idea and lay it in the basis of the mentality of future generations. For example, a family and a teacher are able to form the child's conviction to lead a healthy lifestyle, give up bad habits (Goal 3), take good care of nature and contribute to its preservation in every possible way (Goal 14, Goal 15), contribute to the fight against climate change (Goal 13).

The educational component in this case is a kind of continuation of the pedagogical one. Its role is to ensure that the individual assimilates the system of knowledge, skills and abilities necessary for the development of individual potential and further successful integration of society into a sustainable space. Based on the knowledge gained, each individual is able to learn to think critically, which ultimately will allow and develop measures to implement each of the 17 goals. For example, the knowledge gained, together with basic ideas about sustainable development, contribute to new discoveries, the introduction of new technologies based on the principles of environmental friendliness, rationality, accessibility, which in turn ensures the implementation of Goal 7: Ensuring universal access to affordable, reliable, sustainable and modern energy sources for all; Goals 9: Building of resilient infrastructure, promotion of inclusive and sustainable industrialization and innovation; Goal 11: Ensuring openness, security, resilience and environmental sustainability in cities and towns.

The economic component of inclusive education aims to prepare for the workforce, develop and harness potential in the labor market, thereby contributing to the realization of Goal 8: Promotion of progressive, inclusive and sustainable economic growth, full and productive employment and decent work for all.

4. Conclusion

As can be seen from the above, the article resolves both scientific and applied problems in the field of sustainable development, pedagogy and philosophy on the basis of theoretical generalization and practical support, the main of which are as follows.

Based on the generalization of scientific points of view regarding the interpretation of such concepts as *inclusive education*, *humanization*, *sustainable development*, the author's vision for each category was formed. It has been established that the etymology of inclusion is based on the concept of *integration*, as well as philosophical reasoning about the social integration of an individual in a democratic society. Against this background, it is proposed to understand inclusive education in the context of sustainable development as a system with a high integrative ability, the main goal of which is to ensure the full participation of all members of society, regardless of opportunities, by including them in any processes, which makes it possible to consider inclusive education as a tool for achieving the Sustainable Development Goals.

By determining the content of the theory of humanism of the XXI century, its role in society has been established. It has been proved that humanization is the core of inclusive education and is built on the principles of a new humanitarian model for the development of civilization, including the principle of evolution, personal responsibility, justice, solidarity, moderation, rationality, sustainability, which presupposes the restructuring of the entire economic, social and political system. It has been substantiated that the implementation of this new social paradigm is possible not only through improving the social level and increasing attention to the individual with his needs, but also through the humanization of values.

The expediency of interpreting sustainable development as a new model of human movement into the future based on the humanization of the individual and society has been substantiated. In this regard, inclusive education is assigned with the role of an institution for creating a sustainable society with rational moral foundations.

A doctrinal model of the implementation of Sustainable Development Goals through the humanization of society on the basis of inclusive education has been proposed, the core of which is internal and external humanization, inclusive education is assigned not only the role of ensuring the full participation of all members of society, regardless of opportunities, by including them in any processes, but also communicative role, which is defined as any exchange of information between system elements. It has been proposed to consider both individuals with their characteristics and legal, social, pedagogical, economic and educational components as elements of inclusive education. This approach allows reflecting

the interaction not only inside, but also outside the system, providing both moral and economic, social, cultural changes, which in turn affect the life of society, becoming a necessary condition and driving force of the economic, social and environmental aspects of sustainable development. Sustainable development in relation to inclusive education constitutes a global environment. The study results presented for consideration can be used as the basic foundations of a sustainable development strategy.

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What is Right and What is Wrong in the Environmental Governance Model? Environmental Regulations for Improving Environmental Sustainability Ratings

Co jest dobre, a co złe w modelu zarządzania środowiskiem? Analiza przepisów środowiskowych dla poprawy jakości zrównoważenia środowiskowego

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Abstract

The improper allocation of economic and environmental resources damages the United Nations sustainable development Agenda, which remains a challenge for policymakers to stop the rot through efficient governance mechanisms. The study designed an efficient environmental governance framework by extending the different governance factors linked to the environmental sustainability ratings in the cross-section of 67 countries. The results of the two-regime based estimator show that environmental corruption (regime-1), environmental politics (regime-2), and environmental laws (regime-2) negatively correlated with the environmental sustainability rating, whereas environmental democracy (regime-1 & 2) positively correlated with the environmental sustainability agenda across countries. The government effectiveness and the country's per capita income both escalates environmental sustainability ratings. The results align with the Demopolis theory, the effective regulatory theory, and the theory of law and politics. The causality estimates show that environmental corruption and government effectiveness causes environmental politics and economic growth. In contrast, environmental democracy and environmental regulations cause a country's per capita income. The bidirectional causality is found between environmental regulations and environmental corruption on the one hand, while environmental regulations and environmental politics Granger cause each other on the other hand. The results show the importance of environmental regulations in managing

ecological corruption and politics across countries. The variance decomposition analysis suggested that environmental politics likely influenced the environmental sustainability agenda, followed by government effectiveness and environmental democracy for the next ten years. The study emphasized the need to design an efficient environmental governance framework that minimizes environmental corruption and enables them to move towards environmental democracy, stringent environmental laws, and regulations. Government effectiveness would mainly be linked to reducing corruption and political instability to achieve clean, green and sustainable development.

Key words: environmental sustainability rating, environmental governance indicators, environmental regulations, government effectiveness, switching regression

Streszczenie

Niewłaściwa alokacja zasobów gospodarczych i środowiskowych szkodzi Agendzie ONZ na rzecz zrównoważonego rozwoju, która pozostaje wyzwaniem dla decydentów, aby powstrzymać negatywne trendy za pomocą skutecznych mechanizmów zarządzania. W ramach tego studium opracowano efektywne ramy zarządzania środowiskiem poprzez rozszerzenie zakresu różnych czynników zarządzania związanych z ocenami poziomu zrównoważenia środowiskowego wśród 67 krajów. Wyniki pokazują, że korupcja środowiskowa (system-1), polityka środowiskowa (system-2) i prawo środowiskowe (system-2) ujemnie korelowały z oceną zrównoważenia środowiskowego, podczas gdy demokracja środowiskowa (systemy-1 & 2) pozytywnie skorelowane są z Agendą zrównoważonego rozwoju środowiska w różnych krajach. Zarówno skuteczność rządu, jak i dochód kraju na mieszkańca podnoszą oceny zrównoważenia środowiskowego. Wyniki są zgodne z teorią Demopolis, efektywną teorią regulacji oraz teorią prawa i polityki. Szacunki przyczynowości pokazują, że korupcja środowiskowa i skuteczność rządu wpływają na politykę środowiskową i wzrost gospodarczy. W przeciwieństwie do tego, demokracja środowiskowa i regulacje środowiskowe powodują wzrost dochodu na mieszkańca. Dwukierunkowy związek przyczynowy występuje między regulacjami środowiskowymi a korupcją środowiskową z jednej strony, podczas gdy regulacje środowiskowe i polityka środowiskowa Granger są ze sobą bezpośrednio związane. Wyniki pokazują znaczenie przepisów środowiskowych w zarządzaniu korupcją ekologiczną i polityką w różnych krajach. Analiza rozkładu wariancji sugeruje, że polityka środowiskowa prawdopodobnie wpłynęła na program zrównoważonego rozwoju środowiska, a następnie skuteczność rządu i demokrację środowiskową przez następne dziesięć lat. W badaniu podkreślono potrzebę zaprojektowania skutecznych ram zarządzania środowiskiem, które zminimalizują korupcję środowiskową i umożliwią dążenie do demokracji środowiskowej, rygorystycznych przepisów i regulacji dotyczących ochrony środowiska. Skuteczność rządu byłaby powiązana głównie z ograniczaniem korupcji i niestabilności politycznej w celu osiągnięcia czystego, zielonego i zrównoważonego rozwoju.

Słowa kluczowe: klasyfikacja zrównoważoności środowiskowej, wskaźniki zarządzania środowiskowego, regulacje środowiskowe, skuteczność rządu

1. Introduction

The word *Governance* refers to the set of policies and strategies that countries utilize to attain broad-based economic growth. The governments exercise different action plans to stabilize socio-economic and environmental issues and govern sound institutional policies. It remains at six main dimensions, i.e., voice and accountability, political stability, government effectiveness, regulatory quality, the rule of law, and control of corruption. The estimates of the stated governance indicators fall in the values between -2.5 (weak) to 2.5 (strong), which shows variability in the governance performance across countries. The countries ranked based on their percentile ranking ranges from 0 (lowest) to 100 (highest) rank. The given estimates are helpful to monitor the country's governance position in each index and help reach strong governance performance (WGI, 2021). The efficient governance framework is vital to safeguarding environmental and natural resources that need to be comprehensive and practical in all aspects, for instance, from the evaluation phase to governing the environmental system (Bennett & Satter-

field, 2018). The governance framework should be collaborative, linked to addressing communities and stakeholders to move forwards to resolve environmental issues (Gieseke, 2020). Environmental justice and ecological sustainability are the main policy factors for utilizing the environmental governance factors. The power-sharing from governments to the local institutions, communities and non-governmental organizations improve the governance framework. The governance framework should be equitable, fair, transparent, liable, broad, integrated, competent, and efficient (Savage et al., 2020).

Every year, the World Bank Group published different Country Policy and Institutional Assessment (CPIA) reports, mainly focused on twenty essential rating factors, including human resource rating, business regulatory rating, debt policy, economic management, revenue mobilization, public resource equity, financial sector performance, fiscal policy rating, gender equality, macroeconomic management, social inclusion, environmental sustainability rating, property rights, public sector management, budgetary quality, public administration quality, social protection, structural policies, trade rating, and public

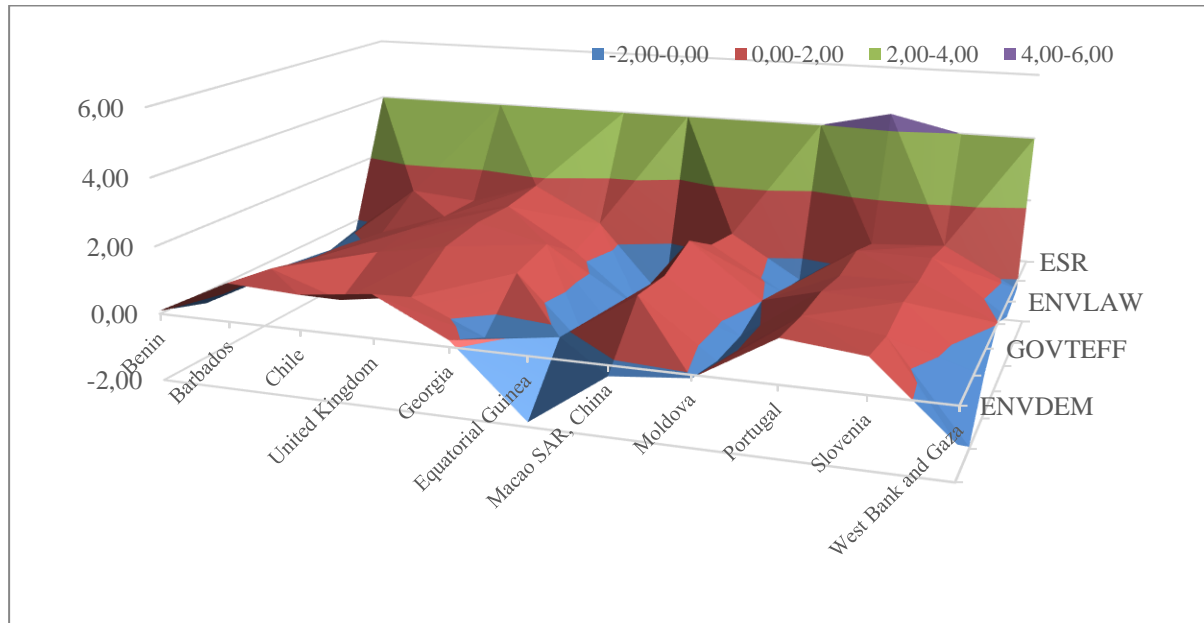


Figure 1. High-Rated Environmentally Sustainable Rating Countries ($ESR \geq 4$) and Few Positive Environmental Governance Indicators, source: World Bank (2020). Note: ESR shows environmental sustainability ratings, ENVLAW shows environmental laws, GOVTEFF shows government effectiveness, and ENVDEM shows environmental democracy.

sector governance rating. The scale is fixed in between 1 (low) and 6 (high) sustainability ratings. The study selected environmental sustainability rating among the twenty stated rating indices directly linked with governmental environmental policies to conserve ecological and natural resources, leading to the sustainable use of ecological resources to control negative environmental externalities (World Bank, 2021). Figure 1 shows high-rated environmental sustainability rating countries with a value greater than equal to four (out of six). Benin economy, in many cases, has negative governance indicator values in environmental politics, government effectiveness, regulations, laws, and corruption, while a country has a positive value in democracy. Equatorial Guinea, Macao, Moldova, and West Bank & Gaza have a negative value in democracy. Barbados, Chile, UK, Macao, Portugal, and Slovenia positively value political stability. Government effectiveness is weaker in the economies of Benin, Equatorial Guinea, Moldova, and West Bank & Gaza. The positive value of environmental regulations has been found in Barbados, Chile, UK, Georgia, Macao, Portugal, and Slovenia. Environmental laws and corruption are mainly found in Benin, Equatorial Guinea, Moldova, and West Bank & Gaza. Based on the crucial discussion, designing an efficient environmental governance framework is imperative to achieve a green and clean, sustainable agenda.

A more significant body of knowledge already exists for governance indicators and their impact on different socio-economic and environmental factors (Qureshi et al., 2019; Mazur et al., 2019; Adams et al., 2019). While very few scholarly works are pre-

sent to design and evaluate an efficient environmental governance framework (Thaler, 2021; Dressel et al., 2021; Reed et al., 2021; Peker & Ataöv, 2021). The present study builds an effective, sustainable environmental governance framework encompassing environmental justice and sustainability features to advance shared global prosperity. Cheng et al. (2020) argued that the Chinese economy faced severe difficulties in attaining environmental sustainability agenda because of the greater industrialization process, which ultimately increases emissions, water use and energy demand. The country is going forward to use a three-line environmental governance mechanism to minimize negative environmental externalities. The results conclude that efficient use of environmental governance framework would be helpful to attain the country's vision of green growth agenda. Van Assche et al. (2020) emphasized developing an efficient governance model that supports environmental integrity and sustainability to move forward towards global prosperity. Tang & Geng (2020) stressed the need to improve the environmental governance process that linked it with the wide-ranging valuation process of natural resource management, mitigate pollution sources, government effectiveness to manage public resources, and lawful activities. Lawless et al. (2020) suggested that societal norms as a mainstream environmental governance framework. It includes holding human rights about environmental protection, unlocking women's potential in the mainstream of all public and private spheres, and environmental protection, equity, and ecological justice. These features help to maintain social dignity, leading towards humanity. Gupta et

al. (2020) highlighted building an efficient governance framework that is accountable to the transparent system of public governance and moves forward towards attaining ecological conservation. Jager et al. (2020) discussed the positivity of the participatory and collaborative governance approach that likely influences ecological standards to meet the sustainability principle and is helpful for decision-making processes to reach out at some conclusive remarks. Ahmed et al. (2021) investigated the asymmetric relationship between governance factors and ecological footprints by using aggregated and disaggregate analysis in the context of the USA economy. The results show that economic globalization increases ecological footprints in a positive asymmetric shock while alleviates it with the negative asymmetric shocks. Further, positive shocks about social globalization improve environmental quality, linking it with political globalization to mitigate ecological footprints. The results emphasized the need to re-structure the environmental governance framework to absorb the negative environmental externalities of globalization worldwide. Moussa et al. (2021) considered a case study of the UK firms that publicly disclosed their environmental targets to perform efficiently in environmentally friendly production. The results show that the UK forms although compassionate about the environment and keen to achieve environmental set targets; however, there is greater variability and inconsistency reported about their disclosure of environmental targets. The results underlined the need to improve corporate disclosure policies about their environmental standards and targets that help manage stakeholders and communities' perceptions about their legitimacy. Nguyen (2021) stressed the need to improve institutional performance and uphold the law to improve tourism activities and environmental sustainability. The study considered more than three thousand tourism companies in Vietnam in the year 2018 and found the U-shaped relationship between the rule of law and foreign inbound tourism, underlined the environmental governance framework. The study underscored developing a better governance framework that reduces the conflict between the performance of the local and foreign tourism companies and the rule of law in a country. Kagaya & Wada (2021) argued that the environmental governance system should be well-organized and problem-solving up to the regional level, leading to its ecological conservation. Watershed management is the important task to control floods, efficient use of water resources, and river management, which is possible when the ecological governance system is tied up with the new environmental standards and sustainability principles. Aguilera et al. (2021) investigated the corporate actions about the environmental sustainability scoring under the environmental governance system that is tied up with the global financial system, regulatory

framework, and stakeholders. The corporate governance actors likely achieve ecological sustainability outcomes that make policies under the sustainability principles. Dressel et al. (2021) suggested that the collaborative governance approach is considered a good exemplary case that is valuable to minimize negative environmental externalities. The greater need to design an ecological governance framework should be flexible to utilize institutional factors to move forward towards a social learning process that benefits stakeholder groups. Jiang et al. (2021) concluded that coherent and efficient ecological governing policies support the effectiveness of government policies to improve air quality levels, leading the governing policies transparent, structurally adjusted, and symmetric disclosure of environmental policies. Gök & Sodhi (2021) collected and analyzed the environmental governance data of 115 countries from 2000 to 2015 and found that high-income countries enjoyed better governance practices that were helpful to improve their air quality indicators. On the other hand, the low- and middle-income countries need to be designed an eco-friendly governance policy to mitigate negative environmental externalities. Based on the literature review, the study formulated the following research hypotheses, i.e.,

H1: The green growth agenda is likely to be positively influenced by environmental democracy and shared political wisdom.

H2: Incentive-based regulations and government effectiveness likely to play their roles to achieve environmental sustainability agenda, and

H3: Environmental corruption is likely to influence ecological sustainability ratings, leading to environmental legislation negatively.

The study contributed to the existing literature from different perspectives. First, the study modified world governance indicators to environmental governance indicators using environmental sustainability ratings (used as a response variable in the study) to build an environmental governance framework in a large cross-section of data. Second, the study proposed three different theories related to the environmental governance framework, i.e., Demopolis theory (emphasis on environmental democracy and environmental politics), Effective regulatory theory (emphasis on government effectiveness and environmental regulations), and Theory of law and corruption (emphasis on environmental laws and environmental corruption). Based on the stated theories, the study built an efficient, sustainable governance system and possessed greater good governance indicators across countries. Finally, the study used the country's per capita income as a control variable related to environmental governance indicators and ecologically sustainable ratings, which gives synergy to the governance framework to move forward towards green development.

Based on the contribution, the study followed the three research questions that related to environmental sustainability, i.e., *to what extent environmental democracy and environmental politics influenced ecological sustainability ratings?* This question is leading the Demopolis theory that argued that greater environmental democracy would likely improve ecological sustainability ratings while impairs due to political instability. The second research question is about the theory of government effectiveness and environmental regulations, i.e., *does government effectiveness and incentive-based environmental regulations increases ecological ratings?* The effective regulatory theory contended that government policies and formal & informal environmental regulations help the world economies to move forward towards green development through contingent evaluation of willingness-to-pay for environmental protection and carbon pricing. Finally, the third research question is: *does environmental legislation and environmental corruption move together in the opposite direction against ecological ratings?* The stringent environmental laws help reduce dirty pollution, while environmental corruption deteriorates ecological sustainability ratings that need to be stabilized through efficient governance mechanisms to stop the rot.

The stated research questions derive the study's main objectives, which are as follows:

- i) To examine the role of environmental democracy and politics in improving ecological sustainability ratings in extensive cross-sectional data.
- ii) To assess the role of effective government policies and sound ecological regulations in enhancing green sustainability agenda, and
- iii) To investigate the impact of stringent environmental legislations and increasing corruption on environmental sustainability ratings across countries.

Based on the study's contribution, proposed set of research questions, and study objectives, the study moves forward to design an efficient environmental governance framework that encompasses all the important considerations of building any framework for their acceptability. The study achieved the stated objectives by utilizing sophisticated statistical techniques that help to formulate sound sustainability policies across countries.

2. Data and Methodology

The study utilized the number of world governance indicators concerning environmental sustainability ratings to form an environment governance indicator, i.e., environmental democracy (denoted by ENVDEM), politics (denoted by ENVPOL), effectiveness (denoted by GOVTEFF), regulations (denoted by ENVREG), laws (denoted by ENVLAW), and environmental corruption (denoted by ENVCOR).

The governance indicators taken from the World Governance database (WGI, 2021) have index values that fall between -2.5 (low governance) to +2.5 (high governance). Further, the data of environmental sustainability rating (denoted by ESR) and GDP per capita (denoted by GDPPC) were taken from the World Bank (2021). The ESR index value contains 1 (low) to 6 (high) sustainability rating data set while GDP per capita is in constant 2010 US\$. The cross-sectional data of 67 countries were used in the analysis for 2019. Table 1 in the appendix shows the list of countries for ready reference.

2.1. Theoretical Underpinning

The study makes sure the following theoretical considerations before designing the environmental governance framework.

- i) The framework covered all essential aspects of human development, including political aspects, social, and economic aspects.
- ii) Government, business entities, and civil society get equally benefited from the green reforms.
- iii) The suggested framework is broad and flexible, and it contains all aspects of public goods.
- iv) The environment and resource conservation agenda is considered a priority and in line with international standards.
- v) The command-and-control mechanism is introduced that is fair and easily applicable to all segments of society.
- vi) Environmental justice, equity, and sustainability are covered in the governance framework, leading to sharing at all levels.
- vii) Greater transparency, access to resources, and freedom of voice are used as governing factors in this framework.
- viii) Political reforms, capacity building, and policy integration are the key determinants of the governance system.
- ix) Well-defined policies, institutional reforms, and practical implications are linked with the framework.
- x) Legislative reforms, technical collaboration and innovation are suggested as a part of the governance framework.
- xi) Regulatory control, business disclosure, and management process streamline with the framework.
- xii) Structural forces, cultural beliefs, and political ecology are considered for the governance framework.
- xiii) Private property rights allow owners to manage resources better and link them with the market incentives that help design the governance framework.
- xiv) Environmental laws are applied in order to implement environmental policies forcefully for fulfilling the need of future generations, and

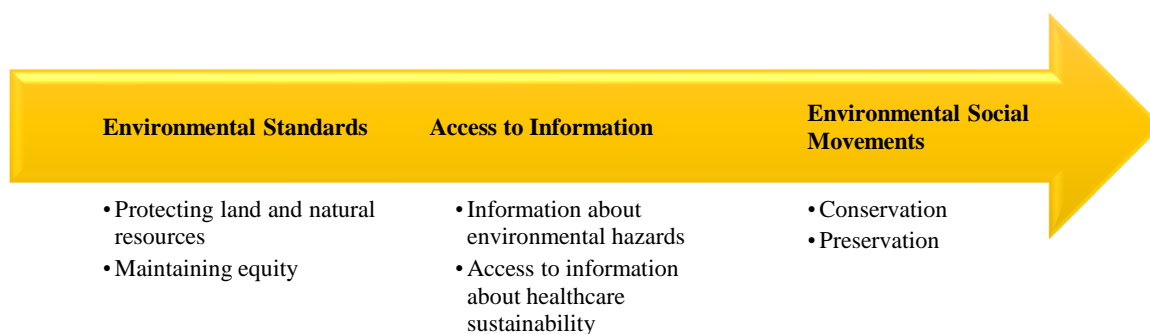


Figure 2. Structure of Demopolis Theory in Environmental Sustainability, source: Authors extract

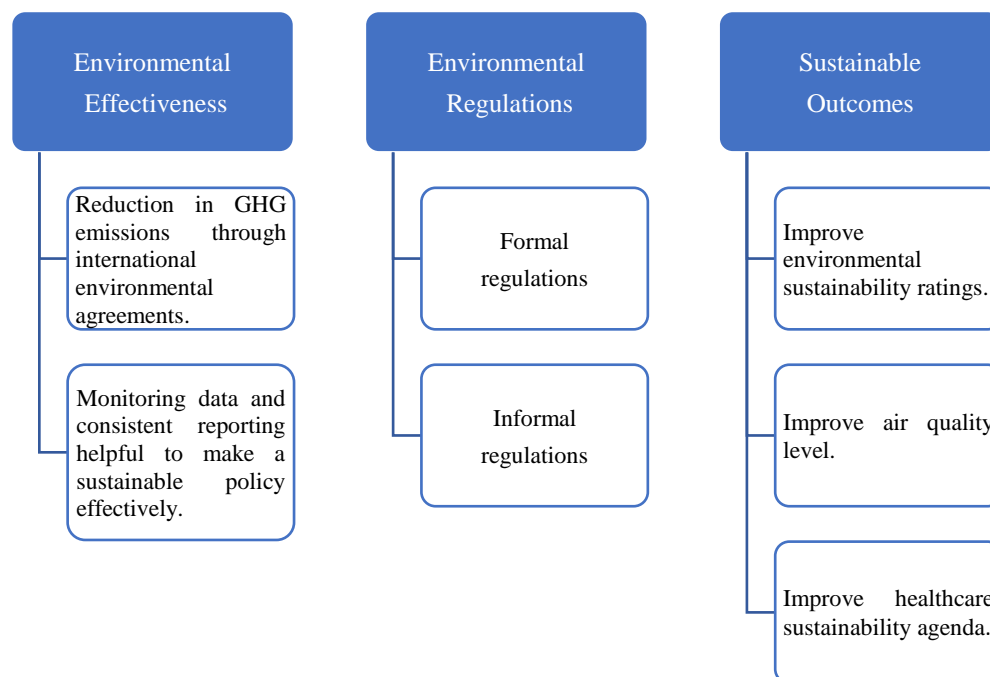


Figure 3. Effective Regulatory Theory, source: Self-extract

xv) Cross-scale governance is applied at the core of the environmental governance framework.

The stated fifteen points are ensured while preparing the environmental governance framework. The study gets benefited from the recent scholarly work of Partelow et al. (2020) and extended their eight suggested theoretical considerations for evaluating environmental governance theory into the three different theories and developed a more pragmatic and flexible governance framework for green development, i.e.

I) Demopolis Theory: The Demopolis theory emphasizes freedom of expression, freedom of voice, and accountability that remains feasible in the country's political structure to correspond to the governance system. The symmetric information is liable when the country has a more significant social interaction with the stakeholders, directly or indirectly associated with the economic and environmental problems (Wang et al., 2020). The study utilized Demopolis theory to achieve the environmental sustainability agenda by using democracy

and politics that remain helpful to improve sustainability ratings. Figure 2 shows the Demopolis theory in the green developmental agenda to move toward sustainable production and consumption.

Figure 2 shows that Demopolis theory stands out of three essential elements. First, it discusses how to maintain ecological standards that are helpful to protect land and natural resources on an equitable basis. Second, it discussed the rights to get information about environmental destructions and healthcare externalities, leading to legislation for damages—finally, the environmental social movements leading the environmental politics towards resource conservation and preservation for the future generation.

II) Effective Regulatory Theory: The Effective Regulatory theory greatly emphasized the need to devise stringent environmental reforms to reduce dirty production. The stated theory linked government effectiveness with ecological regulations to monitor environmen-



Figure 4. Theory of Environmental Laws and Corruption, source: Self-extract

tal and healthcare damages and moving towards a solid regulatory policy to combat the environmental evils, which deteriorating healthcare sustainability agenda. The incentive-based model to improve environmental quality always remains debatable in eco-centric theories, which remains a need to reach some conclusive remarks (Pasgaard et al., 2017). Technological development (Zhang et al., 2018), renewable fuels (Le & Sarkodie, 2020), cleaner production techniques (Gianetti et al., 2020), and carbon pricing (Anser et al., 2021) remains used in environmental regulations to subside the negative environmental externalities. Figure 3 shows the main elements of effective regulatory theory for ready reference.

Figure 3 shows that reliable data and reporting are helpful to devise green policies to mitigate GHG emissions effectively. Formal environmental regulations help to reduce negative environmental externalities through carbon taxes and emissions-cap trading (Zaman et al., 2021). The emerging awareness of environmentally friendly products leading the informal regulations to publicize information about environmental damages (Ramzan et al., 2019). The contingent evaluation technique can formally devise green policies based on willingness to accept or pay for environmental protection (Gupta & Chatterjee, 2021). The green outcomes would be improving environmental

ratings, air quality levels, and improving healthcare status worldwide.

III) Theory of Law and Corruption: The theory of law and corruption comprises environmental laws and corruption. Environmental laws were designed to reduce environmental corruption (Williams & Dupuy, 2017). The protection of environmental and natural resources is essential to move forwards to attain the United Nations sustainable development goals till 2030 (Qureshi et al., 2019). Pollution control laws, waste management, and cleanup costs all are associated with environmental laws (Rajmohan et al., 2019). The formal and informal environmental regulations align international environmental protection agencies to green policies (Coenen et al., 2021). Environmental corruption limits sustainable policies and economic agendas, fueling poverty, criminality, and biodiversity loss (Tacconi & Williams, 2020). The greater need to strengthen the governance reforms and international enforcement to reduce environmental corruption is vital for healthy well-being. Figure 4 shows the main possible elements of the theory of environmental laws and corruption for ready reference.

Based on the theoretical underpinning of the literature, the study formulated the environmental governance model, where environmental sustainability rating influenced the governance factors and the country's economic growth, i.e.

$$\begin{aligned}
 ESR_{67,2019} &= \delta_0 + \delta_1 ENVDEM_{67,2019} + \delta_2 ENVPOL_{67,2019} + \delta_3 GOVTEFF_{67,2019} + \delta_4 ENVREG_{67,2019} \\
 &+ \delta_5 ENVLAW_{67,2019} + \delta_6 ENVCOR_{67,2019} + \delta_7 GDPPC_{67,2019} + \varepsilon_{67,2019} \\
 \therefore \frac{\partial(ESR)}{\partial(ENVDEM)} &> 0, \frac{\partial(ESR)}{\partial(ENVPOL)} < 0, \frac{\partial(ESR)}{\partial(GOVTEFF)} > 0, \frac{\partial(ESR)}{\partial(ENVREG)} > 0, \frac{\partial(ESR)}{\partial(ENVLAW)} > 0, \\
 \frac{\partial(ESR)}{\partial(ENVCOR)} &< 0
 \end{aligned} \quad (1)$$

where ESR shows environmental sustainability rating, ENVDEM shows environmental democracy, ENVPOL shows environmental politics, GOVTEFF shows government effectiveness, ENVREG shows environmental regulations, ENVLAW shows environmental laws, ENVCOR shows environmental corruption, GDPPC shows GDP per capita, and ε shows error term.

Equation (1) shows that environmental democracy, government effectiveness, environmental regulations, and environmental laws are likely to influence environmental sustainability ratings positively. In contrast, environmental politics and environmental corruption are likely to affect sustainability ratings across countries negatively. Figure 5 shows the environmental governance framework for ready reference.

2.2. Econometric Framework

Based on the theoretical literature and supported argument to build an environmental governance framework, equation (1) is empirically estimated by the switching regression approach. Further, the causal inferences have been drawn based on Granger causality estimates. Finally, the forecasted relationship has been analyzed through variance decomposition analysis (VDA). Qnadt (1972) first derived the regime-based switching regression model that overcomes the mixture of generalized distributions in the regression. The sample is segregated based on either known or unknown sample separation. The a priori information about sample segregation in the underlying regimes leading to the known sample segregation; otherwise, it would lead to unknown sample segregation. The current study has some sample information, but this information is not enough to fall in the known sample separation; hence we used unknown sample separation in the two different regimes. The classical switching regression model is presented here that elaborated the equation (1) into two different equations, which includes regime-1 and regime-2 equations and standard equation, i.e.,

$$\begin{aligned}
 &\text{- Regime-1 \& 2 equations:} \\
 ESR_{67,2019} &= \delta_0 + \delta_1 ENVDEM_{67,2019} + \delta_2 ENVPOL_{67,2019} \\
 &+ \delta_3 ENVREG_{67,2019} + \delta_4 ENVLAW_{67,2019} \\
 &+ \delta_5 ENVCOR_{67,2019} + \varepsilon_{67,2019}
 \end{aligned} \quad (I)$$

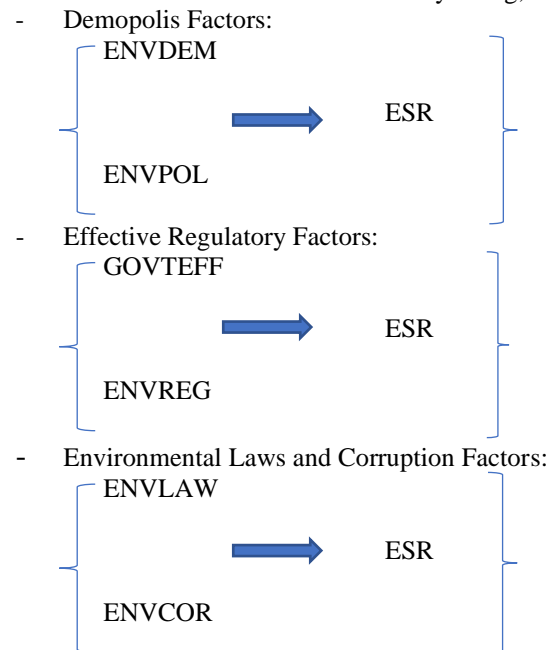
$$\begin{aligned}
 &\text{- Common equation:} \\
 ESR_{67,2019} &= \delta_0 + \delta_1 GOVTEFF_{67,2019}
 \end{aligned}$$

$$+ \delta_2 GDPPC_{67,2019} + \varepsilon_{67,2019} \quad (II)$$

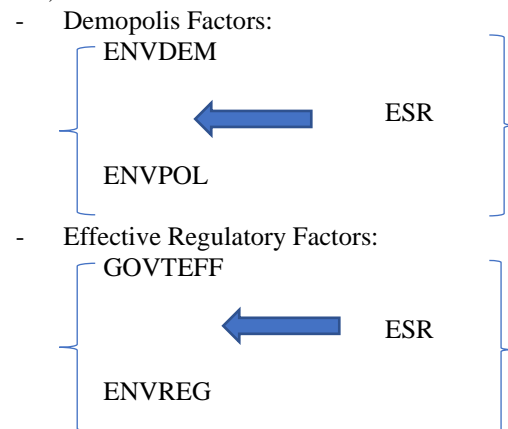
By combining equations (I) and (II), the switching regression equations become similar to the equation (1) as presented earlier.

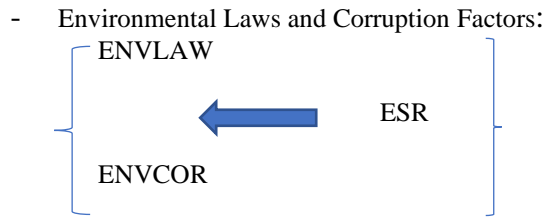
After estimating equation (1), the study moves forward to estimate cause-effect relationships between the governance indicators and environmental sustainability rating. The Granger causality test is applied on the cross-sectional data set and deduce the four possible causation between the stated variables, i.e.

Case I: One-way causation running from governance indicators to environmental sustainability rating, i.e.

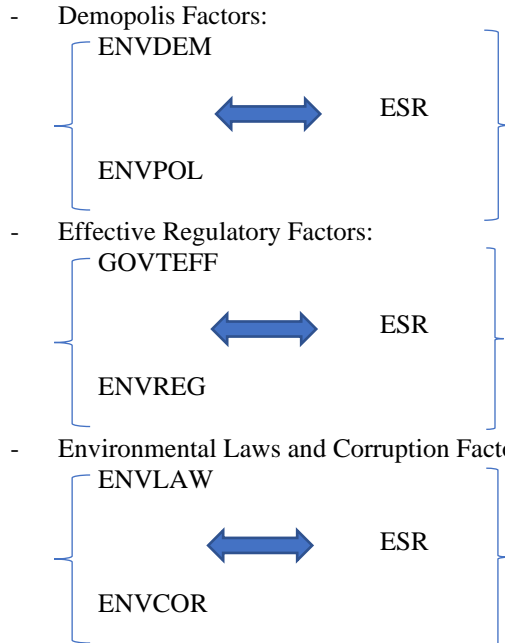


Case II: Reverse causation running from environmental sustainability rating to governance indicators, i.e.

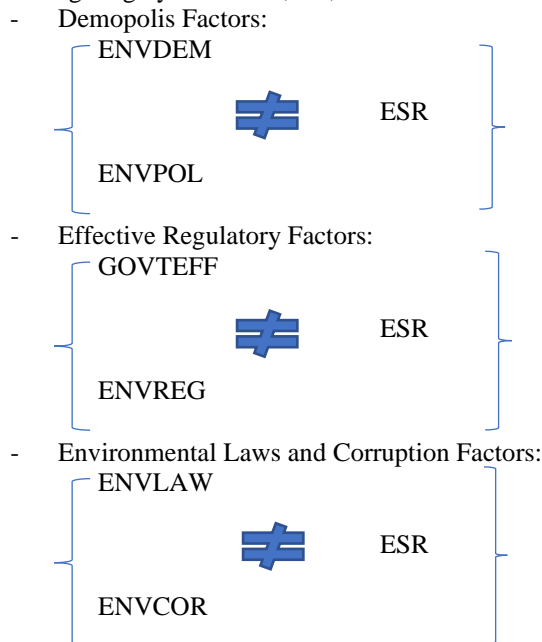




Case III: Two-way causation between governance indicators and environmental sustainability rating, i.e.



Finally, Case IV: No causation between governance indicators and environmental sustainability rating, although highly correlated, i.e.,



After estimating the causal inferences, the study analyzed the forecast estimates between the governance and environmental suitability ratings through the VDA approach. The variation between the gov-

ernance factors that influenced the sustainability rating can be accessed over a time horizon. The study forecasted the estimates for the next ten years' time period and observed the greater magnitude to influence governance factors to sustainability rating. The VDA estimates were calculated based on vector autoregression (VAR) modelling in a multivariate framework. Equation (1) can be decomposed into VAR framework to understand the VDA approach, i.e.,

$$Var(ESR) = E(Var[ESR/Environmental\ Governance\ Factors]) + Var(E[ESR/Environmental\ Governance\ Factors])$$

Where,

$E(Var[ESR/Environmental\ Governance\ Factors])$ = explained variation in the account of changes in the environmental governance factors,

while

$Var(E[ESR/Environmental\ Governance\ Factors])$ = unexplained variation in the account of other random factors other than the governance factors.

The VDA estimates show the fluctuations in the sustainability rating explained by the innovation of the governance indicators.

3. Results and Discussion

Table 1 shows the descriptive statistics of the variables. The average value of environmental governance indicators are mainly with a negative sign, i.e., environmental corruption, democracy, law, and environmental politics have negative values of -0.071, -0.063, -0.024, and -0.055, respectively, while environmental regulations and government effectiveness have a positive mean value of 0.062 and 0.019, respectively. The minimum value of the environmental sustainability rating is 2, while the maximum value is 4.5, with an average value of 3.291. The stated variable is negatively skewed and high kurtosis value. The mean value of per capita income is US\$2320.357. The negative trended values of the selected governance indicators show that environmental sustainability rating would be going down, leading the economies towards unsustainable production and consumption. The environmental governance mechanism should be transparent and equitable, helps to move towards global prosperity.

Table 2 shows that environmental governance indicators positively correlated with the environmental sustainability rating; however, environmental corruption, democracy, laws, and regulations negatively correlated with the country's economic growth, which remains the question of achieving global prosperity. Government effectiveness is the policy variable that is positively correlated with the rest of the governance indicators. Environmental law improves democracy while it increases environmental regulations and government effectiveness – the need for improving governance indicators is key to moving forward towards environmental sustainability.

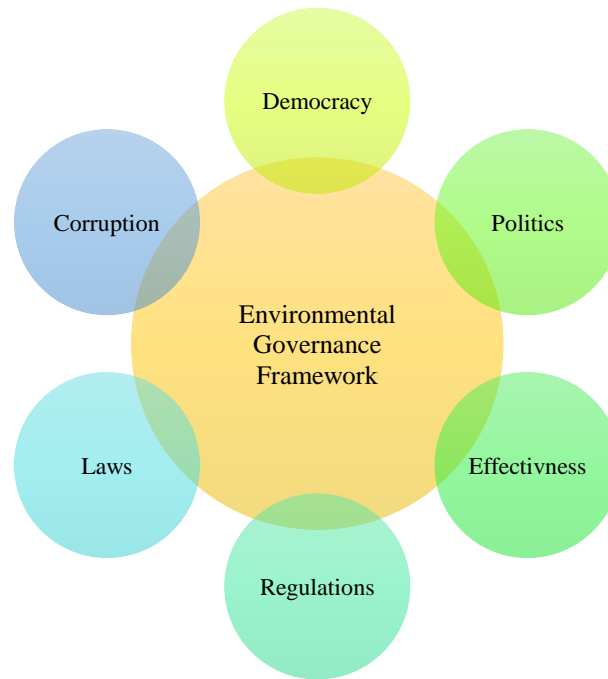


Figure 5. Environmental Governance Framework, source: Self Extract

Table 1. Descriptive Statistics

Methods	ENVCOR	ENVDEM	ENVLAW	ENVPOL	ENVREG	ESR	GOVTEFF	GDPPC
Mean	-0.071	-0.063	-0.024	-0.055	0.062	3.291	0.019	2320.357
Maximum	2.159	1.524	1.878	1.627	2.161	4.500	2.221	9350.748
Minimum	-1.773	-1.974	-1.969	-2.558	-2.048	2	-2.451	208.074
Std. Dev.	0.962	0.943	0.930	0.891	0.887	0.523	0.942	2201.947
Skewness	0.639	-0.254	0.389	-0.372	0.384	-0.458	0.197	1.731
Kurtosis	2.655	2.069	2.217	3.020	2.597	3.186	2.647	5.326

Note: ENVCOR shows environmental corruption, ENVDEM shows environmental democracy, ENVLAW shows environmental laws, ENVPOL shows environmental politics, ENVREG shows environmental regulations, ESR shows environmental sustainability rating, GOVTEFF shows government effectiveness, and GDPPC shows GDP per capita.

Table 3 shows the switching regression estimates and found that in regime-1, environmental corruption has a negative relationship with the environmental sustainability rating scale. In contrast, environmental democracy and environmental politics are positively associated with sustainability, leading the economy towards pragmatic and viable policy options. In regime-2, environmental democracy was positively affected, while environmental politics and laws negatively affected environmental sustainability ratings across countries. Government effectiveness and the country's per capita income increases environmental sustainability ratings, leading towards green and clean development. The results align with the earlier studies, which confirmed that environmental governance indicators improve sustainability rating to move forward towards attaining green growth agenda (Rajesh & Rajendran, 2020; Sun et al., 2020; Rajesh, 2020). Leal & Marques (2021) argued that economic globalization allows dirty polluting industries to set up their production plants into less regulated environmental economies to gain economic profit. Moreover, political globalization improves environmental quality by imposing

stringent environmental regulations to clear out the dirty industries. Environmental corruption and polluting industries can be restricted through incentive-based sustainable regulations. Ganda (2020) concluded that environmental corruption damaged the sustainability rating index, which needs to be limited through stringent environmental laws and regulations. Arminen & Menegaki (2019) found that climate and weather variations and corruption increases energy demand and carbon emissions, leading the global world into economic depression.

The results show that environmental democracy positively influenced the environmental sustainability rating in both regime-1 and regime-2. The result implies that freedom of expression to spread environmental views improves environmental quality to conserve ecological resources for future generations. Pickering et al. (2020) showed different challenges that democracy faced implementing the ecological conservation process, including the low level of public participation for willingness-to-pay for the environment, lack of expertise, governance issues, and limited ecological rights. These challenges are slowing down the governance process of improving envi-

Table 2. Correlation Matrix

Correlation								
Probability	ENVCOR	ENVDEM	ENVLAW	ENVPOL	ENVREG	ESR	GOVTEFF	GDPPC
ENVCOR	1							

ENVDEM	0.757	1						
	0.000	-----						
ENVLAW	0.937	0.762	1					
	0.000	0.000	-----					
ENVPOL	0.705	0.660	0.758	1				
	0.000	0.000	0.000	-----				
ENVREG	0.893	0.701	0.911	0.651	1			
	0.000	0.000	0.000	0.000	-----			
ESR	0.412	0.391	0.400	0.345	0.455	1		
	0.000	0.001	0.000	0.004	0.000	-----		
GOVTEFF	0.913	0.661	0.935	0.728	0.940	0.435	1	
	0.000	0.000	0.000	0.000	0.000	0.000	-----	
GDPPC	-0.099	-0.043	-0.089	0.019	-0.057	0.180	-0.107	1
	0.423	0.726	0.473	0.876	0.645	0.144	0.385	-----

Note: ENVCOR shows environmental corruption, ENVDEM shows environmental democracy, ENVLAW shows environmental laws, ENVPOL shows environmental politics, ENVREG shows environmental regulations, ESR shows environmental sustainability rating, GOVTEFF shows government effectiveness, and GDPPC shows GDP per capita.

Table 3. Switching Regression Estimates

Dependent Variable: ESR				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
C	2.979	0.093	31.708	0.000
ENVCOR	-1.167	0.278	-4.196	0.000
ENVDEM	0.263	0.128	2.042	0.041
ENVLAW	0.404	0.283	1.428	0.153
ENVPOL	0.473	0.106	4.451	0.000
ENVREG	-0.238	0.233	-1.021	0.307
Regime 2				
C	3.123	0.076	41.047	0.000
ENVCOR	0.235	0.200	1.177	0.238
ENVDEM	0.416	0.136	3.044	0.002
ENVLAW	-0.701	0.275	-2.549	0.010
ENVPOL	-0.521	0.151	-3.432	0.000
ENVREG	-0.109	0.198	-0.550	0.582
Common				
GOVTEFF	0.838	0.219	3.812	0.000
GDPPC	8.34E-05	2.16E-05	3.870	0.000
LOG(SIGMA)	-1.297	0.125	-10.360	0.000
Probabilities Parameters				
P1-C	-0.280	0.408861	-0.687195	0.4920
Mean dependent var	3.291	S.D. dependent var		0.523
S.E. of regression	0.541	Sum squared resid		15.232
Durbin-Watson stat	1.961	Log likelihood		-31.753
Akaike info criterion	1.425	Schwarz criterion		1.951
Hannan-Quinn criteria	1.633			

Note: ENVCOR shows environmental corruption, ENVDEM shows environmental democracy, ENVLAW shows environmental laws, ENVPOL shows environmental politics, ENVREG shows environmental regulations, ESR shows environmental sustainability rating, GOVTEFF shows government effectiveness, and GDPPC shows GDP per capita.

Table 4. Diagnostic Tests

Tests	Values	Prob. Value	Remarks
Jarque-Bera Test	0.657	0.719	Residual is normally distributed
Breusch-Godfrey Serial Correlation LM Test	1.499	0.231	Free from autocorrelation problem
Breusch-Pagan-Godfrey Heteroskedasticity Test	0.889	0.520	Homoscedastic
Ramsey RESET Test	0.398	0.691	Model is stable

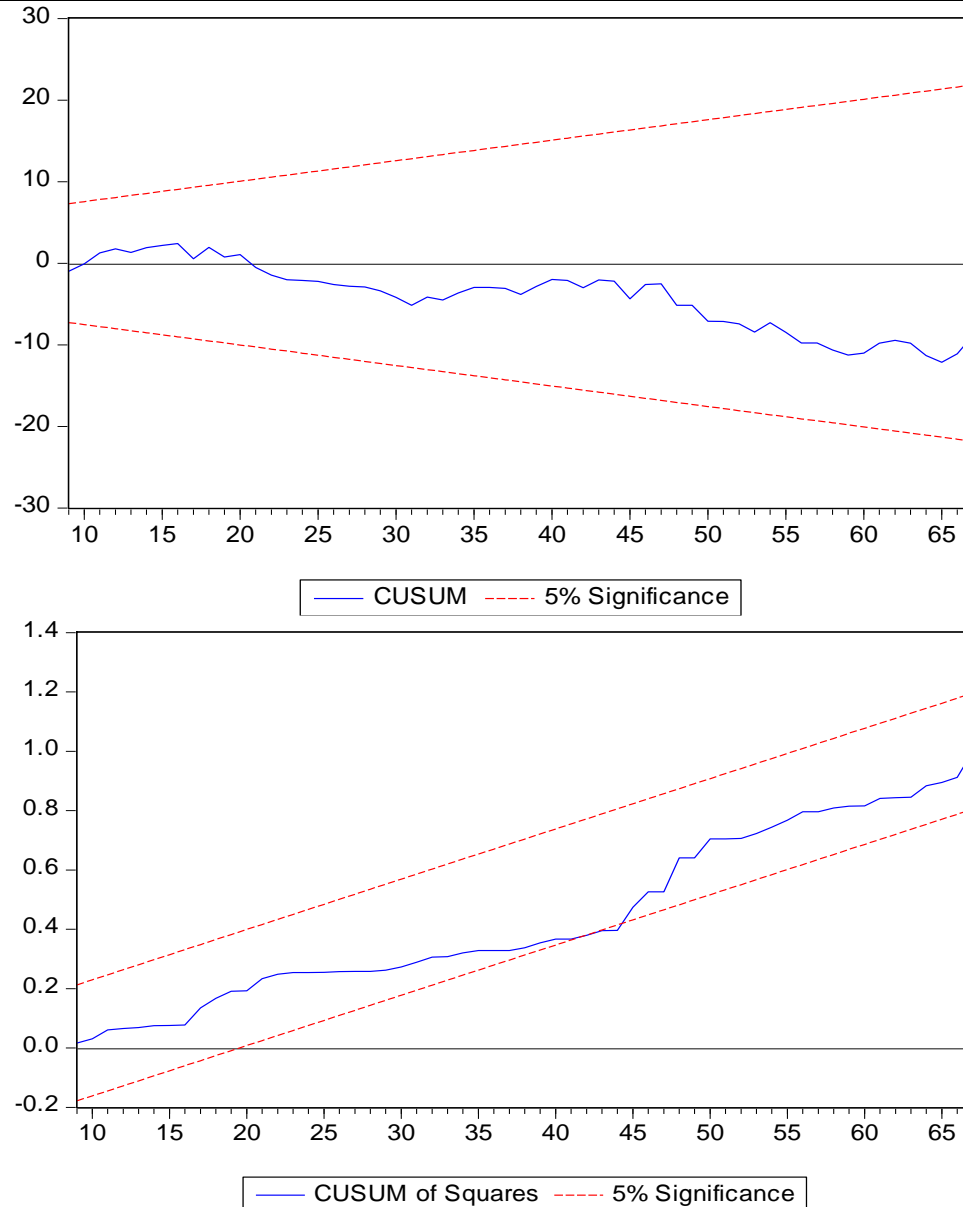


Figure 6. CUSUM and CUSUM Square Test, source: Authors estimation

ronmental quality. Haseeb & Azam (2021) found that corruption and democracy have a differential impact on carbon emissions. The former deteriorates the environment while later improves environmental quality, leading the economies toward more pragmatic solutions to stop the rot and improve democracy betterment of the future generation. Usman et al. (2020) argued that democracy is helpful to improve air quality levels and reduces negative environmental externalities.

The negative relationship found between environmental laws, politics, and ecological suitability rating in regime-2 apparatus implies that the imposition of stringent laws for the betterment of the environment leading deterioration in the sustainability ratings because of a higher level of environmental politics. Asongu & Odhiambo (2020) suggested that governance indicators need to be improved to tackle negative environmental externalities. Barbosa et al. (2021) confirmed the viability of imposing stringent

Table 5. Granger Causality Estimates

Unidirectional Causality		Bidirectional Causality	
Causal Factors	F-statistics	Causal Factors	F-statistics
ENVCOR→ENVPOL	2.698 (0.075)	ENVREG↔ENVCOR	3.199 (0.047)
GOVTEFF→ENVCOR	2.602 (0.082)		3.072 (0.053)
ENVCOR→GDPPC	3.500 (0.036)	ENVREG↔ENVPOL	5.673 (0.005)
ENVDEM→GDPPC	4.710 (0.012)		2.519 (0.089)
ENVLAW→ENVPOL	4.692 (0.012)	Note: ENVCOR shows environmental corruption, ENVDEM shows environmental democracy, ENVLAW shows environmental laws, ENVPOL shows environmental politics, ENVREG shows environmental regulations, GOVTEFF shows government effectiveness, and GDPPC shows GDP per capita. The small bracket shows the probability value.	
ENVLAW→GDPPC	4.064 (0.022)		
GOVTEFF→ENVPOL	6.563 (0.002)		
ENVREG→GDPPC	3.384 (0.040)		
GOVTEFF→GDPPC	3.067 (0.053)		

environmental laws to improve environmental quality. In the absence of environmental laws, the impact of environmental quality negatively affected human well-being and biodiversity loss. Hence, it is crucial to move forward to improve ecological standards through devising sustainable laws for resource conservation. Murshed et al. (2021) concluded that ecological footprints could be limited by imposing stringent regulations coupled with renewable energy that help move forward towards global prosperity.

The per capita income and government effectiveness played an essential role in improving environmental sustainability ratings, as continued economic growth and government efficient policies helpful to build solid institutional support that takes care of environmental resources and way forwards towards shared prosperity. Adekunle (2020) argued that governance factors are helpful to determine the role of environmental resources in attaining ecological sustainability. The regulatory quality and the rule of law are headed to transform the green development agenda through good governance reforms. The government effectiveness needs more caution to improve environmental quality to enhance institutional performance. Khan et al. (2021) concluded that sound institutional quality is helpful to draw a positive image of the country to the way forward towards attaining ecological sustainability, leading to improve regulatory bodies and utilizing a green energy mix that enables the world to progress for green growth agenda. Kamah et al. (2021) found that institutional quality intervenes in the growth-sustainability nexus to decrease environmental damages and support inclusive growth agendas. Table 4 shows the diagnostic testing estimates of the regression apparatus.

The results show that the Jarque-Bera statistics (used for assessing the normality of the residuals) are statistically insignificant; hence it accepted the null hypothesis that the residual of the regression estimates

is normally distributed. Further, the study used a serial correlation test and confirmed that the regression estimates have no such autocorrelation problem; hence the result is generally consistent and unbiased. The heteroskedasticity test is also in line with the other diagnostic estimates and confirmed that the residual of the regression estimates has constant variance. Finally, the model stability is checked by the Ramsey RESET test and confirmed that the model estimates are stable over time. Figure 6 shows the CUSUM and CUSUM square estimates for ready reference.

The CUSUM and CUSUM square test confirmed that the model is statistically significant at a 5% level; hence the given regression estimates are stable in the long run. Table 5 shows the Granger causality estimates and found that environmental corruption Granger causes ecological politics and per capita income, whereas environmental law and government effectiveness both Granger cause to environmental politics and economic growth. Further, government effectiveness Granger causes environmental corruption, while environmental democracy and environmental regulations Granger cause economic growth. Environmental regulation has a two-way linkage with environmental corruption, and environmental politics to support regulation led corruption and politics across countries. Based on the causal estimates, the study further moves to estimate forecasted variance decomposition error of environmental sustainability rating influenced by the environmental governance indicators.

The stability of the VAR model is essential before going to estimate variance decomposition analysis. The model stability can be checked by the inverse roots of AR characteristics polynomial. The AR inverse roots should be less than the unity, corresponding that the polynomial values remain inside the unit circle. Figure 7 clearly shows that the VAR model is

stable as the inverse roots of AR polynomial characteristics remain inside the circle and value less than the unity. Hence, the study safely moves to the estimates VDA model.

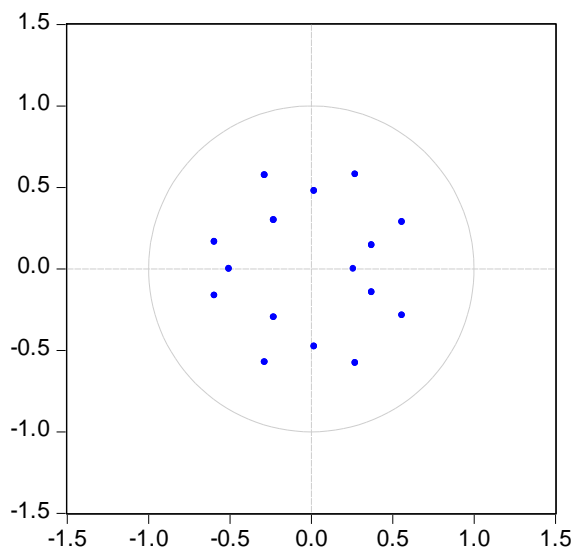


Figure 7. VAR Stability Test, source: Authors estimates

Table 6 shows the VDA estimates of ESR, indicating that shock to ESR account is 100% and 70.498% variability in itself in the first and tenth periods, respectively, which found a downward trend over the time horizon. Further, variability in the ESR from 0% to 2.533% can be explained by the innovation to corruption indicator, showing an increasing trend over the next ten years' time period. The other governance indicators, including environmental democracy, laws, politics, regulation, and government effectiveness, explained their innovation to ESR from 0% to 4.404%, 1.716%, 8.844%, 1.800%, and 8.657%, respectively. The per capita income explained their innovation on ESR from 0% to 1.545% over the time horizon.

The results further suggested that environmental politics will greatly influence ESR, followed by government effectiveness and environmental democracy, whereas the least influenced will be of per capita income on ESR over time. The results emphasized the need to propose sustainable policy implications to support the green developmental agenda across countries.

4. Conclusions and Policy Implications

The environmental governance framework comprises socioeconomic and political considerations related to sustainable development, which helps to reduce environmental corruption and promote laws, regulations, and fair politics to achieve a clean and green developmental agenda. This study offered a sustainable governance design to support government effectiveness indicators that help to improve environmental sustainability ratings in a cross-sectional panel of 67 countries. The results show that

environmental corruption, stringent environmental laws and environmental politics are the vital detrimental factors of the sustainability agenda that sabotaged the dream of fair economic and environmental resources. The causality estimates confirmed the corruption led economic growth, government effectiveness led political stability, democracy led economic growth, and environmental laws led politics across countries. Further, the two-way linkages between environmental regulations, corruption, and politics open new avenues of sustainability debate, leading the economy to be more vibrant and pragmatic in broad-based development. The forecasting estimates suggested that environmental politics, government effectiveness, and democracy would likely influence environmental sustainability rating for the next ten years. Based on the findings, the study proposed the following policy implications for making an efficient environmental governance framework worldwide, i.e.

- i) The cost of environmental corruption impairs economic and environmental resources. The lack of governance framework and ease of environmental policies leading the situation more worsen. The need to set up an anti-corruption unit, strengthen governance framework, harness environmental knowledge, and improve leadership qualities may minimize the stem of corruption worldwide.
- ii) The causes of environmental corruption are many, including inadequate transparency mechanism, distorted environmental policies, and political instability leading to more injudicious resource distribution that creates many social evils. The absenteeism of environmental laws and regulations further put pressure on the natural environment that negatively affects the countries' health and wealth. The need for a transparent mechanism for conserving natural resources and stringent government regulations may be helpful to achieve green sustainability agenda.
- iii) Environmental democracy is the sustainable policy option to revitalize economic and natural resource policies to equitably address the resource constraints and set a standard for meeting future generation needs. The right to information, equal participation and access to justice are the main ingredients of democracy used to prevent environmental resources. The Rio Declaration is mainly emphasized to access justice to reach the natural resource market to move forward towards a healthy environment. Public participation is imperative for sustainable development. Technocracy may allow ecological rights to limit environmental corruption.

Table 6. Variance Decomposition Analysis of ESR

Period	S.E.	ESR	ENVCOR	ENVDEM	ENVLAW	ENVPOL	ENVREG	GDPPC	GOVTEFF
1	0.513090	100	0	0	0	0	0	0	0
2	0.571078	81.23694	0.661115	1.978861	0.224227	6.913550	1.141690	0.201169	7.642446
3	0.589529	76.42874	0.727542	1.857895	0.600333	9.627328	1.296293	1.491724	7.970141
4	0.607248	72.36996	2.505920	4.127292	0.773061	9.091139	1.257067	1.454434	8.421128
5	0.615466	71.55775	2.441952	4.270633	1.411975	8.871668	1.348676	1.424033	8.673311
6	0.619353	70.77850	2.539362	4.386761	1.549510	8.877238	1.782131	1.500061	8.586432
7	0.620158	70.61555	2.532828	4.408625	1.638455	8.854890	1.778515	1.537606	8.633526
8	0.620734	70.52213	2.528741	4.401808	1.714441	8.842957	1.797102	1.540091	8.652727
9	0.620805	70.50607	2.532588	4.400996	1.716176	8.844541	1.800194	1.544916	8.654517
10	0.620843	70.49813	2.533942	4.404034	1.716086	8.844550	1.800116	1.545683	8.657455

Note: ENVCOR shows environmental corruption, ENVDEM shows environmental democracy, ENVLAW shows environmental laws, ENVPOL shows environmental politics, ENVREG shows environmental regulations, ESR shows environmental sustainability rating, GOVTEFF shows government effectiveness, and GDPPC shows GDP per capita.

- iv) The ease of environmental laws and regulations put many constraints on ecologically sustainable development that need to be effectively controlled by government intervention via carbon taxes and emissions-cap to reduce dirty production. The sustainable strategy calls for more environmentally friendly policies, leading the sustainability ratings more towards progressive development, and
- v) Environmental politics is all about politics related to the environment and its long-term sustainability. Environmental challenges cannot be minimized through knowledge and technological spillovers while it remains needed to opt for different environmental politics to fix environmental damages. Political solutions to tackle climate change is the foremost policy agenda to control global average temperature. Creating the international liaison is likely to improve the environmental sustainability agenda, which helps to get shared wisdom and green policies.

The improvement in the environmental sustainability agenda remains a dream for the environmentalists and government officials to make environmentally friendly policies and control dirty production through collaboration and technical expertise. The environmental governance framework is helpful to create a liaison between the community and their stakeholders and give autonomy to make pro-environmental decisions, which reducing negative environmental externalities. Environmental democracy, laws and sustainable regulations are helpful to the way forward towards healthy policies, which stop the rot and making economies more towards pragmatic solutions.

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Appendix

Table A: List of Countries

Countries (67)	Azerbaijan, Belgium, Benin, Burkina Faso, Barbados, South Sudan, Chile, China, Côte d'Ivoire, Congo, Rep., Colombia, Germany, Spain, United Kingdom, Georgia, Ghana, Guinea, Equatorial Guinea, Guatemala, Guyana, Honduras, Japan, Kazakhstan, Kenya, Kyrgyz Republic, Korea, Rep., Lao PDR, Liberia, St. Lucia, Liechtenstein, Luxembourg, Macao SAR China, Morocco, Moldova, Mexico, North Macedonia, Malta, Mongolia, Mozambique, Malawi, Malaysia, Namibia, Niger, Nicaragua, Pakistan, Portugal, Paraguay, Romania, Russian Federation, Samoa, Saudi Arabia, Singapore, Slovak Republic, Slovenia, Seychelles, Chad, Togo, Timor-Leste, Tonga, Trinidad and Tobago, Tanzania, Uganda, United States, Uzbekistan, Vietnam, Vanuatu, West Bank and Gaza.
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Efficiency Evaluation and Influencing Factors of Government Financial Expenditure on Environmental Protection: An SBM Super-efficiency Model Based on Undesired Outputs

Ocena efektywności i czynniki wpływające na rządowe wydatki finansowe na ochronę środowiska: model Super-efektywności SBM oparty na niepożądanych efektach

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Abstract

In recent years, the adoption of the precise approach for coordinating socio-economic growth and environmental protection to attain sustainable development has become an urgent challenge to be addressed in China. The current development of environmental governance and the efficiency of government financial expenditure on environmental protection (EPEE) deserves enormous attention. With the aid of the provincial panel data, this study emphasized on the use of the SBM super-efficiency model based on unexpected output to quantify the efficiency of China's government expenditure on environmental protection from 2013-2018 and constructed the Ordinary Least Squares (OLS) regression model to investigate the influencing factors of the government expenditure on environmental protection. The results of the efficiency measurement portray that the aggregate EPEE in China is unsatisfactory. The efficiency value for the western region is greater than that of the central and eastern regions, while the values obtained from the eastern region are above that of the central region. Population size and urbanization level have negative implications on the efficiency value, while the regional economic development level positively promotes the efficiency of the government expenditure on environmental protection. Finally, the corresponding countermeasures and suggestions for policy implementation are outlined accordingly.

Key words: the efficiency of government expenditure on environmental protection, unexpected output, SBM super-efficiency model, influence factor

Streszczenie

W ostatnich latach przyjęcie precyzyjnego podejścia do koordynacji wzrostu społeczno-gospodarczego i ochrony środowiska w celu osiągnięcia zrównoważonego rozwoju stało się pilnym zadaniem w Chinach. Na ogromną uwagę zasługuje obecny rozwój zarządzania środowiskiem oraz efektywność rządowych nakładów finansowych na ochronę środowiska (EPEE). Z pomocą danych panelowych z prowincji, badanie to kładło nacisk na wykorzystanie modelu super-wydajności SBM opartego na nieoczekiwanych wynikach do ilościowego określenia wydajności chińskich wydatków rządowych na ochronę środowiska w latach 2013-2018. Skonstruowano kwadraty (OLS) modelu regresji do badania czynników wpływających na wydatki rządowe na ochronę środowiska. Wyniki pomiaru efektywności pokazują, że zagregowany EPEE w Chinach jest niezadowolający. Wartość efektywności dla regionu zachodniego jest większa niż w regionach centralnych i wschodnich, podczas gdy wartości uzyskane

z regionu wschodniego są wyższe niż w regionie centralnym. Negatywnie na wartość efektywności wpływa wielkość populacji i poziom urbanizacji, natomiast regionalny poziom rozwoju gospodarczego pozytywnie wpływa na efektywność wydatków rządowych na ochronę środowiska. Na koniec nakreślono możliwe sposoby poprawy sytuacji i sugestie dotyczące wdrażania polityki.

Słowa kluczowe: efektywność wydatków rządowych na ochronę środowiska, nieoczekiwane wyniki, model super-efektywności SBM, współczynnik wpływu

1. Introduction

Since the introduction of the Chinese reform and opening up in 1978, the Chinese economy has been characterized by rapid development. Currently, China has been positioned as the second-largest economy in the globe, and it is playing an influential role in the world. Nevertheless, with the rapid growth of the Chinese economy, it has been bedevilled with heavy environmental costs to be paid accordingly. The extensive method of economic growth has increasingly led to huge environmental problems and brought severe challenges to sustainable development policies in China and other countries.

Recently, several countries have progressively attached great importance to the enormous impact of environmental problems such as climate change on human beings and actively held relevant international conferences, which have greatly contributed to improving the environment. United Nations conference on world environmental conventions held in Paris in May 2019 attracted the government of China to attach great importance to environmental governance and protection issues, and have taken a series of measures and formulated relevant policies to promote China's deep participation in global environmental governance actively. The policies implemented are evidenced in the 17th, 18th, and 19th annual National Congress of the Communist Party of China (CPC), respectively postulating the basic national policies of *saving resources and protecting the environment, promoting the construction of ecological civilization and increasing the protection of the ecological environment, and solving outstanding environmental problems*. Besides the central government initiatives, the provincial governments have also made positive contributions. The Jiangsu provincial government thoroughly studied and implemented the policy of the recent 19th National Congress of CPC, and issued the implementation suggestions on strengthening the ecological environment protection plans in an all-round way and resolutely pursuing pollution prevention and control, which put forward important measures to promote the high-quality development of Jiangsu's ecological environment and build a new Jiangsu which is *strong, rich, beautiful and civilized*.

The externality of environmental problems, the public good approach of environmental quality, and fuzzy property rights of environmental resources have led to market failure in the field of environmen-

tal economies, that is, the excessive use of environmental resources and insufficient supply of environmental treatment policy needs urgent government intervention to solve environmental pollution problems (Siebert & Siebert, 1998). The government expenditures on environmental protection are a vital protection measure for government intervention in environmental governance, and the efficiency of the government disbursement on environmental protection reflects the effectiveness of environmental governance and its improvement (Halkos & Paizanos, 2013; Kuai et al., 2019; Xu & Hu, 2020). Recently, the issue of how to coordinate economic growth and environmental protection to achieve sustainable development has been prioritized in China. As people progressively pay attention to environmental protection, it is expected that the government attaches great importance to the efficient utilization of the government expenditure on environmental protection.

Therefore, this study uses the inter-provincial panel data and the SBM super-efficiency model based on the unexpected output to measure and analyze the efficiency of government expenditure on environmental protection (EPEE) from 2013 to 2018, and then empirically investigate the influencing factors of EPEE based on OLS regression model, and puts forward corresponding countermeasures and suggestions for policy implementation to promote the efficient use of the government expenditure on environmental protection, and to promote the sustainable development process in China continuously.

2. Literature Review

The Data Envelopment Analysis (DEA), propounded by (Charnes et al., 1978), has been widely applied in measuring the EPEE. Also, (Biao, 2012; Wang, 2018; Zhang et al., 2019), used the DEA model to examine the EPEE in China. Their results indicated that the EPEE value obtained in the western region exceeds the eastern and central regions, which are in unison with the study results (Wang, B.; Liu, J., 2011). Conversely, a different conclusion was drawn by (Huang, 2011) suggesting that the DEA-SBM model applied to the EPEE in 30 designated provinces pointed out that the efficiency in the economically developed eastern region is generally greater than that of central and western regions. (Zhu et al., 2014) also used the DEA model to measure the efficient use of government expenditure concerning environmental protection and concluded that the efficiency of eastern and western provinces is congru-

ent but higher than that of central provinces. To add, (Sun, K.; Sun, 2016) used the data of the government expenditure on environmental protection in the Jilin Province, China and evaluated the EPEE in eight prefecture-level cities in Jilin Province using a two-stage DEA model, with an empirical analysis on the factors affecting the EPEE in each city with restricted dependent variables. The results indicated that the efficiency level of municipal governments is incongruent and should be greatly improved.

When using the DEA model, it is necessary to consider the evaluation index system of EPEE. Concerning the selection of input indicators, there is no doubt that much attention is given to financial, environmental protection expenditure. However, there is no uniform standard for the selection of output indicators. Most scholars enumerate the industrial *three wastes* (aggregate amount of industrial waste gas discharge, the aggregate amount of industrial wastewater discharge, and the aggregate yield of the industrial solid waste) as the main output indicators (Hongguo, 2015; Yongbin, 2015). (Cheng, C.; Chen, 2017) determining output indicators from three dimensions: local environmental pollution degree (total wastewater discharge, sulfur dioxide discharge), the local environmental governance capacity (domestic garbage removal), and the local environmental governance result (artificial afforestation area in that year).

In identifying the factors affecting the efficiency of government expenditure on environmental protection, (Dasgupta et al., 2002; Zhao, J.; Li, S.; Wang, 2020) revealed that the number of residents' complaints about environmental pollution depends on the government's emphasis on environmental pollution control, and the more complaints there are, the better the efficiency of government environmental protection. (Krajewski, 2016) depicted that there is a significant positive relationship between economic growth and government environmental protection expenditure. Moreover, an examination of the Tobit model to analyze the influencing factors of the EPEE depicted that government decentralization, regional economic development level, industrialization degree, and population size have negative effects on the EPEE, while population and education level have significant positive effects on the EPEE (Wang, Q.; Li, 2018).

Furthermore, (Amankwah-Amoah & Syllias, 2020) analyzed environmental sustainability initiatives and found that fostering environmental sustainability involves demonstrating concern for the environment and seeking to minimize environmental waste, resource depletion, pollution, and emissions that lead to enormous financial expenditure on resources. Reducing the environmental footprint of organizations through the adoption of measures such as Research and development, recycling, waste reduction, redesigning production and delivery systems, and incorporating environmentally friendly raw materials in

the production stages will minimize financial expenditure and carbon emissions (Aguilar-Hernandez et al., 2021; Petrović & Lobanov, 2020; Zafar et al., 2019). Therefore, the evaluation of the efficiency of China's government expenditure on environmental protection is of great significance.

To sum up, it is evidenced that a lot of domestic and foreign scholars have conducted in-depth research on the efficient utilization of the government expenditure on environmental protection, which has laid a solid research foundation for this paper, but there are still the following limitations that this seeks to address. To begin with, the measurement methods adopted by earlier scholars are relatively simple, without considering the slack part of efficiency and unexpected output. To add, the evaluation index system needs to be further improved. Again, the data used cannot be updated in time, making it difficult to reflect the new trend of the efficiency of Chinese government expenditure on environmental protection in recent years. Concerning these reasons enumerated, this study used the SBM super-efficiency model based on unexpected output and used six consecutive years of data from China as the research sample to measure the efficient use of the provincial governments' financial expenditure concerning environmental protection, and explore its impacting factors, to provide countermeasures and suggestions for promoting the EPEE in China, and to enrich the research knowledge in related fields.

3. Materials and Methods

3.1. The SBM Super-Efficiency Model of Unexpected Output

Data Envelopment Analysis (DEA) is widely applied to the efficiency measurement of the public sectors and Mathematical Economics because it can effectively eliminate statistical errors (Ahn et al., 1988; Farrell, 1957). DEA is a quantitative analysis method to investigate the relative effectiveness of comparable units of the same characteristics using the linear programming method according to the multiple input and output indicators. The basic DEA models are divided into two categories: the CCR model based on the constant return on the scale and the BCC model based on variable return on the scale, both of which are radial angles. Concerning the radial DEA model, the relaxation improvement is not reflected in the measurement of the radial distance efficiency value, (Tone, 2001) defined the SBM model as (Slacks-based Measure) to overcome the problem of variable relaxation in 2001. However, this model cannot further evaluate multiple decision-making units (DMUs) to distinguish their efficiency values. To rectify this defect, (Tone, 2002) proposed the use of the SBM super-efficiency model described as more complicated and not just an increase of the restriction condition of $j \neq k$. The super-efficiency value of effective DMUs is often considered to be

greater than 1 so that effective DMU can be distinguished. SBM super-efficiency is only applicable to effective DMU. For SBM effective DMU k , its non-oriented constant return to scale to SBM super-efficiency model is expressed as follows:

$$\min \rho_{SE} = \frac{\frac{1}{m} \sum_{i=1}^m \bar{x}_i / X_{ik}}{\frac{1}{s} \sum_{r=1}^s \bar{y}_r / y_{rk}}$$

$$s. t. \bar{x}_i \geq \sum_{j=1, j \neq k}^n x_{ij} \lambda_j$$

$$\bar{y}_r \leq \sum_{j=1, j \neq k}^n y_{rj} \lambda_j$$

$$i = 1, 2, \dots, m; r = 1, 2, \dots, s; j = 1, 2, \dots, n (j \neq k)$$

Where the effective production possibilities that can be constructed by the DMUs other than DMU k are described as:

$$\{(x, y): x \geq \sum_{j=1, j \neq k}^n x_{ij} \lambda_j, y \leq \sum_{j=1, j \neq k}^n y_{rj} \lambda_j\}$$

The projected value of (\bar{x}, \bar{y}) of the evaluated DMU of k in the SBM super-efficiency is the optimal solution of the model.

Again, (Tone, 2002) did not give the projected formula of the SBM super-efficiency model with unexpected output, so (Cheng, 2014) improved on the model and restructured the SBM super-efficiency model with unexpected output as follows:

$$\min \rho$$

$$= \frac{1 + \frac{1}{m} \sum_{i=1}^m s_i^- / X_{ik}}{1 - \frac{1}{q_1 + q_2} (\sum_{r=1}^{q_1} s_r^+ / y_{rk} + \sum_{t=1}^{q_2} s_t^{b-} / b_{tk})}$$

$$s. t. \sum_{j=1, j \neq k}^n x_{ij} \lambda_j - s_i^- \leq x_{ik}$$

$$\sum_{j=1, j \neq k}^n y_{rj} \lambda_j + s_r^+ \geq y_{rk}$$

$$\sum_{j=1, j \neq k}^n b_{tj} \lambda_j - s_t^{b-} \leq b_{tk}$$

$$1 - \frac{1}{q_1 + q_2} \left(\sum_{r=1}^{q_1} s_r^+ / y_{rk} + \sum_{t=1}^{q_2} s_t^{b-} / b_{tk} \right) > 0$$

$$\lambda, s^-, s^+ \geq 0$$

$$i = 1, 2, \dots, m; r = 1, 2, \dots, q; j = 1, 2, \dots, n (j \neq k)$$

Where the added constraint

$$1 - \frac{1}{q_1 + q_2} (\sum_{r=1}^{q_1} s_r^+ / y_{rk} + \sum_{t=1}^{q_2} s_t^{b-} / b_{tk}) > 0$$

can be eliminated during linear conversion. The DEA model for undesired output can be expressed as a negative number.

3.2. Indicators Selection and Data Sources

In this study, the efficiency of government financial expenditure on environmental protection in 30 designated provinces (municipalities and autonomous regions) is taken as the research object. However, data inadequacy concerning Tibet in China was not included in the research scope. To compare the effi-

ciency values among regions, 30 provinces (municipalities and autonomous regions) are categorized into eastern, central, and western regions according to their geographical location. The eastern region comprises 11 provinces and cities (Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan). The central region is also made up of 8 provinces (Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan). And finally, the western region is also made up of 11 provinces, cities, and autonomous regions (Sichuan, Chongqing, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang, Guangxi, and Inner Mongolia). This study selected the period spanning 2013-2018 for the analysis.

By drawing lessons from the previous studies and further considering the availability and authenticity of data, the input index selected for measuring the efficiency of the government expenditure on environmental protection in this study is the government expenditure on environmental protection of provinces (municipalities and autonomous regions) in each year, and the output index was selected from three dimensions, namely, environmental pollution reduction, environmental pollution control, and ecological environment quality. The wastewater discharge, the sulfur dioxide discharge, and the industrial solid waste production were selected as indicators to measure environmental pollution reduction. While the comprehensive utilization of industrial solid waste and the harmless treatment rate of domestic garbage are selected as indicators to measure environmental pollution control. The artificial afforestation area and green coverage rate of the built-up area within the period were also selected as indicators to measure ecological environment quality. Among them are wastewater discharge, sulphur dioxide discharge, and industrial solid waste production are undesirable output indicators. All the selected data used to analyze the variables in this study were collected from the China Statistical Yearbook 2014-2019.

4. Estimation Results and Discussion

4.1. Efficiency Value Analysis

In this study, the SBM super-efficiency model based on unexpected output is selected to quantify the efficiency of the government expenditure on environmental protection (EPEE) in the selected 30 provinces (municipalities and autonomous regions), and an in-depth analysis is carried out from the national level, the regional level, and the provincial level respectively. The estimation results obtained are shown in Table 1.

1) Analysis of the national-level

Table 1 reports the EPEE of 30 provinces from 2013 to 2018. It indicates the calculation of the average efficiency values of the selected provinces (municipalities and autonomous regions).

Table 1. The EPEE in China from 2013 to 2018

	2013	2014	2015	2016	2017	2018	Mean value for six years	National ranking
Beijing	1.020	1.037	1.011	1.008	1.047	1.145	1.045	4
Tianjin	1.016	1.019	1.015	1.020	1.023	1.045	1.023	8
Hebei	0.447	0.431	0.450	0.613	0.405	1.010	0.559	24
Liaoning	0.518	0.482	0.487	0.724	0.631	1.009	0.642	20
Shanghai	1.003	1.005	1.003	0.361	1.098	1.098	0.928	14
Jiangsu	1.004	1.002	1.002	1.001	1.001	0.563	0.928	13
Zhejiang	0.641	0.457	0.536	0.504	0.505	0.376	0.503	27
Fujian	1.029	0.777	0.501	0.238	0.233	0.260	0.506	26
Shandong	1.008	1.013	1.039	0.690	1.014	1.005	0.962	11
Guangdong	0.202	0.313	0.360	0.436	0.220	0.205	0.289	29
Hainan	1.303	1.312	1.322	1.296	1.274	1.233	1.290	1
Mean values of eastern region	0.835	0.804	0.793	0.717	0.768	0.814	0.789	-
Shanxi	1.081	1.094	1.100	1.057	1.002	0.875	1.035	6
Jilin	0.237	0.383	0.435	0.397	0.348	0.469	0.378	28
Heilongjiang	0.280	0.253	0.316	0.327	0.173	0.327	0.279	30
Anhui	1.015	1.040	1.048	1.036	1.035	1.035	1.035	7
Jiangxi	0.668	0.780	0.729	0.502	0.364	0.428	0.578	23
Henan	0.642	0.712	0.548	0.543	0.600	0.484	0.588	21
Hubei	0.578	0.832	0.501	0.561	0.517	0.498	0.581	22
Hunan	0.424	1.010	0.516	1.009	1.036	1.062	0.843	16
Mean values of central region	0.616	0.763	0.649	0.679	0.634	0.647	0.665	-
Sichuan	0.217	0.210	0.476	0.760	1.023	0.556	0.540	25
Chongqing	1.080	1.066	1.045	1.017	1.014	1.038	1.043	5
Guizhou	1.012	1.026	1.054	0.703	1.081	1.062	0.990	9
Yunnan	1.094	1.061	1.043	0.723	0.418	1.019	0.893	15
Shanxi	0.720	1.011	0.566	1.002	0.342	0.587	0.705	18
Gansu	0.458	1.018	1.057	1.088	1.042	1.085	0.958	12
Qinghai	1.254	1.243	1.279	1.198	1.244	1.366	1.264	2
Ningxia	1.066	1.099	1.064	1.175	1.061	1.094	1.093	3
Xinjiang	0.563	0.621	0.795	0.826	1.101	1.017	0.821	17
Guangxi	0.762	0.584	0.545	0.745	0.568	0.759	0.661	19
Inner Mongolia	1.019	1.049	1.017	1.027	0.730	1.037	0.980	10
Mean values of western region	0.840	0.908	0.904	0.933	0.875	0.966	0.904	-
Overall mean value	0.779	0.831	0.795	0.786	0.772	0.825	0.798	-

palities and autonomous regions) with their respective nationally ranked values. The initial 8 provinces include (municipalities and autonomous regions) whose efficiency value is greater than 1, accounting for 26.67%, and the remaining 73.33% are ineffective decision-making units. This portrays that the aggregate efficiency of China's EPEE is below par. The positive effect of the government expenditure on environmental protection is not harmonized with the rapid growth of environmental expenditure, which serves as the motivation and key focus of this study. In the subsequent sections, the researchers analyzed the changing trend of EPEE in China.

First of all, the change of the overall mean value from 2013 to 2018, as shown in Figure 1 below, depicts that it is in a relatively fluctuating state. The dynamic trend of the efficiency value experienced continual fluctuation until the end of the period. Secondly, by observing the values obtained for each year, the researchers identified that the mean efficiency value of each year never reached the effective Decision-Making Unit (DMU); however, the results

obtained were greater than 0.77. This demonstrates that, though there is an excess of government environmental protection expenditure in China, however, it fails to make maximum utilization of the government environmental protection expenditure assigned to reach the most effective utilization state. Again, the utilization rate is still at the intermediate stage, and there is an expectation of great improvement to be achieved in the successive periods. Finally, the maximum efficiency value rose to (0.831) in 2014 and then decreased in succeeding years. But the decline of the efficiency value was not huge; the lowest value reached (0.772) in 2017. The disparities between the maximum and minimum values were only 0.059. Through the analysis of the relevant policies implemented by the Chinese government, the researchers found that in 2013 China issued the Air Pollution Prevention and Control Action, which took effect in 2014, and the measures implemented produced a positive result, thus promoting the efficient utilization of the government expenditure on environmental protection in 2014. Based on the afore-

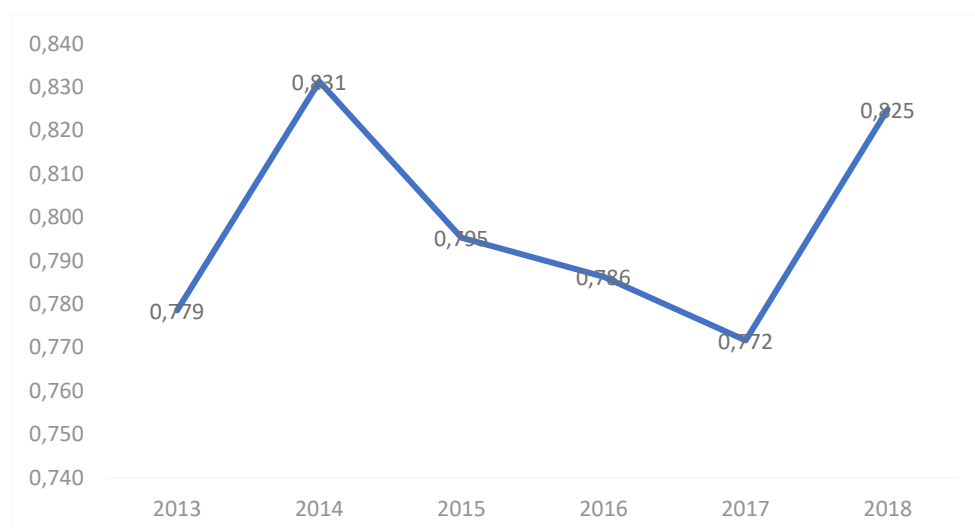


Figure 1. The changing trend of the overall mean value of EPEE from 2013 to 2018 in China

mentioned, water pollution prevention and soil pollution remediation policies were implemented in 2014. All the designated provinces (municipalities and autonomous regions) increased the financial expenditure on environmental protection. However, compared with air pollution treatment, water pollution prevention, and soil remediation, results are difficult to achieve in a short time. Therefore the efficiency value was projected to decline in the preceding years. Contrarily, it rose again in 2018. The central government of China has been playing a leading role in terms of environmental governance, with the vision that the development of the environmental protection sector depends on the change of government policies to a great extent. Suppose the Chinese government pursue the policy of attaining efficiency of the government expenditure on environmental protection to reach an effective unit. In that case, it must follow the operating standards of the market economy, optimize the allocation of resources through effective policy measures, and make every effort to promote environmental protection in China.

(2) Analysis of the regional level

The study selected 30 provinces (municipalities and autonomous regions) and apportioned them into the eastern region, the central region, and the western region, as shown in Figure 2 with an indication of the change in the trend of each region's efficiency value. From the analysis of Table 1 and Figure 2, it can be deduced that from 2013 to 2018, the efficiency values of all the regions showed a dynamic fluctuation trend. Specifically, the fluctuation trend of the western region displayed an upward trend; the eastern region showed a downward trend at the initial stage and climbed up, while the central region showed a downward trend at some point. It can be intuitively found from Figure 2 that the efficiency value of the western region is greater than that of the central and eastern regions, while the eastern region is slightly higher than that of the central region. Two main rea-

sons contributed to this phenomenon: one is the difference in developmental stages between regions, and the other is the gradual transfer of industries to inland areas in recent years. As far as the western provinces are concerned (municipalities and autonomous regions), most provinces have less developed industrial facilities, and tourism has become the key development industry.

Ecological construction, such as returning farmland to forests, protecting natural forests, and harnessing wind and sand sources, has further promoted the efficient utilization of government expenditure on environmental protection in China's western region. Put differently, the difference in industrialization degree among the three regions directly influences the difference in pollution emission and governance level, which is reflected in the level of efficiency and the use of government and environmental protection expenditures. Concurrently, the industrial transfer in recent years, especially the inland migration of the manufacturing industry, not only relieves the environmental pressure in the eastern region but also increases the environmental pressure in the central region, resulting in the lower efficiency utilization of government environmental protection expenditure in the central region than in the eastern and western region of China. Generally speaking, although there are differences in the level of efficiency in the use of government environmental protection expenditures among the three regions, the differences are not widely significant, and they are currently showing a trend of catching up with each other.

(3) Analysis of provincial level

Figure 3 shows the mean value of each province (municipalities and autonomous regions) from 2013 through 2018. Analysis from Table 1 and Figure 3 indicate the top five provinces (municipalities and autonomous regions) with the highest average efficiency values: Hainan (1.290), Qinghai (1.264), Ningxia (1.093), Beijing (1.045), and Chongqing

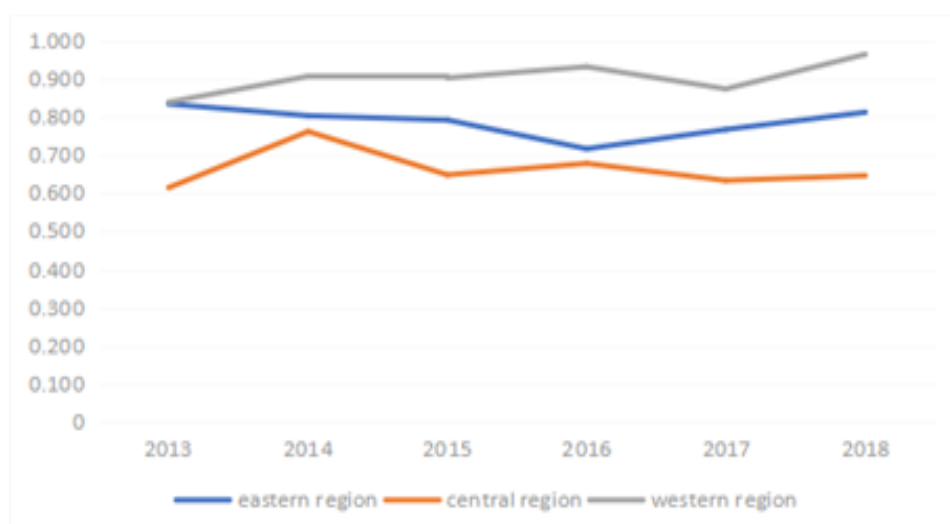


Figure 2. The changing trend of the EPEE in various regions

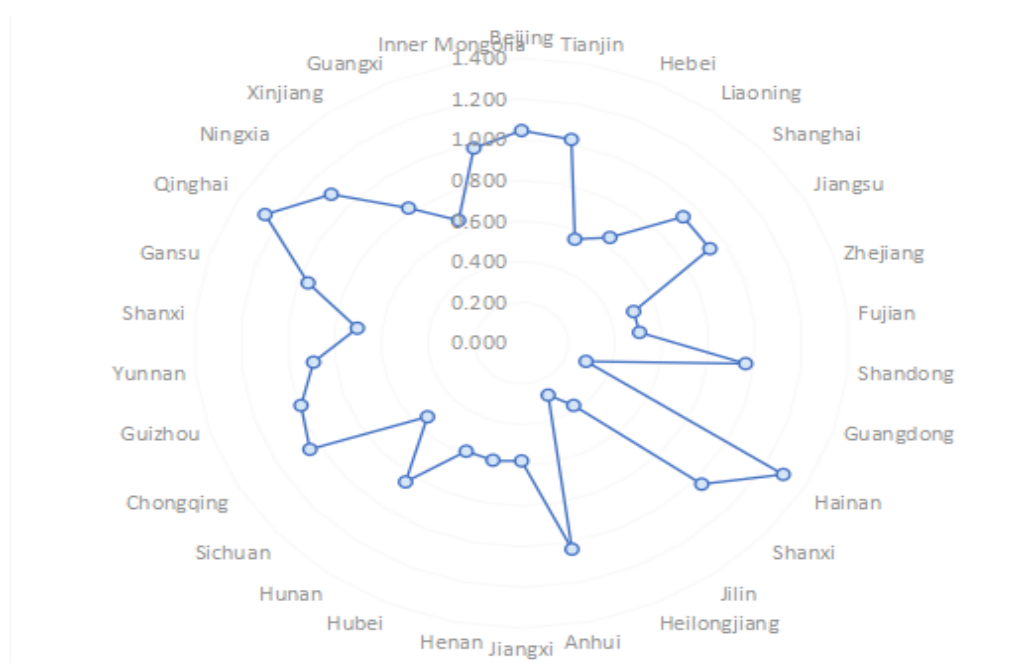


Figure 3. The EPEE of the 30 provinces (municipalities and autonomous regions)

(1.043), all of which are greater than 1. It is not weird to find that the top three provinces (autonomous regions) have the following common characteristics. Firstly, the population size of these three regions is relatively small, all of which are less than 10 million people, so they occupy a significant portion of pollution emissions. Secondly, these areas focus on the development of tourism, with pleasant climate and scenery, supplemented by the government's strong support and the gradual improvement of transportation system which attracts a large number of indigene and foreign nationals in recent years. In particular, Hainan Province, which ranks first, is vigorously developing the tourism industry, often referred to as the *smokeless industry*, which has reduced the pollution impact on the environment. From the period the State Council of the People's Republic of

China issued the Opinions on Promoting the Construction and Development of the Hainan International Tourism Island in the year 2010, the local government has regarded it as a major strategic plan and has paid full attention to the coordinated development of regional economy and the environment, and made efforts to initially put up a world-class island leisure resort in the year 2020. Although Ningxia is an economically underdeveloped region, the autonomous regional government has invested a lot of funds to enhance the progress of environmental protection in recent years. In 2018, Ningxia's government environmental protection expenditure accounted for 1.94% of GDP, significantly higher than the figure 1.27% obtained in 2013. Simultaneously, the autonomous region's government has strengthened supervision, thus promoting the efficient utili-

zation of government expenditure on environmental protection. The fourth and the fifth places are Beijing and Chongqing, respectively. Compared with some bigger provinces, it was realized that the municipalities that are directly under the central government are more convenient and centralized in terms of management, and their policies are better implemented. Concurrently, the implementation of environmental protection policies in these two regions is more accurate and efficient. As an illustration, Chongqing promulgated the Chongqing Environmental Protection Regulations and implemented unique environmental protection policies that fully use its constraints and benefits. As the political center of China, Beijing is even more aggressive in implementing environmental protection policies, giving full attention to the government's vision. In March 2020, Beijing issued the first internal regulation of the Communist Party in ecological, environmental protection, which put forward disciplinary requirements for the inspected projects and regulated and restrained the ecological, environmental protection inspection teams and directors.

The three bottommost provinces are Jilin, Guangdong, and Heilongjiang, among which Heilongjiang has the lowest average efficiency value (0.279). Guangdong also has low efficiency due to excessive capital investment and a large population as an economically developed province. The large size of the population base directly leads to an increase in supervision difficulty. Although the government has invested a lot of capital, it is difficult to attain efficiency, resulting in a waste of financial expenditure in various fields where supervision is cumbersome. The net effect is low efficiency. Jilin and Heilongjiang belong to the three northeastern provinces-former heavy industrial bases. Since the reform and opening-up policy was implemented in 1978, the coastal provinces and cities (such as Shanghai, Jiangsu, and Zhejiang) have achieved remarkable development as compared with the provinces along the prosperous Yangtze River Delta region, the development of Northeastern China, where heavy industry is concentrated, lags obviously.

It is evidenced that, for long periods, the three northeastern provinces did not place much emphasis on the development of light and tertiary industries, which led to the imbalance of industrial structure and paid a heavy environmental cost. The environmental problems keep accumulating over the years, and the backwardness of economic development directly leads to the inefficient use of the government expenditure on environmental protection in the Jilin and Heilongjiang provinces. Recently, the vision of promoting and revitalizing old industrial bases, vigorously developing the economy, and implementing environmental protection policy is key to the province. The Chinese Central Government and the local governments of the three northeastern provinces have taken active measures to strengthen environ-

mental protection and governance. The environmental protection work in the three northeastern provinces has been strengthened, and the environmental deterioration menace has been curbed. However, it will take time to catch up with the other advanced provinces (municipalities and autonomous regions).

4.2. Analysis of Influencing Factors

The EPEE in 30 provinces is measured by adopting the super-efficiency SBM model based on the unexpected output spanning the period 2013 to 2018. The analysis of this study includes a regression model to analyze the influencing factors further. In most previous studies, because the maximum efficiency value of 1 is considered to be the truncated value, most works of literature used the Tobit regression model. However, there is no truncation problem of efficiency value in terms of super efficiency, and it is not prudent to adopt a special Tobit of regression model to deal with truncated value. Therefore, this paper constructs the OLS model to analyze the influencing factors in detail.

By considering the available data, this study takes the EPEE as a dependent variable and takes population size (pop), regional economic development level (gdp), urbanization level (urban), industrialization level (indu), and population education level (edu) as independent variables. Regarding the acquisition of index data, this paper measures the population size via the aggregate population at the end of the year, measures the level of regional economic development via regional GDP, measures the urbanization level through the proportion of the urban population to the aggregate population at the end of the year, it also measures the degree of industrialization through the proportion of the value-added of the secondary industry to the regional GDP, and measures the education level of the population through the proportion of students in ordinary colleges and junior colleges to the total population. All the data used were gathered from the Chinese Statistical Yearbook from 2013-2018.

Table 2. Analysis of regression results

Variable	Coefficient	Sig.	Tolerance	VIF
pop	-0.460	0.000***	0.876	1.142
gdp	0.302	0.098*	0.139	7.218
urban	-0.306	0.097*	0.137	7.317
indu	-0.059	0.415	0.892	1.122
edu	0.017	0.821	0.857	1.167

Note: significance level indicating * means $p < 0.1$,
* * means $p < 0.05$ and * * * means $p < 0.01$

Table 2 presents the regression results of the factors affecting the efficient use of government expenditure on environmental protection in China. Firstly, the collinearity test is carried out by observing the tolerance and variance expansion factor (VIF) of each of the variables. It is assumed that when the tolerance is closer to 0, or VIF is greater than or equal to 10, it

indicates that there may be multicollinearity among the variables. It can be observed from the table below that the tolerances of all explanatory variables are greater than 0.1, and the VIF is lower than 7.5, so it can be concluded that there is no multicollinearity among variables, which can be included in the regression equation.

It can be observed from Table 2 that the population size negatively affects the efficient utilization of the government expenditure on environmental protection, and the coefficient of the efficient expenditure is -0.46, which passes the 1% significance level test. This demonstrates that the larger the population size, the lower the efficiency value. The reason may be that the population size is too large to produce a crowding effect, which leads to an increase in environmental governance costs. Besides, there is limited government investment in the field of environmental governance, and residents generally have insufficient knowledge on environmental protection policies which indirectly inhibit the growth of efficiency. For instance, areas with a large population face the difficulty of government supervision, which invariably leads to low-efficiency value.

The coefficient of the regression results obtained for the level of regional economic development and the efficiency of the government expenditure on environmental protection is significantly positive, which passes the 10% significance level test. This indicates that the higher the level of regional economic development, the higher the efficiency value. Emphasis can also be placed on Maslow's hierarchy of needs theory, which states that when the basic needs (the physiological and safety needs) are satisfied, people tend to pursue a higher level of life. Currently, with the continual growth of the economy, the expectation for people living in a specific environment and quality of life are increasing. For instance, in many first-tier cities, more and more people are willing to live in the suburbs with a better environment. Residents' expectation of environmental quality has brought gargantuan pressure to the government, thus invariably promoting the environmental governance level. Notwithstanding, the people's quality of life is generally high, and their awareness of environmental protection is relatively strong, which has played a positive role in promoting the efficient use of the government expenditure on environmental protection in economically developed areas.

Urbanization negatively affects the efficient utilization of the government expenditure on environmental protection. The coefficient of urbanization expenditure is -0.306, which qualifies the 10% significance level test. This result portrays that the utilization rate of the environmental protection funds is generally not high in areas of rapid urbanization. Modern urbanization is described as the urbanization of *migrant workers*. China's transformation from the agricultural population to the non-agricultural population has increased urbanization problems. With the

continuous influx of rural populations, the population scale has increased rapidly in urban areas, leading to higher resource consumption, negatively impacting the original urban functions and structures. Some external problems such as land, water shortage, atmosphere, urban noise, electromagnetic radiation, and environmental pollution have gradually emerged. Concurrently, most migrant workers are engaged in manual labor in Chinese cities. As a result, the urgent survival needs of migrant workers need to be addressed by the government, which indirectly leads to the investment impulse of local governments to a certain extent, resulting in government actions incompatible with the national environmental protection measures in China.

Theoretically, the degree of industrialization negatively affects the efficient utilization of the government expenditure on environmental protection, while the level of education affects the latter positively, but none of the effects is significant. To some extent, industrial development is the main source of environmental pollution. In areas with high industrialization levels, industrial wastes, as well as the amount of resource consumption, are the contributing factors for environmental pollution.

This study reveals that the regression coefficient of the industrialization degree is not significant. The initial reason is attributed to the Central Government of China's promotion, transformation, and upgrading of the industrial structure leading to the acceleration and transformation of economic development. The second reason is that the vigorous guidance of the Chinese Government and the active cooperation of Chinese people enhance the green and healthy development of China's industries. Hence, Chinese industrial development is no longer at the expense of environmental damage as compared to the preceding periods.

The education level has not yet played a significant role in promoting the efficient use of government expenditure on environmental protection. In China, educational resources are relatively scarce, culminating in the low-level education standards, which indirectly leads to insufficient knowledge on environmental protection awareness of citizens. However, with the continued balanced development of China, as well as the distribution and mutual support of educational resources among different regions in China, it is anticipated that the educational level of the current generation is likely to have a significant positive effect on the efficient utilization of the government expenditure on environmental protection.

5. Conclusions and Policy Recommendation

This study used the SBM super-efficiency model based on the unexpected output to measure the efficient use of the Government's financial, environmental protection expenditure. The study also measures the efficiency value in detail by analyzing the na-

tional, regional, and provincial levels of EPEE to determine the changing trends in their mean values. Finally, a regression model is constructed to ascertain the influencing factors of the efficient utilization of government expenditure on environmental protection. The main conclusions derived from the study are enshrined as follows:

From an overall perspective of the study, the aggregate efficiency of utilization of the government environmental protection expenditure in the 30 selected provinces (municipalities and autonomous regions) in China has minimal fluctuation during the period 2013 to 2018, and the efficiency value has remained between 0.75 and 0.85. Although the maximum utilization of government environmental protection expenditure has not been realized, the overall efficiency value has remained at the intermediate level; results obtained indicate that there is still room for improvement in the subsequent period. The regional level analysis indicated some differences between the eastern, the central, and the western regions. The efficiency value of the western region is greater than that of the central and the eastern regions, while the eastern region is slightly above the central region. Also, the provincial-level analysis indicated that most provinces had not reached an effective state of decision-making units for a prolonged period. The province with the highest efficiency value is Hainan, and the province with the lowest efficiency value is Heilongjiang. The two provinces have wide differences in geographical location and industrial development, resulting in a difference in efficiency values.

The analysis of the influencing factors also indicated a significant positive correlation between the regional economic development level and the efficiency of the government expenditure on environmental protection. The size of the population and urbanization level impact the efficiency value negatively, while the industrialization degree and population education level has no significant impact on the efficient use of the government expenditure on environmental protection.

In connection with the above conclusions, this study proposes the subsequent countermeasures and suggestions:

First, the Chinese Central Government, which is serving as the leader of the environmental protection team and the maker of all decisions, should fully consider the difference between the eastern and western regions and formulate appropriate policies and measures that would eliminate the *one-size-fits-all* phenomenon in China. Simultaneously, the local governments should implement relevant policies to suit the local conditions by implementing policy innovations on time without deviating from the guiding ideology of the Chinese Central Government to improve the efficiency of the local government expenditure on environmental protection. Also, supervision is key in carrying out any effective tasks. The

environmental protection control department needs to be governed with a strict supervision system to ensure efficient utilization of resources. Studies have shown that environmental regulation mechanisms promote regional green technology innovation, improving the efficient utilization of government environmental protection expenditure (Guo et al., 2019). The Central Government should consider the series of challenges the regional supervision unit faces from a global perspective and implement a long-term development plan of supervision work with the rule of law. To ensure implementation effectiveness, responsibilities should be clearly defined, and the inspection of the performance of duties by local governments and their environmental protection agencies should be strengthened in China. Another factor worth consideration is to highlight the key functions of supervision and institute transformational measures from *mainly checking enterprises* to *simultaneously monitoring and supervising the government officials*. Further consideration should be geared towards the standardization of the supervision system and improving the supervision procedures through innovative supervision methods. Conversely, there should be openness and transparency in the process of supervision. Eventually, teamwork and platforms for deliberations should be instituted and strengthened to improve the quality of law enforcement for personnel and timely dissemination of information.

Second, it is suggested that the local governments should appropriately adjust the percentage of government expenditure on environmental protection efficiency based on performance. The empirical results of this study show that only 26.67% of the provinces have efficiency values greater than 1, and the remaining 73.33% representing the other provinces have not fully utilized the government expenditure on environmental protection, and there is a phenomenon of redundant expenditure. Therefore, the provinces that have achieved greater efficiency are expected to reduce pollution emissions, improve the waste utilization rate and increase the greening in their areas as soon as possible without reducing environmental protection capital expenditure. In terms of the regions with low efficiency, the scale of the government expenditure on environmental protection should be reduced reasonably to improve efficiency through the application of the funds. When deciding the proportion of the environmental protection expenditure to be invested, the central and local governments should fully consider each province's local economic development level, population size, and urbanization level before final disbursement is implemented.

In other words, institutions should not blindly make huge investments because of the high level of economic development, nor reduce their investment owing to the small population size. The institutions should comprehensively consider several influenc-

ing factors and rationally disburse the government expenditure. For example, Guangdong Province, which is an economically developed province, also has the characteristics of a large population and more migrant workers. Although it has invested a large number of financial grants to environmental protection funds annually, its efficiency is still second-to-last in line. The number of populations is a difficult factor to control in Guangdong Province because a large number of foreign workers are attracted to the place due to its standard of development. The large population size increases the environmental pressure and raises the problem of supervision in Guangdong Province. Further, Guangdong Province needs to strengthen its supervision policies and reduce government expenditure on environmental protection to upgrade its efficiency in using funds.

Third, environmental awareness is the embodiment of every citizen's comprehensive quality of life, which is highly related to the citizen's education level. The regression coefficient results obtained concerning the educational level and the efficiency of the government expenditure on environmental protection are positive. Although it is not significant, it demonstrates to a certain degree that the overall improvement of the educational level of citizens is conducive to the implementation of China's environmental protection policy. Emphasizing that if all the departments concerned in making decisions are to make better environmental protection policies, they should start with ideological education, strengthen the publicity of environmental protection, and make citizens consciously participate in environmental protection. Institutions can vigorously promote environmental protection public welfare policies; introduce the learning contents concerning environmental protection, garbage classification, and waste utilization into the classrooms of basic and secondary schools throughout China, and implement environmental protection propaganda work down to the grassroots level, and finally make every citizen realize that protecting the environment and resources of the nation is the duty of every citizen. If all individuals cultivate the habit of protecting their environment and agree to start from scratch, make joint efforts, and persevere, we can have clean water and blue sky for the current society and future generations in China and the entire globe.

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Data Availability

All data used are available and would be supplied upon request.

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Studies on Improving the Performance of Small and Micro Enterprises through Green Innovation

Badania nad poprawą wyników małych i mikroprzedsiębiorstw poprzez stosowanie zielonych innowacji

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Abstract

It is an important goal of China's 2025 Strategy to build an environmental governance system with the government as the leading role, enterprises as the main body, and social organizations and the public all participate actively. In this context, whether and how small and micro enterprises, as a force of rejuvenating the country through science and technology, participate in the construction of environmental governance system is discussed in this paper. This study uses the 12th China small and micro enterprise survey database to deeply analyze the direct and indirect effects between green innovation and small and micro enterprise performance, and finds that: in the direct effect analysis, the direct promotion effect of green innovation on the financial performance of small and micro enterprises is related to the development stage of small and micro enterprises, which is significant in the initial stage and mature stage, but not significant in the growth stage; in the indirect effect analysis, green innovation can indirectly improve the overall performance of small and micro enterprises by improving their environmental and social responsibility performance. At the same time, green innovation can amplify the role of other factors in promoting the overall performance. This study not only enriches the research scope of green innovation theory from the subdivision dimension, provides a new perspective for the integration of green innovation and social responsibility theory, it also provides theoretical reference and guidance for the green innovation practice of small and micro enterprises.

Key words: green innovation, environmental and social responsibility, performance of small and micro enterprises

Streszczenie

Ważnym celem chińskiej Strategii 2025 jest zbudowanie systemu zarządzania środowiskowego, z rządem odgrywającym wiodącą rolę, przedsiębiorstwami jako głównym organem i aktywnie uczestniczącymi organizacjami społecznymi i społeczeństwem. W niniejszym artykule omówiono, czy i w jaki sposób małe i mikroprzedsiębiorstwa uczestniczą w budowie systemu zarządzania środowiskiem. W badaniu wykorzystano 12. bazę danych ankietowych małych i mikroprzedsiębiorstw w Chinach, aby dogłębnie przeanalizować bezpośrednie i pośrednie

zależności między zielonymi innowacjami a wynikami małych i mikroprzedsiębiorstw. Stwierdzono, że: w analizie skutków bezpośrednich bezpośredni wpływ promocji zielonych innowacji na finanse wyniki małych i mikroprzedsiębiorstw jest związany z fazą rozwoju małych i mikroprzedsiębiorstw, jest ona istotna w fazie początkowej i dojrzałej, ale nieistotna w fazie wzrostu; w analizie skutków pośrednich zielone innowacje mogą pośrednio poprawić ogólne wyniki małych i mikroprzedsiębiorstw poprzez poprawę ich wyników w zakresie odpowiedzialności środowiskowej i społecznej. Jednocześnie ekologiczne innowacje mogą wzmocnić rolę innych czynników w promowaniu ogólnej wydajności. Niniejszy artykuł nie tylko wzbogaca zakres badawczy teorii zielonych innowacji z wymiaru podpodziałowego, zapewnia nową perspektywę integracji zielonych innowacji i teorii odpowiedzialności społecznej, ale także dostarcza teoretycznego odniesienia i wskazówek dla praktyki zielonych innowacji małych i mikroprzedsiębiorstw.

Słowa kluczowe: zielone innowacje, środowiskowa i społeczna odpowiedzialność, wydajność małych i mikroprzedsiębiorstw

1. Introduction

Statistics from the *Analysis and Prospects: Report on the Survival and Development of China's Small and Micro Enterprises* show that the total number of small and micro enterprises in China in 2019 be about 100 million. The 2014 European Commission report showed that small and micro enterprises accounted for 98.7% of the total number of enterprises, and employees accounted for 50.2% of the total number of employees (Targoutzidis et al., 2014). In 2018, the US Census Bureau showed that small and micro enterprises accounted for 95% of the total number of enterprises (US Census Bureau, 2018). Small and micro enterprises continue to develop on a global scale, their economic development mode is changing rapidly, and their employment absorption capacity is strong. They have become a propeller of regional growth and a regulator of social stability. Small and micro enterprises not only provide more jobs for the society, but also practice most of the innovation of technology and management and promote the development of economy. According to the national statistical yearbook of China, the final product and service value of small and micro enterprises accounted for more than 43% of GDP in 2018, and the tax payment accounted for more than 47%. In addition, about 50% of China's patent invention rights and 42% of new product development came from small and micro enterprises. Small and micro enterprises have become an important pillar of national economy and an important driving force of social development and play a pivotal role in social economy. Under the background of global high concern for sustainable development, China is also actively building the environmental governance system based on sustainable development. Because a large part of pollution in China comes from enterprises, enterprises play an important role in environmental governance practice, and small and micro enterprises are a force that cannot be ignored. As one of the sources of pollution, small and micro enterprises are not only the key monitoring objects of pollution prevention and control, but also an important carrier to promote green innovation and green production mode. Traditional view is that compared with large

and medium-sized enterprises, small and micro enterprises are often relatively conservative due to the restrictions of various resources and have high organizational commitment to traditional products. When facing risks, especially when their own survival and control rights are threatened, they are more willing to adopt the attitude of avoiding rather than preference, and then the willingness to innovate is lower (Cao et al., 2017; Chen et al., 2017). The green innovation that this research focuses on refers to the activities of small and micro enterprises to reduce environmental pollution through technological and product innovations to create new market opportunities to improve the overall performance of the enterprise. This activity has the dual attributes of environmental protection and innovation. In the process of implementing green innovation strategy, small and micro enterprises will face the dual pressure of environmental protection and innovation. Can they show stronger green innovation willingness than large and medium-sized enterprises? What are the specific driving factors? How to choose the path? The research on this issue is not only related to the sustainable development of small and micro enterprises, but also related to the sustainable development of China's economic and social environment.

This research can bring the following contributions. (1) By focusing on the subdivision dimension of green innovation, this paper reveals the impact of different indicators of green innovation on the sustainable development performance of small and micro enterprises, and deepens the existing green innovation theory; (2) By introducing the intermediary model and interaction model, this paper tests the indirect effect of green innovation on the sustainable development performance of small and micro enterprises, expands the channels for green innovation to play its value, and reveals the path of action between green innovation and the performance of small and micro enterprises; (3) It not only provides the possibility for small and micro enterprises to bring green innovation, corporate environmental social responsibility performance and corporate financial performance into the overall framework for systematic management, but also improves the theoretical extension of the impact process of green innovation on

corporate performance, and opens up new ideas for effectively improving the performance of small and micro enterprises and promoting the sustainable development of small and micro enterprises.

The research content of this paper is arranged as follows: the second section, literature review, to understand the impact of green innovation on enterprise performance and the role and motivation of green innovation of small and micro enterprises; the third section is the research design, select of green innovation indicators and corporate environmental and social responsibility measurement indicators, construct an analysis model of the direct and indirect effects of green innovation on the performance of small and micro enterprises; the fourth section analyzes the path of green innovation on the performance of small and micro enterprises; the fifth section is the conclusion.

2. Literature review

(1) Green innovation and corporate performance

Green innovation is an innovation composed of new or complete technologies, products, processes, services, and management concepts. It can not only realize value-added for enterprises, but also significantly reduce the adverse impact on the environment (Arfi, 2017). Green innovation is increasingly regarded as an important strategy for enterprises to obtain sustainable competitive advantage in the new arena (Chan, 2016), whose purpose is to make enterprises produce good environmental benefits, not just to reduce the pressure from the environment (Chen et al., 2018). Green innovation can effectively improve energy utilization using alternative energy, improvement of process and resource recycling, and promote cost minimization by reducing resource use, to ensure that the production and manufacturing processes of enterprises comply with environmental regulations and avoid environmental pollution penalties (Craig et al., 2006; Dangelico et al., 2019). As a forward-looking strategy to fundamentally solve environmental problems, green technology innovation can be reflected in the establishment of technical barriers and cultivation of long-term competitive advantages of enterprises through the dual value effect on environment and finance, it is the key factor for enterprises to occupy the market and realize sustainable operation (Chen et al., 2018; Calabrò et al., 2019). Green innovation can be divided into green process innovation and green product innovation (Fernando et al., 2019; Fu et al., 2019), green process innovation includes clean production technology innovation and end treatment technology innovation, which aims to reduce harmful substances, reduce pollutant emissions and improve energy efficiency by improving existing production processes or developing new processes (Gemechu et al., 2016).

The environmental characteristics of green product innovation can help enterprises to build differentiated competitive advantages (Ioannou et al, 2012), including establishing a good green image and improving social trust in the environmental performance of enterprises. At the same time, the differentiated advantages brought by green product innovation can help enterprises obtain environmental premium, thereby improving corporate financial performance (Jiang et al., 2016).

(2) The role and motivation of green innovation in small and micro enterprises

Most small and micro enterprises will face difficulties in financing, rising operating costs, and greater pressure on survival in the process of growth. Innovation can alleviate the degree of energy constraints and improve the performance of small and micro enterprises (TU et al., 2014). Compared with large enterprises, small and micro enterprises lacking resources and political influence are more dependent on favorable entrepreneurial environment, to continuously improve their ability to obtain external resources and survival opportunities, therefore, the innovation of external environment and internal operation is the key to improve the performance of small and micro enterprises at this stage (Li et al., 2015). Enterprises are deeply embedded in the external institutional environment, especially small and micro enterprises. In addition to being driven by internal profit creation, their strategic decisions will also be constrained by external institutional pressure. As far as the current external institutional pressure is concerned, small and micro enterprises mainly face the pressure from external stakeholders on natural environment protection and green mode of production, to achieve sustainable development, it is necessary to adopt green innovation strategies to respond to these institutional pressures and obtain the necessary legitimacy (Cao et al., 2017). Through a questionnaire survey on owners and managers of 211 small and micro enterprises, this paper explores the growth mechanism of small and micro enterprises from the perspective of resources, financing, learning and other innovation, and finds that the improvement of small and micro enterprises' performance should not only focus on the internal structure and policies, but also consider the external environment (Gemechu et al., 2016). Innovation input ability, innovation management ability, R&D and manufacturing ability, innovation output ability and innovation external environment all have a certain impact on the overall performance of small and micro enterprises (Jiang et al., 2016). The network membership of China's SME Industry Association will have an impact on innovation and enterprise performance, at the same time, innovation has a positive impact on the overall performance of small and micro enterprises (Qiao et al., 2014).

(3) Review of existing research

Existing studies have shown the importance of green innovation in improving the performance of small and micro enterprises, but there are also some shortcomings. First, green innovation can promote the performance of small and micro enterprises, but the existing studies only show whether it can improve the performance, and the implementation of green innovation will convey to the outside world the willingness of small and micro enterprises to actively abide by environmental regulations and meet green needs, however, there is a lack of research on how green innovation affects the sustainable development of small and micro enterprises. In practice, due to the different roles of environmental responsibility, enterprises will show different degrees of green innovation behavior. How small and micro enterprises should carry out green innovation and how to set more efficient innovation path need further analysis. Second, many scholars have studied the effect of green innovation on the performance of small and micro enterprises, but the existing literature mainly uses the resource-based view to analyze the impact of green innovation on corporate financial performance or environmental performance. However, under the background of global emphasis on the construction of environmental governance system, the coordinated development of financial performance and environmental performance can better evaluate whether small and micro enterprises can meet the requirements of sustainable development. For small and micro enterprises, they need to create the best financial performance to ensure their long-term viability in the market, it also requires the ability to provide products or services based on technologies that reduce environmental burdens and even generate environmental benefits. Therefore, this paper uses both financial performance and environmental social responsibility performance to comprehensively measure the sustainable development performance of small and micro enterprises. Third, although the existing studies agree that green innovation has a certain effect on the performance improvement of small and micro enterprises, there is a lack of quantitative research on the contribution. In view of the above shortcomings, this paper studies the path of green innovation promoting the performance of small and micro enterprises based on quantitative effect.

3. Research design

In order to ensure the scientific of the indicators and the availability of relevant data, we determine the indicators of green innovation based on *Corporate Social Responsibility Report* and *Annual Financial Report of Small and Micro Enterprises*, and analyze the indicators closely related to green innovation in the corporate social responsibility report and the annual financial report of small and micro enterprises, establish the green innovation evaluation index system

closely related to the performance of small and micro enterprises. Based on *Environmental Protection Corporate Social Responsibility Guidelines*, an index system of environmental social responsibility closely related to the performance of small and micro enterprises is established. In the aspect of performance measurement of small and micro enterprises, the return on total assets (%) in the annual financial report of small and micro enterprises is taken as the performance measurement index of small and micro enterprises. The research process includes three steps: first, selecting green innovation indicators, based on the *Fourteenth Five-Year Plan for National Economic and Social Development of the People's Republic of China and Outline of Vision Goals for 2035*, using literature analysis and factor analysis to analyze the elements related to green innovation; secondly, based on the *Environmental Protection Corporate Social Responsibility Guide*, the paper analyzes the elements related to the environmental social responsibility of small and micro enterprises by literature analysis and factor analysis; thirdly, analyze the direct effect of green innovation on the performance improvement of small and micro enterprises; fourth, analyze the indirect effect of green innovation on the performance improvement of small and micro enterprises.

3.1. Evaluation index of green innovation

According to the research viewpoints of Chen (2017), Chiou (2011) and Xie (2021), based on the comprehensive discussion of experts, this study subdivides green innovation into 12 indicators to measure. In addition, quoting the coding criteria of Mallin (2013) and Xie (2021) using content analysis to quantify environmental information, the evaluation methods of green innovation indicators are as follows: if the CSR report has a text description of the relevant indicators, the score is 1; if quantitative or detailed description is involved, the score is 2; if there is no description, the score is 0; The final value is the sum of the scores of all indicators.

The selected 12 green innovation evaluation indicators are shown in Table 1. Factor analysis is used to verify the correctness of index selection. The total variance explanation of the output results of factor analysis of 12 green innovation indicators shows that the first principal component is 80.63%. Kmo and Bartlett test results show that the green innovation system Kmo sampling appropriateness quantity is 0.892, and Bartlett sphericity test significance is 0. The data shows that the accuracy and consistency of index selection can be used for subsequent analysis and application.

3.2. Environmental social responsibility indicators of small and micro enterprises

In order to guide enterprises to fulfill their environmental protection social responsibility, promote the standardization and promotion of their social respon-

Table 1. Green innovation indicator settings and data sources

	Indicator	Literature sources	Data Sources
Green innovation	Green R&D investment/sales	Chen et al., 2001; Edwards, 2007; Chiou et al., 2011; Block, 2012; Aghion, 2017; Dangelico, 2019; Xie, 2021;	2014-2019 Corporate Social Responsibility Report
	End technology R&D investment/sales		
	Green technological transformation investment/sales		
	Green innovation auxiliary system investment/sales		
	Number of green innovation patents approved in recent five years		
	Impact of green process innovation on reducing environmental pollution		
	The impact of green innovation on reducing raw materials and operating costs		
	The influence of green innovation on the improvement of product performance and quality		
	Sales revenue of green new products / total sales revenue in recent 5 years		
	The market share of new green products for enterprises		
	Number of green products with green certification		
	Environmental friendliness of green products		

Table 2. Indicator setting and data sources of environmental social responsibility of small and micro enterprises

Indicator	Measurement method	Literature sources	Data Sources
Environmental costs	Percentage of pollution treatment fee in total product cost	Chen et al., 2001; Edwards, 2007; Chiou et al., 2011; Block, 2012; Aghion, 2017; Dangelico, 2019; Xie, 2021	2014-2019 Corporate Social Responsibility Report
Ecological compensation	Percentage of ecological compensation fee in total product cost		
Environmental organization Awards	Award level of world / national / local environmental protection organizations		
Certification	Years of ISO9000 and ISO14000 series certification		
Energy consumption	Energy consumption per unit value		
Environmental education and training	Percentage of environmental education and training cost in total training cost		
Green consciousness	The degree of understanding efforts of enterprises in guiding green consumption		
Green culture	The degree of green recognition in corporate culture		
Green personnel input	The number of green management personnel		

sibility behaviors, and promote the sustainable development of China's environmental protection enterprises, China Environmental Protection Industry Association organized 13 units to compile the first group standard on environmental protection enterprises' social responsibility in 2019: *Corporate Social Responsibility Guidelines for Environmental Protection*. According to the characteristics of the production and operation activities of environmental protection enterprises, there are 11 specific issues of environmental corporate social responsibility and their implementation suggestions were given as the core content, including: the enterprise decision-making and measures, undertaking public environmental responsibility, biodiversity protection, integrity and fair operation, NIMBY effect response, consumer service, cleaner production, occupational health and safety, innovation and application, supply chain management and information disclosure. Based on the analysis of specific issues and implementation suggestions of corporate social responsibility in the

corporate social responsibility guidelines for environmental protection, and referring to the studies of Christian (1997), Chen (2001), Ilias et al. (2018), this study selects 8 evaluation indicators of green innovation as shown in Table 2.

3.3. Sample selection and data sources

The data of this study mainly comes from the small and micro enterprises in the small and micro enterprise directory system. In view of the lack of a unified paradigm for the disclosure of environmental information by small and micro enterprises in China, we should learn from the existing research methods on enterprise environmental information disclosure (Albertini, 2014; Mallin et al., 2013), in addition to the second-hand data from wind and other databases, this paper mainly uses content analysis method to mine the CSR reports of heavy pollution small and micro enterprises from 2014 to 2019. In order to obtain reliable and comprehensive data, this study screened the research objects through the following

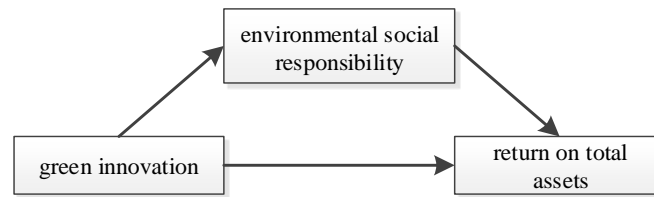


Figure 1. The mediating effect model of green innovation on return on total assets of small and micro enterprises

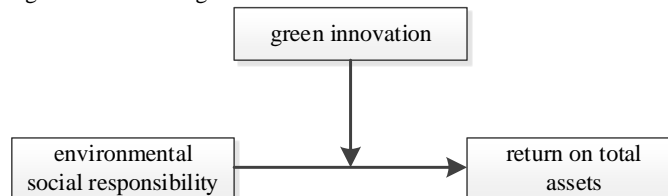


Figure 2. Interaction effect model of green innovation on return on total assets of small and microenterprises

steps: (1) collected 1900 small and micro enterprises which were recorded in wind database and small and micro enterprise directory system; (2) according to the Environmental Protection Verification Industry Classified Management Directory (HBH [2008] No. 373), 890 small and micro enterprises with heavy pollution were further screened out; (3) delete the small and micro enterprises that did not publish the CSR report from 2014 to 2019; Finally, the research data of 211 small and micro enterprises were obtained. Including metal and nonmetal industry, petrochemical and plastic industry, pharmaceutical manufacturing industry, textile and clothing industry, food manufacturing, agricultural and sideline products processing industry, paper and paper products industry, etc. Nevertheless, there are still 62 small and micro enterprises with missing data. In order to ensure the sample size, this study uses the regression interpolation method to fill in the missing values, and finally obtains the balanced panel data composed of a total of 1266 research samples of 211 small and micro enterprises from 2014 to 2019.

3.4. Analysis method of action path

According to the mutual influence and intermediary effect model of multiple factors proposed by Miller et al. (2014), this study first uses regression analysis model to analyze the direct effect of green innovation on the performance of small and micro enterprises; then, the intermediary model and interaction model are established to analyze the interaction of small and micro enterprises' environmental social responsibility index, green innovation index and small and micro enterprises' performance index.

Direct action model. In order to analyze the direct relationship between green innovation and the performance of small and micro enterprises, this paper takes the return on total assets (%) as the evaluation of the performance of small and micro enterprises and establishes a regression analysis model of the two. The life cycle stage of small and micro enterprises is considered in the analysis process. According to the enterprise life cycle and model of enterprise life cycle revised by Li (2015), 211 small and

micro enterprises are divided into three categories according to their life cycle stages: start-up small and micro enterprises (68 in total, with a duration of 0-2 years), growth small and micro enterprises (61 in total, with a duration of 2-4 years) and mature small and micro enterprises (82 in total, with a duration of 4-6 years).

Indirect action model. Based on the research of Edwards & Lisas (2007), Preacher & Hayes (2008), Jin & Liu (2021), this paper constructs the mediating effect model and interaction effect model respectively to analyze the interaction effect among environmental social responsibility index, green innovation index and performance index of small and micro enterprises. The model is shown in Figure 1 and Figure 2. Figure 1 is the mediating effect analysis model based on the indicators of environmental social responsibility of small and micro enterprises, in which green innovation is the independent variable, environmental social responsibility is the mediating variable, and the return on total assets of small and micro enterprises is the dependent variable. The percentile bootstrap method recommended by Zhang et al. (2016) and Hayes et al. (2013) will be used to test the mediating effect. Figure 2 shows the interaction effect model of green innovation on the return on total assets of small and micro enterprises, in which the environmental social responsibility index of small and micro enterprises is taken as the independent variable, the green innovation index is taken as the interactive variable, and the return on total assets is taken as the dependent variable. The study will use the SPSS macro (process) compiled by Hayes (2013) to verify the interaction.

4. Analysis of action path

4.1. Analysis of the direct effect of green innovation on the performance of small and micro enterprises

The bivariate correlation analysis results of green innovation index and return on total assets of small and micro enterprises show that they are significantly correlated at the level of $P=0.01$. A linear regression analysis was performed on the green innovation in-

dicators and the return on total assets of small and micro enterprises, and the path coefficient was 0.698.

In order to analyze whether there are significant differences in the relationship between green innovation index and small and micro enterprise performance in different life cycle stages of small and micro enterprises, the contribution value of green innovation index to the total return on assets of small and micro enterprises is constructed, which is defined as green innovation/total return on assets of small and micro enterprises. The discriminant function could explain 100% of the variance, and the correlation was significant at the level of $P=0.01$. The results show that the contribution value of green innovation to the total return on assets of small and micro enterprises has significant differences among the three stages, so it is necessary to carry out regression analysis for the three stages. The results of bivariate correlation analysis of green innovation and return on total assets of small and micro enterprises in the three stages are shown in Table 3.

Table 3. Correlation analysis of green innovation and return on total assets

Variable	Initial stage	Growth period	Mature period
Pearson correlation	0.298	-0.203	0.815**
Sig.	0.081	0.187	0
Number of cases	68	61	82

The regression results show that the green innovation in the start-up period is weakly correlated with the return on total assets at the P value of 0.01, and the linear regression path coefficient is 0.298, indicating that in the start-up period, the increase in green innovation has a certain degree of improvement in the performance of small and micro enterprises. Green innovation in the mature period is significantly related to the return on total assets at the P value of 0.01, and the linear regression path coefficient is 0.815, the improvement of green innovation has the most obvious effect on the performance of small and micro enterprises. The correlation between the two variables in the growing period is not significant, and the linear regression path coefficient is -0.203, indicating that the degree of effect in the growing period is not significant.

This phenomenon can be explained by the characteristics of the development stage of small and micro enterprises in China. In the early stage of small and micro enterprises, the company has fewer personnel, and the operation right and ownership are often concentrated on the entrepreneurs. The entrepreneurs have clear strategic ideas, have high enthusiasm for entrepreneurial prospects, and are willing to invest more time and money in improving the quantity of green process innovation and the performance and quality of products, which will slowly improve the performance of small and micro enterprises. In the growth period, 67% of small and micro enterprises

in China go bankrupt. At this stage, they will encounter two problems. One is that the enterprise has a certain turnover and scale and enters the preliminary standardized management. However, many management decisions still need the participation of the boss. If the management right and ownership are not separated, they will encounter management crisis. The other problem is that the boss's strategy is very scientific, however, the ability of employees cannot keep up, and the return on investment of green innovation may be extremely low. It takes a long time and high investment to reflect the performance of small and micro enterprises. Many of these problems make entrepreneurs doubt and even retreat from green innovation.

In the mature period, the enthusiasm of employees, the self-cultivation of leaders, and the core competitiveness of enterprises have reached a relatively perfect state. The innovation speed of green products, the number of patents approved for green products, and the sales revenue of green new products have enhanced and magnified other aspects of small and micro enterprises, showing the characteristics of high investment and high return, so as to efficiently produce the chain reaction of sustainable development.

4.2. Analysis of the indirect effect of green innovation on the performance of small and micro enterprises

The analysis of the correlation between the environmental and social responsibility indicators of small and micro enterprises, green innovation, and return on total assets respectively shows that there are 8 significantly related indicators under the condition of a P value of 0.05. There is only one index, green personnel input, which has no significant correlation with green innovation and return on total assets.

(1) Analysis of mediation model validation

Taking environmental cost as an example, this paper constructs the intermediary model between environmental cost and green innovation and small and micro enterprise performance, and the results are shown in Table 3. The total effect is the effect of green innovation on the performance of small and micro enterprises, which is significant at the level of $P=0.05$, and the path coefficient is 0.7813. It can be seen that improving the level of green innovation can directly affect the performance of small and micro enterprises. Taking the environmental cost as an example to construct the mediating model, the indirect effect of mediating variable is 0.3391, and the bootstrap 95% confidence interval of the mediating effect test of environmental cost does not contain 0, which indicates that the mediating effect of environmental cost between green innovation and small and micro enterprise performance is significant. The contribution of mediators to the total indirect effect was 43.40%. The mechanism by which green innovation affects the performance of small and micro enterpri-

Table 4. The mediating effect of green innovation on the performance of small and micro enterprises

Path	Effect value	Bootstrap	Bootstrap95% CI		Proportion of relative mediating effect
		Standard error	Lower limit	Upper limit	
Total effect	0.7813	0.0654	0.6387	0.9791	
Direct effect	0.4087	0.1193	0.2035	0.7084	
Indirect effect (Environmental costs)	0.3391	0.1981	0.1099	0.6121	43.40%
Total effect	0.7918	0.0654	0.6312	0.9436	
Direct effect	0.5143	0.1082	0.3154	0.7874	
Indirect effect (Environmental organization Awards)	0.2361	0.1157	0.0465	0.4965	29.81%
Total effect	0.7873	0.0724	0.6132	0.9532	
Direct effect	0.4452	0.0912	0.2643	0.6564	
Indirect effect (Certification)	0.3236	0.0653	0.1886	0.4527	41.10%
Total effect	0.7922	0.0724	0.6251	0.9569	
Direct effect	0.6012	0.0989	0.4087	0.8326	
Indirect effect (Environmental education and training)	0.1564	0.0542	0.0539	0.2543	19.74%

Table 5. Results of interaction effect of environmental social responsibility, green innovation and small and micro enterprises performance

Interactive path	Coefficient	Standard error	t	p	Interaction effect
Environmental cost * Green Innovation	0.1902	0.0793	2.4734	0.0152	0.3591
Ecological compensation*Green Innovation	0.1718	0.0654	2.5682	0.0094	0.3216
Environmental protection organization award * Green Innovation	0.2325	0.0712	2.8843	0.0045	0.4356
Certification * Green Innovation	0.2852	0.0883	3.1571	0.0198	0.5345
Energy consumption * Green Innovation	0.2107	0.0802	3.0162	0.0185	0.3916
Environmental education and training * Green Innovation	0.1865	0.0794	2.1365	0.0099	0.3431
Green consciousness * Green Innovation	0.1906	0.0713	2.0441	0.0083	0.3014
Green culture * Green Innovation	0.1638	0.0709	1.9512	0.0076	0.3122
Green personnel * Green Innovation	0.1927	0.0658	1.2508	0.0054	Nix

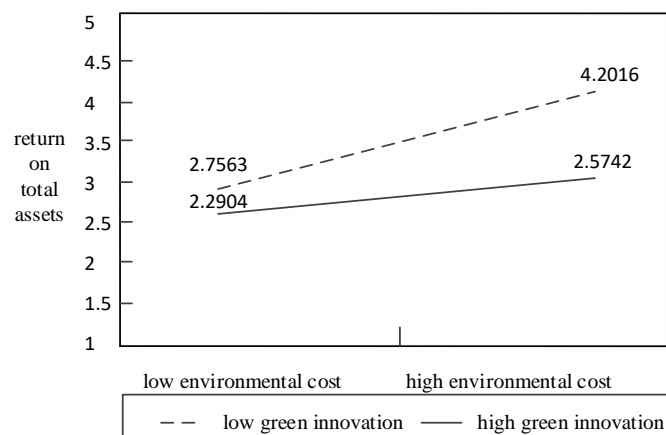


Figure 3. Relationship among environmental social responsibility (independent variable), green innovation (interactive variable) and small and micro enterprise performance (dependent variable)

ses through environmental costs is that as the level of green innovation increases, pollution treatment fees are reduced, and at the same time, corporate products meet environmental protection requirements and service satisfaction increases, which will expand the overall market for small and micro enterprises. Both of these aspects will affect its return on total assets.

Similar analysis is applied to other indicators of environmental social responsibility of small and micro enterprises. The results show that green innovation can indirectly promote the performance of small and micro enterprises through variables such as environmental cost, environmental organization reward, qualification certification, environmental education and training, as shown in Table 4.

(2) Interactive model validation analysis

The results of interactive model analysis are shown in Table 5. The results show that green innovation is an interactive variable that affects the relationship between environmental cost, ecological compensation, environmental organization reward, qualification certification, energy consumption, environmental education and training, green awareness, green culture and small and micro enterprise performance. Taking environmental cost as examples, in order to intuitively illustrate how interaction variables affect independent variables and dependent variables, we use the slope diagram of $M \pm 1SD$ for comparison (see Figure 3).

The simple slope plot of $M \pm 1SD$ shows that each pair of variables is an enhancement. The indirect effect analysis results show that green innovation has amplification effect, and green innovation is not a single factor to promote the performance improvement of small and micro enterprises, but a unified whole is formed by relying on environmental and social responsibility indicators and mutual conditions. Therefore, it can be said that green innovation enhances the impact of environmental social responsibility on the performance of small and micro enterprises, and the interaction effects are 0.5 and 0.5216 respectively. The interaction effect is calculated by the method in Reference Jin (2021) and Zhang (2016). The results are shown in Table 4. It can be seen from table 4 that the factors that green innovation has amplification effect on the environmental social responsibility performance of small and micro enterprises include environmental cost, ecological compensation, etc., while the indicator *green personnel* do not show amplification effect.

From the perspective of the relationship between environmental and social responsibility indicators and green innovation, at the micro level within small and micro enterprises, the increase in environmental costs is on the one hand the result of corporate environmental awareness, on the other hand, it is promoted by the improvement of the level of green innovation. Changes in environmental costs will significantly affect the resource allocation methods of small and micro enterprises. Increasing environmental costs is an inevitable requirement for improving the competitiveness of small and micro enterprises. At the macro level of society, the development of green innovation needs the improvement and implementation of government rules and regulations, education and incentive measures. In the process of economic development, China has been learning from foreign advanced production development and innovation systems, and has entered the society of green production. Green innovation means that green involves all aspects of the development of small and micro enterprises. The interaction between environmental social responsibility indicators and green innovation can be understood from the perspective of sustainable

development. With the active implementation of sustainable development strategy, green innovation emphasizes harmonious coexistence, and the improvement of green innovation level means that small and micro enterprises can maintain the stability of green and survival, ensure the green quality of products and services, form a virtuous cycle process, and produce spillover effects. Therefore, it can be said that green innovation is the only way for small and micro enterprises to obtain market leading advantages.

5. Discussion and conclusion

Due to the epidemic, most small and micro enterprises are currently experiencing serious declines in operating income and tight cash flow. According to a joint survey of 995 small enterprises conducted by Tsinghua University and Peking University, in 2020, 29.6% of small businesses' operating income dropped by more than 50%, 58% of small enterprises' business income dropped by more than 20%, and only 4% of small enterprises business income dropped by less than 10%. In addition, about 50% of small and micro enterprises in China are in the growth stage, and the effect of green innovation on improving performance may not be very significant at this stage. In this complex environment, whether small and micro enterprises should become more active green innovation promoters, and how to solve the problem of *harmonious coexistence* have become the most concerned issues of current managers.

When facing environmental pollution problems, the government's environmental regulations are important, but more importantly, it is to actively guide all kinds of enterprises to become active promoters of environmental protection, not just passive responders to environmental pressures. Therefore, how to effectively guide them to environmental protection and green innovation is a subject of both theoretical and practical significance. This study provides some support for small and micro enterprises to firmly follow the green innovation route. The study found that green innovation can directly improve the performance of small and micro enterprises, and there is a life cycle phenomenon in the direct promotion effect of green innovation on the performance of small and micro enterprises. When the development of small and micro enterprises is in the initial stage and mature stage, the direct effect of green innovation investment on the performance of small and micro enterprises is very significant; In the growth period, the direct effect is not significant. In addition, there is a significant interaction between green innovation and environmental social responsibility indicators of small and micro enterprises, which can enhance and enlarge the performance of small and micro enterprises, at the same time, it has amplification

effect on 8 indicators of environmental social responsibility of small and micro enterprises. These indicators provide clear guidance for the green innovation practice of small and micro enterprises. Combined with the conclusion of this paper, this paper mainly puts forward two policy suggestions. First, the incentive and qualification certification of environmental protection organizations present a strong indirect effect, indicating that the government can guide small and micro enterprises to carry out more green innovation activities through government regulation. Therefore, it is of positive practical significance to continue to adhere to and improve the formulation and implementation of green environmental protection systems and rules, which can not only enhance the long-term competitive advantage of small and micro enterprises, at the same time, it is also conducive to play the main role of small and micro enterprises in the process of building environmental governance system. Secondly, in addition to environmental costs and ecological compensation, environmental education and training, green awareness and green culture also show strong indirect effects, which shows that small and micro enterprises not only need to actively integrate green development concept into process improvement and product design process, and constantly improve green production process and green product quality. In addition, small and micro enterprises should also fully realize the scientific nature of incorporating green innovation, green awareness, green culture, and sustainable development performance into the corporate performance management framework, and actively establish a good corporate image. In order to build a trustworthy relationship network, strive to identify the cognitive requirements and expectations of social participants for the sustainable development of small and micro enterprises, and strive to integrate the *harmonious symbiosis* culture into the corporate green culture.

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Possibilities of Developing Sustainable World by Introducing Bioeconomy: Global Perspective

Szanse na zrównoważony rozwój świata poprzez wprowadzenie biogospodarki: perspektywa globalna

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Abstract

At the time of the study, the world economy is attempting to form a resource-efficient policy. The purpose of this study is to investigate the evolution of the development of strategies and tactics of bioeconomic policy in the international space. The study substantiated the specific features of the implementation of special state and regional programmes of the advanced countries of the world, which differ in socio-economic ideas and prospects for their implementation. The comparative review of strategies identified similarities and differences between them, which allowed to differentiate strategic documents for the implementation of bioeconomic policy in certain areas. The study provides graphic visualisation of distribution of the countries according to the established orientation. The authors of the study proved the convergent difference of bioeconomic policy within each of the above areas by development goals, key objectives, and means of achieving them in a certain spatial dimension.

Key words: strategic guidelines, biotechnological manifestation, bioresource direction, bioenergy

Streszczenie

W czasie przeprowadzania niniejszego badania gospodarka światowa próbuje opracować politykę efektywnego gospodarowania zasobami. Celem pracy jest zbadanie ewolucji rozwoju strategii i taktyk polityki bioekonomicznej w przestrzeni międzynarodowej. W badaniu przedstawiona jest specyfika realizacji specjalnych programów państwowych i regionalnych rozwiniętych krajów świata, różniących się ideami społeczno-gospodarczymi i perspektywami ich realizacji. Porównawczy przegląd strategii wskazał podobieństwa i różnice między nimi, co pozwoliło na wyodrębnienie dokumentów strategicznych do realizacji polityki biogospodarczej w określonych obszarach. Autorzy pracy wypracowali graficzną wizualizację rozmieszczenia krajów zgodnie z ustaloną orientacją. W wyniku badania udało się ujawnić zbieżną różnicę polityki biogospodarczej w każdym z powyższych obszarów ze względu na cele rozwojowe, cele kluczowe i sposoby ich osiągnięcia w określonym wymiarze przestrzennym.

Słowa kluczowe: wytyczne strategiczne, biotechnologia, kierunek biozasobów, bioenergia

Introduction

The strengthening of global challenges caused by anthropogenic impact on the environment necessitates the search for innovative ways of production and consumption of tangible and intangible goods. In these conditions, a special role is played by the bioeconomic direction of sustainable development, the importance of which is emphasised by the rapid pace of its implementation in the international arena. European countries have made a considerable contribution to the development of bioeconomic policy, promoting their ideas for the development of innovative concepts. Strategic initiatives are covered in the specially developed state and regional programmes to support the bioeconomic principles of business, a targeted policy of promoting innovative ideas, which will create a resource-efficient and competitive market environment with minimal destructive effects on the natural environment. Therefore, the purpose of the study lies in a theoretical and applied justification of the directions of bioeconomic policy based on the comparative analysis of strategies and tactics of their implementation, taking into account the unique features and capabilities of the state.

The first mention of bioeconomics dates back to the second half of the 20th century in the works of the American economist of Romanian origin N. Georgescu-Roegen (1971), who argued for the existence of thermodynamic law of entropy in economic processes, which necessitates minimising the consumption of scarce raw materials, because there is no other way to preserve existing reserves for future generations. Geneticists J. Enriquez-Cabot and R. Martinez have demonstrated a modern view of the bioeconomy development, emphasising the need to create a new economic sector related to the introduction of biotechnology in industrial production (Enriquez, 1998). K. McCornic and N. Kautto (2013) presented their reflections on the interpretation of such concepts as *Knowledge-based bio-economy*, *Bio-based economy* and *Bioeconomy*.

A relatively small number of domestic scientists express scientific interest in bioeconomics, but some of their studies deserve special attention. Among the constellation of researchers, a prominent place is occupied by the studies of M.P. Talavyria (2015), who argues about the combination of human and nature in the use of natural resources. V.V. Baidala (2017) emphasises the relationship between people arising in the process of production, exchange, distribution, and consumption of organic products, while V.M. Butenko (2016) identifies biotechnology in the production of organic products, which, in her opinion, will meet the needs of society without reducing the capabilities of future generations. A.M. Proshchalykina (2016) reduces the bioeconomy to a high-tech part of the economy, which will increase energy efficiency through the development of renewable energy and promote the greening of the industrial sector.

One of the first attempts to conceptualise the interpretation of bioeconomics in Ukraine was made in 2008 in the study *Trends in commercial biotechnology* (Philp, 2018), published by scientists from the Institute of Chemistry and Chemical Technology of the Lviv Polytechnic National University.

The popularisation of bioeconomic research in Ukraine has been gaining momentum since the beginning of 2012 due to the approval of a strategic document on bioeconomic orientation in the European Union (Innovating for Sustainable Growth..., 2012) and the development of strategic prospects for bioeconomy in most European countries. A detailed review of the issue suggests that a substantial contribution to the development of European bioeconomic policy was made by the German Bioeconomy Council, which systematically studies the strategies of leading countries by components of goals, objectives, industry (Bioeconomy Policy. Part I..., 2015; Bioeconomy Policy. Part II..., 2015; Bioeconomy Policy. Part III..., 2018). At the same time, the development of a new bioeconomic policy has become a basic object of study in the research by L. Staffas, M. Gustavsson and K. McCormick (2013), who provide a detailed review of strategies within the *Bio-based economy* and *Bioeconomy*. L. Kelleher, M. Henchion, and E. O'Neill (2019) reviewed the development of the bioeconomy in Ireland, R. Meyer (2017) analysed five major obstacles to bioeconomy development. Despite the considerable amount of scientific studies, the issues of argumentation of the directions of implementation of bioeconomic policy in the international space, which determines the choice of the study, remain understudied.

The theoretical and methodological framework of this study is formed by a systematic approach to studying the preconditions for the development of bioeconomic policy in the leading countries of the world. In the process of study, general scientific and special methods were used: abstract logical (establishing relationships and developing the author's interpretation), inductive and deductive methods of scientific cognition (systematisation of bioeconomy strategies and author's generalisation), descriptive analysis (to substantiate sectoral features of bioeconomy); heuristic technique (to generate options for solving the problem under study); graphic (to clearly display the results of the study). The advantage of the study lies in the author's approach to the study of sustainable world development, which involves the identification of biotechnological, bioenergetic, and bioresource approaches in the implementation of bioeconomic policy.

Characteristics of the levels of the bioeconomy development on a global scale

The promotion of bioeconomic objectives has been successfully carried out in parallel outside the European Union. The United States, Canada, Japan and

Table 1. International perspective of bioeconomy strategies, compiled by the authors

Country	Year	Programme title	Responsible institution
Japan	2010/2012	National Plan for the Promotion of Biomass Utilization (2010); Biomass Industrialization Strategy (2012)	National Biomass Policy Council
USA	2012/2016	The Bioeconomy Blueprint (2012); Strategic Plan for a Thriving and Sustainable Bioeconomy (2016)	The White House Office; The Department of Energy
Malaysia	2012	Bioeconomy Transformation Programme (2012)	Ministry of Science, Technology and Innovation
South Africa	2013	The Bio-economy Strategy	Department of Science and Technology
United Kingdom	2015	Building a high value bioeconomy: opportunities from waste (2015); UK Synthetic Biology Strategy Plan <i>Biodesign for the Bioeconomy</i> (2016)	The House of Lords Science and Technology Select Committee; The Synthetic Biology Leadership Council
Norway	2016	Familiar resources – undreamt possibilities	Interministerial collaboration led by the Ministry of Trade, Industry and Fisheries
Thailand	2017	Bioeconomy Roadmap	Pracharath Collaboration
Canada	2017	A Forest Bioeconomy Framework for Canada	Canadian Council of Forest Ministers
Argentina	2017	Bioeconomia Argentina	Ministry of Agro-Industry
New Zealand	2017	Primary Sector Roadmap – Te Ao Turoa	Ministry for primary Industries

several other developed countries have recognised the bioeconomic direction as a priority development for the coming decades and have taken an active position on the formation of their national priorities in the bioeconomic direction (Table 1).

American strategic directions for the development of bioeconomic prospects are based on the guidelines of the OECD programme, which consider biotechnological research as the prerogative of the bioeconomy. The United States has recognised the bioeconomic direction as the most profitable and fast-growing sector of the economy for the next millennium, adopting its strategic programme in 2012, The National Bioeconomy Blueprint, which is divided into two parts. The first describes the background and development factors of the American bioeconomy, while the second covers strategic areas of the bioeconomy, namely regulatory barriers, human capital, bioeconomic partnerships, and covers research, tracing their path from laboratory to market. The strategy treats bioeconomy as one that is based on the use of biological science and innovation research for economic activity and social benefit (Bikse et al., 2019). The next updated *Strategic Plan for a Thriving and Sustainable Bioeconomy* programme was presented by the US Department of Energy and Renewable Energy in 2016 with a focus on improving the value chain, mobilising national biomass, researching consumer and market demand, and enhancing collaboration and cooperation (Asada et al., 2020).

In Canada, references to *Bio-Based Economy (BBE)* were first noted in the report *Canadian Blueprint: Beyond Moose and Mountains*, published by the National Industry Association, which promoted a competitive biotechnology ecosystem (The Canadian Blueprint..., 2009). The non-governmental organisation BioteCanada associated the bioeconomy with

biotechnology, the implementation of which was considered potentially capable of improving the quality of life of the population and bringing the Canadian economy to a new competitive level. In 2011, one of Canada's provinces, British Columbia, initiated a bioeconomic council chaired by the Secretary of Labour, Tourism and Innovation to explore the region's potential for bioeconomy and accelerate revenue growth.

A significant breakthrough in Canada's bioeconomic policy has been the recognition of the Recommendation to Build Alberta's Bioeconomy (2013) as one of the most important policy documents, as it reflects a wide range of bioeconomic perspectives, not limited to the development of biotechnology. Emphasis is placed on the availability of natural potential, namely forest resources that can be actively used in the future. The deployment of bioeconomic policy at the national level begins with the approval of the strategy *A Forest Bioeconomy Framework for Canada* (2017), which emphasises the circular, competitive, and innovative manifestation of sustainable production. Bioeconomic policy is at different stages of development in the world. Apart from the approved specialised integrated programmes, which cover biotechnological research and bioenergy in a complementary relationship with the bioeconomy, some countries outline a single direction. Innovative studies of nano- and biotechnologies in various fields are the hallmark of many countries on the way to bioeconomic development (Table 2).

Despite the fact that, mainly, advanced countries are active consumers of biotech products, over the past decade, countries such as Kenya, Uganda, Paraguay, Uruguay, Namibia, Sri Lanka and others have significantly intensified their activities in this direction. Some countries recognise biotechnological research as key to the development of modern society. For ex-

Table 2. Biotechnological manifestation of bioeconomic policy, compiled by the authors

Country	Year	Programme title	Responsible institution
South Korea	2006/2012	2th Framework Plan for Promotion of Biotechnology (2006); Strategy for Promotion of Industrial Biotechnology (2012)	Government
Kenya	2006/2011	A National Biotechnology Development Policy (2006); National Bioprospecting Strategy (2011)	Kenyan Cabinet; Kenya national Council for Science and Technology
India	2007/2014	Biotechnology Development and Innovation Strategy (2007); Biotechnology Strategy II (2014)	Ministry for Science and Technology
Uganda	2008/2014	Renewable Energy Policy (2007); National Biotechnology and Biosafety Policy (2008); Biomass Energy Strategy (2014)	Ministry of Finance, Planning and Economic Development; Ministry of Energy and Mineral Development
Columbia	2009	National Science, Technology and Innovation Policy	National Council for Economic and Social Policy
Tanzania	2010	National Biotechnology Policy	Ministry of Communication, Science and Technology
Sri Lanka	2010	National Biotechnology Policy	National Science Foundation Committee on Biotechnology
Paraguay	2011	The Strategy on Agricultural and Forest Biotechnology	The Ministry of Agriculture and Livestock
Uruguay	2011	The sector Plan on Biotechnology	Interministerial Committee
Russia	2012	Comprehensive programme for the Development of Biotechnology	Ministry for Economic Development
China	2012/2016	12th FYP on Bioindustry Development (2012); 13th FYP on Bioindustry Development (2016)	The State Council (Science, Technology and Education)
Australia	2013/2016	National Collaborative Research Infrastructure Strategy (2013); Queensland Biofutures 10-Years-Roadmap and Action Plan (2016)	Department of Industry, Innovation, Climate Change, S&R, Tertiary Education; Queensland Department of State Development
Namibia	2015	National Programme on Research, Science, Technology and Innovation	National Commission on Research, Science and Technology
Brazil	2016	National Strategy for Science, Technology and Innovation	Ministry of Science, Technology and Innovation

Table 3. Bioenergy legislation in the context of bioeconomic development, compiled by the authors

Country	Year	Programme title	Responsible institution
Senegal	2006	National Biofuel Strategy	The Ministry of Agriculture
Nigeria	2007	Biofuel Policy and Incentives	The Nigerian National Petroleum Corporation
Mali	2009	National Strategy for the Development of Biofuels	The Ministry of Energy and Water Resources
Mozambique	2009	National Biofuel Policy and Strategy	Ministry of Energy
Mexico	2009	The Bioenergy Strategy	Inter-ministerial Commission on Biofuels
Indonesia	2014/ 2015	National Energy Policy (2014); Grand Strategy of Agricultural Development 2015-2045 (2015)	Ministry of Energy and Mineral Resources

ample, in Australia, the bioeconomic strategy as a separate official document is absent, but the policy of bioeconomic orientation is viewed through the lens of the implementation of biotechnological developments. The Australian Government is considering strategic perspectives for the implementation of biotechnology in virtually all industries, especially agriculture, forestry, and fisheries.

The Commonwealth Scientific and Industrial Research Organisation, which is responsible for research and works with leading institutions around

the world, has demonstrated considerable interest in bioeconomy. The Commonwealth of Scientific and Industrial Research Organisation (CSIRO) has established a bioeconomic website that highlights Australia's prospects for bioeconomy and lists key national research related to bioeconomic development, including biosafety, climate adaptation, sustainable agriculture, water use, etc. Bioeconomic policy of some countries is limited only by bioenergy legislation (Table 3).



Figure 1. Differentiation of countries according to strategic bioeconomic development priorities, compiled by the authors

Notes: ■ – bioenergetic direction; ■ – biotechnological direction; ■ – bioresource direction

Table 4. Features of bioeconomic policy implementation in key areas, compiled by the authors

Direction	Bioresource	Biotechnological	Bioenergetic
Socioeconomic idea	Sustainable development	Economic growth	Energy independence
Development goals	Biologisation of production	Commercialisation of scientific research and biotechnological products	Minimisation of dependence on fossil fuels
Tasks	Consumption of safe bioproduction	Development of science and biotechnologies	Promotion of biofuels
Means of achievement	Natural resource potential	Intellectual potential	Biomass potential
Implementation approach	Synergetic	Interdisciplinary	Multidisciplinary
Spatial dimension	National and regional level	Global and national level	National level, country territories

The main priority strategic goals in the development of bioeconomic policy of these countries are the production of fuel from renewable biological resources and the achievement of energy independence. Thus, considering the strategic priorities of the above legislative documents, it is proposed to identify the following key areas of bioeconomic policy development, namely:

- biotechnological, which provides, above all, economic benefits from the implementation of biotechnological research;
- bioenergy direction, given the isolation of bioenergy as a branch of the bioeconomy of individual states that prefer to meet energy needs without harming the environment;
- bioresource, which aims at the active use of biotic raw materials in the manufacture of food and non-food products.

The bioeconomic priorities of individual countries are visualised in Figure 1.

The map indicates the dark grey countries that are developing bioeconomic policy through the lens of biotechnological research. Black reflects the bioenergy advantage of states, while light grey highlights those who choose a bioresource direction for the de-

velopment of bioeconomic policy, actively implementing strategic programmes that simultaneously cover the production of bioproducts, including biofuels and the implementation of biotechnological developments. The implementation of the bioeconomic policy of the European Union is dominated by the bioresource direction, which has been developing rapidly for several years in a row, meeting the key goals of sustainability. In the process of comparative review of strategies, clarification of similarities and differences between them, the study identified a set of socio-economic ideas, priorities and means to achieve them, as well as provided a spatial basis for the implementation of bioeconomic policy within the above directions (Table 4).

The socio-economic idea is to choose the priority areas of bioeconomic policy. Therefore, within the bioeconomic direction, the key goals of sustainable development prevail, which can be achieved through the biologisation of production to obtain safe and quality products. The biotechnology orientation is dominated by the possibility of commercialisation of scientific biotechnological developments for economic growth. The desire to obtain maximum energy independence through the transformation of biomass

is implemented through the bioenergy direction. In conclusion, the development of an inclusive bioeconomy is possible only with all the components in their complementary interrelation during the implementation of the bioeconomic policy.

Features of the European bioeconomy development

The strategic bioeconomic document *The Bioeconomy to 2030: Designing a Policy Agenda* (2009) was first presented within the framework of the Organisation for Economic Co-operation and Development (OECD) project as part of the International Futures Programme, which proposed to consider the bioeconomy in the narrow meaning with an emphasis on biotechnological knowledge and its implementation in sustainable and competitive production to obtain additional economic results. The statutory imperative of this document was biotechnology, in particular, state aid for their development, cooperation with the private sector in this area, the establishment of intellectual property rights to encourage investment in biotechnology, the development of fundamental organisational principles for public dialogue on biotechnology.

The innovative approach to understanding the economy has aroused the interest of the international community, which has contributed to the active spread of the bioeconomic direction and the development of unique national strategies. Legislative documents in the above context have been initiated in almost 50 countries, most of which were within the European Union. Strategic perspectives differ in the components of goals, objectives, applications in industries; have their unique features and specifics depending on the capabilities of each state, its industry affiliation and the availability of natural resources. However, all strategies are closely linked to their social focus and emphasise the need to replace fossil fuels in industry and the energy sector with renewable biotic resources, reduce recycling materials and preserve the environment. The vision of the European Commission for the Development of the Bioeconomy is set forth in the strategy *Innovating for Sustainable Growth: A Bioeconomy for Europe* (2012). The strategic guidelines cover the following main aspects: increased investment in research and development; creation of favourable (political and economic) conditions for stakeholders; development of marketing communications.

The key focus of the European bioeconomy is on environmental growth, which can be achieved by improving the management mechanism of renewable biological resources and the development of an innovative, resource-efficient, and competitive society that would ensure the protection of the natural environment. The initial development of the European bioeconomy took place during the meeting in Lisbon (Portugal) in March 2000, which recognised the

Knowledge-based Economy (KBE) as the most competitive economy capable of achieving economic growth by meeting the social and environmental needs of society. Two key conferences became the theoretical basis for the further development of the bioeconomic paradigm. At the first international conference *New perspectives on the Knowledge-based Bio-economy*, J. Potochnik (2005) made a report *Transforming life sciences knowledge into new, sustainable, eco-efficient and competitive products*, where he presented the concept of Knowledge-based Bio-economy. For the second time, the bioeconomic concept, which is based on biotechnological research, was recommended in 2007 at the international conference *En Route to the Knowledge-Based BioEconomy* in Cologne (Germany), which outlined the prospects for bioeconomics for the next 20 years.

The above events have contributed to the realisation that the bioeconomic concept has a unique potential for European countries which, however, had remained little known. The Belgian report at the conference *The Knowledge-based Bio-economy towards 2020* in 2010 called for a shift in biotechnological emphasis to address key sustainability issues (Maes, Van Passel, 2019). An updated interpretation of the European bioeconomy was highlighted in the White Paper *The European Bioeconomy in 2030*, published by a community of several European platforms (Global Animal Health, Plants for the Future, Food for Life, Sustainable Chemistry, Sustainable Farm Animal Breeding and Reproduction, Forest Based Sector, Biofuels, Agricultural Engineering, Aquaculture and Innovation) within the Bio-Economy Technology Platforms project (BECOTEPS). According to the claims, bioeconomics belongs to sustainable production, which allows to transform biomass into a number of foods, health, industrial goods, and energy (The European Bioeconomy in 2030, 2011). The intensification of the bioeconomic direction in the European Union is especially connected with the development of a public-private partnership *Biobased Industries* (BBI), which is represented by European companies, small and medium-sized enterprises, voluntary associations conducting joint research. At that time, funding for research and technological development increased to 3.85 billion euros under the Eighth Framework Programme *Horizon 2020* entitled *Food security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy* (2014-2020), which promotes bioeconomic policies in the EU (Schütte, 2018). As a result, annual turnover from the bioeconomy has increased by 25% over the last decade (Ramcilovic-Suominen, Pölzl, 2018). The renewed Horizon Europe 2020 programme (2021-2027) offers 10 billion euros for food and natural resources, including the bioeconomy.

In general, financing the development of the bioeconomy covers three key aspects, including invest-

Table 5. Bioeconomic development programmes of the European Union, compiled by the authors

Country	Year	Title	Responsible institution
EU	2012/2018	Innovating for Sustainable Growth: Bioeconomy for Europe (2012); A sustainable Bioeconomy for Europe: strengthening the connection between economy, society and the Environment (2018)	European Commission
Germany	2010/2014	National Research Strategy BioEconomy 2030 (2010); National Policy Strategy on Bioeconomy (2014)	Federal Ministry for Education and Research; Interministerial collaboration
Netherlands	2012	Framework Memorandum on the Bio-based Economy	Ministry of Economic Affairs
Sweden	2012	Swedish Research and Innovation Strategy for a Biobased Economy	Swedish Research Council; Swedish Government Agency for Innovation Systems; Swedish Energy Agency
Austria	2013	Policy Paper on Bioeconomy (2013); Research, Technology and Innovation Strategy (2014); Bioeconomy A Strategy for Austria (2019)	Ministry of Transport, Innovation and Technology; Ministry of Education, Science and Research; Ministry of Sustainability and Tourism
Finland	2014	The Finnish Bioeconomy Strategy Sustainable Growth from Bioeconomy (2014)	Ministry of Employment and the Economy
Belgium	2014	Bioeconomy in Flanders	Interdepartmental Working Group
Spain	2016/2018	The Spanish Bioeconomy Strategy – 2030 Horizon	The Ministry of Agriculture, Food and the Environment; The Ministry of the Economy and Competitiveness
Italy	2017	Bioeconomy in Italy: A unique opportunity to reconnect economy, society and environment	The Italian Presidency of the Council of Ministers
Latvia	2017	Latvian Bioeconomy Strategy 2030	Ministry of Agriculture
France	2017	A Bioeconomy Strategy for France	Interministerial collaboration
Ireland	2018	National Policy Statement on the Bioeconomy	Government of Ireland

ment in research and development (R&D); implementation of innovative developments in business processes and popularisation of bioeconomic principles of management among the public. Further European initiatives are aimed at implementing the above aspects, which provoked the establishment of a venture fund for the development of a circular bioeconomy with the support of the European Commission and the European Investment Bank with funding of 250 billion euros, which will allow to achieve the goals of the European Green Course. The bioeconomy strategy in an improved interpretation, *A sustainable Bioeconomy for Europe: strengthening the connection between economy, society and the environment* (2018). The updated version provides a comprehensive action plan aimed at large-scale expansion of the bioeconomic aspect and its implementation, mainly in all industries and agriculture in order to achieve the goals of sustainable development and implementation of the Paris Climate Agreement, which replaced the Kyoto Protocol and entered into force in 2016 (Table 5).

The bioeconomic policy of the European Union is focused on expanding investment in research and development; increasing competitiveness and strengthening market positions of organic products; intensifying political interest and promoting the bioeconomic foundations of management in general. Leading position in the development of the bioeconomy among European countries is occupied by Germany, which was one of the first in the international arena to publish its national strategy entitled *National Research Strategy BioEconomy 2030* (2011), which provides a specific course of bioeconomic orientation in agriculture, forestry, and fisheries, developed for the next six years. After lengthy negotiations and discussions, a revised National Policy Strategy on Bioeconomy (2014) was adopted under the auspices of the Federal Ministry of Food and Agriculture, which sets out strategic goals, systemic approaches and practical recommendations for conducting business on biological renewable raw materials and proposals on the implementation of technical and economic changes in bioproduction technology.

A considerable role in shaping Germany's bioeconomic prospects is played by the independent advisory body of the Federal Government, the German Bioeconomy Council, established in 2009 with the participation of experts from scientific institutions to provide advice on economic and political principles of operation and practical application of the bioeconomy broadly, that is, in trade, agriculture and forestry, horticulture, fishing, woodworking, paper, textile, chemical, and pharmaceutical industries (Viaggi, 2018). In the same year, the Bioeconomy Science Center was established in North Rhine-Westphalia, the first institution to deal with bioeconomy problematics. Therewith, research on this subject is conducted in 60 German universities and 37 specialised higher education institutions related to the bioeconomy have been established. In addition, 61 communities and 17 departmental institutions are engaged in developments in the bioeconomic sector (Urmetzter et al., 2018).

Among European countries, the Netherlands also takes an active position in the context of the bioeconomy, focusing mainly on agriculture and the food industry. As for Finland, its advantages are the availability of considerable forest reserves, which identified the key motives of the bioeconomy programme and contributed to the innovative development of the bioindustry. *Swedish Research and Innovation Strategy for a Biobased Economy* (2012) identifies knowledge gaps and examines key research needed for bioeconomy development, namely more economical use of fossil resources and their replacement by biotic raw materials, changes in the structure of consumption of quality products, cooperation between scientific institutions and industry. In general, the Swedish bioeconomy reflects national perspectives in a global context.

After several years of preparation, at the end of 2015, Spain intensified its national bioeconomy strategy, which was focused mainly on food production. The priority sectors were agriculture, forestry and fisheries, as well as the chemical and bioenergy sectors. Financial support for the implementation of the strategy was provided by the Spanish government and the European Union programme *Horizon 2020*.

Conclusions

Bioeconomic policy is widely implemented in most developed countries. The prerogative of its implementation for some is to maintain leading positions in the international arena and generate additional income from innovative products (biotechnology), while the dominant goals of other countries are to achieve sustainable development goals, including promoting food security, mitigating change climate, reducing the burden on ecosystems, etc. (bioresource direction). Other countries are limited to the transformation of the energy sector on a bioeconomic basis, which allows to achieve partial energy independ-

ence (bioenergy direction). Strategic guidelines depend on the availability of natural resource and intellectual potential, as well as the possibility of their implementation within the state.

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Green Economy – Vector of Sustainable Development

Zielona gospodarka – wektor zrównoważonego rozwoju

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Abstract

The article is devoted to the formation of theoretical, methodological foundations and the development of conceptual approaches to the practical provision of the green economy, considered as a vector of sustainable development. The study substantiates the need to create a new global economic school. The existence of two concepts of economic development of future generations is established. The author's vision of economic growth in the conditions of sustainable development is formed, as well as its necessity is also proved. A component model of sustainable development is proposed, which allows reflecting the essence and content of the green economy. The positive experience of *green integration* is summarized. The negative aspects on the way to the practical implementation of the Millennium Development Goals are identified.

Key words: sustainable development, Millennium Development Goals, economic growth, green economy, green technologies, green construction, green marketing, green tourism

Streszczenie

Artykuł poświęcony jest kształtowaniu podstaw teoretycznych, metodologicznych oraz rozwojowi koncepcyjnych podejść do praktycznego zapewnienia zielonej gospodarki, traktowanej jako wektor zrównoważonego rozwoju. Badanie uzasadnia potrzebę stworzenia nowej globalnej szkoły ekonomicznej. Ustala się istnienie dwóch koncepcji rozwoju gospodarczego przyszłych pokoleń. Kształtuje się autorska wizja wzrostu gospodarczego w warunkach zrównoważonego rozwoju, a także udowadnia jego konieczność. Proponowany jest składowy model zrównoważonego rozwoju, który pozwala odzwierciedlić istotę i treść zielonej gospodarki. Podsumowano pozytywne doświadczenia zielonej integracji. Zidentyfikowano negatywne aspekty na drodze do praktycznej realizacji Milenijnych Celów Rozwoju.

Słowa kluczowe: rozwój zrównoważony, Milenijne Cele Rozwojowe, wzrost ekonomiczny, zielona ekonomia, zielone technologie, zielone budownictwo, zielony marketing, zielona turystyka

1. Introduction

The current conditions of humanity's existence indicate the presence of a number of problems that form a system of challenges for the progressive development of future generations. Such challenges include the systemic inconsistencies that have been formed between the processes of economic, social and environmental development. The traditional model of economic growth, due to its irrationality, faced an increasing set of social and environmental restrictions, which as a result led to the loss of its legal capacity. In this regard, there was a need to form a fundamentally different concept (sustainable development), a global socio-economic transition, which, along with a qualitative update of the technological base, increasing production efficiency and competitiveness, is designed to improve the quality of life and the living environment.

The concept of sustainable development contributed to the expansion of the range of scientific, methodological and applied tasks. In modern scientific literature, there is no universal categorical apparatus, there is no approved system of markers and indicators for assessing social, economic and environmental progress, there is no unified approach to solving the climate problem, including such an extreme point of view as non-recognition of the very fact of its existence. All this makes it difficult to develop practical strategic solutions for the implementation of sustainable development policies.

Despite all these differences, the vast majority of scientists believe that the material basis for the transition to a model of sustainable development is the formation and development of a specific eco-oriented sector in the structure of the economy - the *green economy*, which, unlike the traditional (*brown economy*), is based on the use of *clean* resource-saving technologies.

However, there is also no single vision in this area to date. Some authors consider the green economy as a process, others argue that it is a certain state. There is no universal methodology for assessing progress in the field of green economy, which could serve as a base for various countries. Moreover, the implementation of the basic principles of sustainable development, as well as the green economy, occurs at different speeds and on different scales in different parts of the world, which necessitates the generalization of experience that can be applied in an adapted form by other states. All of the above indicates the relevance and timeliness of the study submitted for consideration.

2. Methodology

The purpose of the study is to substantiate the theoretical, methodological foundations and develop conceptual approaches to the theoretical, method-

logical and practical support of the green economy, considered as a vector of sustainable development.

The goal set made it necessary to solve the following tasks: to justify the expediency of creating a new global economic school, to form conceptual provisions regarding the category *economic growth* in the context of sustainable development, to expand the scientific vision of the essence and content of the green economy, to generalize positive world practices and identify the main lessons in the practical implementation of the green economy.

The object of the study is the process of interaction between the green economy and sustainable development.

The subject of the study is theoretical, methodological and practical approaches to the development of the green economy in order to implement the Millennium Development Goals, which are also the base for UN Sustainable Development Goals, introduced in 2015.

The work was based on theoretical and methodological approaches to the study of economic growth from the point of view of representatives of fundamental concepts: classical (P. Rosenstein-Rodan, R. Nurks, H. Leibenstein, A. Hirschman, G. Singer), neoclassical (A. Marshall, A. Pigou), Keynesian (J. M. Keynes), monetarism (K. Brunner, G. Simons, M. Friedman, I. Fischer), as well as the modern concept of sustainable development (K. Raworth, P. Erker). The paper uses the methodological experience of the study of the green economy and sustainable development (D. Pearce, E. Barbier, A. Markandya, S. Bobylev, N. Zubarevich, S. Solovyova, Y. Vlasov).

To substantiate the feasibility of creating a new global economic school, the article used both general scientific and economic methods of cognition: logical, inductive, deductive, statistical, graphical and tabular methods of interpreting information, methods of analysis, modelling, due to which the existence of two concepts of economic development of future generations was established, the essence of the concept of green economy was determined, a component model of sustainable development based on green economy was formed, the connection between the green economy and sustainable development was proved, conclusions were formulated.

The information and empirical base of the study was made up of official materials of European and international statistics (Eurostat, UN, World Bank, UNIDO, OECD, etc.), data from national and international analytical and research organizations, program and strategic documents regulating sustainable development and the development of the green economy at the international (UN), national (UNWTO, SROON, IFC World Bank Group) and regional levels (24/7 Wall Street, Miljönär, Avfall Sverige), other normative acts regulating the development of the green economy, data published in monographs,

scientific journals, collections proceedings, conference materials, periodicals, including on the Internet.

3. Findings and Discussion

3.1. On economic growth in the context of sustainable development

The development of a green economy requires, first of all, the creation of a new global economic school, since it is the economic school that is the foundation on which the development of future generations is based. According to previous studies, the last economic school that allowed humanity to move to a new stage of development was the school of monetarists, which is based on the idea of the money supply as a determining factor in the formation of economic conditions, price levels, income, employment and macroeconomic equilibrium in general.

Speaking about monetarism, it should be said that the theories of American economists G. Simons, I. Fisher, F. Knight (20-40s of the twentieth century) had a significant influence on its formation. The activation of monetarism in the United States, as one of the varieties of neoliberalism, began in the late 40s and early 50s of the twentieth century. The founder of the new economic theory of that period is considered to be the American economist K. Brunner, who used the category *monetarism* to define a general theoretical approach that recognizes the exceptional importance of money in the economy. Thus, monetarism, as a system of economic views, became an alternative to the neo-Keynesian concept due to its inability to solve the problems of economic development of the United States in the 50-60s.

The analysis of the studies of the formation and development of the monetarist economic school suggests that the intellectual leader of modern monetarism was the outstanding American economist, Nobel laureate Milton Friedman (1912-2006), whose main monetarist ideas are set out in the fundamental work *Monetary History of the United States of 1867-1960* written in collaboration with Anna Schwartz. He formulated four theoretical postulates, which to a certain extent did not contradict the ideas of monetarism of K. Brunner, who claims that *the money supply determines the economic situation* (Brunner K., 1961) rather, they scientifically expanded the boundaries of the idea of monetarism: *economic growth is achieved both with rising and falling prices, provided that their growth is moderate and predictable*. From the last statement, it follows that in addition to the general theoretical approach, the authors already interfere with the applied aspect, namely, monetary policy in the economy (Friedman M., Schwartz A., 1963).

After a while, among the adherents of the monetarist school there were also those who did not quite share the classical (Friedman's) approach. For example, Peter Temin expressed doubts about the Friedman's

causes of the crisis of the 1930s in America, denying the claim that most of them were of endogenous origin. This point of view is reflected in the works of the monetarist Paul Krugman, who said that the financial crisis of 2008, like the crisis of the 30s, showed that central banks could not control the broad money supply, and this money supply was little related to GDP, respectively, the Federal Reserve System could not prevent the Great Depression, as stated by M. Friedman. Against the background of dramatic events in the economy and economic policy, several varieties of monetarism were formed with their own doctrines, models, as well as a new direction was formed - global monetarism.

As we can see, the period of the formation and development of monetarism was characterized by the emergence of a number of theories that explained the nature of cyclical development and offered stabilization options. Drawing parallels with the present time, it should be noted that a similar situation is observed. Economists around the world, realizing the need to form a fundamentally new economic school, create separate fragmented theories and models that often contradict each other, generating a discussion of both theoretical and applied nature.

Generalization of scientific research in the field of sustainable development allowed us to establish the existence of two concepts of economic development of future generations. According to one of them, *it is necessary to overcome economic growth*. So in the study, Kate Raworth says that *the modern world has made extraordinary progress. However, the big problems that threaten the well-being of people have not disappeared anywhere. Unfortunately, the current economic thinking does not take this into account, so it needs to be transformed in accordance with the realities of the XXI century*. It is important to note that the author focuses not on stopping economic growth in general, but on reducing the consumption of material goods (Raworth K., 2019).

Another concept is polar opposite to the first one, according to which economic growth cannot be stopped. The founders of the theory of economic growth are P. Rosenstein-Rodan, R. Nurks, H. Leibenstein, A. Hirschman, G. Singer. Among the contemporaries who assert the need for economic growth, as well as the fact that it (economic growth) is not the cause of the deterioration of the ecological state, is P. Erker. The scientist provides basic statistical data as evidence, according to which, with the growth of the UK GDP by 40-50%, there was also a reduction in emissions of CO₂ to 30% (Erker P., 2004). The most up-to-date data on the volumes of CO₂ in the country context are presented in the annual report of BP Statistical Review of World Energy, according to which the total volume of carbon dioxide emissions in the world in 2019 reached 34.2 billion tons, i.e. increase of 1.1%. At the same time, the largest percentage of emissions is accounted for by countries with developing economies (+2.4%),

Table 1. The essence of the concept Green Economy (Pearce, Barbier and Markandya, 1991; UNEP, 2009, Nairobi, 2011; The green economy, 2011; A guidebook to the Green Economy, 2011; ICC, 2012; Building an Equitable Green Economy, 2013; Green economy transition approach, 2013)

Definition of Green Economy	Source
<i>The green economy is an economy that should come to the aid of environmental policy. The essence of the green economy has not been revealed.</i>	David Pierce, Edward Barbier and Enil Markandya
<i>The green economy is an economic activity related to the production, distribution and consumption of goods and services that lead to an improvement in the well-being of people in the long term, at the same time, without exposing future generations to significant environmental risks and reducing the shortage of environmental resources.</i>	UNEP, United Nations Environment Programme
<i>A green economy is an efficient economy based on low-carbon development that leads to improved human well-being and social justice, while significantly reducing environmental risks and preventing the loss of biodiversity.</i>	UNEP Summary report for representatives of government structures in Nairobi
<i>A green economy is an economy that seeks long-term social benefits in short-term activities and leads to improved human well-being and reduced inequality, without exposing future generations to significant environmental risks and environmental deficits.</i>	UNCTAD, United Nations Conference for Trading and Development
<i>The green economy is an economy that includes new sectors of the economy and should become an important starting point for large-scale economic empowerment, meeting the needs and providing opportunities to enterprises that pay more attention to social development.</i>	Government of South Africa
<i>A green economy is a sustainable economy that provides a better quality of life for everyone within environmental constraints.</i>	Coalition for a green economy
<i>A green economy is an economy in which economic growth and environmental responsibility mutually reinforce each other, while simultaneously supporting progress and social development.</i>	International chamber of commerce
<i>The green economy is not a state, but a process of transformation and constant dynamic progress that eliminates the systemic distortions and dysfunctions of the current economy and leads to well-being and equal access to opportunities for all people, while ensuring the preservation of environmental and economic integrity.</i>	Danish Group 92
<i>A green economy is an economy that focuses on using opportunities to simultaneously advance economic and environmental goals.</i>	United Nations commission on sustainable development
<i>A green economy is an economy in which public and private investments are carried out in order to minimize the impact of economic activities on the environment and where market problems are eliminated through proven policies and legal frameworks aimed at systematically taking into account the state of ecosystems, managing associated risks and stimulating innovation.</i>	European Bank for Development and Reconstruction

while the countries of the European Union (including the UK) have reduced emissions by 3.9% (BP Statistical Review of World Energy, 2020). The growth in the volume of garbage processing has grown from 4% in the 80-90-ies, to 44% today. Thus, with a global view, it turns out that scientists, expressing different points of view, are talking, in fact, about the same concept. Someone calls it a green economy, someone calls it a carbon economy, due to the lack of a generally accepted concept. Taking into account the fact that the economy in its classical sense is a set of production relations corresponding to a given stage of development of the productive forces of society (Cambridge Dictionary online, 2021) it would be wrong not to talk about economic growth. It is worth talking about it, but from the perspective of current trends.

So, in the context of the formation of a holistic conceptual economic form that will bring civilization to a new level of development, economic growth is called such growth, which is provided not only by technology, but to a greater extent by intelligence (human capital). The more intelligence we invest, the higher the cost of the finished product, which

means the higher the level of GDP and the welfare of the population. Taking into account the cyclical nature of the economy, this dependence will be repeated, which in turn will ensure sustainable economic growth.

According to the basic laws of economics, economic growth is carried out in two ways: intensive (quantitative) and extensive (qualitative). Quantitative growth is an infinite material growth that should recede into the historical distance. The new global economy should be based on qualitative growth due to intelligence (Boichenko, Martynovych, Shevchenko, 2021). In addition to the theoretical basic concept of economic development in the XXI century, it is necessary to form a methodological support for assessing the level of sustainable development in all its components. All this will make it possible to practically implement the principles, tasks and millennium development goals.

3.2. About the green economy and sustainable development

The discussion about the need to form a fundamentally new approach to further economic develop-

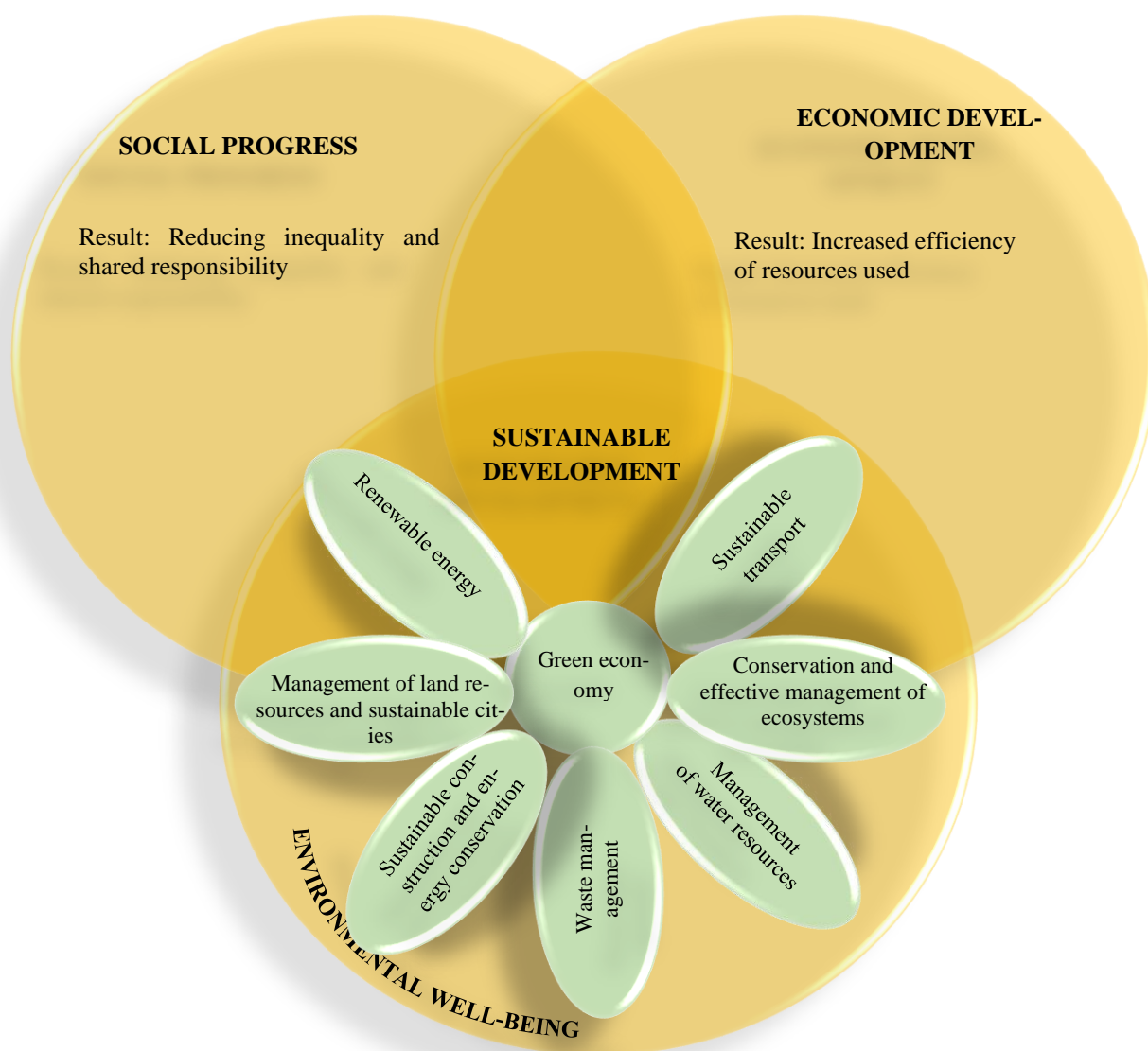


Figure 1. Component model of sustainable development based on the green economy

ment, which is not limited only to material or monetary resources, has been conducted for more than a dozen years. Despite this, to date, there is still no generally accepted theory of future development in the world, but one of the vectors has been identified, the name of which is *green economy*. According to the green growth concept of the Organization for Economic Co-operation and Development (OECD), the promotion of economic growth and development should be carried out under the condition of preserving natural assets and uninterrupted provision of ecosystem services on which our well-being depends (OECD). It follows from this definition that the green economy is the engine of economic growth. The analysis of the existing terminology has shown that the essence of the green economy is not limited only to growth (Table 1).

The green economy is considered as a process of transforming dynamic progress, promoting eco-

nomical and environmental goals, minimizing the impact of economic activity on the environment, developing an efficient economy, etc.

The analysis of the basic normative documents in the field of sustainable development allowed us to come to the conclusion that the presented definitions reflect the actions (process) that determine the state of the triad of sustainable development and involve focusing efforts on the implementation of the Millennium Development Goals (Fig. 1).

The authors consider renewable energy; sustainable transport; sustainable construction and energy conservation; management of water resources; waste management; management of land resources and sustainable cities; conservation and effective management of ecosystems as actions that determine the state of the triad of sustainable development.

Since renewable energy sources are significantly safer for ecosystems, as well as economically profit-

able, the green economy contributes to the implementation of the Sustainable Development Goals for each component (environmental, economic and social ones). For example, providing access to affordable, reliable, sustainable and modern energy sources contributes to the creation of a solid infrastructure, ensuring inclusive, sustainable industrialization and innovation, which in turn contribute to steady, inclusive and sustainable economic growth, full and productive employment, decent work for all, this increases the well-being of the population, reduces inequality and encourages shared responsibility.

Developed infrastructure and transport have a significant impact on the environment and account for 20% to 25% of global energy consumption and carbon dioxide emissions. According to the statistical review of world energy, almost 97% of emissions are generated as a result of direct burning of fossil fuels (BP Statistical Review of World Energy 2020). Therefore, *sustainable, environmentally friendly transport* contributes to reducing emissions, which in turn reduces the greenhouse effect, thereby contributing to the fight against climate change and its consequences, ensuring the well-being of future generations.

Sustainable construction and energy conservation contributes to the environmentally responsible and efficient use of resources throughout the entire life cycle of a construction object (planning, design, construction, operation, maintenance, repair, demolition). Existing environmentally friendly facilities have a positive impact on the health of residents, which ensures the openness, safety, resilience and sustainability of cities and settlements.

Green management of water resources contributes to the protection, restoration of terrestrial ecosystems, promotes their rational use, combating desertification, stopping and reversing the process of land degradation and stopping the process of loss of biological diversity. Thus, in 1986, one of the worst droughts in history occurred in the Indian state of Rajasthan, which led to famine. After this disaster, local residents, teaming up with the scientific and industrial association, created water collectors and engaged in partial regeneration of the soil and forests of the region. As a result, the forest cover has increased by more than 30%, the groundwater level has risen by several meters, and the productivity of arable land has increased (UN, 2020). This increased yields and contributed to the elimination of hunger, ensuring food security, improving nutrition, promoting the development of sustainable agriculture.

Management of water resources is closely related to the management of land resources. Land resources are used for various purposes, which include organic agriculture, forest restoration and ecotourism. Healthy woodlands replenish groundwater reserves by passing water through their roots and at the same time filtering drinking water for millions of people

around the world. Green spaces contribute to the fight against drought, fires, coastal flooding, landslides and erosion. In addition, trees contribute to the provision of natural air conditioning. Thus, according to American studies, the shade from trees can reduce the cost of air conditioning of detached houses by 20-30 % (Arthur Gutenberg, 1955) this, in turn, ensures rational consumption and production, resilience and sustainability of cities and settlements.

Waste management involves its collection, transportation, recovery and disposal, including control over these operations, as well as supervision of waste disposal sites, including operations performed by sellers and intermediaries (Directive 2008/98/EC). Waste management helps to reduce the adverse impact of waste on human health and the environment. If the traditional economy combines labor, technology and resources to produce end-use goods and waste, then the concept of a green economy is based on the principle of a healthy planet, which involves the return of waste back to the production cycle. Currently, there are about 200 names of various wastes, classified according to different characteristics: by origin, by composition, by aggregate state, by hazard class, by type, etc. Accordingly, depending on the type of waste, there are also various methods of sorting and processing. It should be noted that in the countries of the European Union there is a steady increase in the amount of waste (Fig. 2).

Thus, in 2018, 812 million tons of waste were generated in the EU, not counting basic mineral waste, which corresponds to 1,828 kilograms (kg) of waste per capita (Eurostat). Of these wastes, 7.9% were hazardous to health or the environment, which corresponds to 143 kg per one citizen (Eurostat). Another 8.5% was food waste generated during the production, distribution and consumption of food, which in general amounted to 69 million tons or 154.6 kg per capita in 2018 (Eurostat). In the period from 2004 to 2018, the amount of non-mineral waste generated per capita in the EU increased by 1.0%, and for the period of 2014-2018 this indicator increased by 4.8%. This trend is associated not only with the growth of consumption in the European Union, but also with the refusal of China and other Asian countries to accept 24 categories of waste in 2018 (Reuters).

In this regard, the component model of sustainable development contributes to the solution of theoretical and methodological problems. It allows us to reflect the essence and content of the green economy, the meaning of which is to combine the process and the state, and consider them simultaneously, without separating them from each other, since all the components of sustainable development and the green economy are in constant dynamics and interaction. In addition, based on the proposed model, approaches to sustainable development indicators were systematized and work is underway to create a classification of green economy indicators.

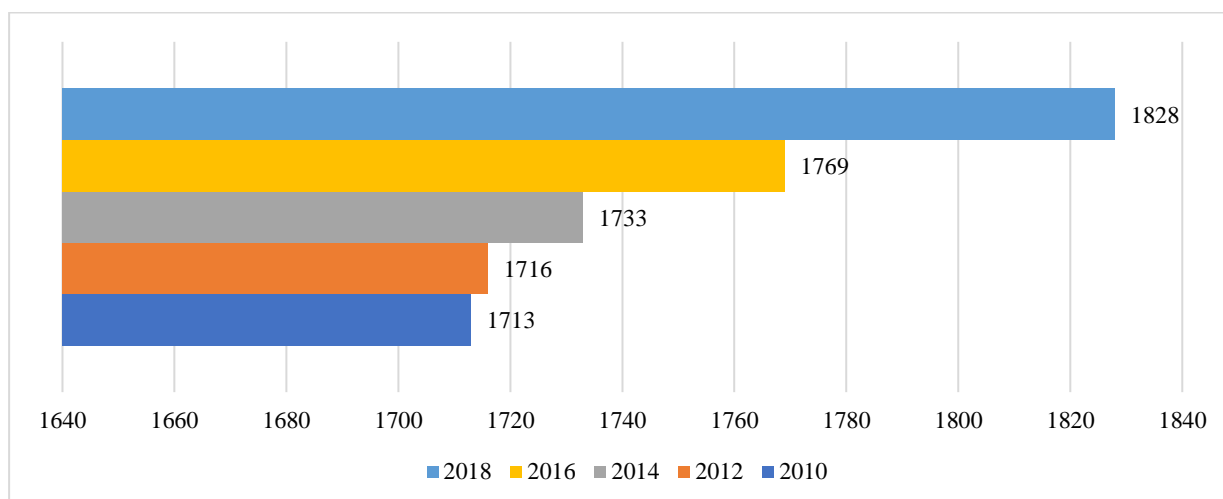


Fig. 2. Waste generation in the EU, with the exception of large mineral waste by hazard level, kg per capita for 2010–2018 (Eurostat)

3.3. General-to-specific approach

As already noted above, all countries are different in their potential, and, accordingly, in their level of development, so it is impossible to make the transition to *sustainability* on the whole planet at the same time. These are consistent, balanced decisions involving various spheres of activity, with a financial component, on the basis of which each state will have its own life cycle of transition. There are countries that have already achieved tangible results on the path to sustainable development, there are those, however, that are just taking the first steps. Against this background, there is a need to generalize the existing experience of *green integration*, to establish positive and negative aspects on the way to the practical implementation of the Millennium Development Goals.

3.3.1. Green tourism

The United Nations Environment Programme (UNEP) has identified ten key sectors for the transition to a *green economy*: agriculture, housing and utilities, energy, fisheries, forestry, industry, tourism, transport, waste disposal and recycling, as well as management of water resources. Due to the fact that tourism permeates and integrates all spheres of life and the vast majority of sectors of the economy (construction, trade, transport, accommodation, food, etc.), since it employs more than 320 million people, and its share in global GDP before the pandemic was 3.3 (10.4 percent) trillion U.S. dollars, we consider it appropriate to pay attention to this area in more detail (WTTC).

In the presented study, the authors understand under tourism in the context of a *green economy* such tourism activities that fully take into account the current and future economic, social and environmental impacts, as well as the preferences of consumers of services, industry and local communities (UNEP, UNWTO World Tourism Organization).

Regular research in the field of tourism (Anar Ospanova) allowed us to come to the conclusion that the green tourism market requires clearly defined organizational, economic and managerial foundations of both general theoretical and applied nature, since the vector of *greening* for tourism is also new. Based on this, there is a need to eliminate the content imperfections of the categorical apparatus, determine the goals of tourism taking into account new challenges and development trends, etc.

On the other hand, changes in the market structure, including due to the pandemic, together with systemic problems in tourism that both scientists and practitioners have been trying to solve for many years, have led to a number of applied consequences, such as: low level of dissemination of effective global green tourism practices, spontaneity and fragmentation in the provision of *green services*, imperfect financial and pricing policy in the field of green tourism, insufficient development of tourism marketing and management of the *green services* sector, etc. In the current situation, it is advisable to generalize the existing experience in the formation and implementation of mechanisms for providing green tourism services, taking into account current needs. Analysis of scientific publications in the field of green tourism (D. Zakirova, D. Ulanov, A. Church, T. Coles, R. Fish, A. Fyron, S. Vorobchuk, A. Kharin, D. Erova, M. Rutinsky, Y. Zinka, B. Finogeeva), allowed us to establish that the main reason for the intensification of its development in Europe is the crisis in the agricultural sector, generated by mechanization and modernization, which displaced manual labor. Thus, in the vast majority of rural regions of Europe, agriculture has ceased to be the most important form of land use and job creation. While the tourism sector was diametrically opposed to becoming popular and gaining momentum in development.

Despite the fact that during the pandemic, tourism in the EU decreased by 61% (Eurostat), according to

WTO statistics, in 2019 France, Spain, Italy and Germany entered the top ten world destinations, and *green* travel amounted to 7 up to 20% of total travel (UNWTO). According to experts, from 0.5 to 0.9 million jobs are associated with green tourism. More than 2 million placements are concentrated in rural estates (Eurostat).

For Kazakhstan, the generalization of the European experience in the development of green tourism as a vector of sustainable development is valuable both from a theoretical and practical point of view. The same as for Europe, the experience of Kazakhstan can be useful, since certain developments in this regard has already been made. Thus, a large-scale green project for the development of green technologies was created on the basis of the Kazakh village of Arnasay, which involves teaching children at school based on the principles of sustainable development and the use of green technologies in everyday life. Arnasay schoolchildren conduct research on the introduction of green technologies as part of the general education process, and parents apply these technologies in their gardens and vegetable gardens in a practical way. In 2018, within the framework of the project *Arnasay – Center for Green Technologies*, the Coalition for Green Economy and Development of G-global in Kazakhstan allocated drip irrigation systems, agrofibre and hydrogel on a free basis, thereby laying the foundations for the development of family green entrepreneurship. Thus, for a short time, 60 thousand households have deployed new agricultural technologies, and the economic effect only from the developments of the *Vyacheslavsky* school amounted to 4.5 million tenge per year (10,583 US dollars) (Green Economy. Green technologies).

Based on the experience of European states, on the territory of Arnasay, taking into account its potential (advantageous geographical location, natural potential, good transport interchange and the development of green infrastructures) there are great prospects for the development of various types of green tourism all year round. In this regard, the expediency of using is the experience in the gastronomic tourism of Italy and Austria, because on the territory of Arnasay vegetables are grown all year round, a closed water supply installation for growing fish works, which ensures the obtainment of environmentally friendly products. According to the experience of Austria, it is possible to organize green herb collection tours in Arnasay. Taking advantage of the experience of Finland, which is based on recreation on the shores of protected lakes and rivers, recreation on the *Vyacheslavsky* reservoir can be turned into an all-season one by equipping it with farmsteads based on the experience of Spain, and on the basis of the British and Ukrainian experience, by organizing Christmas green tours. In Germany, green tourism involves participation in international fairs and trade shows, this experience can be depleted with gastronomic

tours, and within the framework of the Kazakh Cuisine festival *Toikazan*, an autumn gastronomic eco tour can be organized.

Thus, green tourism, as one of the sectors of the transition to a green economy, contributes to ensuring economic development, environmental well-being and social progress. At the same time the exchange of experience (not only in the tourism sector) will allow us to take into account the negative aspects and apply the positive aspects towards the implementation of the Millennium Development Goals.

3.3.2. Green construction

According to the California Department of Resources Recycling and Recovery, construction waste, in comparison with other types of waste, poses the greatest threat to the environment, which means that it requires greater focus on its disposal (CDRRR, 2020). This point of view is reflected in the studies of the IPIT Design Institute, where it is noted that the evolution in the field of construction technologies, the production of new materials encourages builders and designers to be more versatile, as well as to make bold and extraordinary decisions. The construction industry strives to meet the high requirements of the current consumer. At the same time, the development of construction entails an increase in the negative impact on the environment (IPIT, 2021). In this vein, during the construction of a 100-apartment building, an average of 15-20 tons of solid waste is formed, the bulk of which is broken bricks, the remains of hardened concrete and mortar, the remains of wall blocks made of expanded clay concrete, cellular concrete, drywall, foam, mineral wool, etc. From one old five-story building, an average of 3,000 cubic meters of construction and repair waste is generated (Property Times, 2018).

In addition, buildings around the world use about 40% of all primary energy consumed, 67% of all electricity, 40% of all raw materials and 14% of all drinking water supplies, as well as produce 35% of all carbon dioxide emissions and almost half of all solid urban waste (ICS Group, 2021).

It should be noted that 11-13 million tons of solid household waste (SHW) are generated annually in Ukraine. On average, there are about 300 kg SHW per person annually (IFC). According to the study conducted by 24/7 Wall Street, Ukraine in 2019 entered the top ten countries that produce the most garbage per capita (Fig. 3).

The increase in waste generation is due to an increase in the welfare of society. The level of SHW processing in Ukraine is 7-8%, while in the countries of the European Union (EU) up to 60% of SHW waste is processed (Eurostat). Therefore, in Ukraine, more than 90% of SHW is sent to landfills and unauthorized landfills. If this situation persists, then taking into account the overcrowding (5-7% of the total number of authorized landfills), the closure and reclamation of environmentally unsafe landfills

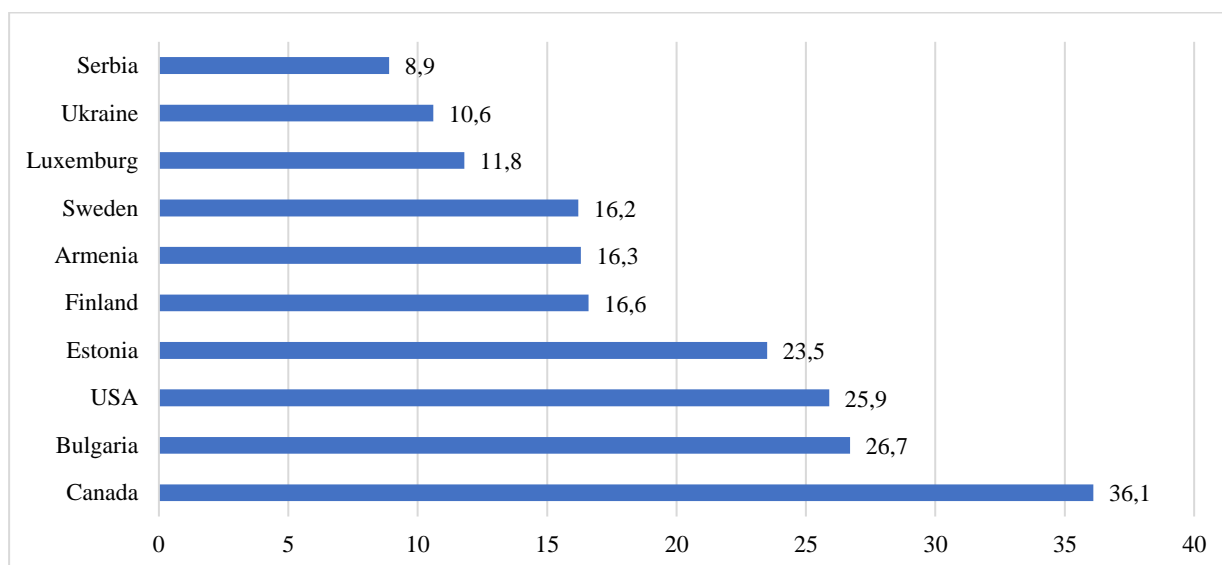


Fig. 3. Rating of countries with the largest amount of garbage per inhabitant for 2019, tons (24/7 Wall Street)

(16%), the need to allocate land for landfills will increase (IFC).

According to the Ministry of Regional Development and the Ministry of Natural Resources of Ukraine, there is the need for the construction of at least 650 new landfills. Independent experts estimate the territories occupied by landfills at 12 thousand square kilometres, which exceeds the territory of Montenegro and Cyprus and is significantly higher than the official estimate of 100 square kilometres (IFC).

The current situation has a negative impact not only on the atmosphere, soil, groundwater and soils, it also negatively affects the flora and fauna, worsens the quality of life of the population living in nearby settlements. As a result of the lack of a system for the separate collection and disposal of waste containing toxic components, environmental pollution with dangerous substances is increasing.

In addition to environmental problems, irrational management of SHW generates a number of economic benefits lost. Thus, according to the UNDP Ukraine could receive income in a single year from the disposal of paper in 180 million UAH, plastic – 740 million UAH, metal – 225 million UAH, which, in general, with regard to the generation of heat and power, would have amounted to 1.3 billion UAH (€130 million) (IFC).

The Government of Ukraine has recognized the management of solid waste as the most urgent and critical problem that should be solved within the framework of the implementation of the strategy for sustainable development until 2030 on the basis of programs for the implementation of green technologies in practical life. Among the main reasons for low initiative in waste disposal are insufficient funding and lack of experience.

Despite the fact that Sweden is ahead of Ukraine by 5.6 tons in terms of garbage per inhabitant, it is also one of the world leaders in waste recycling (Avfall, Sverige, 2019). According to the Avfall Sverige Re-

cycling Association, about 49% of garbage was recycled and 50% of waste was burned for energy production in 2019 (Avfall Sverige, 2019). Besides, the association was organized back in 1947 and currently provides waste collection and recycling in all municipalities of Sweden. We consider this experience at the stage of the formation of a green economy to be valuable not only for Ukraine, since in addition to municipalities, the association also includes other local government organizations, municipal enterprises and regional waste disposal and recycling enterprises, as well as manufacturers, consultants and contractors engaged in this field. Thus, the state authorities, local government bodies, the business sector, which employs about 30% of the population, are engaged in solving the problem. Despite the fact that the Swedes began sorting garbage only in the late 90s – later than other European countries – now separate waste collection for each resident of the country has become a normal thing, so it can be affirmed that the vast majority of the Swedish population is engaged in solving this problem.

SHW disposal is not decisive on a global scale – it is more a consequence than a cause. Therefore, in order to ensure the future for new generations, it is necessary to focus on environmental standards in construction already at the design stage of the object, which will have a positive effect on human health. As the events of 2019-2020 showed, associated with the coronavirus pandemic, there is an increase in demand for high-quality and safe *green* offices in the world. For example, in 2020 alone, the number of objects certified according to the WELL standard in Europe increased by 88%, while in Ukraine, as of 2021, there are several business centers and only one residential complex with a *green* construction and energy efficiency certificate BREEAM.

It should be noted that the coronavirus pandemic not only undermined the health of the world's population, but also had a negative impact on the economy,

the consequences of which humanity has yet to resolve. In this regard, *green* measures aimed at economy growth recovery can provide countries with an opportunity to recover more effectively through a combination of economy growth recovery and job creation. According to one of the forecasts of the World Economic Forum, a *green* economy growth recovery could create up to 395 million jobs by 2030 (World Economic Forum, 2020). This allows us to speak of green economy as a vector of sustainable development.

The main reason for the low proportion of green buildings and structures in Ukraine is the high certification standards and a wide range of criteria that the objects must meet. This leads to an increase in the cost and, often, an increase in the construction time, which generally negatively affects the implementation of the concept of sustainability.

3.3.3. Green marketing

Another effective tool for implementing the Sustainable Development Goals based on a green economy is green marketing, which the authors understand as activities aimed at meeting current needs without compromising the ability of future generations to meet their needs.

In this regard, there is a need to add a sustainable marketing concept to the basic marketing concepts (the concept of improving production, the concept of improving goods, intensifying commercial efforts, pure marketing, social and ethical marketing, modern marketing concept), which not only allows achieving the market goal of the organization, but also using resources effectively and without losses.

As the green economy develops, it should also be noted that there is a need to change the vector of the green marketing complex (marketing mix, 4P theory). Modern trends no longer allow talking about it from the position of the market supply of products that are environmentally friendly (Galkin A., Popova Y., Kyselov V., Kniazieva T., Kutsenko M., Sokolova N., 2020). Global challenges define the green marketing complex of 2021 as a market for sustainable and socially responsible products and services. For this purpose, the green marketing complex is focused on creating environmentally friendly products, using sustainable business practices, promoting the green advantages of existing products, using recycled materials in production, using green energy, reducing production waste, using environmentally friendly methods of buying or selling locally, reducing transport energy, reducing packaging, making reusable or recyclable products, etc.

As an example, let us consider the experience of Sweden again where the problem of plastic recycling is very acute. This is a problem not only for the Swedes, but also for the whole world, since the reuse of plastic, due to its composition, is possible only twice, and some types of plastic, due to the toxicity of some types thereof, will not be processed at all,

respectively, the issue of its disposal is not removed from the agenda. This is where marketing comes to the rescue, or rather a of green marketing complex. For example, due to the communication component (promotion), it is possible to reduce the use of plastic packaging, by persuading the consumer through various media, ads, to abandon it in favor of paper, glass and other containers. So in Sweden, many stores have replaced plastic and polyethylene bags with paper ones. Several large grocery stores now offer special paper bags. Therefore, the package can be used twice. A special tax on plastic bags introduced this year also helped to reduce the use of plastic bags and raise awareness among Swedes. For regular plastic it is 3 crowns, for a thin one - 0.3 crowns (Miljönär, 2020).

In addition, one of the marketing tools on the way to sustainable consumption in Sweden is the Miljönär label, the application of which helps to attract attention to organizations that give society the opportunity to reuse, separate or reduce the volume of waste in any other way.

A similar goal is being implemented by the European Demolition Association, which includes 79 European companies and which, in addition to exchanging experience in the issues of demolition and disposal of SHW, uses green marketing techniques to popularize this area around the world, informing the public and the government about the need for recycling construction waste. In the UK, an important role is assigned to information technologies, namely, they print advertising and information catalogs of rural green tourism objects with a certified characteristic of the range of their services. This experience is valuable in the context of implementing the directions of the green economy as a vector of sustainable development.

4. Conclusion

As can be seen from the above, the formation of theoretical, methodological foundations and the development of conceptual approaches to the practical provision of the green economy, considered as a vector of sustainable development, was carried out on the basis of generalization of scientific points of view regarding the interpretation of such categories as *economic growth*, *green economy*, *sustainable development*.

It was proved that economic growth in the context of the formation of a holistic sustainable economic form that will allow bringing civilization to a new level of development should be understood as such growth, which is achieved not only through technology but, to a greater extent, through the use of human capital. It was proposed to consider the green economy as an engine of economic growth which determines the state of the triad of sustainable development and involves focusing efforts on the implementation of the Millennium Development Goals, which

are the base for the 2015 Sustainable Development Goals.

The author's vision of economic growth in the context of sustainable development was formed, expressed in the form of a component model, which, unlike the existing ones, allows reflecting the essence and content of the green economy by combining the *process* and *state*, due to the fact that all components of sustainable development and the green economy are in constant dynamics and interaction. The presented model is the basis for further research, namely, the classification of indicators of the green economy.

By generalizing the positive experience of *green integration* on the example of *green tourism*, *green construction* and *green marketing*, the need for a differentiated approach to the practical implementation of the Millennium Development Goals was justified.

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Challenges for Improving Agricultural Resilience in the Context of Sustainability and Rural Development

Wyzwania dla poprawy resilencji w rolnictwie w kontekście zrównoważonego rozwoju i rozwoju obszarów wiejskich

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Abstract

Research on economic resilience in agriculture is quite complicated due to the interdisciplinary nature of the notion. In agricultural, climate change, sustainability and food security research it appears as an endogenous phenomenon rather as the main one. This study aims to contribute to conceptualization of economic resilience in agriculture, revealing current and identifying future research directions. Bibliometric analysis supplemented with a literature overview serve this purpose. Results confirm the ambiguity and immaturity of economic resilience concept and its secondary position within overall agricultural resilience research framework.

Key words: economic resilience, agriculture, citation-based analysis, mapping

Streszczenie

Badania resilencji ekonomicznej w rolnictwie są dość skomplikowane ze względu na interdyscyplinarny charakter tego pojęcia. W badaniach dotyczących rolnictwa, zmian klimatycznych, zrównoważonego rozwoju i bezpieczeństwa żywności wydaje się, że jest to zjawisko endogeniczne, a nie główne. Niniejsze opracowanie ma na celu przyczynienie się do konceptualizacji resilencji ekonomicznej w rolnictwie, wskazując na obecne i identyfikując przyszłe kierunki badawcze. Służy temu analiza bibliometryczna uzupełniona przeglądem literatury. Wyniki potwierdzają niejednoznaczność i niedojrzałość koncepcji resilencji ekonomicznej oraz jej drugorzędną pozycję w ogólnych ramach badań resilencji rolnictwa.

Słowa kluczowe: ekonomiczna resilencja, rolnictwo, badania oparte na cytowaniach, mapowanie

1. Introduction

The high exposure of agricultural production to various types of risks in connection with the particularities of agricultural markets requires dedicated support policy measures on a wider scale. Recently, the global pandemic of COVID-19 showed a number of undesirable outcomes that once again stressed the need for reconsidering the resilience of food systems (Kumar et al., 2021).

Research on agricultural economic resilience, however, is scarce and fragmented. To systematize the existing knowledge and usage in the area a bibliometric analysis would be an important step forward to operationalizing the concept and applying resilience framework to agriculture. To the best of our knowledge, despite the fuzziness no such kind of analysis has been carried out on the concept of agricultural economic resilience. Therefore, our aim is to perform a bibliometric analysis, systematize the

body of knowledge in the area and identify gaps for future research.

This paper extends the discussion on agricultural resilience that has become especially important amid the global interruptions of the supply chains due to the pandemic. An earlier paper (Žičkienė et al., 2020) looked into the role of farmer's behavior in the context of agricultural resilience and, thus, was confined to a narrower issue. The present paper applies the scientometric approach and furthers the discussion on agricultural resilience by taking a much wider approach and exploring the whole body of literature on the topic and its relationships with the other disciplines. Thus, this paper provides the overview of the state-of-the-art research in agricultural resilience and draws recommendations for further analysis.

The paper is structured as follows: Section 2 discusses the theoretical background of the agricultural resilience research. Section 3 presents the analytical approach taken. Section 4 presents the main findings. Finally, Section 5 concludes and identifies future research directions.

2. Theoretical preliminaries

The concept of resilience

The resilience concept in the articles reviewed is used quite loosely. Many researchers (Pearson, 2010; Lin, 2011; Altieri et al., 2015) ground their resilience concept on the definition of Holling (1973) and Folke et al. (2010), which refers to resilience as the propensity of a system to retain its organizational structure, feedbacks and functions following a perturbation. Pretty (2008) defines resilience quite similarly – as the capacity of a system to buffer shocks and stresses. Bernues et al. (2011) refer to resilience as a narrower concept defining it as *the short-term capacity to return to a state of equilibrium and maintain functionality when the system is confronted with a strong punctual perturbation and opposes it to adaptive capacity which reflects system's flexibility to face long-term modifications*.

Some researchers do not provide a clear definition of resilience concept used in the papers and its meaning may only be inferred from the context. Many of them (Challinor, 2007; Darnhofer, Fairweather and Moller, 2010) link resilience to system's adaptive capacities, which is defined as the capacity to reduce potentially negative effects of various perturbations either withstanding or recovering from them. Altieri and Nicholls (2013) refer to adaptive capacity as the set of social and agro-ecological preconditions that enable individuals or groups and their farms to respond to a perturbation in a resilient manner. Reidsma et al. (2010) do not explicitly use resilience concept, but similarly use the notion of adaptive capacity. In their work the adaptive capacity concept is expanded to include not only moderation of potential damages and coping with its consequences, but also

taking advantage of emerging opportunities. Thompson and Scoones (2009) and Waage and Mumford (2008) differentiate between resilience and robustness (resistance) however does not provide a clear definition of neither of them.

Giannakis and Bruggemann (2015) present a review of resilience definitions used in regional resilience academic area (based on Martin and Sunley (2015), where there are three distinct approaches used: engineering, ecological and evolutionary. The engineering based concept of resilience focuses on the resistance of a system to perturbations and its ability to *bounce-back* to the pre-shock equilibrium. The ecological concept refers to resilience as a system's ability to keep its structure and feedbacks before moving into a new equilibrium state in the face of a shock. The evolutionary approach treats resilience as a capacity of a system to withstand the perturbation, recover from it or even *bounce-forward*, that is, to respond to shocks by adaptation, adaptability and transformation (Pike et al. 2010 cited from Giannakis et al. (2015)). These three approaches encompass all of the above mentioned definitions of resilience.

Relationships between resilience, vulnerability and sustainability

In the literature analyzed the concepts of resilience, vulnerability and sustainability are very much interwoven and sometimes not easily distinguished. Researchers treat these phenomena either as complementary, or as opposite, or as part of each other. For example, Pretty (2008) refers to resilience as a part of sustainability, which also incorporates persistence (the capacity of systems to continue over long periods). Darnhofer, Fairweather and Moller (2010) propose that resilience offers a vision of sustainability, Altieri and Nicholls (2013) state that resilience is a necessary but not sufficient condition of sustainability. Tendall et al. (2015) refers to resilience and sustainability as complementary concepts. Giannakis and Bruggemann (2015), who analyze resilience of regions and represent resilience approaches coming from economic geography, treat resilience as a separate construct without discussing the linkages between resilience and sustainability.

In some studies resilience concept is closely related to vulnerability. Altieri et al. (2015) argue that resilience (referred to as a response capacity) together with vulnerability and threat determine the risk of negative impact. Schilling et al. (2012) state that vulnerability encompasses exposure, sensitivity and adaptive capacity. This adaptive capacity, although not directly referred to as resilience, can be understood as namely this phenomenon, so in such a case resilience would be a part of vulnerability. Schilling et al. (2012), based on IPCC (2007), distinguish between generic and impact specific adaptive capacities. Simelton et al. (2009) however treat resilience as an opposite of vulnerability, i.e. low-vulnerability cases are viewed as resilient cases.

Determinants of resilience

The question of what increases (or inhibits) resilience is one of the most relevant issues prevailing in academic discussion in the resilience framework. In almost every article under our scope this question is being analyzed, albeit the depth and width of its scrutiny differs significantly.

A variety of ways and methods have been proposed to increase resilience by different authors, comprising a wide range of forms (managerial, technical and financial), scales (local, regional and global) and actors (farmers, industries and governments) (Reidsma et al., 2010). However, the most important factors nurturing resilience surprisingly overlap in a majority of studies. Darnhofer, Fairweather and Moller (2010) cite Folke et al. (2003) and Berkes (2007) to list four temporarily and spatially interacting groups of factors promoting resilience in social-ecological systems: (1) learning to live with change and uncertainty; (2) creating opportunity for self-organization and cross-scale linkages; (3) nurturing diversity in its various forms; and (4) combining different types of knowledge and learning. The latter three factors have been emphasized in a number of studies. Challinor et al. (2007) argue that farmers' abilities to cope with and adapt to climate change significantly depend on their access to relevant knowledge and information as well as on building relevant social networks. Darnhofer, Fairweather and Moller (2010) and Bernues et al. (2011) state that learning through experimentation and monitoring and a diversity of resources, production processes and products allow farmers to better cope with various perturbations. Chagnon et al. (2015), presenting a specialized study of insecticides' usage and ecosystems, argue that diversity is of key importance on ecosystem functioning. Lin (2011) and Altieri et al. (2015) propose that crop diversification is an effective method to improve resilience of agroecosystems. According to Lin (2011), crop diversification can improve resilience in a number of ways: by strengthening abilities to suppress pest outbreaks, dampening pathogen transmission, and by buffering crop production from the effects of negative meteorological events. Diversity creates conditions for redundancy. And redundancy is of paramount importance when some sort of changes occur, since it enables the continuance of the system functioning and provision of its key services. In the other study Altieri and Nicholls (2013) also add that social capital and social organization strategies used collectively by farmers in order to cope with the difficult circumstances are core elements of resilience. Giannakis (2015) basis his research on theoretical and practical findings that at a macro level (regional economy) the resilience is determined by several factors, such as the sectoral composition of the economy (especially its diversity), the skills of the workforce, the innovation rate, the connectivity and the institutional arrangements within regions.

Summarizing, the main determinants of resilience, as cited by the majority of researchers and confirmed by a number of theoretical and practical research findings, can be grouped into these categories:

1. Encouraging learning and acquisition of skills and granting access to relevant information and knowledge.
2. Combining different types of knowledge and stimulating innovations.
3. Nurturing diversity in its various forms at various spatial and temporal levels.
4. Creating opportunities for self-organization, intra and inter-scale linkages.

Types of resilience

In the literature there are two types of resilience researched: specified and general resilience. *Specified* resilience refers to the resilience of *what*, to *what* (e.g., the resilience of pig farming to classical swine fever) (Biggs et al., 2012). Whereas *general* resilience does not deal with any particular shock or particular aspect of the system that might be affected by that shock, but rather considers general system characteristics and capabilities that allow better reaction to various kinds of shocks and perturbations (Martin and Sunley, 2015). Resilience to a specific disturbance or event involves identifying a particular threshold effect such that the system will not recover to the same levels of performance or its earlier pattern of behavior if this threshold is crossed (Resilience Alliance, 2010). It is very important to make a distinction between these two kinds of resilience, because increasing resilience to some particular kind(s) of perturbations may lead to declining resilience to other types of disturbances. For example, if system redundancy is traded off to build resilience to one specific type of disturbance, then the system's capacity to cope with unexpected or completely novel challenges may be diminished (Resilience Alliance, 2010).

Most of the articles analyzed in this paper focus on specified resilience with a frequent focus on namely resilience to climate change and the disturbances related to it. Lin (2011) studies how diversification in agricultural systems can increase resilience of farmers under climate change. Challinor et al. (2007) assess the vulnerability of food crop systems in Africa to climate change. Reidsma et al. (2010) synthesizes results from a number of empirical analyses on the role of adaptation under climatic change and extends the findings by providing the insights on the adaptation of farmers and regions in the European Union to prevailing climatic conditions, climate change and climate variability in the context of other conditions and changes. Altieri et al. in both articles (Altieri and Nicholls 2013) and (Altieri et al. 2015) also analyze resilience to changing climate focusing on how traditional agricultural practices increase resilience and how to design climate change-resilient farming systems. Falloon and Betts (2010) in the similar vein in-

investigate potential impacts of climate change on agricultural adaptation and vice versa. A different line of analysis comes from Darnhofer, Fairweather and Moller (2010) who focus on general resilience of farmers. Similarly, Bernues et al. (2011) discusses critical points of sustainability and resilience of pasture-based livestock farming systems in the context of diverse socio-economic, political and environmental scenarios. Giannakis and Bruggeman (2015), although focusing their analysis on a meso-macro level, also research general resilience, investigating the processes through which the impacts of the recessionary shocks can be diffused to local economies through the linkages and interdependences between economic sectors with an example of Greece.

The context of research

Articles most cited in relation to economic resilience of agriculture is spread across various fields of research, however only a part of articles directly deal with economic resilience. Simelton et al. (2009), Lin (2010) and Altieri et al. (2015) focus precisely on resilience of farming systems. Simelton et al. identify socio-economic indicators associated with crop sensitivity and resilience to drought. Lin (2011) discusses how crop diversification can increase resilience in agriculture. Altieri et al. (2015) present a conceptual framework to assess the resilience of farming systems and some methodological attempts to assess it. Tendall et al. (2015) create a conceptual framework of food system resilience. Darnhofer, Fairweather and Moller (2010) show how resilience theory applied to farming may provide a more comprehensive route to achieving sustainability and offers rules of thumb as guides to building farm resilience. However, a large share of publications comes from the research on sustainability where resilience is mentioned only in relation to sustainability (Pretty 2008, Bernues et al. 2011). Other authors discuss resilience in the context of vulnerability and adaptation to climate change (Challinor et al. 2007, Reidsma et al. 2010, Smith and Olesen 2010, Schilling et al. 2012). Yet the largest share of publications addresses resilience of agriculture indirectly (Kollner and Scholz, 2008; Waage and Mumford, 2008; Thompson and Scoones, 2009, Chagnon et al., 2015) while analyzing other issues. The resilience concept in these articles is used only sparingly and fragmentally.

COVID-19 pandemic and agricultural resilience

In the last two years a very large amount of research was dedicated to the COVID-19 pandemic and its impact on agriculture, where resilience and vulnerability were the two main perspectives approaching this theme. All the dimensions of resilience have been tackled in various studies: robustness or absorptive capacity (Galanakis, 2020; Zarei & Rad, 2020), adaptability (Adnan & Nordin, 2020; Henry,

2020; Cattivelli & Rusciano, 2020; Zimmerer & de Haan, 2020) and transformability (Boughton et al., 2020; Petetin, 2020; Timilsina et al., 2020). However, usually researchers approach only one of the dimensions in their studies and the possible interactions among the dimensions are left behind. In general, the literature on COVID19 pandemic and agricultural resilience is focused more on the negative effects of pandemic rather than on theoretical grounds of resilience. Consequently, resilience concept is again used quite loosely, often reflecting an intuitive meaning of the concept, without its clear definition.

The analysis of the literature of COVID-19 pandemics and agricultural resilience showed that most attention was dedicated to the food supply chains (Sharma et al., 2020; Farell et al., 2020; Worstell, 2020; Bene, 2020; Boyaci-Gündüz et al., 2021; Thilmany et al., 2021). Which is not surprising, since one of the main negative impacts of the pandemics was related to the closure of borders which resulted in unprecedented strain on supply chains (Kerr, 2020). Subsequently ones of the most popular research topics were food security (Bene, 2020; Clapp & Moseley, 2020; Boyaci-Gündüz et al., 2021) and labor supply (Anderson et al., 2020; Ridley & Devadoss, 2021) – vital aspects of food supply chains that were directly affected by the pandemic. In general, it's being predicted that the impact of COVID-19 on agriculture and global food security will be complex (Torero, 2020), and many of the consequences are not yet identified (Jámbor et al., 2020).

A number of studies have presented various ways and measures for the mitigation of crisis and enhancement of agri-food systems' adaptability in the future. For example, Timilsina et al. (2020) propose, that government should take vigorous steps to facilitate farmers using automated machinery facilities; enhancing quality of seeds and fertilizers; provide direct financial funding for vulnerable farmers to build agricultural sector resilience to the pandemic. Lioutas and Charatsari (2021) discuss three potential mechanisms that can mitigate the impacts of major crises in agriculture: resilience-promoting policies, community marketing schemes, and smart farming technology. Worstell (2020) attempts to examine the eight qualities (Connectivity, Local self-organization, Innovation, Maintenance/redundancy, Accumulation of value-added infrastructure, Transformation, Ecological integration, Diversity) proposed as necessary for resilient food systems in the CLIMATED model (Worstell & Green, 2017) and how broadly these qualities apply in COVID-19 scenario. All these studies show that COVID-19 crisis has boosted a large interest in the resilience of agri-food systems. A lot of empirical studies has been performed on the issue, however theoretical discussion on namely resilience phenomenon in agricultural sector at various levels is still lacking.

3. Methods

The data was retrieved on 30th of November 2020. The Clarivate Analytics Web of Science Core collection was chosen for the data mining. It guarantees the high standards of scientific integrity, as journals indexed in CA WoS are considered to apply one of the most formidable standards for a peer review process (Da Silva & Marmon, 2017). The time period for the data analysis covered years 1990-2020. The selected keywords were *economic AND resilience AND agriculture*. The search provided 668 documents. The initial set inclusion and exclusion criteria are presented in Table 1.

Table 1. Inclusion and exclusion criteria for the analysis.

Inclusion criteria	Exclusion criteria
Paper in English	Paper in other, not English language
Paper has abstract	Paper does not have an abstract
Paper provide keywords	Document does not provide keywords
Document type: article, early access, conference material, book chapter, editorial, review.	Document type: communication, technical report, etc.

The rationale for setting the inclusion and exclusion criteria is the following. Authors are usually not familiar with other than English and their native languages, so they would not be capable to critically assess and evaluate papers prepared in other languages. Bibliometric clustering techniques use abstract and keywords for the analysis. Papers without keywords cannot be properly processed, so must be excluded. The selection of document type is important due to the fact, that typically communication or technical reports are not obliged to follow rigorous peer-review procedures (van Raan, 1996). In order to avoid compromising research integrity we decided to avoid such types of papers. Despite the above-mentioned standards, we found all extracted documents satisfying the criteria to be included into the analysis.

The data was processed using VOSviewer 1.16.5 software. The selected tool is used quite frequently in business and economics research (Ferreira, 2018; Davlembayeva, Papagiannidis & Alamanos, 2019; Piñeiro-Chousa et al., 2020; Haque, Ahmad, & Azad, 2020). It is aimed at analyzing large numbers of bibliometric information required for conceptualizing the researched notions (Rosas, 2017), indicating prevailing theoretical streams (Findlay, 2017) or outlining future research directions (Proctor, 2019). This method is highly praised when researching notions, attributed to a number scientific fields (Hu & Zhang, 2017) or considered to be of an interdisciplinary nature (MacLeod, M & Nagatsu, 2018). These insights confirm the suitability of selected research method, as economic resilience in agriculture covers

not only agricultural (Michler et al., 2019) or economical (Giannakis & Bruggeman, 2020) but also environmental (Lipper et al., 2017) and managerial (Di Gregorio, 2017) aspects and can be attributed to various disciplines. For this purpose, we apply four techniques of bibliometric clustering: 1) a bibliographic clustering of publications in economic resilience in agriculture; 2) a co-citation analysis of scientific documents and publication sources in a researched field; 3) co-occurrence of keywords and 4) co-authorship analysis on institutional and country levels.

4. Results and discussion

Figure 1 clearly indicates, that the turning point in the development of research on economic resilience in agriculture is 2004. This year may serve as a threshold for researchers conducting literature review, as it is noted, that after 2004 research on economic resilience in agriculture started gaining momentum and was extrapolated to other disciplines, such as sustainability (Perrings, 2006), water management (2004), assessment of institutional quality (Jayaraman, 2004), adaptive management practices (Lin, 2011), environmental risk and natural resources management (Deshingkar, 2012) or even to a political context (Meitzner, 2010).

In order to reveal the most influential publications on economic resilience in agriculture, we arranged them according to the number of citations (Table 2). Analyzing most cited publications on economic resilience in agriculture we noticed a few interconnected theoretical sprouts. Economic resilience in agriculture has been often researched through the lens of sustainability concept (Pretty, 2008; Bernues et al., 2011; Darnhofer et al., 2010). The highest number of the most cited publications in agricultural economic resilience focus on the adaptation and mitigation of climate change challenges to agriculture (Lin, 2011; Reidsma et al., 2010; Challinor et al., 2007; Smith & Olesen, 2010; Falloon & Bets, 2010; Altieri et al., 2015; Schilling et al., 2012; Altieri & Nichols, 2017). Economic resilience in agriculture was also investigated under environmental research umbrella (Waage & Mumford, 2008; Koellner & Scholz, 2008; Grau, Kuemmerle & Macchi, 2013; Rodrigues et al., 2011; Chagnon et al., 2015). Smaller literature streams, which analyze economic resilience in agriculture are coupled around soil management practices (Simelton et al., 2009; Lal, 2016) and food systems research (Thompson & Scoones, 2009; Tendall et al., 2015).

The most productive institutions in economic resilience of agriculture are presented in Table 3. The analysis of the most productive institutions on economic resilience in agriculture research domain in 1990-2020 revealed a quite high concentration of scientific activities, as almost 25% of all publications

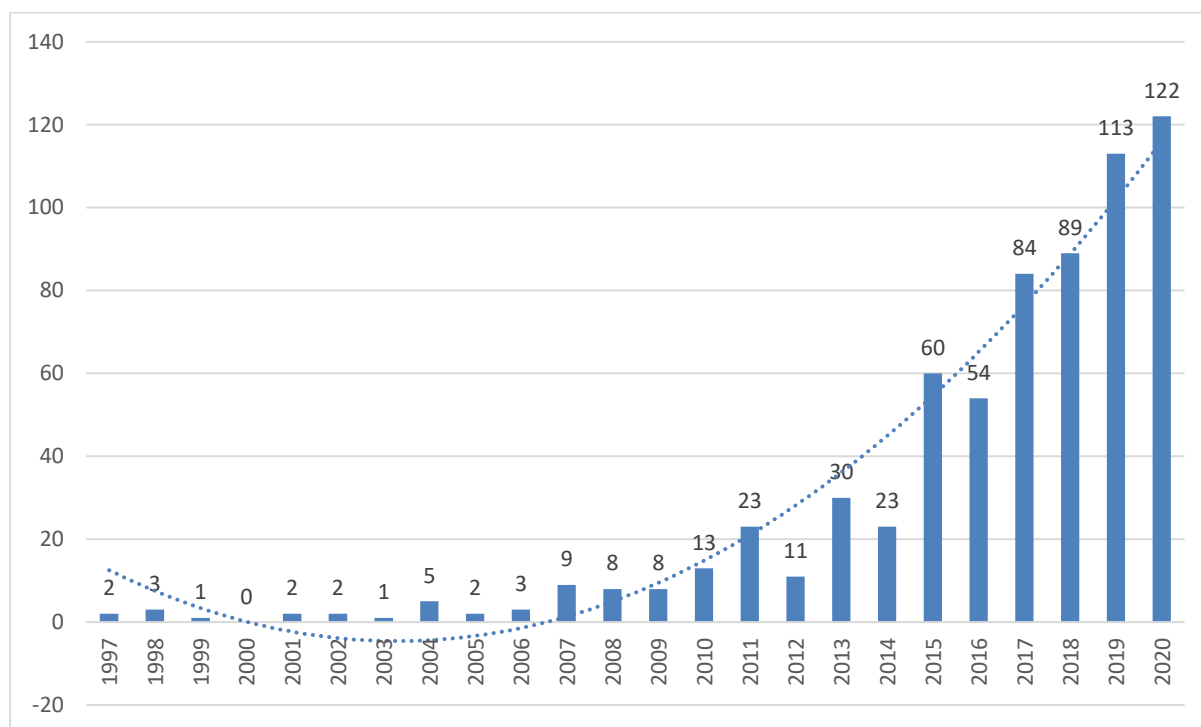


Figure 1. Number of scientific publications on economic resilience in agriculture in WoS DB in 1990-2020

Table 2. Most cited publications on economic resilience in agriculture

Author(s)	Total times cited
Pretty, J, 2008	641
Lin, BB, 2011	467
Reidsma et al., 2010	264
Challinor et al., 2007	249
Falloon & Betts, 2010	225
Altieri et al., 2015	216
Rodrigues et al., 2011	193
Chagnon et al., 2015	174
Bernues et al., 2011	169
Smith & Olesen, 2010	157
Darnhofer et al., 2010	149
Schilling et al., 2012	133
Grau et al., 2013	125
Altieri & Nicholls, 2017	119
Simelton et al., 2009	133
Thompson & Scoones, 2009	115
Waage & Mumford, 2008	109
Tendall et al., 2015	105
Koellner & Scholz, 2008	104
Lal, 2016	107

on economic resilience in agriculture during the researched period was produced by 10 most productive institutions. These findings are consistent with Zorzetto et al. (2006) and Iaria, Schwarz & Waldinger (2018) insights about the concentration of scientific production although they contradict to the overall trend of de-concentration in a World's scientometrics (Maisonobe et al., 2017). It is not preferable from the food security perspective either. As resilience of agriculture is considered to be essential for the food security in the World (Bene, 2020) and ag-

ricultural output is very dependent on local conditions and agricultural practices employed (Singhal & Vatta, 2017), the research on resilience in agriculture should be more dispersed and located in areas close to agricultural production (Busch & Lacy, 2019).

Table 3. The most productive institutions in economic resilience in agriculture domain in 1990-2020

Institution	Number of documents published	% of total publications
CGIAR	32	4,79%
University of California System	21	3,14%
INRAE	18	2,69%
United States Department of Agriculture (USDA)	16	2,40%
Commonwealth Scientific Industrial Research Organisation (CSIRO)	15	2,25%
Wageningen University Research (WUR)	15	2,25%
Indian Council of Agricultural Research (ICAR)	14	2,10%
Centre National de la Recherche Scientifique (CNRS)	12	1,80%
Alliance	10	1,50%
Helmholtz Association	10	1,50%
Total	163	24,40%

In order to better assess the geographical dispersion of research on economic resilience in agriculture, the countries were ranked according to the number of publications on economic resilience in agriculture

domain (Table 4). The analysis revealed an unprecedented concentration of scientific publications of economic resilience in agriculture within 10 most productive countries, which account for more than 92% of all publications in the field. Such accumulation of knowledge in a small number of states creates unfavorable conditions for further knowledge acquisition and dissemination. It also may play a role in hindering increase in competition in production of agricultural goods, since even in the primary sector knowledge-based management practices tend to grant competitive advantage (Vasiljević & Savić, 2013), thus making the achievement of convergence in agriculture even more complicated (Volkov et al., 2019).

Table 4. The most productive countries in economic resilience in agriculture domain in 1990-2020

Country/Region	Number of documents published	% of total publications
USA	157	23,50%
England	81	12,13%
Australia	70	10,48%
Germany	59	8,83%
Italy	49	7,34%
India	47	7,04%
P. R. of China	42	6,29%
France	41	6,14%
Spain	41	6,14%
South Africa	30	4,49%
Total	617	92,37%

The journal engaged into dissemination of research on economic resilience in agriculture are presented in Table 5. Among them, Sustainability is followed by Agricultural Systems with the number of relevant publications differing more than 3 times. Such disparity may be explained by the fact, that Sustainability is more interdisciplinary, in addition, resilience based studies are very often interconnected with sustainability framework, making an above mentioned publication source an ideal vehicle for the dissemination of research in a particular field. It is worth noticing, that only Agricultural Systems is a truly agricultural journal among the most productive publication sources in economic resilience in agricultural domain. Others journals focus on environmental issues (Environmental Research Letters, Regional Environmental Change, Environmental Science & Policy, Ecology & Society), policy (Land Use Policy, Journal of Rural Studies), or publish sustainability related issues (Sustainability, International Journal of Agricultural Sustainability, Agroecology and Sustainable Foods Systems). This fact once again confirms the interdisciplinary nature of economic resilience and reveals the shortage of its research in agricultural economics' domain.

Table 5. Journals with a highest number of publications on economic resilience in agriculture

Publication Source	Number of publications	% of total publications	IF 2019
Sustainability	45	6,74%	2.576
Agricultural Systems	14	2,10%	4.212
Land Use Policy	13	1,95%	3.682
Journal of Rural Studies	12	1,80%	3.544
Environmental Research Letters	11	1,65%	6.096
Ecology and Society	10	1,50%	3.89
International Journal of Agricultural Sustainability	10	1,50%	2.278
Regional Environmental Change	9	1,35%	3.481
Agroecology and Sustainable Foods Systems	8	1,20%	1.636
Environmental Science & Policy	8	1,20%	4.767
Total	140	20,96%	

A bibliographic analysis of research on economic resilience in agriculture

In order to reveal interconnectedness of scientific research in economic resilience in the field of agriculture, we conducted a bibliographic analysis. This method allows to identify the existing layers of the concept under investigation (Brandao et al., 2017) and enables to predict the future research directions of the scientific notion more precisely (Youngblood & Lahti, 2018).

To investigate the reference relationships between different scientific documents researching economic resilience in the domain agriculture we employed a bibliographic coupling technique, which is a common tool in a bibliographic research (Habib & Afzal, 2019). The preselected threshold for the document to be included into the analysis – no less than 25 citations.

Analyzing the results of bibliographic coupling, 8 distinct clusters can be identified (Fig. 2). The biggest and most influential network is dominated by Pretty's (2008) article. The total link strength is 72 in 45 links with 603 citations in total. Second the most influential network is centered around Lin's (2011) publication (blue cluster). The total link strength is 61 in 34 links and 460 citations. The most intensive although not of the highest importance in the development of agricultural resilience research is the violet cluster dominated by Altieri et al. (2015). It shows the highest total link strength among all clusters – 84 in 37 links and 209 citations. The fourth most intensive is the red cluster, which is based

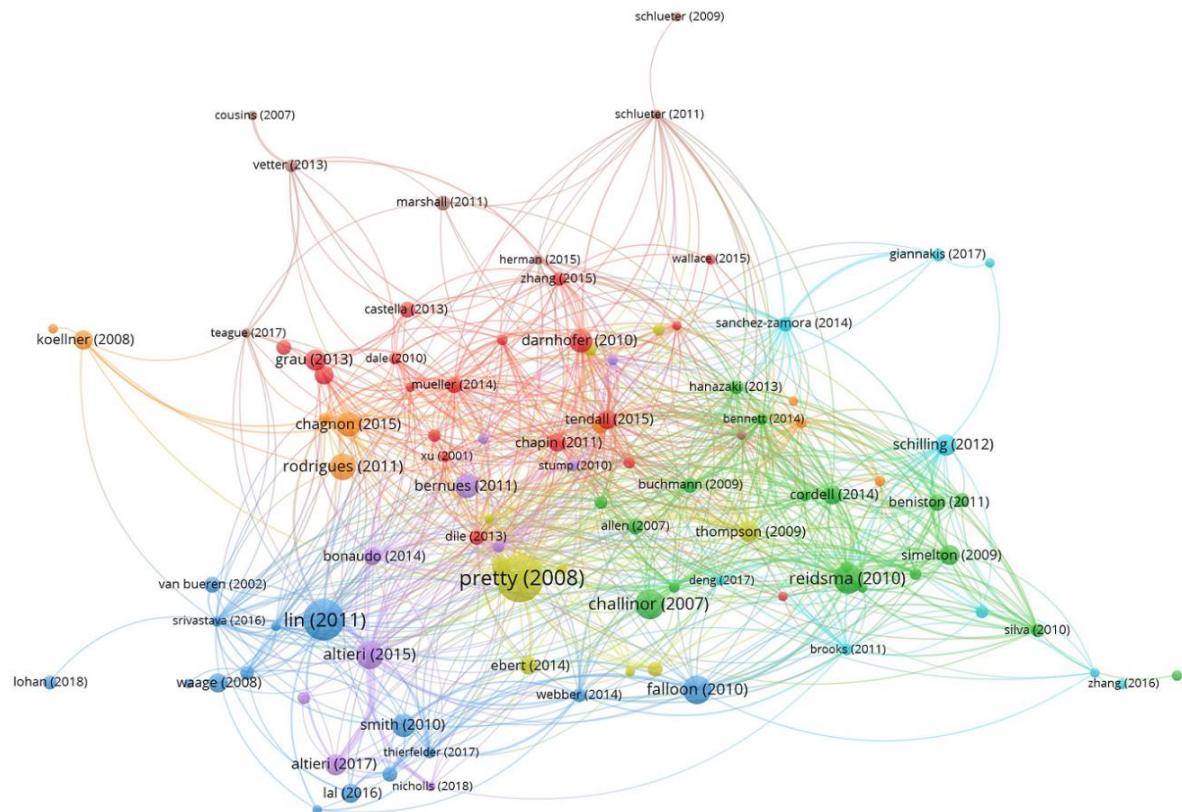


Figure 2. Co-citation coupling of publications, devoted to economic resilience in agriculture in 1990-2020

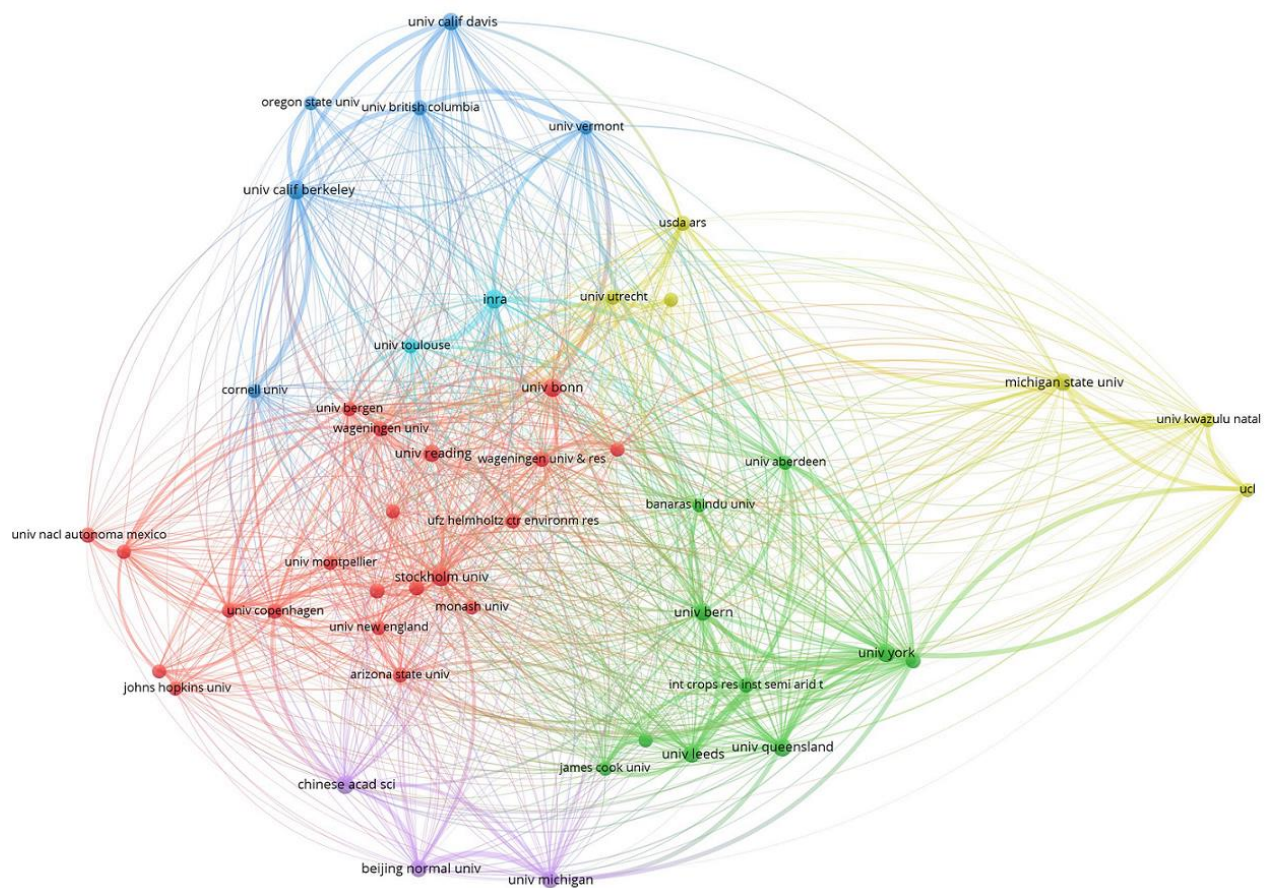


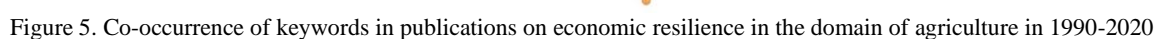
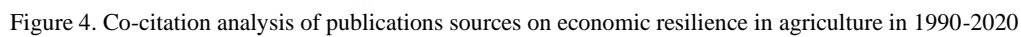
Figure 3. The most productive institutions in economic resilience in agriculture domain in 1990-2020

around Darnhofer (2010). It shows a total link strength of 30, 51 link and a total number of citations – 145. The fifth cluster (the green one) is less polarized, showing two publications of a comparable importance – Challinor (2007) and Reidsma (2010), the latter being in a slightly more important position within the network with the total link strength of 47 in 22 links and 246 citations in related publications. It is worth noticing, that although the green network shows higher number of citations, its total link strength is lower indicating red cluster's higher thematic relatedness and interconnectedness, which presuppose a narrower and more specific research area compared to the green cluster. This is confirmed by a heat map analysis, showing more intense yellow color around red cluster publications. The sixth network (the light blue) is led by Schilling (2012) with a total link strength of 41 in 25 links and 129 citations. The least important are orange and brown clusters, networked around Chagnon (2015) and Schlueter (2011) with total link strength of 27, 17 links, 126 citations and a total link strength of 29 in 22 links with 28 citations respectively. Heat map clearly indicates the higher importance of orange cluster in the development of research in economic resilience in agriculture due to its more integral position within the network and significantly brighter spots showing higher comparative weight of publications attributed to the orange cluster as compared to the brown one. The more or less clear boundaries can be drawn around red, green and brown clusters indicating distinctiveness and thematic proximity. Red cluster publications are more focused on a view on economic resilience within the sustainability framework, green network publications analyze the strategies on farmers' adaptation to climate change and, among them, the economic resilience phenomenon. Brown cluster analyze economic resilience from the socioeconomic perspective, analyzing socioeconomic consequences on rural population due to various environmental risks/disasters.

Further the investigation of the most productive institutions in the domain of economic resilience in agriculture was performed (Figure 3). Only institutions, which have produced no less than 5 publications in a researched field, are included into the analysis. The analysis confirms the Abankina Filatova & Nikolayenko (2018) presumptions about quite separate research topics investigated in different scientific institutions. Oxford University can be considered as the most influential in promoting research on economic resilience in agriculture leading a green cluster of research institutions with a total link strength of 1536 (with 44 links provided only by 6 scientific publications). Other influential institutions lying within the green cluster encompass: University of York, Bern University, University of Queensland, Leeds University and University of Aberdeen. The second most influential cluster is led by University of California at Berkeley (blue network) with a total

link strength of 1271 in 45 links with 9 documents on economic resilience in agriculture published. This network is composed solely of Northern American universities and includes University of California (Davis), Oregon State University, University of British Columbia, Cornell University and University of Vermont. The third one (red cluster) is led by the WUR, which in the analysis is represented by two separate institutions Wageningen University and Wageningen University & Research. It is because till 2016 the research branch of Wageningen University was operating as a distinct institution. Further on, in order to better reveal the contribution of institutions, we analyze these two institutions as one entity. Subsequently its combined total link strength is 1249 with 47 links and 12 documents published. The fourth most important cluster is led by INRA (light blue) with a total link strength of 1001, 46 links and 9 documents published. It is the smallest cluster by number of participants represented only by the University of Toulouse. The fifth (violet color) cluster is led by the University of Michigan (total link strength – 913, 44 links and 7 publications published) followed also by a small number of institutions – Beijing Normal University and Chinese academy of science. The last (yellow) cluster is established around Michigan State University with a total link strength of 860, 41 link and 7 documents. Although network analysis put the red cluster only into the 3rd place according to the influence in the development of research in economic resilience in agriculture, the heat map analysis clearly indicates the intensity, relative weight and a big number of institutions engaged into the research in the relevant area. So researchers interested in the topic should pay attention to the output of the institutions of the red cluster in the future. The small amount of overlapping plots in a density map also indicates a quite high distinctiveness of studies conducted by different institutions in this domain.

In order to reveal publication sources, most engaged in dissemination of knowledge of economic resilience in agriculture, we conducted a co-citation analysis of scientific journals (Fig. 4). The threshold to be included into analysis – no less than 5 published publications on economic resilience in agriculture. The network analysis revealed 5 distinct clusters. The biggest blue-colored cluster is led by the journal *Agriculture, Ecosystems & Environment* (ISSN: 0167-8809) with a total link strength of 29744, 250 links and 533 citations. The second biggest (red color) network is clustered around the *Global Environmental Change* (ISSN: 0959-3780) scientific source. Its measured total link strength is 27727, number of links – 253, total number of citations – 725. Heat map analysis implicates much higher density of the red cluster, which means it is significantly less polarized compared to the blue one, so the knowledge gathering is dispersed among the higher number of scientific sources. It is worth noticing,



that both these journals are published by the same Elsevier publisher. The third cluster (yellow one) is led by a second most cited journal in all disciplines – Science (ISSN: 0036-8075). In this network it shows a total link strength of 26951, number of links – 255 and 601 citations. Heat map shows a quite high interconnectedness of red and yellow clusters indicating a corresponding scientific streams published in these publication sources. The fourth (violet color) cluster is dominated by the Proceedings of the National Academy of Sciences of the United States of America (ISSN: 0027-8424) with a total link strength of 26084, total number of links -253 and 585 citations. It should be noted, that papers published in sources belonging to the violet cluster differ significantly from the articles published in sources of any other cluster, as they tend to focus more on anthropological subjects. The smallest cluster centers around the Climatic Change (ISSN: 0165-0009) journal with a total link strength of 15868, 248 links and 374 citations.

Keywords are considered to reveal the nature of the study and provide the initial and essential information about the research (Baker, 2004). The analysis of co-occurrence of keywords provide insights about the prevailing research directions of the investigated field (van Eck and Waltman, 2014). In order to better understand the development of the research directions on economic resilience in agriculture, we conducted a keyword co-occurrence analysis (Fig. 5). The keyword has to occur at least 5 times in scientific documents to be included into analysis.

Analyzing co-occurrence of keywords, one distinct cluster (violet color) containing such keywords as *adaptation*, *vulnerability*, *climate change* and *vulnerability* emerges. It means that these keywords appear together very frequently and indicate studies aimed at evaluating vulnerability and adaptive capacity of agriculture to climate change. Another distinct cluster, represented by the red color is centered around keywords occurring in research aimed at evaluating sustainability of agriculture or resilience under sustainability framework. A smaller cluster centered on *biodiversity*, *systems* and *sustainable agriculture* keywords can be distinguished. These studies are focused on maintaining the biodiversity of agriculture under the climate change conditions. All other clusters are too densely interconnected to allow drawing their borders and thus hinder a possibility of further analysis. It should be noted, that although the economic resilience in agriculture appears as a focal point of our research and the corresponding keywords were used, no clear cluster representing economic facet of resilience in agriculture was identified. This outcome not only indicates an obvious underrepresentation of economic resilience in agricultural research context, but also specifies a research

area for the future investigations, as this scientific vacuum should be covered.

5. Conclusions

The study revealed that economic resilience in agriculture is a promising research area, since it is quite scarcely researched: both theoretically and empirically. Such a scientific vacuum impedes development of the overall agricultural resilience research, as economic resilience is considered to be an inseparable part of agricultural resilience concept (Chonabayashi, Jithitikulchai & Qu, 2020) and is focal in a development of more sophisticated variations of agricultural resilience, such as climate-smart agriculture (Taylor, 2018).

It was found, that typically, researchers do not concentrate on the economic resilience of agriculture as on the focal research object, but do investigate it under the frameworks related to sustainability, climate change, soil or water management, institutional quality, food security or environmental management. Although these studies provide some additional scientific knowledge on economic resilience in agriculture, it lacks a holistic overarching approach which would be possible if economic resilience in agriculture would be considered as the main research object.

The sidelined position of the economic resilience within the overall agricultural resilience research framework, which is confirmed by a very high geographical concentration of related research, led to a situation, that although introduced quite a long time ago, this notion is still in a state of flux and differences in its definitions may lead to a misconception in research objectives in the area. Although there have already been some attempts to conceptualize resilience into an operational and measurable framework, the general consensus on what exactly economic resilience of agriculture means and what it encompasses has not been achieved yet. Quite a low interconnectedness of a research conducted by various separate research institutions hinders the knowledge transfer and slows down the progress in the development of research in economic resilience in agricultural domain.

The main suggestion for the future research directions is to put economic resilience of agriculture at the forefront of the research. Clear delineation of resilience and its differentiation from sustainability and vulnerability concepts are necessary. Going further, the relationships among different dimensions of resilience - absorption of a shock, adaptation to it and transformation after it – also need attention. Conceptualization of resilience into a measurable construct could boost its empirical research. Studies, directed to indication of factors increasing or hindering eco-

conomic resilience in agriculture, could be especially fruitful. Progress in this area would help to speed up research in other related fields, such as climate-smart agriculture or vulnerability of rural populations in less developed countries as well.

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Time-Frequency Co-Movements Between Biomass Energy Consumption and Human Development in Brics Countries

Relacja czasowo-częstotliwościowa pomiędzy zużyciem energii z biomasy a rozwojem człowieka w krajach grupy Brics

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Abstract

This paper aims to investigate the influence of biomass energy consumption on human development in BRICS countries in the frequency-time domain using the wavelet frameworks. Specifically, the wavelet coherency method of Rua (2013) and the wavelet-Granger causality test of Olayeni (2016) are utilized to quantify the strength and direction of causal relationships through time and across various frequencies simultaneously. The empirical findings uncovered that the causal linkages between human development and biomass energy consumption in the BRICS countries are not homogeneous in different time and frequency scales. We also discover the strong relationship between the two variables in China, Russia, Brazil, and South Africa after the global financial crisis 2008 at low and medium frequencies, while this connection is somewhat low in India over the sample period. This study suggests the importance of biomass energy for human development in BRICS countries.

Key words: biomass energy, human development, BRICS countries, wavelet analysis, sustainable development

Streszczenie

Niniejszy artykuł ma na celu zbadanie wpływu zużycia energii z biomasy na rozwój człowieka w krajach grupy BRICS w relacji częstotliwościowo-czasowej przy użyciu ram falkowych. W szczególności wykorzystano metodę koherencji falkowej Rua (2013) i test przyczynowości falkowej-Grangera Olayeni (2016) do ilościowego określenia siły i kierunku związków przyczynowych w czasie i na różnych częstotliwościach jednocześnie. Wyniki empiryczne ujawniły, że powiązania przyczynowe między rozwojem społecznym a zużyciem energii z biomasy w krajach BRICS nie są jednorodne w różnych skalach czasu i częstotliwości. Wykazano również silny związek między dwiema zmiennymi w Chinach, Rosji, Brazylii i RPA po globalnym kryzysie finansowym w 2008 r. przy niskich i średnich częstotliwościach, podczas gdy związek ten w Indiach jest niski w tym okresie próby. Niniejsze badanie sugeruje duże znaczenie energii z biomasy dla rozwoju człowieka w krajach BRICS.

Słowa kluczowe: energia biomasy, rozwój człowieka, kraje grupy BRICS, analiza falkowa, rozwój zrównoważony

Introduction

Energy is an integral element of economic and societal growth, and the biomass energy consumption is a vital part of energy sources and is as old as humanity. The utilization of biomass energy contributes to job creation, agricultural growth, transportation, and trade openness, resulting in poverty alleviation and sustainable human development (Bilgili et al., 2017;

Adewuyi and Awodumi, 2017). Nevertheless, conventional biomass use is not widely used across the world since it has not met the energy needs of the economy in recent years (Ozturk and Bilgili, 2015). Fossil fuel energy has gained popularity, and conventional biomass usage has diminished because the economy has considerably developed. Specifically, developing energy consumption has become the key determinant in industrialization, and the conven-

tional usage of biomass energy has lost its popularity (Bildirici and Özaksoy, 2018; Drastichová and Filzmoser, 2019). According to Wang et al. (2020), Biomass energy use plays a crucial role in enhancing a country's economy, and then it influences human welfare. Put differently, modern education, health, and communication facilities are intrinsically linked to the available energy supply. Poor health services, fewer chances for education and development, and a high possibility of poverty in the population may be occurred due to the scarcity of energy resources. Therefore, biomass energy consumption needs to create a sufficient amount of energy for the modernization process to facilitate sustainable development. This paper wishes to add to the existing literature by investigating the impacts of biomass energy consumption on human development. United Nations Development Program (UNDP) introduced the concept of human development, known as the expansion of human opportunities and choices. As per Wang et al. (2020), this index has eventually replaced GDP to become the key factor in assessing human development. Human development based on long and healthy life, knowledge, and decent living standard can reflect the entire quality of human being. Improving this index becomes a target for almost every nation. Governments and policymakers must consider all three dimensions of sustainable development, namely environmental, cultural, and social issues. As a result, a better understanding of the interconnection between biomass energy consumption and human development may provide them with clear evidence of the influence of biomass energy consumption on human development.

A systematical understanding of the relationship between biomass energy usage and human development is fundamental. The biomass energy-human development nexus has a very vital implication for policymakers and governments that care about human development on the one hand and the environment and scarcity of natural resources on the other hand. They have to understand whether renewable energy consumption promotes human development or whether human development causes energy use since suitable energy and environmental policy selections rely on nature or the causal association between renewable energy consumption and human development (Ozturk and Bilgili, 2015; Ouedraogo, 2013; Pirlogea, 2012; Khan et al. 2019; Hung, 2021). Consequently, the renewable energy consumption-human development relationship has been extensively examined by many scholars utilizing various econometric techniques and data set.

In this paper, we focus on the causal associations between these indicators in the BRICS countries. The reason for choosing Brazil, Russia, India, China, and South Africa (BRICS) nations for the current study is that the share of biomass energy usage in renewable energy in BRICS countries was high at 36.8%, according to the 2009 International Energy Agency

report (IEA). Besides, there were newly industrialized economies in these nations raising concerns about energy security and environmental pollution, which requests for alternative energy sources (IEA). Several incentives have already been carried out in the BRICS economies to increase biomass energy production, leading to a remarkable rise in biomass production (IEA). More specifically, the large share of global carbon dioxide emissions was a significant indication of the BRICS economy's need for alternative energy sources (Aydin, 2019).

The last few decades have been some empirical works with regard to biomass energy consumption and human development (Dias et al., 2016; Wang et al. 2018; Khan et al. 2019; Reiter and Steensma, 2010). Nevertheless, very few studies have been done in the BRICS countries context (Sinha and Sen, 2016). Also, the present literature describes mixed opinions on the nexus between the two examined indicators. Traditionally, there are two aspects of biomass energy-human development relationship-direct and indirect. The direct connection is studied by Shahbaz et al. (2016) and Aydin et al. (2019), and indirect impact is investigated in terms of economic growth and environmental pollution (Wang, 2019, Wang et al., 2020). Mostly, the emphasis on the adoption of renewable energy sources is a result of environmental issues and climate change (Khan et al., 2019). Consequently, the direct influence of biomass energy usage on human development is subject to the modernization of technique under practice to utilize alternative energy sources in an economy, which requires careful statistical information to construct the interlinkage between human development and biomass energy consumption in BRICS countries.

Taking into consideration the causal relationship, Sinha and Sen (2016), Shahbaz et al. (2016), Wang (2019), and Aydin (2019) employ GMM models, and the latest papers are conducted by Wang et al. (2020). These works concentrate on establishing possible long-run causal relationship among energy consumption, economic development, CO₂ emission, and human development by using time-domain methods including cointegration, ARDL, NARDL, fully modified OLS, and dynamic OLS, which restrict the information effectiveness on policies of economic development as well as human welfare (Adebayo, 2021). As a result, in addition to these techniques utilized, the current paper applies the wavelet framework to capture lead-lag relationships. Put it another way, this approach allows us to explore the causality and association between human development and biomass energy consumption in BRICS countries at different time and frequency domains. Causation between these indicators continues to be a significant subject of investigation for governments and policymakers, not only the nexus it entails but also because of the expectations on prediction. Knowing how and when a certain indicator causes

another helps policymakers identify the usage of their resources, right policies, and strategy for sustainable development purposes.

An in-depth analysis of the importance of biomass energy consumption for human development and the existing energy use pattern in BRICS nations also motivates us to look into the connection between biomass energy usage and human development to explore whether biomass energy use impacts the human development process in these countries. Therefore, our study contributes to the existing literature on renewable energy-human development nexus and uses the wavelet cohesion framework of Rua (2013), wavelet coherence, and a novel approach to causality applying a time-frequency technique developed by Olayeni (2016), which is much easier to interpret. The application of wavelets allows us to capture the interrelatedness of the concerned variables in time and frequency domains, boosting our understanding of possible dependences. Unlike previous works on biomass energy-human development relationship, our study provides additional insights into governments and policymakers with a better understanding of the effects of biomass energy on human development in the BRICS countries because conventional techniques do not allow the estimation of continual variations in the lead-lag connection between variables, nor allow for the causal association of short-and long-run sustainable development strategies. Employing wavelets, we can examine nonlinearities, structural breaks, and various lead-lag scenarios between biomass energy consumption and human development.

The rest of this article is structured as follows. Section 2 describes the literature review. Section 3 represents the data and methodology. Section 4 documents the empirical results, and Section 5 sums up the conclusions and some policy implications.

Literature review

An extensive body of studies has concentrated on the interrelatedness between energy consumption, economic growth, carbon emission, and human development, finding evidence of causality, dependence, and spillovers (Bildirici and Özaksoy, 2018). Several articles confirmed energy to be a dramatic contributor to human development, while few uncovered energy to be irrelevant for a country's development process (Dias et al., 2016; Khan et al., 2019). The current study aims to examine the causal association between biomass energy consumption and human development. Academic researchers have unveiled that biomass energy can impact the environment, economy, and resources toward guaranteeing sustainable development. The relationship between biomass usage and human development in causality has been studied in many papers in recent years. The empirical findings of such papers provided a mix of results due to using various data sets, econometric

techniques and countries' properties (Wang 2019; Wang et al. 2020).

This segment of the present study discusses prior works on the interconnections between economic growth, CO₂ emission, renewable energy consumption, and human development. The literature on the interrelatedness among economic growth, renewable energy usage, and CO₂ emission is vast. Nevertheless, there is no concrete agreement on the nexus across these economic variables. This field has become more attractive based on this lack of consensus, and more contributions are encouraged. Ozturk and Bilgili (2015) examine the long-run relationship between economic development and biomass consumption for 51 Sub-Sahara African nations. Their findings indicate that economic growth is remarkably impacted by biomass usage, trade openness, and population. Bilgili et al. (2017) investigate the comovement and causality between biomass energy, CO₂ emissions, and economic growth in the US. They argue that biomass energy use mitigates CO₂ emissions and increases economic development, which suggests biomass energy usage can be an efficient policy framework for environmentally sustainable development in the US. Adewuyi and Awodumi (2017) investigate the interdependence between biomass energy consumption, economic growth, and carbon emissions in West Africa, and provide evidence that a comprehensive significant connectedness exists across GDP, biomass use, and carbon emission. Bildirici and Özaksoy (2018) identify the intercorrelation between biomass energy usage and economic growth for several European Transition Countries. The results indicate that there is evidence of bidirectional causality between the variables.

Several studies have examined the intercorrelation between human development and economic indicators. However, their results are mixed. For instance, Martinez and Ebenhack (2008) study the intercorrelation between UN human development and energy consumption for 120 countries, and report that three areas are isolated: a steep rise in human development with regard to energy consumption for energy-poor countries; a moderate rise for transitioning countries; and essentially no rise in human development for energy-advanced countries, consuming large amounts of modern energy. Ouedraogo (2013) studies the causality connectedness between energy consumption and human development in 15 developing countries and points out that energy consumption has a neutral influence on human development in the short run. Reiter and Steensma (2010) document that FDI has a strong relationship with human development, which limits foreign investors from entering some economic sectors. Pirlogea (2012) explores the role of energy in human development by examining the impact of energy on sustainable development and economic growth. He highlights that high levels of energy intensity of a country pose threats to its hu-

man development. Dias et al. (2016) focus on the relationship between human development, economic growth, energy consumption, and social growth. The findings shed light on the importance of hunting for alternative development for human development balance, natural resources, and environment. Recently, Wang et al. (2018) estimate the relationship between renewable energy consumption, economic growth, and human development in Pakistan, and provide evidence that renewable energy consumption does not improve the human development process in Pakistan. Specifically, the authors also document that the higher the income of the country, the lower its human development level and CO₂ emission is useful to improve the human development index in this country. Khan et al. (2019) model the nexus between information and communication technology (ICT), economic growth, and human development from 1990 to 2014 using ARDL and VECM techniques. Their results uncover that ICT enhances human development and economic growth has a positive influence on human development. Reiter and Steensma (2010) provide evidence of the links between FDI, economic growth, and human development and confirm that FDI inflows are more strongly connected to human development.

In the context of BRICS countries, Wang (2019) represents an empirical study of the connection between biomass energy consumption and environmental pollution. Applying the generalized system method of the moment model, the results of their findings show that biomass energy usage behaves as a clean energy source in reducing the environmental pollution. Shahbaz et al. (2016) also analyze the relationship among these indicators by using cointegration tests. The results show the existence of long-run equilibrium nexus between biomass energy and economic development throughout 1991-2015. Aydin et al. (2019) report the significant relationship between biomass energy consumption and economic growth from 1992 to 2013. The authors suggest these nations should increase biomass energy to a sustainable environment, enhance economic development, and reduce energy dependency. Sinha and Sen (2016) explore the causal relationship between economic growth, CO₂ emission, trade volume, and human development for BRIC countries between 1980 and 2013 using the GMM approach. The outcomes of this paper reveal that there exist bidirectional spillovers between CO₂ emissions and economic growth. More importantly, the findings support the feedback hypothesis between CO₂ emissions, human development, and economic growth. Wang et al. (2020) employ a wide range of economic techniques to explore the impact of biomass energy usage on human development in 1990-2015. The outcomes of this paper unveil that biomass energy consumption increases human development and bidirectional causality exists between these indicators.

It is clear from the reviewed previous literature that several works have examined the relationship between biomass energy usage and human development. Nevertheless, no prior paper has extensively captured the lead-lag intercorrelation structure between human development and biomass energy consumption in the BRICS countries using wavelet analysis. The advantage of this approach is that it is able to capture the causal associations between the selected variables at different time and frequency domains. As a result, the current study fills the gap in the existing literature.

Wavelet methodology

This paper attempts to explore the causal associations between human development and biomass energy consumption in the BRICS countries. By doing so, we employ continuous wavelets, cross wavelet transforms, wavelet coherence, and causality in continuous wavelet transforms are used to capture how the domestic variance and covariance of two-time series co-vary as well as the co-movement interdependence between two variables in the time-frequency domain. Moreover, the correlation measure in continuous wavelet transforms (CWT) developed by Rua (2013) offers the background for the lead-lag relationship between variables under study. In this section, we briefly introduce wavelet techniques.

Continuous wavelet transform

The continuous wavelet transform $W_x(s)$ allow us to explore the joint behavior of time series for both frequency and time. The wavelet is defined as:

$$W_x(s) = \int_{-\infty}^{\infty} x(t) \frac{1}{\sqrt{s}} \psi^* \left(\frac{t}{s} \right) dt \quad (1)$$

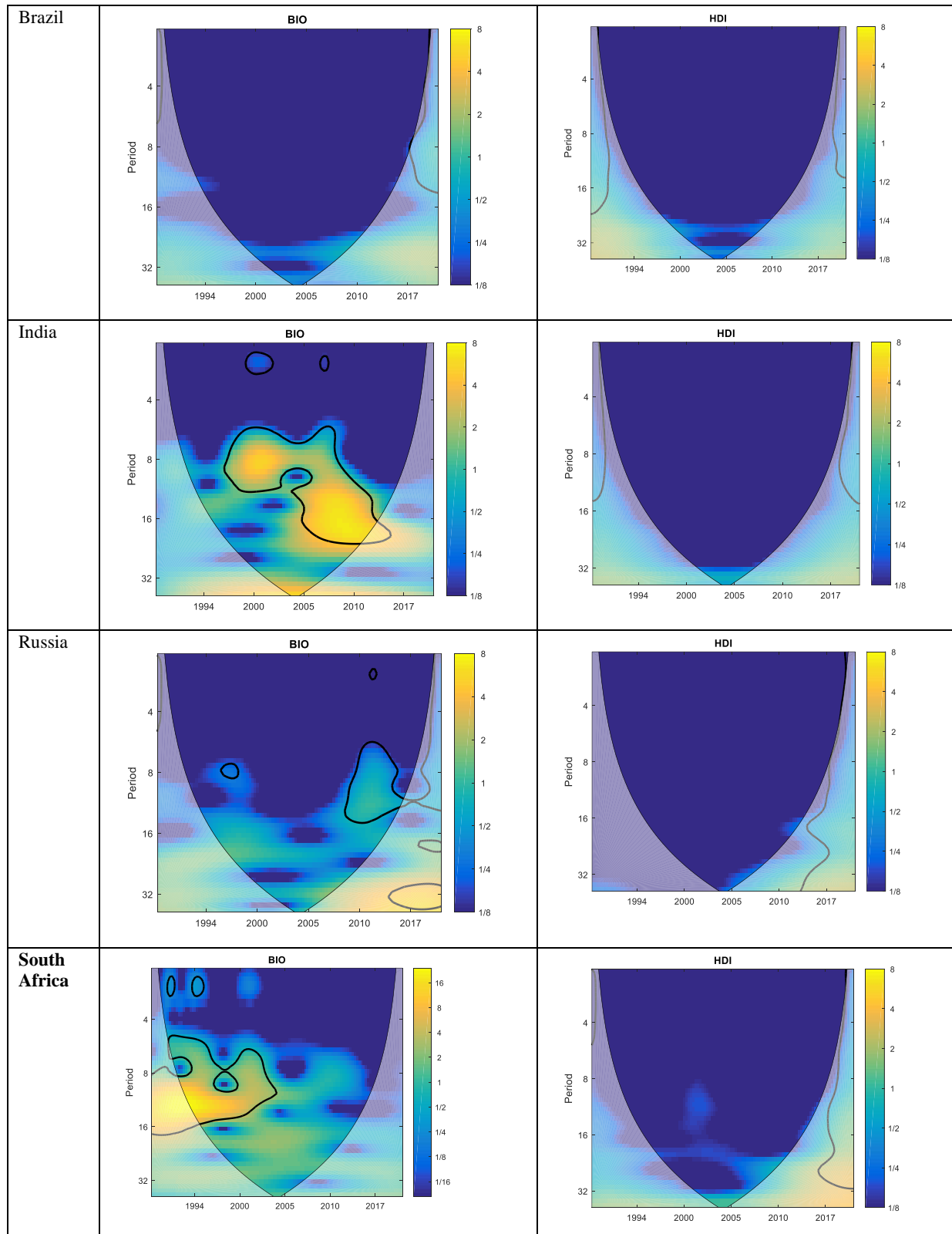
where $*$ represents the complex conjugate and the scale parameter s determines whether the wavelet can detect higher or lower elements of the series $x(t)$, possible when the admissibility condition yields.

Wavelet coherence

The wavelet coherence is computed based on the cross-wavelet transform and wavelet power spectrum of each variable. More accurately, while the wavelet power spectrum measures contribute to the variance of the series at each time scale, cross-wavelet power estimates covariance contribution in the time-frequency space. The cross-wavelet of two series $x(t)$ and $y(t)$ can be defined as:

$$W_n^{xy}(u, s) = W_n^x(s, \tau) W_n^{y*}(s, \tau) \quad (2)$$

where u denotes the position, s is the scale, and $*$ denotes the complex conjugate. Consequently, the wavelet coherence can be calculated as follows:



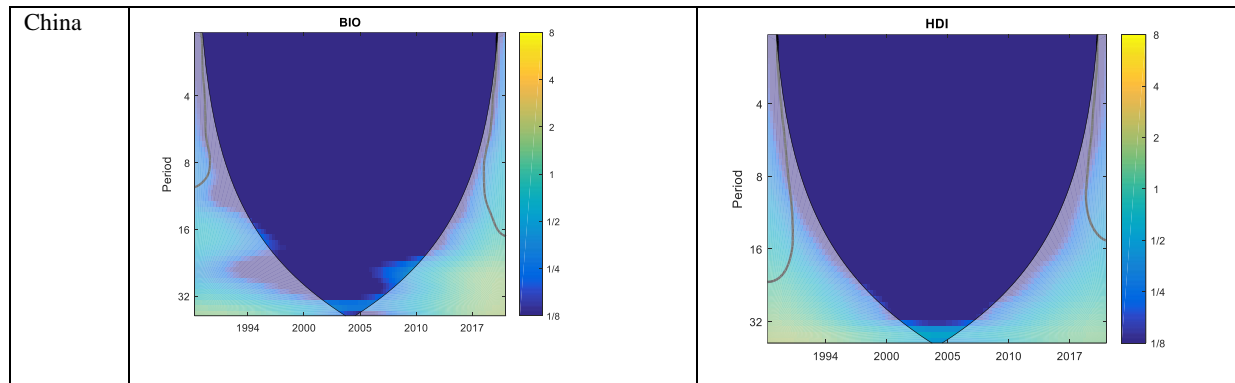


Figure 1. The continuous wavelet power spectrum of BIO and HDI in BRICS countries.

Notes: The vertical axis is the frequency element while the horizontal axis is the time period; the thick black contour illustrates a significant area at the 5% level, and the curved black line represents a cone of influence. The color code for power ranges from blue (low) to yellow (high).

$$R_n^2(s, \tau) = \frac{|S(s^{-1}W_n^{XY}(s, \tau))|^2}{S(s^{-1}|W_X(s, \tau)|^2)S(s^{-1}|W_Y(s, \tau)|^2)} \quad (3)$$

where S connotes smoothing process for both time and frequency at the same time. $R_n^2(s, \tau)$ is in the range $0 \leq R^2(s, \tau) \leq 1$.

Wavelet correlation

To provide the background for the casual association between variables, the Rua (2013) wavelet correlation measure is given by:

$$\rho_{XY}(s, \tau) = \frac{\xi\{s^{-1}|\Re(W_{XY}^m(s, \tau))|\}}{\xi\{s^{-1}\sqrt{|W_X^m(s, \tau)|^2}\} \cdot \xi\{s^{-1}\sqrt{|W_Y^m(s, \tau)|^2}\}} \quad (4)$$

where $\xi(Q) = \xi_{scale}(\xi_{time}(Q))$ with ξ_{scale} as the smoothing operator along scale axis, while ξ_{time} as the smoothing operator along the time axis. As a traditional correlation analysis, $\rho_{XY}(s, \tau)$ is bounded from -1 to +1.

Causality in continuous wavelet transform

The continuous wavelet transform for the Granger causality developed by Olayeni (2016) is employed, which extends the CWT-based correlation measure by Rua (2013). It can be written as

$$G_{Y \rightarrow X}(s, \tau) = \frac{\xi\{s^{-1}|\Re(W_{XY}^m(s, \tau))I_{Y \rightarrow X}(s, \tau)|\}}{\xi\{s^{-1}\sqrt{|W_X^m(s, \tau)|^2}\} \cdot \xi\{s^{-1}\sqrt{|W_Y^m(s, \tau)|^2}\}} \quad (5)$$

where $W_Y^m(s, \tau)$, $W_X^m(s, \tau)$ and $W_{XY}^m(s, \tau)$ are the wavelet transformations and $I_{Y \rightarrow X}(s, \tau)$ as the indicator function which is defined as

$$I_{Y \rightarrow X}(s, \tau) = \begin{cases} 1, & \text{if } \phi_{XY}(s, \tau) \in (0, \pi/2) \cup (-\pi, -\pi/2) \\ 0, & \text{otherwise} \end{cases} \quad (6)$$

It is clear that the big difference between the wavelet correlation and the CWT-Granger causality measure

is the inclusion of the causal information through the indicator function $I_{Y \rightarrow X}(s, \tau)$.

Data

The data used in the current study consist of the annual observation of biomass energy consumption (BIO) which is collected from the Global Material Flows Database. The human development index (HDI) is gained from the database of United Nations Human Development Reports. The biomass energy is measured as tons per capita. In order to empirically examine the biomass energy-human development relationship, we use quarterly times data over the period of 1990Q1-2017Q4 for BRICS countries. The annual data for this paper was transformed into quarterly frequency utilizing the quadratic match-sum approach. This method performs amendments for seasonal deviations since the data is transformed from low to high frequency by dropping the point-to-point data deviation (Haseeb et al. 2020; Hung, 2020). More importantly, this adopted approach has perfectly captured the required larger frequency of data without undermining the real essence of related variables and tallies with past studies Shahbaz et al. (2016), Sharif et al. (2019), Sharif et al. (2020), and Shahbaz et al. (2018). Using quarterly data in empirical research has two merits: first, it raises the degree of freedom, and second, it raises the statistical power of estimation. This results in the estimated wavelet technique may be robust. Table 1 documents the summary statistics, demonstrating the mean value, maximum, minimum, skewness, kurtosis, Jarque-Bera, and standard deviation of the natural logarithm of various variables for an individual country.

It is clear from Table 1 that the average values for HDI in BRICS countries are negative, which fluctuates from -2.03 to -1.67. Biomass energy use has positive values for Brazil and Russia throughout the study, while India, China, South Africa have positive values. The biomass energy consumption has a larger mean than the human development index. Measured by standard deviation, biomass energy is more volatile than human development. In addition,

Table 1. Descriptive statistics of the return series

Variable	Mean	Median	Maximum	Minimum	Std. Dev	Skewness	Kurtosis	Jarque-Bera
Brazil								
Biomass Energy	0.679953	0.59017	1.137983	0.329191	0.238037	0.363656	1.688333	10.49745***
Human Development	-1.754797	-1.74554	-1.65843	-1.88034	0.065125	-0.32753	2.116636	5.644023***
Russia								
Biomass Energy	0.082526	0.098076	0.441978	-0.33722	0.212065	-0.03326	2.06099	4.135435***
Human Development	-1.67421	-1.68314	-1.58166	-1.74319	0.052592	0.263917	1.701059	9.173999***
India								
Biomass Energy	-0.79766	-0.78952	-0.72425	-0.88647	0.043622	-0.50153	2.412534	6.305839***
Human Development	-2.03441	-2.03674	-1.81809	-2.24115	0.125262	0.010734	1.723464	7.606689***
China								
Biomass Energy	-0.62238	-0.66551	-0.23414	-0.99785	0.217195	0.178658	1.865013	6.607391***
Human Development	-1.85203	-1.84992	-1.66953	-2.08013	0.127558	-0.15686	1.707314	8.25746***
South Africa								
Biomass Energy	-0.18607	-0.19147	-0.01408	-0.35033	0.075625	0.306437	2.553228	2.684357***
Human Development	-1.82803	-1.83361	-1.73528	-1.88331	0.041123	0.790952	2.72794	12.02338***

Notes: *** represents the 1% significance level.

the findings of the Jarque-Bera test are significant at the 1% level, which confirms that biomass energy consumption and human development are not normally distributed for all countries under consideration. More accurately, the entire quarterly data exhibit asymmetry and leptokurtic distribution as indicated by skewness and kurtosis coefficients.

Empirical results

Continuous Wavelet Transform (CWT)

Figure 1 reports the continuous wavelet transform power spectrum results for human development index (HDI) and biomass energy consumption (BIO) in BRICS countries. The horizontal (x-axis) and vertical axis (y-axis) present time and frequency, respectively. The CWT has been utilized to depict the variance in both time and frequency. The bold line in a light shade shows the cone of influence, which determines the region impacted by the edge effects. Specifically, the color code for the power spectrum ranges from blue (low power) to yellow (high power). Put differently, the yellow (blue) colored region indicates strong (weak) reaction power to shocks.

As shown in Figure 1, the yellow area mostly occurs at high scales (lower frequency). Biomass energy and human development of BRICS countries experience significant volatility at the 5% significance level. The intensity levels eventually rise from blue to yellow; the yellow area indicates that the variations of BIO and HDI in BRICS are very high. On the other hand, blue areas show fluctuations between BIO and HDI to external shocks such as the global financial crisis. For most BIO, their co-movement is centered around 2007 according to the value of the power spectrum indicated by color, and they exist in

different cycle areas, which are primary centered in the low-frequency area. The variations in 2007 could be due to the influence of political and policy events. However, HDI in BRICS countries exhibited low volatility in all scales and frequencies, implying that the global financial crisis, European debt crisis, and Russian financial crisis has no impact on HDI in the BRICS countries.

Overall, with the findings of CWT of biomass energy and human development index for BRICS countries, we can see a similar pattern for HDI in different time and frequencies, while BIO shows more volatility in the long run.

The cross-wavelet transform (XWT) can experience typical high power between HDI-BIO pairs in Figure 2. In a similar fashion, XWT is analogous to CWT plots in Figure 1. The XWT shows the domestic covariance between HDI and BIO at various scales and periods. The yellow (blue) colors demonstrate high (low) power, the yellow (warmer) colors suggest that the two variables have high joint power. Besides, arrows show the direction of relevance and a lead-lag correlation. If the arrow points right (left), the pair has a positive (negative) relationship. Arrows pointing up and the right suggest HDI leading, and those down and to the right show, HDI lagging, whilst these down and to the left represent HDI leading. The XWT uncovers that the interdependence between BIO and HDI is significant at low and medium frequencies, indicating that the two variables have the same variation in the long run, except in South Africa. Put it another way, the covariance of HDI and BIO showed significant yellow noise around 2007, which suggests that a strong relationship exists among the pairs. At the same time, for the combinations including South Africa, India, and Russia, the relationship on the scales of 8-16 and 16-32 around

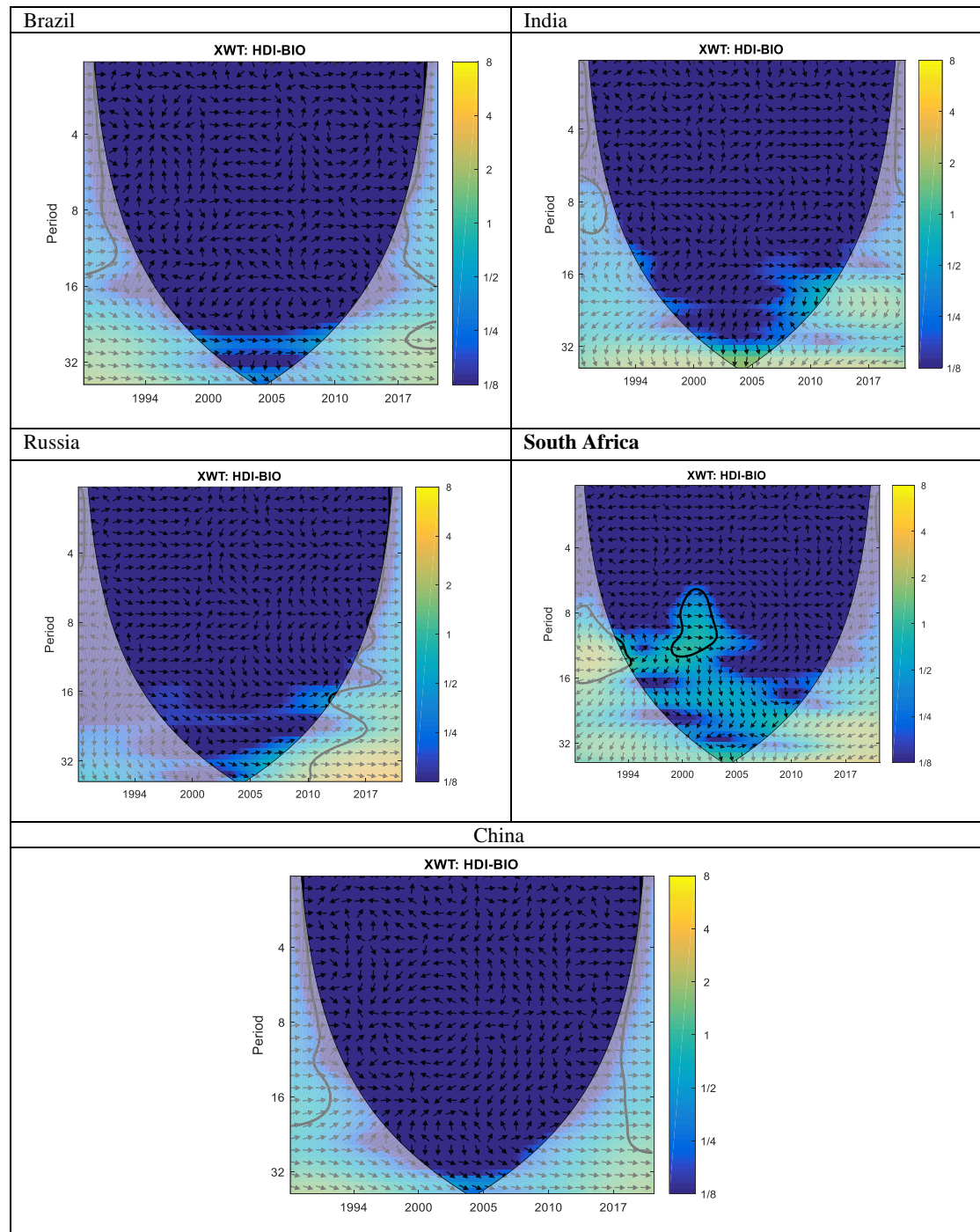


Figure 2. Cross-wavelet transform for BIO and HDI in BRICS countries

2008 is stronger. Furthermore, phase differences reveal that intercorrelation between HDI and BIO was not homogeneous across time and frequencies, as indicated by arrows that point up, down, right, and left across various time and scales. As a result, the findings show that the variation of examined variables in BRICS countries exhibits fundamental changes during the sample period studied.

Wavelet Coherence (WTC)

The results of wavelet coherence are reported in Figure 3. The WCT detects the regions where the two-

time series co-move in the time and frequency domain. Plots of wavelet coherence are the same as those of continuous XWT and CWT, indicated in Figures 1 and 2. The x-axis shows the period, while the y-axis represents the frequency elements, which are transformed to quarterly, and a color code indicates the degree of fluctuation between the pairs. The warmer (yellow) areas suggest that the two variables have strong connections, while cooler (blue) areas suggest that two variables are less dependent. In particular, WTC clearly illustrates zones through time scales where each pair is remarkably dependent or

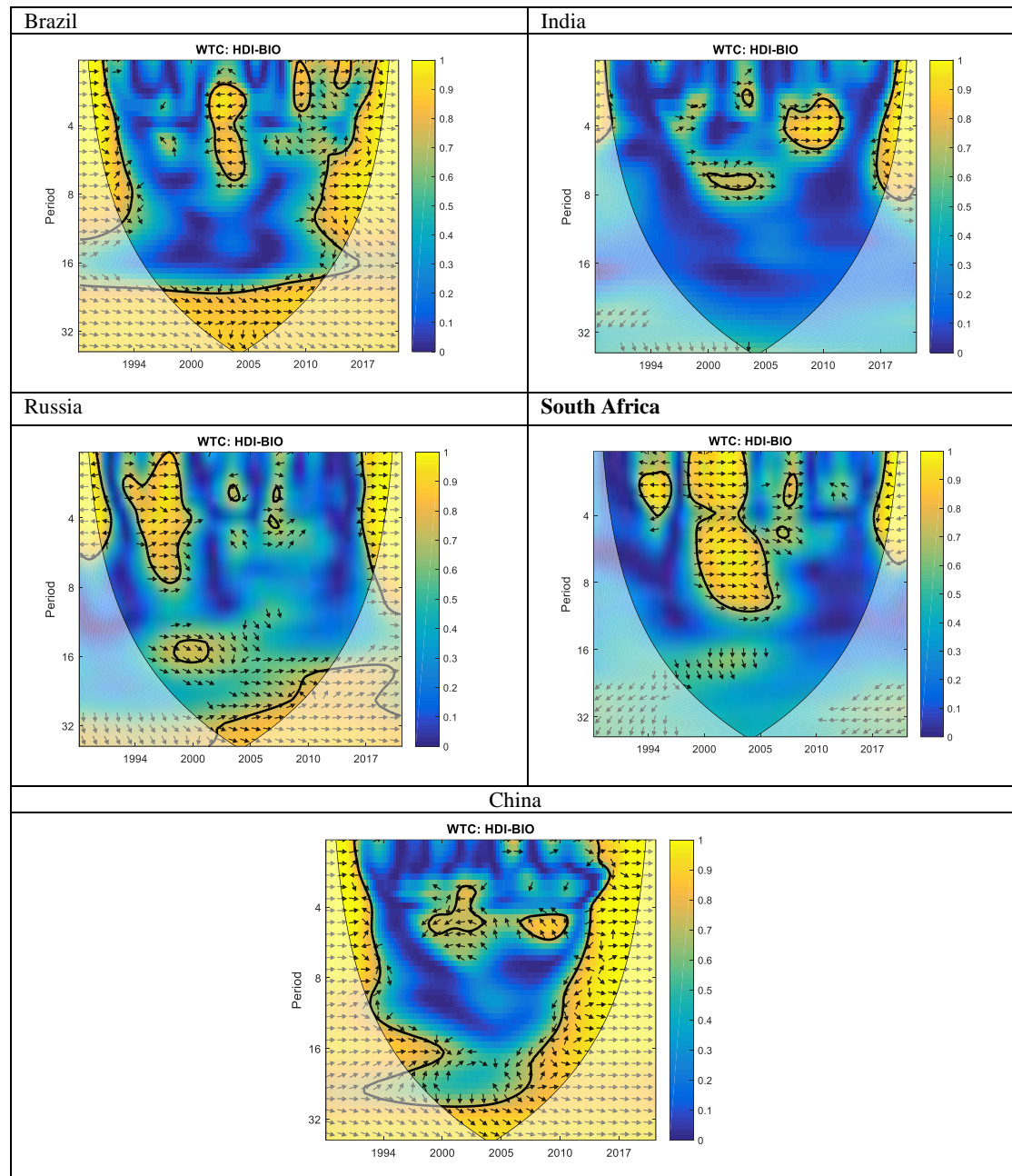


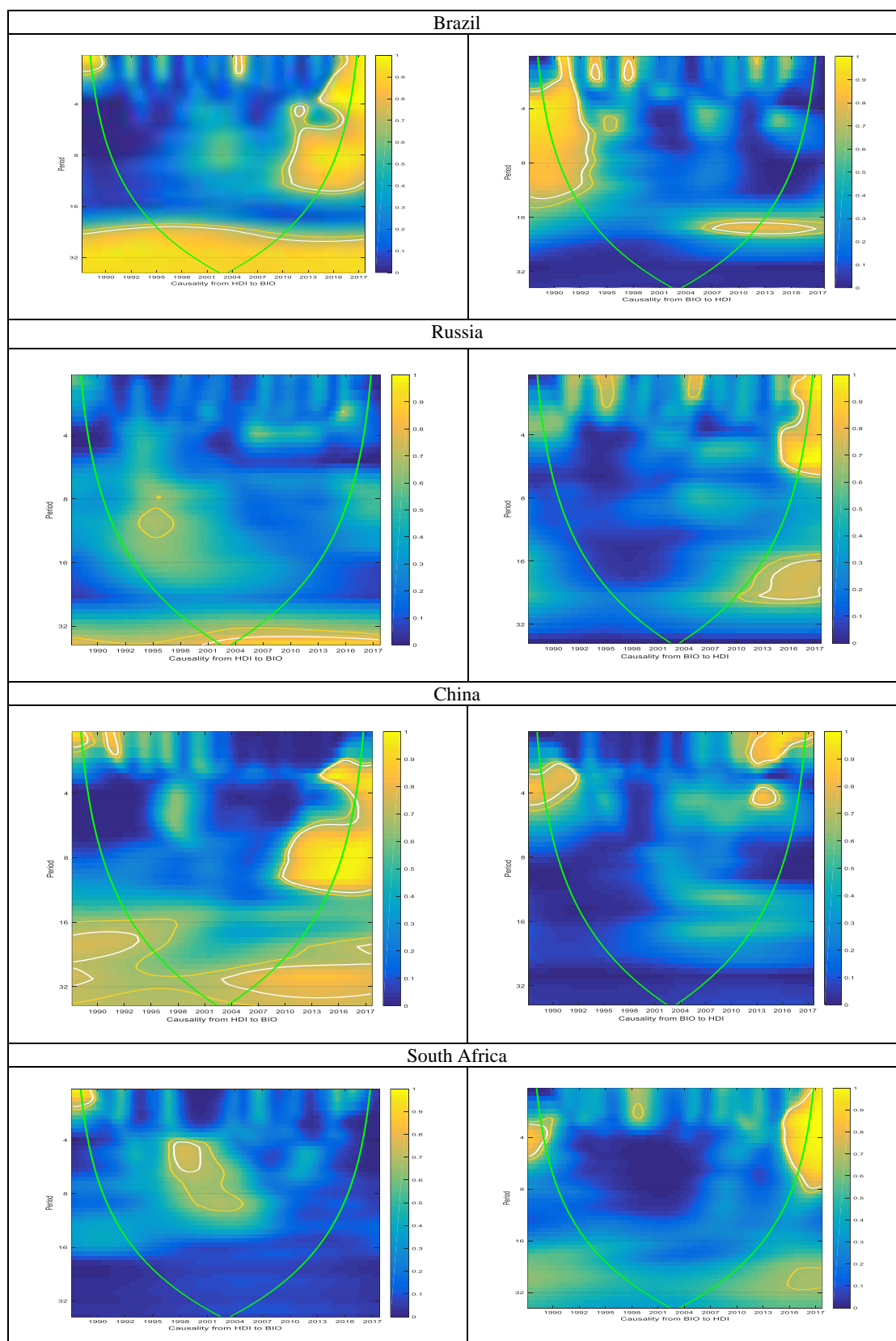
Figure 3. Wavelet coherence for BIO and HDI in BRICS countries

Notes: The vertical axis is the frequency element while the horizontal axis is the time period; the thick black contour illustrates a significant area at the 5% level, and the curved black line represents a cone of influence. The color code for power ranges from blue (low) to yellow (high). Areas inside the black contour plotted in the warmer color present a significant strong relationship. The phase difference between the two variables is shown by arrows. The arrows pointing right and left and up and down imply the direction of correlation and lead-lag correlation.

otherwise, corresponding to the domestic nexus ranging from 0 to 1. Using the phase differences, WTC has similar findings on the causality of the variables where the XWT and CWT uncover structural changes and variations. The arrow pointing in different directions suggests the interdependence and lead-lag nexus between HDI and BIO in BRICS countries.

Wavelet coherences unveil a correlation between human development and biomass energy consumption in the BRICS countries, while wavelet phase differ-

ence identifies the interactive linkages of series by observing lead-lag interdependence at different time and frequencies. Arrows presenting phase differences suggest the direction of the relationship and causal associations. Precisely, right and left arrows demonstrate that the pairs are in-phase and out-phase, respectively. The in-phase wavelet phase difference shows that the HDI and BIO move jointly in a similar direction, while the out-phase suggests that the pairs co-move in opposite directions through time and frequency bands. Put differently, an in-



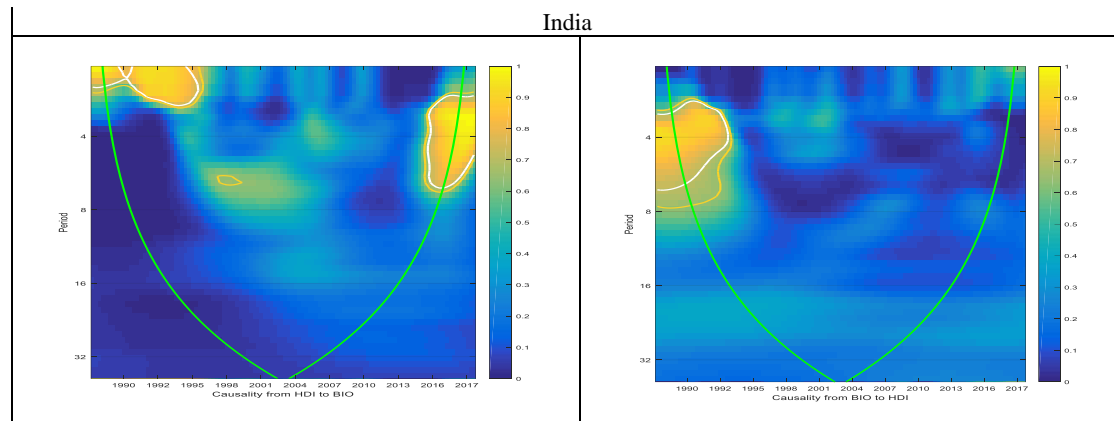


Figure 4. Wavelet based causality from HDI to BIO and BIO to HDI

Note: white and yellow contour indicate statistical significance at 5% and 10% level, respectively. The bold green contour presents the cone of influence that delimits the area not impacted by edge effects. The significance levels are calculated based on the 1000 Markov bootstrapped series.

phase difference indicates a positive correlation, and an out-phase difference shows a negative relationship between HDI and BIO in the BRICS countries. The right up or left down arrows indicate that HDI, as the dependent variable, is leading, and the right and down and left and up arrows suggest that BIO, as an independent variable, is leading.

The plot pair of wavelet coherence suggests that human development and biomass energy consumption exhibit significant connectedness over time and frequency domains in the BRICS countries. The pair (HDI-BIO) coherence rises at lower and medium bands (0-4 months and 4-8 months). Co-movement of human development and biomass energy illustrate high coherence in Brazil, Russia, China, and South Africa, but in India, the connection between these variables is low.

The findings of wavelet coherence for Brazil determined four yellow-colored areas for 1990-1994, 2004-2007, 2008-2010, and 2014-2016, suggesting significant and positive co-movement between HDI and BIO variables. For 1990-1994 and 2014-2016, we find high levels of co-evolution between the two variables for the 1-4-quarter and 16-32 quarter scales, and arrows are pointed upward, indicating that the two variables are in phase with that human development as a leading variable. This implies that HDI precedes an increase in BIO in Brazil. By contrast, between 2004 and 2007, we observe that two variables are out of phase since the arrows are clearly pointed upward and to the left with HDI as part of BIO serving as the lagging variable. Apparently, there exists a causal association between human development and biomass energy use in Brazil at different time and frequencies.

In Russia, China, and South Africa, wavelet coherence, human development, and biomass energy consumption are correlated at all times and across low, medium, and high frequencies. Specifically, there is a strong relationship between HDI and BIO in China during the sample period. We note the existence of a large yellow-colored region for the 2000-2010 pe-

riod, showing a positive and significant interaction between the HDI and BIO for the 0-4 and 6-32 quarter frequencies, where most of the arrows are right side downward direction which suggest that both variables revealing cyclic effect that HDI has a positive causal impact on BIO in these nations. However, in China, the arrows point leftward and downward in one area in 4-8 quarter scales over the period 200-2005, suggesting that HDI negatively influences BIO in this country. Overall, the findings of wavelet coherence between BIO and HDI in Russia, Brazil, China, and South Africa confirm that both time series have a bidirectional relationship during the periods of 1994-2000 and 2010-2016 but 2005-2008, we found a unidirectional causal association between human development and biomass energy use.

According to Figure 3, we find a low level of co-movements between HDI and BIO in India. There are several areas with high wavelet coherence in 1-4 quarters and 4-8 quarter scales, corresponding to 2000-2010. The majority of the arrows point rightward and downward, indicating that HDI and BIO are positively correlated, and HDI leads BIO in the medium run. Nevertheless, we find no causal association between HDI and BIO in the long and very long run for the case of India. Generally, the outcome confirms that a positive nexus between human development and biomass energy use in the medium term, where HDI is leading the biomass energy consumption in India.

Overall, we find a positive and significant association between the two variables for the short, medium, and long-run periods. More importantly, we also unveil a lead-lag interaction in different time and frequency domains between human development and biomass energy use in the BRICS countries.

Figure 4 depicts the findings of the CWT-based Granger causality developed by Olayeni (2016) between human development and biomass energy consumption in the BRICS countries. Casual associations are demonstrated based on contour graphs since there are three dimensions involved: time, fre-

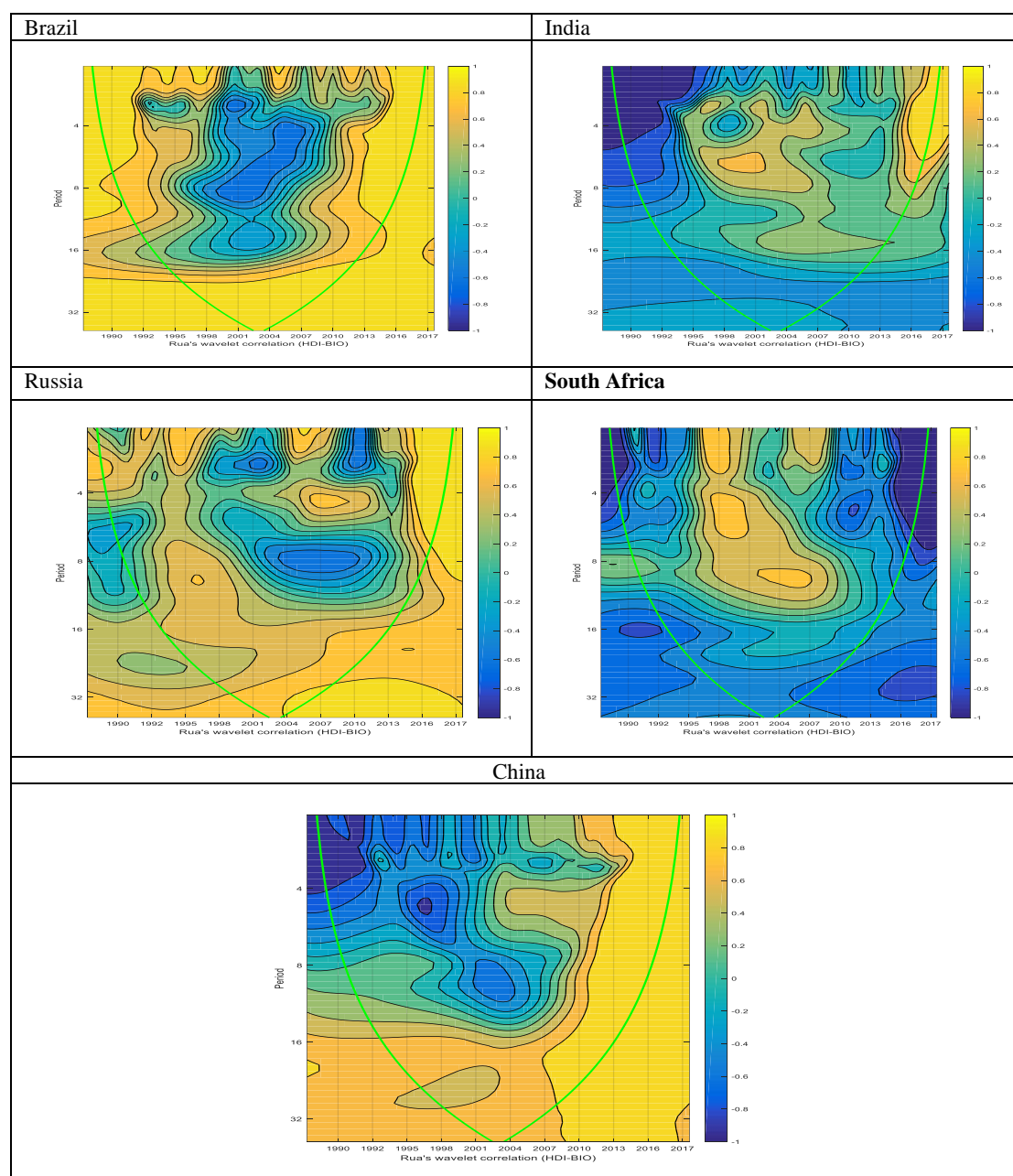


Figure 5. Wavelet-based correlations (Rua, 2013)
Notes: Blue (yellow) shows negative (positive) correlations.

quency, and magnitude of the causal nexus. The horizontal axis shows the period spanning the entire sample period, while the vertical axis measures frequency, which is expressed in quarters ranging from the highest frequency of 4 quarters to the lowest frequency of 32 quarters. The magnitude of causal associations between the two variables is uncovered by a color code ranging from blue (lack of causal relation) to yellow (strong causal association). White and yellow contours describe the significance level of the CWT-based Granger causality at the 5% and 10%. The bold green line is the cone of impact, which delimitates the island not impacted by edge effects.

In Figure 4, we concentrate on three frequencies between human development and biomass energy used in the BRICS countries, such as the 0-4 quarter scale, which reflects the short term, 4-8 quarter scale, which is associated with the medium term, and 8-16 and 16-32 quarter scales, which related to the long term. These frequencies are selected to evaluate whether the long-term, medium-term, and short-term nexus between HDI and BIO are different or similar. It is clear from Figure 4 that the pairs reveal the near-total persistence of significant causal associations between HDI and BIO at all time scales and frequencies in China, Brazil, Russia, and South Africa, but the absence of a significant causal relationship at the

lowest frequencies (from 16-32 quarters approximately) over the sample period for the two examined variables in India.

Interestingly, in China and Brazil, the co-movement between human development and biomass energy use experienced an increasing trend, particularly after the global financial crisis of 2008. This causal relationship also attained its peak in the low and medium frequencies during the period shown. Moreover, in South Africa, a strong bidirectional effect between the two variables is found from 1990 to 1995 and from 2015 to 2017 on 0-4 quarter scales. Nevertheless, this causal effect has become a little bit weak in the low frequency in India. The causality findings reveal that HDI impacts BIO variables in India. Overall, the causal effects from human development to biomass energy consumption in the BRICS countries are more pronounced than in the opposite direction, especially at low and medium frequencies. Hence, an increase in biomass energy usage is accompanied by an increase in human development. This finding is consistent with Wang et al. (2018) for Pakistan, Wang (2019) and Wang et al. (2020) for BRICS countries.

Rua's (2013) measure of CWT correlation is given in Figure 5. This approach is conducted to check the validity of the above results of the causal associations between human development and biomass energy use in the BRICS countries. These plots illustrate a positive relationship between the two variables and generally confirm the findings in WTC and in the causal effects as described in Figures 3 and 4. It is evident that both variables have high positive connectedness during 1990-1998 and 2008-2016 at different quarter bands of scales (low, medium, and high frequency) in cases of Brazil, China, South Africa, and Russia. Nevertheless, such correlation is existent for the whole sample period at high and low frequencies. Besides, there is a weak relationship between these variables at medium frequency, which suggests the neutrality hypothesis during the periods in these countries. By contrast, In India, a high negative correlation appears between 2010 and 2016 on the 16-32 quarter scale, as indicated by regions of blue color. These results demonstrate that there seem to be significant causal associations between human development and biomass energy use in the BRICS countries, as visualized in Figures 3, 4, and 5. These outcomes aligns with the findings of Dias et al. (2016), Wang et al. (2018) and Khan et al. (2019).

In general, the primary novelty of our empirical outcomes lies in their capacity to depict the causal associations between human development and biomass energy consumption in the BRICS countries. Our results offer fresh insight into the strength and direction of causal connections between the two variables in the time and frequency domains. More accurately, we employ the recent wavelet-based Granger causality test of Olayeni (2016) to determine the particular

frequencies and time periods where the casual connectedness is more intense and identifying the prevailing causality direction. As a result, the present paper results may be seen as a supplement to the empirical evidence on the human development-biomass energy relationship provided by the present literature. Further, our findings also extend the results of Khan et al. (2019), Reiter and Steensma (2010), Shahbaz et al. (2016), Aydin et al. (2019), Sinha and Sen (2016) and Wang et al. (2020) with the estimates of reaction of the relationship of biomass energy consumption to human development. They argue a significant interaction between biomass energy consumption to human development.

Concluding remarks and policy implications

The essence of the study is whether biomass energy consumption has any causal effect on the human development index in the BRICS countries in the time-frequency space. Nevertheless, past studies have neither evaluated this connection in a non-linear approach nor considered this nexus in terms of both time and frequency. The in-depth analysis is done by applying the wavelet framework using quarterly data for the 1990-2017 time period. Specifically, the wavelet coherency method of Rua (2013) and the wavelet-Granger causality test of Olayeni (2016) are utilized to quantify the strength and direction of causal relationships through time and across various frequencies simultaneously.

The empirical findings uncover that the causal linkages between human development and biomass energy consumption in the BRICS countries are not homogeneous in different time and frequency scales. We also discover the strong relationship between the two variables in China, Russia, Brazil, and South Africa after the global financial crisis 2008 at low and medium frequencies, while this connection is somewhat low in India over the sample period. More importantly, the remarkable causality is mostly concentrated at a lower time horizon (between 1 and 16 quarter scales). The possible explanation for this is that the higher frequency element of the nexus receives much attention from people due to their closer association with environmental issues, hence enhancing the spillover of uncertainty between human development and biomass energy use in the medium term. On the other hand, the causal associations between both indices at longer horizons turn out to be quite limited, suggesting that little attention is paid to the transitory long-run relationship in the two indicators. Further, the low and medium casual relationships running from human development to biomass energy are more pronounced than in the opposite direction, which unveils that the human development index of the BRICS countries embodies vital information about the low and medium evolution of biomass energy consumption.

Policy lessons drawn from the preceding depend not only on the causal association between biomass energy consumption and human development but also on the direction and magnitude of the influences. Empirical findings suggest that human development in the BRICS countries is associated with increased biomass energy consumption. This implies that it is necessary to decline energy intensity of output via the adoption of energy-efficient technologies and seek alternative clean energy sources to reduce CO₂ emissions associated with biomass energy usage to enhance growth. Put differently, governments need to employ the resources of renewable energy to reduce the energy crisis in the BRICS countries. BRICS governments can achieve their millennium growth purposes to reduce severe poverty and hunger and secure the objective of achieving environmental sustainability by resolving energy crises. Overall, biomass energy usage benefits the human quality of life, so policies to increase biomass energy usage in the energy consumption should be conducted. BRICS nations should raise awareness about biomass energy and encourage biomass energy production and consumption. Put it another way, development of the biomass energy infrastructure and encouragement of biomass energy consumption are significant energy policy tools because they enhance human welfare while also being impacted by it. There are direct and indirect influences between biomass energy consumption and human development. If energy needs are gained from biomass energy sources, energy dependence on fossil fuels from these nations will decrease, which enables sustainable economic growth and development. Since this study estimates the biomass energy-human development nexus in BRICS countries and at different time and frequency domains, future studies could investigate this relationship in other regions. Future studies could explore energy output-human development linkages for other renewable energy apart from biomass or biomass sources on global warming and economic growth in detail.

Declarations

1. Availability of supporting data. Please contact author for data and program codes requests. R and Matlab are used to organize data.
2. Competing interests. The authors declare that they have no competing interests.
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4. Authors' contributions. NTH conceived of the study, carried out drafting the manuscript.

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Impact of the Agreements of the Eurasian Economic Union on the Competitiveness of the Agricultural Sector of the Member States

Wpływ porozumień Euroazjatyckiej Unii Gospodarczej na konkurencyjność sektora rolnego państw członkowskich

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Abstract

The purpose of this study is to obtain scientific and practical results aimed at the use of the advantages of integration processes within the Eurasian Economic Union to increase the sustainability and competitiveness of the development of sensitive industries of the agri-food sector in the Eurasian Economic Union member states. The assessment of the potential for export growth and the potential for import substitution was performed according to the methodology for assessing the potential for export growth and is based on previous research developments. The study assessed the impact of the Treaty on the Eurasian Economic Union on the stability and competitiveness of such processing industries as: canned milk (condensed and non-condensed products), cheese making, production of sunflower oil, sausages and white sugar. It has been established that competitive pressure from foreign producers in the context of the development of integration processes can revive the internal competitive environment.

Key words: free trade, economic benefits, product promotion, globalisation, integration

Streszczenie

Celem niniejszego opracowania jest uzyskanie wyników naukowych i praktycznych mających na celu wykorzystanie zalet procesów integracyjnych w ramach Euroazjatyckiej Unii Gospodarczej dla zwiększenia równowagi i konkurencyjności rozwoju wrażliwych branż sektora rolno-spożywczego w krajach Euroazjatyckiej Unii Gospodarczej. Ocena potencjału wzrostu eksportu i potencjału substytucji importu została przeprowadzona zgodnie z metodologią oceny potencjału wzrostu eksportu i opiera się na wcześniejszych osiągnięciach badawczych. W opracowaniu oceniono wpływ Traktatu o Unii Euroazjatyckiej na stabilność i konkurencyjność takich gałęzi przemysłu przetwórczego jak: konserwy mleczne (produkty skondensowane i nieskondensowane), serowarstwo, produkcja oleju słonecznikowego, wędlin i cukru białego. Ustalono, że presja konkurencyjna ze strony producentów zagranicznych w kontekście rozwoju procesów integracyjnych może ożywić wewnętrzne środowisko konkurencyjne.

Słowa kluczowe: wolny handel, korzyści ekonomiczne, promocja produktów, globalizacja, integracja

Introduction

The existence of any state always presupposes interaction with others. This interaction constitutes the fundamental principle of international relations. No matter how diverse the spheres and directions of international cooperation are and no matter how great their significance, the central and most important moment of international cooperation remains economic and political. The solution of problems of interaction in other areas largely depends on their effectiveness.

Integration is currently being rolled out globally. There is a considerable number of regional integration agreements in the world (according to the World Trade Organisation (hereinafter referred to as *the WTO*), as of January 2013, over 500 such agreements were notified to the WTO secretariat). Free trade agreements prevail (83%). Customs unions account for only about 7% of the total. The low share of customs unions is due to the fact that this form of integration requires more substantial coordination of policies by the participating countries. There are about 10-12 integration associations in the world, which plan the creation of an economic union as a goal for the future (Baldwin, 2016).

The establishment and development of integrated structures is one of the essential trends in the transformation of the modern economy and is, in the opinion of many scientists, a means of resolving the contradictions of globalisation (Laursen, 2018). Economic integration at the global, regional, and sub-regional levels is considered as an important initiative for achieving economic growth and development, and the establishment of the Eurasian Economic Union (hereinafter referred to as “the EAEU”) is considered as a step towards better economic growth and success among the selected post-Soviet states (Mostafa and Mahmood, 2018). In modern conditions, practically no country in the world can effectively develop without interacting with other countries. Countries are united based on their political, economic, geopolitical, or geo-economic interests. To implement these interests, various integration groups are being created. Nowadays, there are about 300 regional trade agreements in force in the world, including agreements on economic integration, on the establishment of customs unions and agreements with a partial scope of action, covering a certain list of products (Bulatov, 2002).

Having studied the works of researchers-economists (Kühn, 2017; Kofner et al., 2017; Muravska and Berlin, 2016), international economic relations, developing based on the international division of factors of production, acquire key importance for many national economies, which are undergoing a transformation of relations between the internal life of states and the external environment. Since the interaction of any state with others is a fundamental principle of international relations. No matter how diverse the

spheres and areas of international cooperation are, and no matter how great their significance, the central and most important moment of international cooperation remains economic and political. The solution of problems of interaction in other areas largely depends on their effectiveness.

This forms a tendency towards an increase in the economic interdependence of states and, in general, an increase in the globalisation of the world community. Under these conditions, the achievement of the stability of national economies and an increase in the volume and diversity of consumed economic benefits can be achieved only through the integration of individual groups of states based on certain forms of liberalisation of foreign economic relations within the groups and the application of agreed protective measures in relation to third states. The study of integration processes, including in the post-Soviet space, is of interest to many scientists who distinguish several areas in the modern period:

1. There is an intensification of the interdependence of countries in various areas (trade, investment, capital movement, exchange of technologies), which contributes to the further strengthening of this interdependence (Surugiu and Surugiu, 2015; Hirst et al., 2015; Kamshibaev and Kulmaganbetova, 2015).
2. The most important sectors of the economy of individual countries (agriculture, industry, services) work not only and not so much for the national market as for the international one (Vinokurov, 2017; Hussein and Ogurtsova, 2017; Schoper et al., 2018; Gaidar, 2005).
3. Most countries associate their future, their survival with their ability to take part in international technical and economic competition (Moreau-Defarge, 1996; Cavusgil and Knight, 2016; Hitt et al., 2016; Mironov, 2013).

Notably, with a sufficiently large number of articles on integration problems, most of the works are aimed at assessing the overall impact on the agricultural industry and identifying the negative consequences of integration processes (De Luca et al., 2017). Our approach involves examining the positive impact of integration processes on the agro-industrial complex of the EAEU member states (its specific industries and production). Proceeding from the above, the purpose of this study is to obtain scientific and practical results aimed at using the advantages of integration processes within the EAEU to increase the sustainability and competitiveness of the development of sensitive industries of the agri-food sector in the EAEU member states. To achieve the purpose of the study, the following main tasks were solved:

- the impact of the studied agreements on the stability and competitiveness of sensitive industries of the agrarian sector of the republic was assessed;

- the factors of integration processes influencing the sustainability of development and increasing the competitiveness of agricultural production have been identified;
- positive factors have been identified that allow using the advantages of integration processes within the EAEU;
- economic conditions have been developed to optimise interaction with the EAEU countries;
- proposed general directions for optimising interaction with the EAEU countries, aimed at increasing the sustainability and competitiveness of the agricultural sector of the EAEU member states.

Materials and methods

The main idea is to assume that the level of competitiveness of the industries of the Union member states will increase with intensified integration, as well as if the following assumptions are met:

1. Primary products, materials, and components of local production (within country A), with increased integration with country B, are replaced by supplies of similar raw materials from country B, provided that the consumer properties of production resources of country B are higher than those produced in country A.

Empirical verification of this assumption within the framework of the study was complicated by the high labouriousness of obtaining the corresponding estimates. At the same time, the validity of this assumption can be accepted without verification. The concept of product quality also requires a special comment. Consumer properties, as well as the quality of the product, cannot be easily measured due to its complexity, however, it appears acceptable to use approximate indicators. When analysing world trade, it is often assumed that the quality of goods is correlated with their prices (unit cost) for different exporters (the higher the prices, the higher, provided that other things being equal, the quality of goods). Therewith, quality is also associated with the competitiveness of products in the world market: for example, studies (Alcalá et al., 2014; Jaimovich and Merella, 2012) demonstrate a positive interrelation between the cost of a unit of production and the Balassa index.

2. Improving the consumer properties of the resources used in the country leads to an increase in the quality of finished products. For a significant part of the industries, the validity of this assumption was confirmed (the regression equations showed the presence of a significant connection between competitiveness at the level of intermediate products and the corresponding final product) and quantitative estimates of the connection between the quality of resources and final products were obtained, which were used to assess the integration effect.

The assessment of the potential for export growth and the potential for import substitution was performed according to the methodology for assessing the potential for export growth based on previous research developments. The starting point is the concept of the Hausmann-Klinger product space (Hausmann and Klinger, 2006), according to which the *proximity* between any pair of goods can be calculated based on information about the extent to which there is a tendency in world trade to jointly export these two goods on a noticeable scale, i.e. with the presence of a comparative advantage, fixed by the Balassa index:

$$BI_{i,c,t} = \frac{\left(\frac{x_{i,c,t}}{\sum_i x_{i,c,t}} \right)}{\left(\frac{\sum_c x_{i,c,t}}{\sum_i \sum_c x_{i,c,t}} \right)}, \quad (1)$$

where $X_{i,c,t}$ is the export volume of commodity i in country c in year t .

The resulting aggregate theoretical indices were compared with the actual Balassa indices. If the theoretical index exceeded the actual one for a particular industry, their ratio was interpreted as a potential export growth rate for this industry (otherwise, it was assumed that there were no prerequisites for a potential export growth, and the growth was assumed to be zero). The volumes of potential export growth were also calculated based on the data on the initial volume of exports.

Secondly, the described methodology was applied to imports to solve a problem that is symmetric to the increase in exports – to activate import substitution. The Balassa index was calculated for imports, which was interpreted differently than for exports: the excess of this index by one signaled the high dependence of the industry on imports (low competitiveness in terms of imports). It was assumed that it is in such industries that there is a potential for import substitution due to the intensification of domestic production. If the theoretical index of Balassa for the import of goods in a particular industry was lower than the actual one, their ratio was taken as the potential rate of decline in imports for this industry. The information base of the study is data obtained from the results of national and departmental statistical observations, information from administrative sources, expert assessments and economic calculations.

Results

The most important feature of our time is the growth of the interdependence of the economies of different countries, the development of integration processes at the macro and micro levels, the intensive transition of countries from closed national economies to an open economy. All this is conditioned by the laws of economic development at the present stage, in which, according to many scientists, international integration is a means of resolving the contradictions of globalisation (Kheifets and Ovdeenko, 2003). In-

Table 1. Leading integration groups of the modern world economy, Source: Compiled by the authors based on data from (Main integration associations..., 2020; Ziyadulaev, 2015)

Abbreviation	Year established	Number of member countries	Territory, million sq. km	Population, million people	Share in world GDP, %	Share in world exports, %
EU	1957	27	4.3	493	21.2	38.1
ASEAN	1967	10	4.5	580	4.4	7.0
NAFTA	1988	3	21.6	441	22.6	19.2
MERCOSUR	1991	10	18.7	368	3.2	3.3
Total		50	49.1	1882	51.4	67.6
EAEU	2015	5	21.2	179.6	2.4	2.5

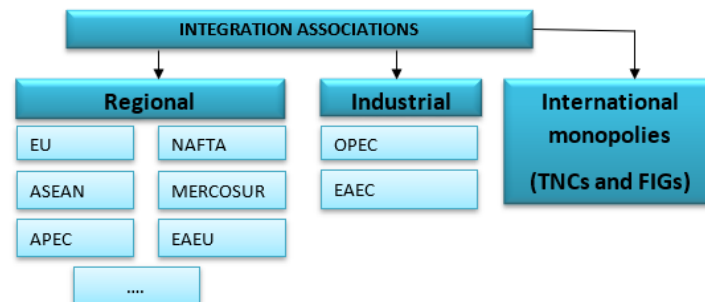


Figure 1. Types of international integration associations

ternational economic integration (IEI) is an objective, conscious, and guided process of convergence, mutual adjustment and merging of national economic systems that have the potential for self-regulation and self-development. It is based on the economic interest of independent economic entities and the international division of labour (Gelvanovsky, 2011; Moiseeva et al., 2019). Integration has many essential characteristics that, taken together, distinguish it from other forms of economic interaction between countries (Khudyakova, 2007):

- elimination of restrictions on the movement of goods, as well as capital, human resources between the member states to the agreement;
- coordination of the economic policies of the participating countries;
- interpenetration and interweaving of national production processes, the development of technological unity of the production process within the region;
- broad development of international specialisation and cooperation in production, science and technology not based on the most progressive and profound forms, joint financing of economic development and its innovation mechanism;
- convergence of national laws, provisions and standards;
- purposeful regulation of the integration process, the development of economic interaction management bodies;
- regional nature of integration processes.

The motives for the development of integration processes are, in the opinion of many scientists (Shkvarya, 2015; Gelvanovsky, 2011), their orientation, firstly, increasing the welfare of integrating

countries both on the part of producers, due to the growth of incomes due to the development of new trade flows, and consumers due to lower prices for certain goods caused by the development of a competitive environment; secondly, the strengthening of the economic positions of the member countries of international integration associations in relations with third countries. Furthermore, another of the motives for the development of regional associations was the success of international integration, manifested in the creation and strengthening of interstate trade and economic blocs – the EU, ASEAN, NAFTA, MERCOSUR, which occupy the main place in the world gross product and export (Table 1).

Evidently, the EAEU is a young integration association and not so large in terms of the number of member states, but occupying a significant territory, it is still not economically powerful enough in comparison with other regional integration associations (RIA). Therefore, an inherent feature of the development of the world economy and the system of international relations is the transformation of the world economy into a system of interconnected national economies and their associations, developing on the basis of regulatory influences from international economic organisations, transnational companies (TNCs), financial and industrial groups (FIGs) (Figure 1).

However, in the current period, TNCs are practically depriving the state of the functions of solving economic problems and achieving interdependence and complementarity. In international trade, their share exceeds 50%, and in exports and imports of individual countries reaches 80%. In more detail, the theoretical foundations of the development of integration

Table 2. Comparative analysis of the advantages and disadvantages of opening the domestic market for goods of foreign manufacturers, source: compiled by authors according to data from (Lipsits, 2012)

Positive influence	Negative influence
<ul style="list-style-type: none"> - citizens will be able to buy more goods; - the income of trading companies will increase, and the state will be able to receive a large amount of taxes from them; - the amount of taxes paid by buyers when purchasing imported goods will increase; - an increase in the standard of living of citizens who have jobs and the ability to buy imported goods will improve the internal political situation in the country and increase the chances of the ruling party to win the next elections. 	<ul style="list-style-type: none"> - sales of domestic goods will decrease; - incomes of domestic manufacturing firms will fall, and the state will receive less taxes from them; - layoffs in the domestic industry will begin, unemployment will increase, which will lead to a fall in tax revenues from wages and an increase in the cost of unemployment benefits; - the unemployed and the owners of domestic firms will protest against the policies of the current government, and this will reduce its chances of retaining power; - the country's dependence on the supply of goods from abroad will increase, which may weaken its political independence.

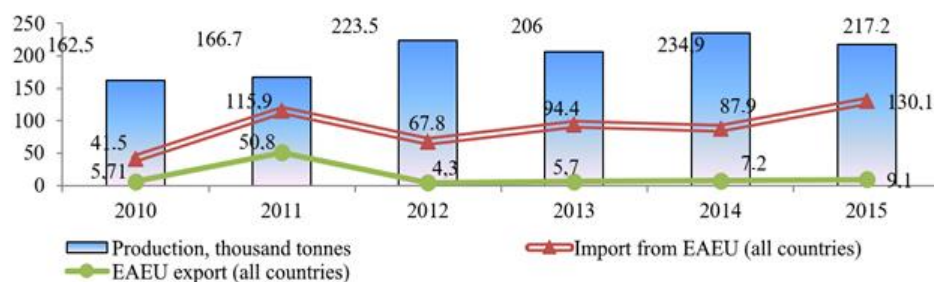


Figure 2. Import and production of sunflower oil in EAEU, thousand tons

Table 3. Assessment of the impact of the EAEU Treaty on the sustainability and competitiveness of sunflower oil production in the EAEU member states, source: Compiled by the authors

Name of the protocol to the EAEU Treaty	Impact of the protocol to the EAEU Treaty	
	on the competitiveness of the industry	on the sustainability of the industry
On measures of state support for agriculture of the EAEU member countries	Increased support and lower cost of raw materials (sunflower seeds) will ensure lower prices throughout the chain, which increases its competitiveness	Due to the purchase of cheaper raw materials, the load of domestic capacities increases, their stability and competitiveness of finished products is ensured
On the application of sanitary, veterinary, and quarantine phytosanitary measures	Compliance with technical regulations for growing sunflower seeds increases the quality and safety of the product, contributes to the free movement of goods through the customs territory, which ensures competitiveness	Increases sustainable production through the release of high-quality goods, and generates demand, including in the external market
On technical regulation within the framework of the EAEU	The introduction of the requirements of the <i>Technical Regulations for Fat and Oil Products</i> contributes to the implementation of national, interstate and international product quality standards, which increases the growth of its competitiveness	The high demand for a product that is safe according to technical regulations creates conditions for the sustainable development of the industry
On the application of special protective, anti-dumping, and countervailing measures	Does not have a direct impact, since it is aimed at relations with third countries	
General principles and rules of competition	Provides conditions for creating a single competitive field in the EAEU countries for the production of agricultural goods and gives an impetus to increase their competitiveness	

and their content (neoliberalism, corporatism, structuralism, neo-Keynesianism), the classification of goals (according to the time criterion – short-term and long-term, according to the degree of importance, according to the areas of implementation, according to the space they cover) and the stages of development of integration associations in the world

economy (division and cooperation of labour, economic cooperation, economic integration, globalisation) were considered in detail at the previous stage of the study (Moldashev and Nikitina, 2015). It was found that the opening of the domestic market does not always form incentives for the development of the economies of the countries taking part in the in-

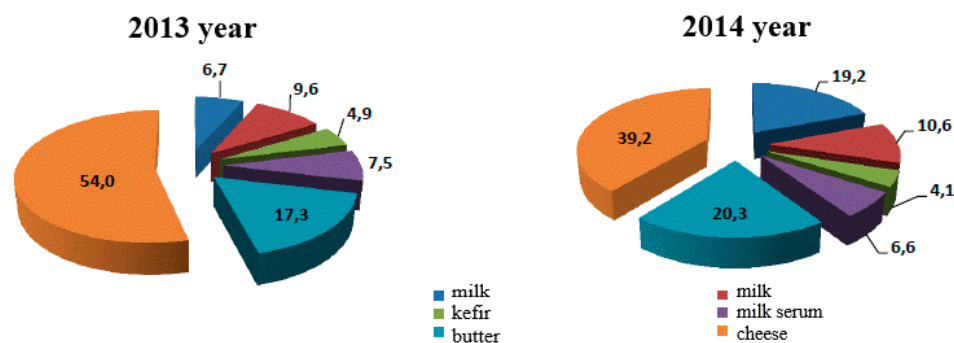


Figure 3. Structure of imports of dairy products of the EAEU for 2013-2014, %

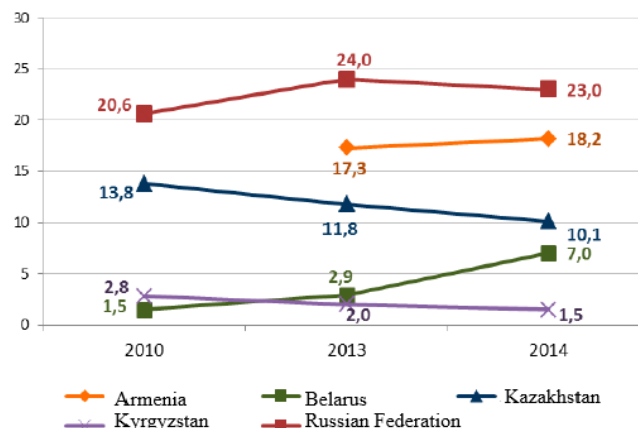


Figure 4. Imports of dairy products of the EAEU member states, %

tegration association, and along with positive factors, many negative factors are manifested (Table 2). Notably, the creation of the Customs Union, and subsequently the EAEU, according to many scientists, stopped the negative trend of weakening trade and industrial ties and resumed the establishment and strengthening of economic ties between the member states (Abdrakhmanova, 2013; Khasbulatov, 2006). The growth rates of the production of products in such industries as: dairy products, cheese making, the production of sunflower oil, sausages and white sugar, in recent years have remained below the growth rates of imports of food products, which is mainly due to persisting internal problems: a low level of technological equipment of agricultural enterprises and farms, the small-scale nature of agro-industrial production constraining innovation processes in this area, etc. And the aggravation of these problems in the context of the development of integration is associated with growing competition in the markets.

For example, over the period of development of integration processes in the Eurasian space, the production of sunflower oil is described by an increase in the main indicators. Thus, for 2010-2014, there was an increase in the volume of domestic production from 162.5 to 234.9 thousand tons, or 44%. However, in 2015, there was a decrease in production by 1.5%, which is a consequence of the economic crisis and high growth rates of imports (Figure 2).

Table 3 provides an assessment of the impact of the EAEU Treaty on the sustainability and competitiveness of sunflower oil production.

In the structure of EAEU imports in 2014, the largest share was made of cheese and cottage cheese – 39.2%, butter – 20.3%, non-condensed milk and cream – 19.2%. At the same time, compared to 2013, the share of cheese decreased, and butter, milk and non-condensed cream increased, respectively (Figures 3, 4). Despite the favourable conditions for the import of raw materials provided by the EAEU (the rates of import customs duties are 0% and differ from the rates of the CCT by the decision of the Interstate Council of the Eurasian Economic Community No. 18 dated November 27, 2009), the dependence of Kazakhstan's sugar production on imports, including white sugar is considerably high (Figure 5).

Kazakhstan's acceptance of free trade terms within the Customs Union facilitated the flow of significant volumes of more competitive granulated sugar from Russia and Belarus (Figure 6). Therewith, the geography of imports of white sugar for Kazakhstan has recently been changing towards non-CIS countries due to lower prices than in Russia.

Thus, if the share of imports from the Russian Federation in consumption in 2009 was 55.9%, then in 2015 it was 23.6%. Notably, in 2015 the volume of white sugar produced, covered by subsidies, amounted to 1.1 thousand tons. This support is mainly due to the presence of low resource potential.

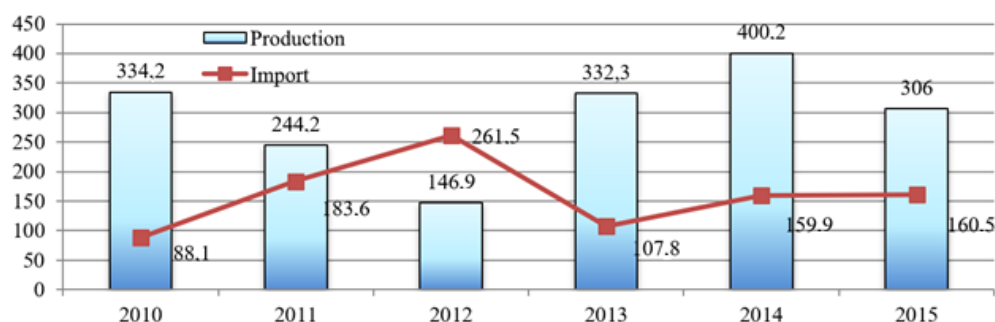


Figure 5. Production and import of white sugar in Kazakhstan, thousand tons

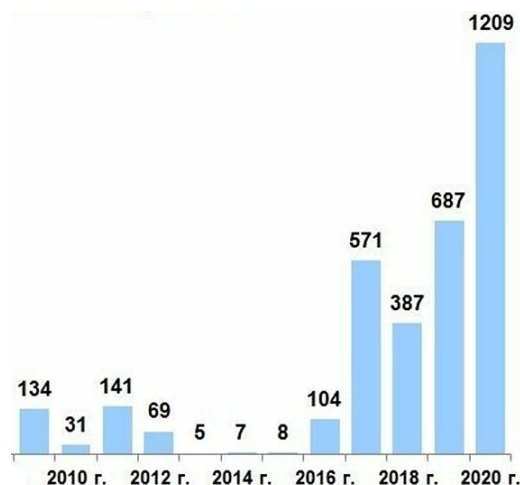


Figure 6. Export of white sugar in Russian Federation, thousand tons

Table 4. Assessment of the impact of the EAEU Treaty on the sustainability and competitiveness of the sugar industry in the EAEU member states, source: compiled by the authors

Name of the protocol to the EAEU Treaty	Impact of the protocol to the EAEU Treaty	
	on the competitiveness of the industry	on the competitiveness of the industry
On measures of state support for agriculture of the EAEU member countries	It allows the use of intensive technologies and ensures an increase in the yield of sugar beets, reduces the cost of raw materials (the purchase of sugar beets is subsidised by the state), which increases its competitiveness	A possible increase in crops and sugar beet yields will allow loading the capacity of sugar factories and ensure the relative stability of their functioning
On the application of sanitary, veterinary, and quarantine phytosanitary measures	The use of quarantine measures improves the quality of seed material, and, accordingly, an increase in productivity, ensuring an increase in competitiveness	The control over the quality of imported raw materials, such as raw cane sugar and white sugar, is increasing, which will lead to an increase in the quality of products. Does not significantly affect stability
On technical regulation within the framework of the EAEU	The implementation of the <i>Technical Regulations for Food Products</i> contributes to the implementation of national, interstate, and international product quality standards, affects the growth of competitiveness	The use of this regulation facilitates the delivery of high-quality raw materials – imported raw cane sugar for the production of white sugar. Does not significantly affect stability
On the application of special protective, anti-dumping, and countervailing measures	It does not have a direct impact, since it is aimed at relations with third countries. However, from 2019, in relations with third countries, it will be possible to protect the internal market in accordance with the WTO rules	
General principles and rules of competition	Provides conditions for creating a single competitive field in the EAEU countries for the production of agricultural goods and gives an impetus to increase their competitiveness	

Indeed, during the study period, the production of sugar beet in the republic decreased by half, due to a decrease in cultivated areas by 41% and a decrease in yield by 18.1%. The impact of the rest of the protocols on the sustainability and competitiveness of the sugar industry is illustrated in Table 4.

The integration of Kazakhstan into the Eurasian space has increased the dependence of the sausage market on the products of the EAEU countries. Thus, from 2010 to 2015, despite the annual increase in the volume of production of these products, the growth of imports increased from 25.6 to 33.2 thousand

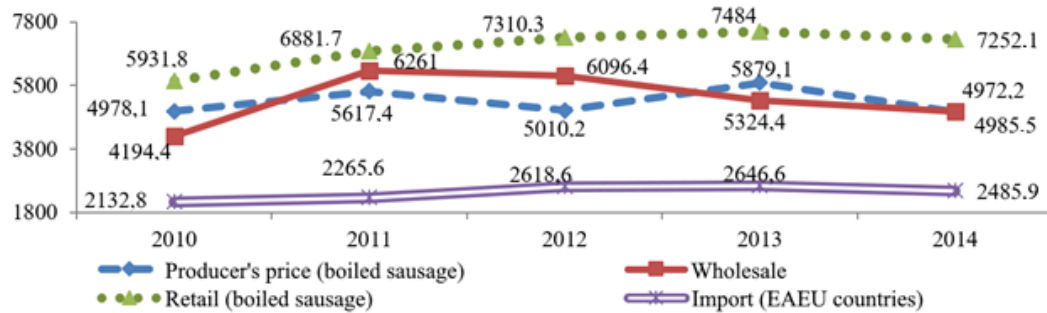


Figure 7. Changes in the dynamics of prices on the sausage market, USD per tonne

Table 5. Assessment of the impact of the EAEU Treaty on the sustainability and competitiveness of the sausage industry in the EAEU member states, source: compiled by the authors

Name of the protocol to the EAEU Treaty	Impact of the protocol to the EAEU Treaty	
	on the competitiveness of the industry	on the competitiveness of the industry
1	2	3
On measures of state support for agriculture of the EAEU member countries	Reducing the cost of storing and purchasing feed and feed additives, supporting selection and breeding work in beef cattle breeding contributes to an increase in livestock productivity, an increase in the quality of fattening and a decrease in prices on the market. This affects the growth of competitiveness	An increase in the volume of livestock production allows for a more rational use of capacities, for the reconstruction of existing capacities and for the commissioning of additional capacities, increases jobs, generates demand and stimulates production
On the application of sanitary, veterinary, and quarantine phytosanitary measures	Provision of improved product quality and safety, creation of the ability to export to the markets of other countries, and contribution to the growth of competitive goods	Ensuring food, veterinary safety, and sanitation contributes to improving product quality, increasing demand and market stability
On technical regulation within the framework of the EAEU	Development and implementation of technical regulations <i>On the safety of meat and meat products</i> contributes to the optimal ratio of price and quality of goods, which increases competitiveness	A well-functioning system of stocking and slaughtering livestock is being developed, including for bringing quality raw materials to processing, export stability
On the application of special protective, anti-dumping, and countervailing measures	Does not have a direct impact, since it is aimed at relations with third countries	
General principles and rules of competition	Provides conditions for creating a single competitive field in the EAEU countries for the production of agricultural goods and gives an impetus to increase their competitiveness	

tons. The share of imports in consumption was 44%, with an increase in the share of the EAEU countries. Therewith, the effect of strengthening interstate relations amounted to 33 thousand dollars, which is the result of saturation of the national market with a cheaper product (Figure 7).

Mainly boiled sausage is imported to the national market from Russia (99.8%), at a price lower than that of the domestic producer. This restrains the growth of wholesale prices, which formed at the level of 4,985 USD/t, or 12% below the price of Kazakhstani commodity producers. Since, in particular, in Kazakhstan, the share of meat processing, according to the Ministry of Agriculture of the Republic of Kazakhstan, in 2014 was only 26%. Sausage production capacities are only 31% loaded.

The impact of the implementation of other protocols of the EAEU Treaty on the industry in question is clearly displayed in Table 5.

Discussion

The domestic market of the EAEU member states is described by a high dependence on imports, especially in goods of such processing industries as: canned milk (condensed and non-condensed products), cheese making, the production of sunflower oil, sausages and white sugar. The existing potential growth opportunities for this industry of sunflower oil production in the context of deepening integration processes are constrained by internal problems. Firstly, there is a shortage of capacities for the primary processing and storage of the harvested crop, which also leads to a decrease in competitive advantages. Secondly, an ineffective system of relations between agricultural producers and processing enterprises.

In this context, the conditions created within the framework of the EAEU Treaty affect how to solve

these problems and improve production relations in this industry, since the requirements in the common market of the Eurasian space are changing. Therewith, the conditions of the Protocol *On the Application of Sanitary, Veterinary and Sanitary, and Quarantine Phytosanitary Measures* are important for the development of this industry, which contribute to the development and implementation of international and regional standard approaches. This is due to the low quality of sunflower seeds as a raw material for the country's oil and fat industry. Currently, the yield of sunflower is 4-7 c/ha, for comparison in Russia this figure is 13-15 c/ha.

In general, domestic cheese producers are not competitive in the Kazakhstan market. It is difficult for them to pursue a policy of import substitution, and they are inferior both in quality and in price characteristics. Notably, sustainable development and ensuring the competitiveness of the cheese-making industry in the republic is constrained not by pressure from cheap imports from Russia, Belarus, and Kyrgyzstan, but by the presence of persisting internal problems: the lack of high-quality raw materials in a sufficient volume, its high purchase price, an imperfect system for selling milk, etc. Therefore, Russia and Belarus will remain the main exporters to the Kazakhstan cheese market. In this context, the regulatory and legal obligations of Kazakhstan to the EAEU allow to solve these problems, where special emphasis should be made, in particular, on the active implementation of the requirements of technical regulation "On the safety of milk and dairy products" at enterprises, since currently the republic is facing an acute problem of low productivity of dairy cows and low protein content in milk, with increasing costs for keeping cows.

In addition, the operation of this protocol contributes to strengthening control over imported products in the customs territory by means of sanitary, phytosanitary measures, technical regulations. As for the sugar industry: in general, integration ties within the EAEU ensure coverage of the domestic market for white sugar needs and do not put pressure on domestic producers, due to their non-competitiveness in price (although the price of raw sugar remains low). For the development and growth of domestic white sugar production, measures to implement the EAEU Protocol *On State Support for Agriculture* are more important, which makes provision for support to processors of agricultural products.

In general, in the context of the strengthening of the integration process in the Eurasian space, one of the directions for solving the problems of the sausage production industry is the implementation of measures to increase stability and competitiveness on the basis of the adopted EAEU documents. The use of the significant potential of protective measures laid down in the protocol *On the safety of meat and meat products* will help develop a system

for ensuring product safety at all stages of its *life cycle*, as well as eliminate unnecessary technical barriers for business. Furthermore, to solve the problem of the weak development of the meat processing industry in the EAEU member states and the extremely inadequate use of the available capacities, the implementation of measures of the EAEU Protocol *On measures of state support for agriculture of the EAEU member countries* is of current importance. The sustainability of the canned milk industry, especially in the condensed milk and cream sector, is influenced by the presence of problems of low-quality raw materials due to the fact that the dairy sector is currently 80% concentrated in households, as well as a lack of production capacity. To solve these problems of the industry, the implementation of measures under the Protocol *On measures of state support for agriculture of the EAEU member countries* is of utmost importance. Further implementation of these measures will help increase the stability and competitiveness of the industry, as well as create opportunities for import substitution.

Conclusions

Thus, the analysis of the impact of the studied agreements on sensitive sectors of the agricultural sector of the EAEU member states allowed to conclude that new mechanisms are being developed in production areas to introduce international quality standards and strengthen control over the safety and quality of imported products. This, in turn, allows to create conditions for sustainable production and growth of competitiveness of the industries under consideration. It was found that increased competition stimulates domestic producers to look for ways to improve the quality and competitiveness of their products. And therefore, competitive pressure from foreign producers in the context of the development of integration processes can revive the domestic competitive environment and force domestic producers to restructure, update, and diversify production, reduce prices and improve product quality, and take into account customer demand more fully.

Therefore, in the future, it is necessary to count on the positive impact of these documents, which can be derived in the long term as industrial relations expand and change towards the introduction of interstate standards, technical regulations, sanitary, veterinary, and quarantine standards, an increase in state support for the *green box*, etc. Studies have led to the conclusion that integration can have positive economic effects, which include the following:

- an increase in trade within the integration block, which leads to an increase in production, and when the market expands for producers, a scale effect appears for its further development;
- the effect of trade reorientation, which increases the production of export goods in a member

- country and promotes more rational use of resources, the development of specialisation in production that has comparative advantages;
- mobility of factors of production, which contributes to an increase in economic growth due to an increase in demand for products and a decrease in the price of products for the consumer;
- increasing the volume of foreign direct investment from partner countries, which creates incentives for the development of the industry;
- competition from enterprises of partner countries reduces the degree of market monopolisation, leads to an increase in the efficiency of market mechanisms, and provides enterprises wide access to financial, labour resources, and the latest technologies.

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Air Pollution Regulations in China: A Policy Simulation Approach with Evolutionary Game

Przepisy dotyczące zanieczyszczenia powietrza w Chinach: podejście do symulacji polityki i gry ewolucyjnej

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Abstract

In the institutional context of China's political centralization and fiscal decentralization, this study explores the environmental regulations that make the central and local governments join efforts in air pollution control. Policy simulations in an evolutionary game show that the best approach is to internalize environmental costs and benefits in local governments' objective function. The effectiveness of several policy instruments is examined individually and jointly, including administrative inspection, transfer payment, and environmental taxes. It is shown that in case environmental consequences are not internalized, appropriate application of policy instruments can incentivize goal-oriented local governments to choose the socially optimal strategy.

Key words: air pollution, environmental regulation, evolutionary game, numerical simulation

Streszczenie

W kontekście instytucjonalnym chińskiej centralizacji politycznej i decentralizacji fiskalnej, niniejsze badanie analizuje regulacje środowiskowe, które zmuszają rządy centralne i lokalne do wspólnych wysiłków na rzecz kontroli zanieczyszczenia powietrza. Symulacje polityki w grze ewolucyjnej pokazują, że najlepszym podejściem jest internalizacja kosztów i korzyści środowiskowych w funkcji celu samorządu. Skuteczność kilku instrumentów polityki jest badana indywidualnie i wspólnie, w tym kontroli administracyjnej, płatności transferowych i podatków ekologicznych. Wykazano, że w przypadku braku internalizacji konsekwencji środowiskowych, odpowiednie zastosowanie instrumentów polityki może zmotywować zorientowane na cel samorządy lokalne do wyboru społecznie optymalnej strategii.

Słowa kluczowe: zanieczyszczenie powietrza, degradacja środowiska, gra ewolucyjna, symulacja numeryczna

1. Introduction

Despite China's endeavors to promote the Sustainable Development Goals (SDGs) since 2015, its environmental pollution has increasingly drawn public and governmental concerns in the world (Xue et al., 2018). Particularly, the air pollution in the Beijing-

Tianjin-Hebei (BTH) region has occupied media and public discussions in recent years (Ravetti et al., 2019). Several cities in BTH and surrounding areas are among the top ten cities with the worst air quality in the nation, which deviates from the good health and well-being of SDGs. Ironically, governments at all levels in China can orchestrate temporary politi-

cal blue sky during major international events such as the Beijing Olympic games, which is often followed by a dramatic deterioration in air quality worse than before (Shen and Ahlers, 2019).

Ample attention has been paid to the technical solutions to preventing and controlling air pollution such as flue gas desulfurization and denitration (Yao et al., 2019) and clean coal and low carbon energy technologies (Feldman and Hart, 2018). However, fighting air pollution is far from a technical challenge alone because it requires governments' collaborative will to put technologies to work. Simply put, China's air pollution control hinges on coordination of governments' environmental regulations and implementations.

Effectively fighting air pollution in China requests sound appreciation of its institutional context. Fiscal decentralization and political centralization in China, or Chinese-style decentralization, have promoted astronomical economic growth, but too often local governments prioritize economic development at the expense of environmental pollution (Diao et al., 2009). On the one hand, the Chinese government system is politically centralized with strong top-down mandates, and officials are incentivized by political promotion granted by the central government (Mok and Wu, 2013). On the other hand, local governments are given discretionary authority and residual tax rights as a result of fiscal decentralization. Therefore, political centralization determines that China's environmental governance is not environmental federalism but authoritarian environmentalism (Zhao and Percival, 2017). In recent years the central government in China has resolved to lead the way to an ecological civilization, but fiscal decentralization and political promotion present mixed incentives to local government officials (Chen et al., 2016).

Chinese-style decentralization institution makes the evolutionary game theory (EGT) a suited tool for studying the strategic interactions between the central and local governments in fighting air pollution. Initially proposed by Maynard-Smith and Price (1973), EGT provides a promising framework to inquire into changes in beliefs and norms over time and predict the results of competing strategies in a dynamic social setting (Newton, 2018). This study contributes to environmental economics literature by exploring the effects of governmental policies within an EGT framework. This is among the first attempts on conducting environmental policy simulations in EGT. Most applications of EGT in environmental studies have focused on theoretical conditions that would yield the evolutionarily stable strategy (ESS) (Zhao et al., 2018; Jiang et al., 2019; Zhang et al., 2019). Numerical simulations that complement the ESS conditions are almost always parameter sensitivity analysis, mostly regarding the commitment level of parties in the game (Gao et al., 2019; Jiang et al., 2019). Since commitment levels are the out-

come of their employed games, these simulations serve to demonstrate the robustness of theoretical results. Sometimes, sensitivity analysis is conducted with respect to a policy-related parameter, such as governmental subsidy in Zhao et al. (2018), ecological compensation fee in Gao et al. (2019), and punishment in Peng et al. (2019). But such an analysis is always of limited scope. In contrast, this study conducts policy simulations involving multiple policy instruments allowed to vary in a broad space, both individually and, more importantly, jointly. We systematically study the effectiveness of three popular policy instruments at the disposal of the central government – environmental supervision, transfer payment, and environmental taxes – in order to uncover their combinations that would lead to the ideal cooperative outcome. This paper thus represents an innovative application of EGT that expands the research toolbox for policy studies on environmental dimensions and beyond.

In order to substantially reduce air pollution reflected in SDGs, we simulate the dynamic interactions between the central and local governments in a wide range of scenarios. The EGT simulations reveal that the best mechanism for fighting air pollution is one in which local governments explicitly consider environmental benefits and losses when formulating their environmental policy. Local governments would have strong incentives to ramp up implementation when environmental performance really affects their interest. Such an endogenous institutional design does not require deliberate intervention by the central government and would intrinsically gain cooperation from local governments. When local governments do not endogenize the environmental consequences in decision-making, however, the central government can design and execute policies with appropriate combinations of policy instruments that would guide local governments towards the ideal collective efforts in air pollution control. Typically, a modest level of environmental inspection is mandatory in effective policy solutions, and the central government should increase the amount of transfer payment to subsidize governance cost by local governments. Environmental tax revenue should be dedicated to environmental protection initiatives to alleviate the common pool problem.

2. Literature Review

This study is related to several groups of literature. The literature on environmental regulations in China is massive, many of which recognize its unique social and institutional characteristics. However, little attention has been paid to expressly investigate the effectiveness of authoritarian environmentalism under Chinese-style decentralization. Examining environmental protection from the perspective of fiscal decentralization alone has yielded mixed results (Song et al., 2018), because in China political cen-

tralization dictates fiscal decentralization. One feature that separates this paper from the literature is its integration of political centralization and fiscal decentralization into a unified framework. Political blue sky is a key environmental issue in China, but most literature is limited to revealing its causes (Shen and Ahlers, 2019), and evaluating its consequences (Liu, et al., 2017). Instead, this study aims to propose solutions to the challenge of political blue sky by modelling and simulating with EGT.

Another group of related literature is those applying EGT in environmental studies. For example, Zhao et al. (2018) analyze the strategic interaction between enterprises and consumers with bounded rationality in a carbon-labeled product market. Peng et al. (2019) build an EGT model involving government regulatory departments and electronics manufacturing enterprises for the implementation of extended producer responsibility for e-waste. Zhang et al. (2019) conduct an evolutionary game model to analyze haze pollution control between a superior government and two local governments from the regional synergistic governance perspective. In contrast, this paper focuses on policy design to promote cooperation between the central and local governments in air pollution control.

More broadly, at an international level, this study complements and extends the literature on environmental federalism (Alm and Banzhaf, 2012). Sjöberg and Xu (2018) find no evidence of a race-to-the-bottom in the U.S. when states assume more decentralized enforcement responsibilities in environmental protections. Sjöberg (2016)'s study on Swedish municipalities reveal that local politicians affect not only environmental policies, but also the outcome through implementation and enforcement. In an empirical study on 110 countries, Fredriksson and Wollscheid (2014) uncover that environmental policy decentralization tends to be associated with weaker environmental policies, yet this effect is less negative in politically centralized systems. This study explores environmental protection interactions in China, a country featuring strong political centralization yet financial and environmental decentralization. However, the presence of these two features is by no means unique to China, only differing in degree across nations. Decentralized policymaking is shown to yield inefficiently weak policies due to associated neglect of transboundary pollution spillovers (Silva and Caplan, 1997) and inter-jurisdictional capital competition (Kunce and Shogren, 2007). It is also documented that greater political centralization leads local politicians and congressional legislators to pay more attention to national party mandate because their political careers depend on it (Enikolopov and Zhuravskaya, 2007). The results in this study suggest that political centralization can improve environmental policy stringency and collaboration between the central and local governments.

3. Institutional Context and Policy Instruments

This section first discusses how Chinese-style decentralization affects governments' environmental regulations in air pollution control. Then, we outline three policy instruments at the disposal of the central government that can guide local governments' strategies to lead to the ideal cooperative outcome. The complex relationship between the central and local governments is depicted in Figure 1.

3.1. Institutional context

In response to growing public concerns over the environmental dimensions of SDGs in China, a series of strict environmental regulations have come into effect in recent years. The institutional relationship between the central and local governments is crucial for the implementation of environmental regulations. As shown in Figure 1, China's fiscal system is largely decentralized, while its political structure is centralized with strong top-down mandates and a homogeneous political structure. There are several key issues in understanding the relationship between the central and local governments in environmental protection.

First, in Chinese-style decentralization, the interest between the central and local governments in environmental protection is not completely consistent. For instance, the central government has promulgated the policy of eliminating backward production capacity in high-energy-consuming industries. However, local governments may rely on these to-be-eliminated industries for local fiscal revenue and economic growth. Especially in regions with ample energy-intensive industries, there are often local policies and measures to counter the implementation of the central government's policy.

Second, environmental regulation is subject to discretion in implementations, because environmental decentralization requires self-financing by local governments. There exists a clear mismatch between positive externality created by air pollution control and the governance cost borne by local governments (Zhang, et al., 2018). In a goal-oriented environment, local governments greatly value accomplishment measures of GDP growth, which results in intense competition among rival jurisdictions (You et al., 2019). Environmental regulations are an important *policy tool* for local governments to attract mobile taxpayers by creating lax jurisdictional environmental regulations that lower costs and tax burden borne by firms (Lai, 2019).

Third, despite its determination to fight air pollution, the central government cannot monitor the behaviors or efforts of local governments effectively all the time. The cost of such supervision is prohibitively too high, and the efforts and ambitions of local governments are often unobservable. Therefore, there is information asymmetry within the principal-agent framework of decentralized environmental govern-

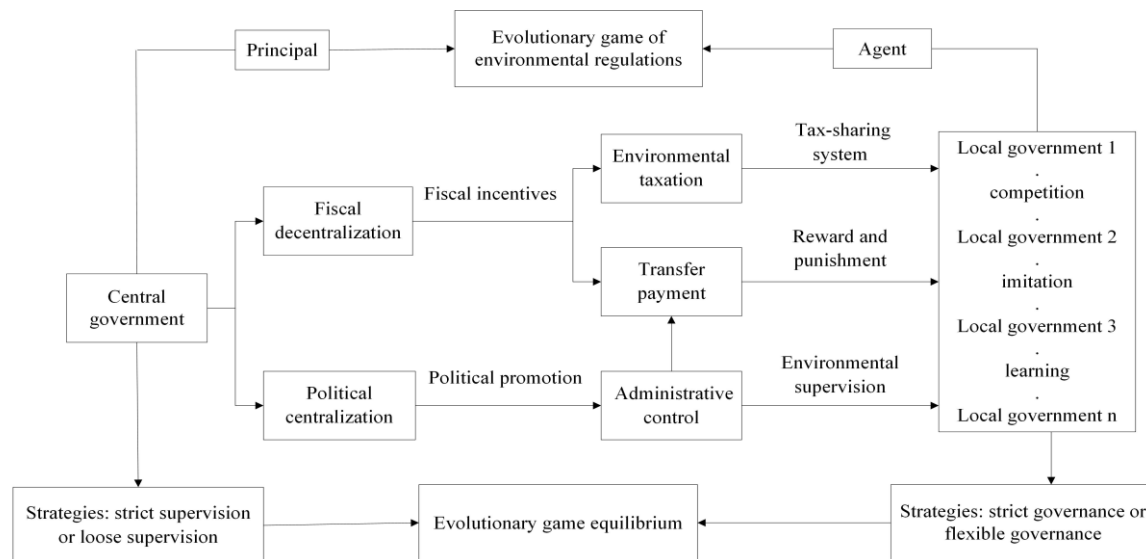


Figure 1. Institutional relationship between central and local governments in air pollution control

ance (Diebecker and Sommer, 2017). The fundamental issue is thus how the central government can design effective institutions with available policy instruments so that local governments are willing to cooperate with it by adopting strict environmental governance.

3.2. Policy instruments for fighting air pollution

For the purpose of spurring local environmental governance reform, this section analyzes the conventional and economic policy instruments at the disposal of the central government: administrative inspection, transfer payment, and environmental taxes. The first policy tool is the administrative measure of inspection. A challenge in environmental protection, including air pollution control, is that local environmental protection agencies report to local governments. This relationship entails inevitable conflict of interest. To address this challenge, in 2017 the six regional environmental protection *inspection centers* of the Ministry of Environmental Protection were officially upgraded to the Regional Environmental Protection Supervision Bureaus and were granted greater power and mandate in environmental inspections. These regional environmental protection agencies report directly to the central government and are responsible for carrying out a larger share of monitoring, supervision, and enforcement of environmental regulations. The central government can choose strict supervision strategy (enforcing all-round environmental protection supervision) or loose supervision strategy (carrying out spot checks in selected areas) via national and regional environmental supervision authorities. However, in Chinese-style decentralization, local governments have enough autonomy to choose a strict or lax governance strategy. Environmental inspection is thus a key policy tool for the central government to push and motivate local governments to carry out strict governance.

Because their economy features heavy polluting industries, some regions such as the BTH face overwhelming challenges in fighting air pollution. These heavily polluted provinces are in urgent need for subsidies from the central government and tax revenues in their fight against pollution (Chu et al., 2018). In order to implement the *Air Pollution Prevention and Control Action Plan*, in 2013 the central government established a dedicated fund for air pollution control with an initial annual budget of 5 billion yuan. The fund significantly increased year by year to 16 billion yuan in 2017. As local governments often undertook unauthorized use and lax management of this dedicated fund, a new institutional system needs to be designed to hold local governments accountable. This system would be a combination of the vertical transfer payment in fiscal decentralization and the reward and punishment in political centralization, to regulate local governments' opportunistic free-riding behaviors. Once local governments are found for not strictly controlling air pollution, they would be subject to punishment by the central government: a complete refund of the allocated special funds, plus an administrative fine of the equal amount.

Environmental taxation has replaced the pollutant discharge fee to get China's air pollution under control since January 2018. However, local governments have conflicting incentives for collecting environmental protection taxes. On one hand, facing the challenges of economic transformation and tight fiscal budget, local governments may tend to collect environmental taxes at higher rates on more pollutants when they strictly control air pollution. On the other hand, the Laffer Curve suggests that maintaining a moderate overall tax burden is an important condition for promoting economic growth (Aslim and Neyapti, 2017). Nowadays, the tax burden on Chinese enterprises is substantial despite govern-

ments' attempt to reduce it. The environmental protection taxes have increased the overall rate of the tax system, resulting in an increase in business operating costs and a possible reduction in tax base. Therefore, it is possible that environmental tax revenues may decline when local governments strictly tax polluting firms at higher rates. In extreme cases, polluting enterprises might be forced to shut down, thus paying no taxes to the local government. It is common for polluting enterprises to shop around for jurisdictions with a lower tax burden and local governments often work hard to attract these mobile taxpayers and job creators. Given the central government's vertical transfer payment, the low-tax-burden competition among local governments creates a common pool problem in air pollution control in which they want to pass on more costs to the central government (Saarimaa and Tukiainen, 2015). In this study we would consider the two policy parameters to investigate regarding the environmental taxes: the tax burden (low vs. high) and the retaining ratio by local governments and examine how they may impact the evolutionary game equilibrium.

4. The Evolutionary Game Model

4.1. The game setup

Based on arguments above, the interaction between the central and local governments in air pollution control can be modelled as a non-cooperative evolutionary game as follows.

Variables C_1 and C_2 represent the costs of strict and lax governance respectively in air pollution control to local governments, which include the implementation cost of environmental regulation. It is assumed $C_1 > C_2$, as strict enforcement carries a higher cost. The collected environmental protection taxes are shared by the local and central governments, with $0 \leq \alpha \leq 1$ representing the share for local governments. R_1 and R_2 represent total environmental tax revenues when local governments adopt strict and lax governance respectively in air pollution control. Intuitively it is assumed that $R_1 > R_2$, but if the tax burden is so high that some enterprises have to reduce production or are forced to shut down, then $R_1 < R_2$. Such a relationship between tax rates and tax revenues is known as the Laffer Curve in economics.

The net benefit created by local governments adopting strict governance in air pollution control is Δ_1 and the loss caused by lax governance is Δ_2 . Given the dreadful smog situation in China, it is assumed that $\Delta_1 < \Delta_2$. That is, strict governance will improve the situation, but doing little or nothing would make

it much worse. The spillover coefficient for net benefit or loss is denoted by $0 < \eta < 1$, indicating net benefit or loss regarding air pollution control in the jurisdiction of a local government would spill over to adjacent regions, which is considered part of the benefit or loss to the central government that oversees the whole nation.

The supervision cost of the central government is C_3 . J is the transfer fund to a local government for air pollution control; if a local government is caught for incompliantly spending the fund, it will be subject to an administrative fine of the same amount. In order to quantify the intensity of the central government's environmental supervision, β represents the probability of the central government to inspect a particular jurisdiction. When the central government chooses the strict supervision strategy, $\beta = 1$.

To sum up, Table 1 shows the payoff matrix for the central and local governments.

Table 1. Payoff matrix for the central and local governments

Local governments	Central government	
	Strict supervision	Loose supervision
Strict governance	$-C_1 + \alpha R_1 + \Delta_1 + J$ $-C_3 + (1 - \alpha)R_1 + \eta\Delta_1 - J$	$-C_1 + \alpha R_1 + \Delta_1 + J$ $-\beta C_3 + (1 - \alpha)R_1 + \eta\Delta_1 - J$
Lax governance	$-C_2 + \alpha R_2 + \Delta_2 - J$ $-C_3 + (1 - \alpha)R_2 + \eta\Delta_2 + J$	$-C_2 + \alpha R_2 - \Delta_2 + (1 - 2\beta)J$ $-\beta C_3 + (1 - \alpha)R_2 - \eta\Delta_2 - (1 - 2\beta)J$

4.2. Evolutionary analysis of the game

Assume the local government adopts strict governance with probability x and lax governance with probability $1-x$. In the meantime, the central government chooses strict supervision with probability y , and loose supervision with probability $1-y$.¹

The expected utility of a local government adopting strict governance is

$$U_1 = y(-C_1 + \alpha R_1 + \Delta_1 + J) + (1 - y)(-C_1 + \alpha R_1 + \Delta_1 + J) \quad (1)$$

and its expected utility of adopting lax governance is

$$U_2 = y(-C_2 + \alpha R_2 - \Delta_2 - J) + (1 - y)[-C_2 + \alpha R_2 - \Delta_2 + (1 - 2\beta)J]. \quad (2)$$

The overall expected utility of a local government is

$$\overline{U}_{12} = xU_1 + (1 - x)U_2. \quad (3)$$

Similarly, the expected utility of the central government choosing strict supervision is

$$U_3 = x[-C_3 + (1 - \alpha)R_1 + \eta\Delta_1 - J] + (1 - x)[-C_3 + (1 - \alpha)R_2 - \eta\Delta_2 + J] \quad (4)$$

and its expected utility of choosing loose supervision is

$$U_4 = x[-\beta C_3 + (1 - \alpha)R_1 + \eta\Delta_1 - J] + (1 - x)[- \beta C_3 + (1 - \alpha)R_2 - \eta\Delta_2 - (1 - 2\beta)J]. \quad (5)$$

The overall expected utility of the central government is

¹From the modelling perspective, the central government including various relevant ministries and administrative arms such as the regional supervision bureaus is treated as a single entity, and local governments are treated as a ho-

mogenous group. In practice, as there is a multitude of local governments, x can be understood as the percentage of them adopting strict governance. Due to the uniqueness of the central government, y is best understood as the probability for its adoption of strict supervision.

$$\overline{U_{34}} = yU_3 + (1 - y)U_4. \quad (6)$$

The replicator dynamics equation of the game system is:

$$\begin{cases} \frac{dx}{dt} = x(1 - x)[C_2 - C_1 + \Delta_1 + \Delta_2 + \alpha(R_1 - R_2) + 2\beta J + 2yJ(1 - \beta)] \\ \frac{dy}{dt} = y(1 - y)[(1 - \beta)(2J - C_3) - 2xJ(1 - \beta)] \end{cases} \quad (7)$$

For the replication dynamic system (7), there are 4 sets of potential pure-strategy Nash equilibria, i.e., (0, 0), (0, 1), (1, 0), and (1, 1) that are fixed points of the evolutionary dynamics, which can be determined by the Jacobian matrix partial stability (Friedman, 1991).

In the determinant and trace of the Jacobian matrix, it can be expressed that $\pi_1 = C_2 - C_1 + \Delta_1 + \Delta_2 + \alpha(R_1 - R_2) + 2\beta J$ represents the net benefit to local governments adopting strict governance when the central government employs loose supervision, and $\pi_2 = C_2 - C_1 + \Delta_1 + \Delta_2 + \alpha(R_1 - R_2) + 2J$ represents the net benefit to local governments adopting strict governance when the central government employs strict supervision. Similarly, $\pi_3 = (\beta - 1)C_3$ represents the net benefit to the central government employing strict supervision when local governments adopt strict governance, and $\pi_4 = (1 - \beta)(2J - C_3)$ represents net benefit to the central government employing strict supervision when local governments adopt lax governance. When $0 < \beta < 1$, we have $\pi_1 < \pi_2$, $\pi_3 < \pi_4$, and $\pi_3 < 0$. Therefore, the evolutionary stability of equilibrium points is summarized in Table 2 that includes six situations.

There is no ESS between the central and local governments in the 6th situation, as all the game outcomes are saddle points thus unstable. However, there may exist mixed-strategy equilibrium in which participants would evolve and interact with each other strategically over time.

In the other five situations presented in Table 2, there exists an ESS point to which the evolutionary game system will coverage in equilibrium. Among the four pure-strategy outcomes, (0, 1) corresponds to the *worst* evolutionary equilibrium of non-cooperation when local governments adopt lax governance while the central government chooses strict supervision. On the contrary, point (1, 0) corresponds to the *optimal* and thus ideal evolutionary equilibrium of cooperation when local governments adopt strict governance under loose supervision from the central government. It is deemed optimal due to the low aggregate governance cost for accomplishing the desired outcome. Besides, constant high pressure from the central government would not be a sustainable solution. Instead, the central government should focus on guiding local governments' choice with well-designed regulations. Points (0, 0) and (1, 1) are deemed the *second worst* and *suboptimal* evolution equilibriums respectively.

From the policy perspective, the principal issue is to design policies so that the point (1, 0) is the ESS in the dynamic interactions between the central and local governments. This ESS is ideal because the intensity of environmental supervision enforced by the central government is low due to its trust on local governments to fight air pollution diligently. Thus, in the evolutionary game system, the question is how to incentivize more local governments to adopt strict governance when the central government does not have to keep high-intensity supervision. In the next section, we will investigate via simulations the individual and joint effect of the policy instruments to accomplish this objective.

5. Simulation Analyses of the Evolutionary Game

In this section, we first assign the parameters in the dynamic model based on official information and existing literature, and then study their impact in two scenarios via simulations. In practical scenarios, it is assumed that local governments do not directly consider environmental impacts when formulating their policies, while in theoretical scenarios they explicitly incorporate environmental cost and benefit into decision-making. In both scenarios we aim to examine the impact and effectiveness of various policy instruments in leading to ESS.

5.1. Parameter assignments

Among the parameters in the evolutionary game model (7), C_1 , Δ_2 and R_1 are the main parameters, and the others can be set according to their relationship with them. Unfortunately, it is impossible to directly collect their data from any official or other reputable source of information. Based on the principle of uniformity and availability, the national environmental pollution loss measured in Liu and Wen (2008) is assigned for Δ_2 , the total amount of investment in environmental pollution control obtained from the National Environmental Statistics Bulletin is assigned for C_1 , and the pollutant discharge fee from the same source is assigned for R_1 . The ratio of these three variables is calculated as $C_1 : \Delta_2 : R_1 = 1 : 0.5 : 0.05$. Therefore, in simulations they are assigned as $C_1 = 10$, $\Delta_2 = 5$ and $R_1 = 0.5$. Besides, $C_2 = 4$ satisfies the assumption that the cost of lax governance is less than that of strict governance, and $\Delta_1 = 2$ satisfies the assumption that the environmental benefit of strict governance is less than the environmental loss due to lax governance. $R_2 = 0.3$ satisfies the assumption that the environmental tax revenue from lax governance is less than that from strict governance, and $C_3 = 0.5$ assigned by the pollutant discharge fee is regarded as the supervision cost of the central government (He, 2015). In simulations, the step for parameters β , α , J and R_1 is 0.1. The value interval of β is [0.1, 0.9] with $\beta = 0.5$ as the initial state. Respectively, the value interval for α is [0, 1] with the initial state of $\alpha = 0.5$,

Table 2. Evolutionary stability of equilibrium points

situation	#1			#2			#3		
(x, y)	$\pi_1 > 0, \pi_4 > 0$			$\pi_1 > 0, \pi_4 < 0$			$\pi_1 < 0, \pi_2 < 0, \pi_4 < 0$		
	det	trI	Stability	det	trI	Stability	det	trI	Stability
(0, 0)	+	+	Unstable	-		Saddle	+	-	ESS
(0, 1)	-		Saddle	+	+	Unstable	-		Saddle
(1, 0)	+	-	ESS	+	-	ESS	-		Saddle
(1, 1)	-		Saddle	-		Saddle	+	+	Unstable
situation	#4			#5			#6		
(x, y)	$\pi_1 < 0, \pi_2 < 0, \pi_4 > 0$			$\pi_1 < 0, \pi_2 > 0, \pi_4 < 0$			$\pi_1 < 0, \pi_2 > 0, \pi_4 > 0$		
	det	trI	Stability	det	trI	Stability	det	trI	Stability
(0, 0)	-		Saddle	+	-	ESS	-		Saddle
(0, 1)	+	-	ESS	+	+	Unstable	-		Saddle
(1, 0)	-		Saddle	-		Saddle	-		Saddle
(1, 1)	+	+	Unstable	-		Saddle	-		Saddle

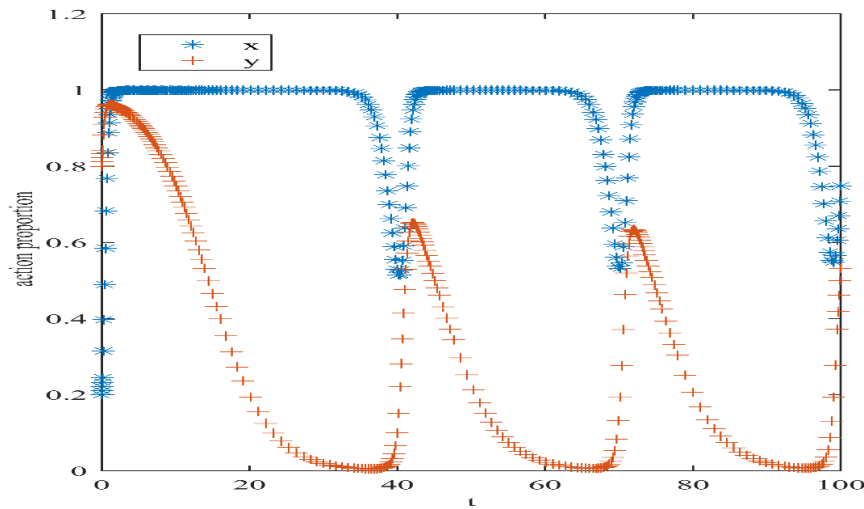


Figure 2. Dynamic evolutionary process in practical scenario. For vertical axis, x and y represent the proportion (probability) of local governments and the central government taking strict governance or supervision, respectively. The horizontal axis t represents the round of simulation.

and the value interval for J is $[0.1, 10]$ with the initial state of $J = 5$.

5.2. Simulation of practical situations

Practically, Local governments value greatly economic indicators such as GDP growth and fiscal revenues, often disregarding environmental benefits and losses when formulating their air pollution control policies. Accordingly, $\Delta_1 = \Delta_2 = 0$ is assumed in the practical simulations in this section, and other parameters are assigned as per Section 5.1. Our interest is to examine the effect of several policy parameters: the sharing of the environmental tax, the environmental tax burden, the intensity of environmental supervision, and the transfer payment by the central government.

5.2.1. Convergence of the system

The simulation begins with $x = 0.2$ and $y = 0.8$.² The dynamic evolutionary process is depicted in Figure

2, showing a mixed strategy features the saddle point (19/20, 9/50), around which the strategic choices of both sides of the game display a cyclical pattern. The central government's position swings between loose and modest-intensity supervision, while local governments are sometimes committed to governance and half-heartedly so at other times.

5.2.2. Effect of sharing environmental tax revenues

The evolutionary process is simulated when the value of α is 0 and 1. When $\alpha = 0$ there is one saddle point (19/20, 1/5), and when $\alpha = 1$ the saddle point is (19/20, 4/25). Further, the results show that when α varies between 0 and 1, it is impossible to make net benefits positive for local governments adopting strict governance. Therefore, the way environmental tax revenue is shared between the central and local governments is not a valid policy parameter. As a result, only $\alpha = 1$ is considered hereafter given that environmental taxes belong to local taxes in practice.

²Choosing other initial values does not qualitatively change the results.

Table 3. Effects of environmental tax burden on the optimal evolutionary equilibrium

	R_l	β						
		$\beta=0.3$	$\beta=0.4$	$\beta=0.5$	$\beta=0.6$	$\beta=0.7$	$\beta=0.8$	$\beta=0.9$
J	$R_l=0.5$	[9.7,10]	[7.3,10]	[5.8,10]	[4.9,10]	[4.2,10]	[3.7,10]	[3.3,10]
	$R_l=0.2$		[7.7,10]	[6.1,10]	[5.1,10]	[4.4,10]	[3.9,10]	[3.4,10]
	$R_l=0.1$		[7.8,10]	[6.2,10]	[5.2,10]	[4.5,10]	[3.9,10]	[3.5,10]
$ \Delta J_{0.5} $			2.4	1.5	0.9	0.7	0.5	0.4
$ \Delta J_{0.2} $				1.6	1	0.7	0.5	0.5
$ \Delta J_{0.1} $				1.6	1	0.7	0.6	0.4
$\Delta J'$			0.4	0.3	0.2	0.2	0.2	0.1
$\Delta J''$			0.5	0.4	0.3	0.3	0.2	0.2

concern ($R_l < R_2$) may affect the evolutionary outcome.

When simulating Sections 5.2.1 and 5.2.2 again with $R_l < R_2$ and $R_l \in [0.1, 0.2]$, it is found that there is no evolutionary stable strategy between the central government and local governments.

Compared to Section 5.2.3, the concern for the negative effect of an environmental tax burden by local governments makes the central government slightly elevate its supervision intensity to $\beta \in [0.7, 0.9]$, so that the system can reach the optimal ESS.

Compared to Section 5.2.4, the concern for the negative effect of environmental tax burden by local governments raises the values of β and J at the optimal ESS point (1, 0). Specifically, when $\beta < 0.4$, no matter how J changes, the system cannot reach the optimal equilibrium. When β varies, the required interval of J for system to reach the second worst equilibrium (0, 0) is unchanged from Section 5.2.4. However, the required interval of J for the system to reach the worst equilibrium (0, 1) expands slightly to [0.3, 3.1). When $J = 3.1$, the system converges to the suboptimal equilibrium (1, 1). When $J > 3.1$, the joint effect of β and J complies with the law of diminishing marginal rate of substitution, which is shown in Table 3.

In Table 3, rows 3-5 show the range of J under different combinations of R_l and β such that the system would converge to the optimal equilibrium. Rows 6-8 show the incremental change in the length of interval of J when β increases corresponding to rows 3-5 respectively. The last two rows show the change in the length of the interval for J when R_l equals 0.2 or 0.1 (row 4 or 5) compared to the case $R_l=0.5$ (row 3) within each column. The results show that as β increases steadily, the incremental change $|\Delta J|$ for the system to reach the optimal equilibrium is diminishing more slowly (rows 6-8). Meanwhile, compared to the case $R_l=0.5$, when R_l decreases from 0.2 to 0.1, the required variation of ΔJ for the system to reach the optimal evolutionary equilibrium is increasing. This relationship between R_l and J characterizes the common pool problem in air pollution control – local governments with environmental tax discretion prefer to shift the governance costs through fiscal transfer payments to the central government.

To summarize the simulation results in the practical scenarios, in order to make local governments choose strict governance, the central government can use the administrative measure of environmental inspection (β), or combine it with the incentive measure of transfer payments (J). Although sharing environmental tax revenues cannot make local governments undertake strict governance, these revenues would somewhat counter their preference for lax governance. The collection and expenditure of environmental tax revenues are regulated by the central government, which can restrain local governments' discretion of low tax burden competition and alleviate the common pool problem of passing costs to the central government. In short, when the administrative and fiscal tools are coordinated, goal-oriented local governments will participate in the collective action against air pollution.

5.3. Simulation of theoretical situations

In the theoretical situations, it is assumed that local governments incorporate the environmental benefits and losses caused by their environmental policies into decision-making. Based on Section 5.1, $\Delta_1 = 2$ and $\Delta_2 = 5$ are assigned, and the other parameters stay the same as in Section 5.2. Similarly, our interest is to examine the effectiveness of the policy parameters on the ESS.

Figure 4 depicts the evolutionary equilibrium of the game system, in which the strategy of local governments quickly converges to 1 (strict governance) and the strategy of the central government converges to 0 (loose supervision) within 30 rounds of simulation. The regulatory game thus converges to the optimal ESS.

Now we turn to the effects of policy instruments in terms of shaping the evolutionary equilibrium. Corresponding to Sections 5.2.2 to 5.2.5, we sequentially examine the effect of related policy parameters. In all these simulations, no matter how the policy parameters change within their range, the ESS point is always (1, 0). Therefore, regardless of the setups for the three policy instruments – environmental tax revenue sharing, environmental inspection, and transfer payment – the game system will always converge to the ideal equilibrium, if the environmental costs and benefits are incorporated in decision-making.

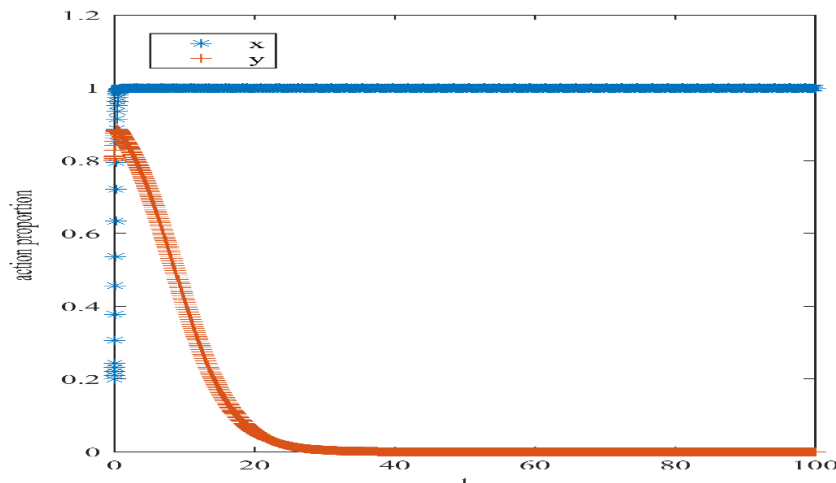


Figure 4. Evolutionary equilibrium in theoretical scenario

The invalidity of these policy instruments brings important enlightenment to China's environmental protection challenges. For the goal-oriented bureaucrats, the endogenization of environmental protection costs and benefits is much more effective than exogenous institutional instruments such as inspection or the *carrot and stick* effect with transfer payment. When Green GDP is incorporated in the performance evaluation system, local government officials would have to accommodate environmental consequences in their policymaking. Simulations demonstrate that such deliberations would naturally lead to the socially desirable outcome, without any intervention by the central government.

6. Conclusions

In China, fiscal and environmental decentralization leads to a race to the bottom among local governments that adopt lax air pollution regulations. This study explores how to bring local governments on board fighting air pollution via policy design. New to literature, policy simulations are conducted in a non-cooperative evolutionary game to explore how to shape cooperative actions.

In the theoretical scenario, when local governments explicitly consider the environmental benefits and losses of air pollution control, the ideal equilibrium will emerge naturally, regardless the central government's policies. When environmental performance is endogenized in local authority performance measures and the promotion standards for the goal-oriented bureaucrats, collective actions would naturally emerge among local governments. In the practical scenario, when local governments do not endogenize environmental benefits and losses in decision-making, the central government can design and execute policies with appropriate combinations of environmental inspection and transfer payments to propel local governments to cooperate.

The results in this study offer several important policy implications. First, the most effective institutional design leading to the ideal cooperation in fighting air pollution features indicators on environmental protection explicitly included in statutory local authority performance measures. In practice, one-vote veto system would change the governmental mindset by sending the clear message that no officials would be promoted if they fail in environmental protection.

Second, despite the political will to construct ecological civilization, the central government does not possess enough information to hold local governments accountable for their opportunistic behaviors. For this reason, China's centralization of environmental oversight is necessary to overcome conflict of interest and attain high-quality regulations and monitoring. Reforms such as the establishment of Regional Environmental Protection Supervision Bureaus within the Ministry of Ecology and Environment represents solid progress in this direction. Therefore, good governance of air pollution will be achieved with policies that combine effective high-quality institutions with professional officials who are accountable for cultivating ecological civilization.

Third, the central government should transfer more funds for environmental protection to fill local financial capacity gaps. Local governments have borne a disproportionately large share of the costs for environmental protection. For example, in 2015, the nationwide total investment in pollution control was 880.63 billion yuan, and the direct investment in pollution control facilities was 469.42 billion yuan. However, in 2017, the central government allocated only 49.7 billion yuan dedicated to environmental protection. As demonstrated in simulation results, insufficient transfer payments would not be able to spark effective environmental protection by local governments.

Fourth, measures must be adopted to address the controversial common pool problem in the financial transfer system. Local governments are responsible for collecting environmental taxes and are given a certain level of discretion to spend them. Since local governments usually prefer to keep a relatively low tax burden in order to attract investments, they tend to collect insufficient environmental taxes on polluting firms, which tightens their budgets and thereby reduces investment in environmental protection. Such behaviors by local governments increase their reliance on the financial transfer from the central government. To control rent-seeking of local governments, the environmental tax revenues should be put in special funds strictly dedicated to environmental protection. In the meantime, the central government needs to enhance tax and environmental authorities' capacity to better direct financial resources to environmental protection so that local governments cannot shift the costs of pollution control to central transfer payments.

A few ideas generated in this study warrant exploration in future research. For example, as an additional policy measure, how would inter-regional horizontal transfer payments may affect evolutionary game equilibrium? In addition, air quality has been temporarily improved worldwide due to the Covid-19 pandemic and lockdowns in most countries since the spring of 2020. It is of great interest to explore how a similar but lasting effect can be achieved with sound environmental governance. These ideas will be pursued in upcoming projects.

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Feminist Mining: A Step towards Sustainable Mining in India

Feministyczne górnictwo: krok w kierunku zrównoważonego górnictwa w Indiach

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Abstract

Economic growth and development with least harm to the environment is one of the biggest challenges for the human. Mining which is considered to be the most inherently unsustainable industry, is at the same time, plays key role in the development process in India and across Globe. It occupy primary position in the supply chain, contributing to the foreign direct investment, exports, government taxes, GDP (National Income) and provide huge labour employment.

This paper studies industrial elimination of women, prolong industrial patriarchy, impetuous production, rising demand pressure has added to the quadrupling problems of land degradation, disposal of over burden/waste discharge, deforestation, pollution(air, water, and noise), and damage to forest flora and fauna, occupational health hazards and extreme global environmental damage in a rapid, continuous manner. These continuous and multi-layered problems are giving us reason to re-visioning steps, where we went wrong.

Theoretical foundation of eco-feminism traces that negligence and suppression of women in general and in the mining industry, is one of the probable cause that hit environment fiercely. With this in mind, this paper suggests theory of eco-feminism into male centric mining industry as a perspective which is more likely to lead to industrial sustainability, making it more responsible and may provide pro-environmental solutions to the industry. This feminist concept extending it from individualistic level into mining organisations proposes as one of the alternative to combine ecology and commerce to envision sustainability.

Key words: sustainability, ecology, environmental degradation, feminism, economic development

Streszczenie

Wzrost gospodarczy i rozwój przy jak najmniejszej szkodliwości dla środowiska to jedno z największych wyzwań dla człowieka. Górnictwo, które jest uważane za najbardziej z natury niezrównoważony przemysł, odgrywa jednocześnie kluczową rolę w procesie rozwoju w Indiach i na całym świecie. Zajmuje podstawową pozycję w łańcuchu dostaw, przyczyniając się do bezpośrednich inwestycji zagranicznych, eksportu, podatków rządowych, wzrostu PKB (Dochodu Narodowego) i zapewnia ogromne zatrudnienie.

Ten artykuł bada przemysłową eliminację kobiet, przedłużanie patriarchatu przemysłowego, gwałtowną produkcję, rosnącą presję popytową, która przyczyniła się do problemów degradacji gruntów, usuwania nadmiernego obciążenia / odprowadzania odpadów, wylesiania, zanieczyszczenia (powietrza, wody i hałasu) oraz szkód flory i fauny leśnej, zagrożeń dla zdrowia w miejscu pracy i ekstremalnych globalnych szkód środowiskowych w szybki i ciągły sposób. Te ciągłe i wielowarstwowe problemy dają nam powód do rewizji działań, w których popełniliśmy błędy.

Teoretyczne podstawy ekofeminizmu dowodzą, że zaniedbania i represje wobec kobiet w ogólności i w górnictwie są jedną z prawdopodobnych przyczyn działań, które mocno uderzają w środowisko. Mając to na uwadze, niniej-

szy artykuł przedstawia teorię eko-feminizmu w przemyśle wydobywczym zorientowanym na mężczyzn jako perspektywę, która z większym prawdopodobieństwem doprowadzi do zrównoważonego rozwoju przemysłu, czyniąc go bardziej odpowiedzialnym i może zapewnić prośrodowiskowe rozwiązania. Ta feministyczna koncepcja, rozszerzająca ją z poziomu indywidualistycznego na organizacje górnicze, proponuje jako jedną z alternatyw połączenie ekologii i handlu w celu osiągnięcia zrównoważonego rozwoju.

Słowa kluczowe: zrównoważoność, ekologia, degradacja środowiska, feminizm, rozwój ekonomiczny

Introduction

Mining is about all the processes involved in extraction of any kind of minerals from earth (surface or beneath). Mining encompasses exploration of non-renewable resources from the earth crust including seas in gaseous, solid and liquid forms, subsequent processing, recapturing by-products for their domestic, industrial and commercial purposes playing important role in human development and business over decades (Sigam and Garcia, 2012). The history of Mining or digging and extraction in India dates back to the early Harappa Civilization. The country (India) is endowed with wide variety of the minerals and a major contributor to economic growth and development. Mining sector is one of the key driver's for economic growth, employment generation and synergies other core industries like power, steel, locomotive, fertilizer, cement, etc (Kirsch, 2010). Mining in India has changed its phase and pace over decades. Histories have shown that, mining was done to sustain livelihoods, very conventional and as forms of artisanal. From private, artisanal and small scale mining to colonisation and organised on nationalisation further diversified across nation on globalisation (Chauhan, 2010; Lahiri-Dutt, 2018). The advent of technology, mechanisation, social perspectives attached with industry such as strength, dark, protectiveness and regulatory framework in the forms of Acts are the major drivers for not only change but also shaping mining industry as *male-centric* industry. Characterised by *masculinity*, power, domination with a motive of profits guided by industrialisation (1970's) and globalisation (1991) promoted aggressive and speedy extraction of minerals in India (Lahiri-Dutt, 2011).

This dominating trends of production, consumption are deeply interlocked with gender inequitable relationships that headed generations towards deeply unsustainable directions (Bradshaw, 2019). Leaving behind traditional economic developmental processes, in the lust and confidence of patriarchy, opportunistic rush or influx towards the mining rich land, ease of extraction, lack of standardised production regimes has become a matter of Indian mining shock in the forms of growing nexus of illegal mining, resource overuse, neither proper mine closure plan nor its implementation, commodity price fluctuations, conflict between industry and society or local communities, unexpected closure of commercial mines; fines; penalties, etc. (Mohanty and Goyal 2012; Syed Maqbool Geelani, Bhat S.J.A., 2013). As

mining activities are increasing in volume and variety, strong and multi-layered negative pressure on environment brings problem of sustainability (Kirsch, 2010).

Sustainability means development and wellbeing of current generation, nature, economy as well as maintaining the same for our future generations (Azapagic, 2004; Abrahamsson et al., 2014; Vintró et al., 2014). Sustainability is the ability to maintain and develop its triple bottom line dimensions altogether that is economic, social and environment. With all three dimensions are having different perspective, Social dimensions speaks about human rights and holistic participation of community including men and women both. Sustainability cannot be achieved without holistic participation of half of the India's population in each and every aspect. Linking gender equality with sustainable development is one of the key agendas of sustainable developmental goals and it is also important as moral and ethical imperative (Bradshaw, 2019). In the mining industry, sustainability aims to minimize the environmental impacts which are inherent to this activity (Gomes et al., 2014; Onn and Woodley, 2014). Therefore, in order to achieve long-term sustainability of one of the most polluting industry i.e. Mining industries, its current functioning, decision making mechanism (which is highly masculine brains) are needs to be reassessed by feminist approaches in order to make them more ethical towards environment and society.

Eco-feminism is about establishing bonds between feminism and environmentalism. Eco-feminism argues that the exploitation and limited participation of women and the degradation of the environment are consequences of patriarchy and capitalism (Shiva, 1988; Waring and Steinem, 1988). Eco-feminism proposes that only by overturning current values (mostly patriarchal), imbibing care, nurture and incorporating cooperation over aggressive and dominating behaviours, can benefit society and environment as well (Buckingham, 2015). The detailed perspectives such as biological, social, ideological are thoroughly explored that establishes closer links between women with nature. The Eco-Feminism principle and there under attributes of care and nurture nature can be used as a remedy towards environmental destruction. Considerable evidences from different sectors from all over the world recognising that women generally expresses different concerns than men with regards to environmental problem's (Ergas and York, 2012) and are more pro-environmental

and provides better environmental solutions. Evidences from organisations/industries and nations are taken where women proved and gave outstanding performances when provided positions with power and concern for environmental protection (Bradshaw, 2019).

Mining Industry, Society and Development: Literature Review

A) Indian Mining Industry

Over the ages, mining industry has evolved gradually as primary sector after agriculture becoming essential for livelihood and survival of human being. Mining is playing vital role in the process of modern economic development and socio-cultural changes. India has considerable domestic reserves of minerals. India ranks 5th in the top 20 (Non-UN Countries) ranked on production value of metallic mineral and coal and India scores 56th rank (out of 182 non-UN Countries) on its mineral resources (Index, 2018). Particularly, in India, the mining and quarrying sector's contribution (at current price) to GVA (Gross Value Addition) accounted for about 2.38% for the year 2018-19. The estimated average daily employment of labour engaged in mining sector (excluding atomic and minor minerals) was 4,77,399 in 2017-18. India produces almost 95 types of minerals and ranks leading mineral producing country for the valuable minerals such as Chromite, Barytes, Coal and Lignite, Bauxite, Iron-Ore, Steel, Zinc, Copper, Manganese, etc (Mines, 2019). Government of India through its various ministries like Ministry of Mines, Ministry of Coal, and Ministry of petroleum and Natural Gas is responsible for directing the entire minerals and mining sector in the country that includes legislation, administration, policy formulation etc. Legislation governing and controlling the mining sector through various regulatory frameworks such as The Mines Act 1952, Mines and Mineral (Development and Regulation) Act 1957, The Minerals Concession Rules, 1960, The Mineral Conservation and Development Rules 2017, Etc.

B) Society and Industrial Development

The very first mining was evolved out of the efforts in search of stone for making weapons for hunting and tools. Primary stone tools are approximately 2.6 million years old, predating even Homo Sapiens around 1.9 million years ago. Mining and usage of metals majorly gold, silver, copper and gemstones have been done extensively during the Pre-Vedic period i.e. (circa 400-1600 B.C.). The artisans of pre-Harappa (Circa 4000-2000 B.C.) and Harappa-Mohenjo-Daro-Indus valley (Circa 3000-1500 B.C.) civilizations used stones, chemicals like soda, lime and gypsum and alloys of copper, bronze for building and other developmental purposes. Yet, mining and usage of coal and steel was unknown prior to 1777. However, the word *Angara* (derived from

Agni) is used as a meaning fuel, occurs in several places. The Yajurveda (1100-1000 B.C.) mentions copper, gold, silver, lead, tin and iron specially, but it is also significant to note that the Vedic Sage's used to dig the earth in search of Agni. *Arthashastra* (400 B.C.), written by Chanakya (Kautilya), give most primitive and authentic records of minerals (Khanija) and the industrial mining (Scholz, 2017). Similar descriptions of metals and metallurgy in medicine have been described in Charka and Susruta Samhitas (1200-400 BC) (Mahesha, 2011). During Ashoka's empire stone inscriptions depicts usage of steel and its various forms during 4th century BC. From the records of great historians and global travellers like Megasthenes (c.300 B.C.) Pliny (AD77), Fa Hien (5th Century), Huen Tsang (7th Century), Al Beruni (11th Century), Tavernier (1665-69) several information on mining, usage and trade of steel, its alloys and gemstones over ages were found in India (Vajda, 1976). The evolution of mining parallels to the history of civilization and so many important cultural eras have been named and associated after various minerals or their By-products: the Stone Age (prior to 4000 B.C.E), the Bronze Age (4000 to 5000 B.C.E), the Iron Age (1500 B.C.E to 1780 C.E.) the Steel Age (1780 to 1945), and the Nuclear Age (1945 to the present) (Lahiri-Dutt, 2011). However, in India, first aluminium industry was set-up in 1808, it was in the year 1774 for coal mines and 1777 for iron ore, when first time permission was accorded by Warren Hastings for actual mining of coal and iron ores. Although, not much attention was given at that time due to coal's poor quality, higher cost involved in its extraction and other political reasons, which laid so much delay to the process of industrialisation, but the very start-ups may be seen as the fuel for industrial revolution in India.

Environmental Degradation

Mining in India plagued with several environmental socio economic problems. There are multi-level, direct and indirect, short-term and long term negative impacts associated with mining. It is like we are moving forward, outperforming economically but we are getting closer towards our own extinction. The ecological, social sufferings in terms of diseases, pollution, and unequal distribution of wealth will be too high that our future generations would not enjoy the very fruits of development. Every steps involved in proposed mining plan is adding multi-level degradation to the environment and society at large (Ritsema, 2002; Kirsch, 2010; Worldwide, 2010; Pimentel et al., 2016). This phase of proposed mining plan is applicable mainly to the extraction of ore deposits such as iron, zinc, coal etc.

Exploration & Prospecting: This stage deals with geophysical identification of mineral from earth

crust, followed by drilling to evaluate minerals according to purpose. This phase includes field surveys, studies, drilling, boreholes and other exploratory excavations. This exploratory phase involve huge clearing of area's vegetation, disturbing faunas, use of heavy machineries, drilling rigs, creates noise and air pollution in addition. This exploration is done in core ecological balanced areas thus sensitizing flora, fauna and surrounding population.

Development & Design: A model design for the ore body is developed which includes methods and technology requirements to assess the commercial feasibility of the mine. Construction of approach roads, clearance of vegetation, and removal of overburden. This also involves key observation, technological, chemical exploration of underdeveloped area having reserves.

Mine Construction: This phase deals with reaching to the ore or mineral by the use of technology i.e. either open caste or underground mine. This is done by exploitation, land clearances, geographical modification of land, rehabilitation and resettlement. This also impact land, water, noise, air pollution and ecological imbalance.

Production: This phase is the longest in the overall life of mine which ends for more than 10 to 40 years or even more. This phase involves actual mining and extraction of minerals or ores. This is the phase which adds to highest negative impact not only to nearby area but globally. This has multiplying environmental impact.

Closure: This phase represents end of the life of a mine and end of mining processes. This stage is as critical as it involves long term degradation impacts. The left-out or completed mines have higher chances of collapse, water flooding, overall geographical change of the land forms, chemical leaks and changing form that pollute ground water quality and air pollution, abandoned mines are un-rehabilitated.

Post-closure: After closing its reclamation, restoration and rehabilitation stage, in which efforts are made to reduce the negative footprints by ecological restoration, which is very nascent concept in India. It is generally ignored which lead to overall environmental degradation, pollution, etc.

In totality, Mining activities causes physical, chemical, biological and socio-economic changes in the area such as soil pollution and change in the landscape of the area, drainage of acid waste in water, mercury and lead contamination in water, loss of flora-fauna and other biotic life forms, rehabilitation, resettlement of population are the first hand problems (Chauhan, 2010; Mohanty and Goyal, 2012; Syed Maqbool Geelani).

The level of degradation by its inherent nature, whose negative impact can be mitigated by following traditional/subsistence/need based method of mining by human. Yet, Men as breadwinners, considered dominant breeds and are major drivers of change (mechanisation, scientific revolution, industrialisation, etc.) focuses on major transformation of society and economy contributing to the most pressing ecological and social problems of our day much earlier causing natural death of ecology (Merchant, 2006). For example, Rapid and Populous rehabilitation and relocation of natives arises as direct outcome of mining, who are close to nature not only causes social change but also poses to the challenges of loss of livelihood, loss of their subsistence thus food insecurity, mental and physical health problems (Ahmad and Lahiri-Dutt, 2006). It has become a prolonged arena which has been dominated by men and one where masculine practices and discourses were common from the boards (policy formulation) or in exploration or in extraction processes of nature as wild and in need of discipline and control. These irresponsible mining practices with priority on production and safety rather than environmental concerns impact and compromise our communities, our health and environment and affect deeply and specifically women in multiple ways.

Journey from Mining to Prejudice Mining: Complete Patriarchy

Women labour and utilization of services of women is as old as our Indus civilization about 3000 B.C. Histories also agrees that women were found shouldering men in almost all the occupations of life (Kaur, 1987). Yet, Labour history is mainly about men, and gender history is usually about Women (Van Goethem, 2006). Studies in general shows that our labour history was gendered; the positions held by her, the inter and intra sector environment, culture and treatments received from their counterparts were almost gendered as *systems of domination or systems of inequality* that both diverged and converged (Boris et al., 1999). Industrial societies are organised on the basis of gender i.e. Men are workers, women are mothers' (Brush, 1999). Although much about participation of women in the labour market could not be found out in recorded form, but women have played a critical role in mining industry. Records, mostly oral histories, have revealed that in early mines, men and women laboured together (Gier and Mercier, 2006). Typically, they were labourers (e.g. shale pickers, manual coal loaders, paners, ore carriers), goods and services provider (e.g. cooks, shopkeepers) and often solely responsible for their domestic duties. In extractive industries, women were mainly involved in the supporting mining activities ranging from crushing, grinding, churning, collecting ores, washing and panning, to amalgamation in

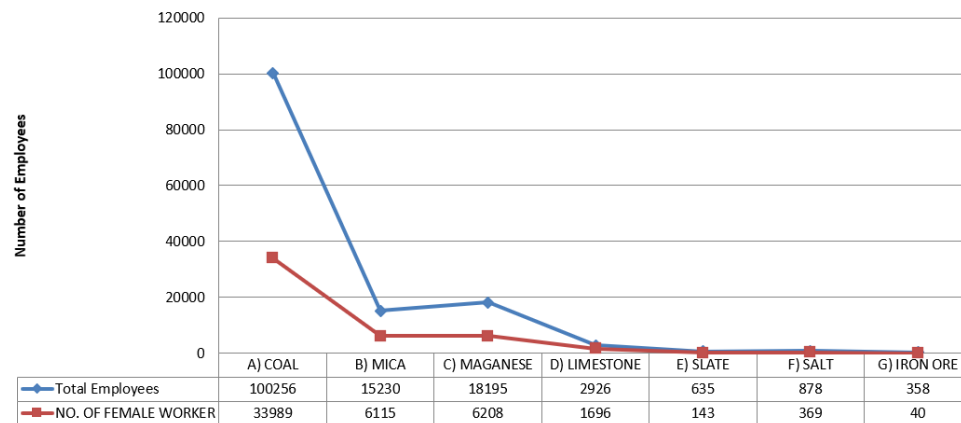


Figure 1. Average Number of female deployed daily in the mines majorly coal, mica, manganese, salt, slate, during 1907, source: (Wilson, 1907)

the specific gold mines (Hinton et al., 2003). The period and aftermath of World War I provide glimpses of women active participation of women in the labour market. One of the major reason could be the war that lead to massive death of soldiers (male) and scarcity in manpower in the labour market. The same brought women into active employment in metal industry, particularly, arms industry during the war, that broke the hegemony of men in industrial labour. As post-war period was a crucial period towards identifying and securing rights of labourers in general, this period was very much important for emergence of women workers representations in the form of initiatives to stand, argue and defend for their rights, equality, took initiatives to participate in policy formulation, etc on various platforms, globally. They actively participated in first International Labour Conference to represent their rights equally from almost 83 countries, show their energy and will to work in mining industry (Zieger, 2010). Thus, it may be inferred that, Mining sector as primary sector after agriculture has given equal opportunity to both male and female to participate actively for their survival and livelihood. The essence of industry in shaping our everyday life and economy is well recognised by literature. While talking about organised/structured mining labour force in Indian Mining industry, during the year 1907 the average number of persons working in and about mines regulated by the Indian Mines Act, was 151,983, of whom 98,824 worked underground and 53,159 on the surface; 96,769 were males, 49,116 were females and 6,098 children under 12 years of age.

The numbers shows women were deployed sufficiently in different mines in India. Another researcher conducted investigation in three principal coal fields in India are in Jharia, Raniganj and the Central Provinces having altogether 885 mines, in which over 263000 persons were employed out of the total labour force in 1944, roughly a quarter were women (Deshpande, 1946). Some studies also found that women played major role in Indian artisanal mining (Hilson, 2002; Lahiri-Dutt, 2006). It

can be seen from records that unorganised Mines pre-post nationalisation involves 70% of female workforce. Africa deploys highest number of female artisanal miners ranging to 40-50% while in some other regions the percentage raised even to 60 to 100% women (Amutabi and Lutta-Mukhebi, 2001; Onuh, 2002). In west African countries and villages of Nigeria, Kenya women were dominant and exclusively employed in salt mining (Onuh, 2002).

Later on with rise in labour laws, protection of human rights specifically women and children, safety, increasing cases of harassment/exploitation of women, distinguish on the basis of physical ability lead to deteriorating female numbers. Differences in wage payment on the basis of gender, disparity in access of getting education and employment, mechanisation, transformation from subsistence economy to commercialisation added to this (Lahiri-Dutt, 2007). Several studies says that mining is having traits of masculinity and extractive industries ended up with only deployment of male (Mercier, 2011). Post-colonization, as the processes of globalisation expanded, mining has grown as more masculine (Mayes and Pini, 2010). Transition from 18th to 19th century was a historic turmoil for all people and industries across world. The great depression, decolonization, end of World War-I were the prominent junctures for all nation. During that phase, the conditions and sentiments of labour, social justice and humanity were recognised as prominent factors for establishing universal peace (Zieger, 2010). Thus, in 1919, International Labour Organisation (ILO) was constituted, as a specialised agency for providing recommendations, developing conventions protecting rights of labours and developing labour standards in the matters such as: Hours of working of a labour, Prohibition of women and child during night time, Minimum age for entering into mines, Welfare facilities, etc.

Accordingly, India while coming out of colonisation, inspired by the conventions of ILO and Mining regulations existing for British India mines by lord Cross, 1890, shaped their first Mines Act 1952 which

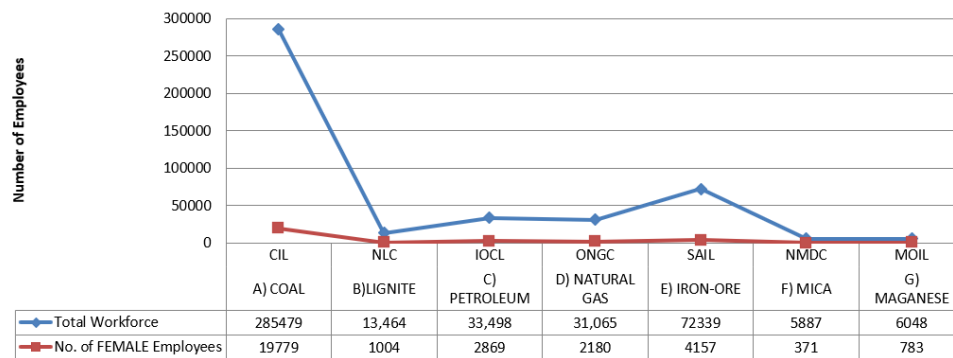


Figure 2. Average number of Female employee by big Mining Giants in the Year 2019, source (CIL; IOCL, 2019; MOIL, 2019; NLC, 2019; NMDC, 2019; ONGC, 2019; SAIL, 2019).

came into force from 01.07.1952 (Udayakumara, 2008; Lahiri-Dutt, 2012, 2019; DGMS, 2020).

Rule 46 of Mines Act, 1952 prohibits employment of women in the terms that no women shall be employed below ground in any part of mine and above ground only limiting hours i.e. between 6 a.m. to 7 p.m. (Lahiri-Dutt, 2012; Sudhamani, 2017). Limiting the hours of women work deprives women from the opportunity to work in shifts, which are strictly applicable in large organised mines with better wages. It is found that gender exclusions emerged at uniform particular historical moments across the world (Gier and Mercier 2006). This perception was even enforced by series of mining countries such as British Mines act of 1842, Germans in 1878, North America in 1890 Sweden in 1900, Russia in 1917, Japan in 1933 (Sudhamani, 2017; Lahiri-Dutt, 2019). It is found that workplaces, especially mines, were not and still are not gender-neutral locations (Schilt and Connell, 2007). The impact of such changes were so deep and strong that even in 2019, the average number of female deployment in mining industry has deteriorated to meagre 6-7% by big business giant.

Struggle for Sustainability Mining: An Indian Scenario

As India is among one of top ten countries in minerals reserves, there is no other choice in resources than mining, that contribute to nation's development. Thus the controversies of 20th century have been shifted towards reducing detrimental imprints through sustainable mining. Sustainable development have become a bustle word in natural resources especially non-renewable resources as their stock is limited and their attached environmental problems. India has formulated number of policies, laws, rules and regulations over years for mining industries striving towards sustainability. Looking the mining scenario, conflicts around and loopholes attached lead to time to time amendments, modification, additions in the several acts such as Environment Protection (Amendment) Act (EPA, 2006), New Mineral Policy (2008), etc. provisions under regulatory-leg-

islative mining framework for environmental protection. India is known to be among one of the country that flooded with acts and its rulings. Yet, the industry is facing challenges of sustainability due to long and bureaucratic system of getting approvals, sometimes duality in control between state and central and most common is the governance failure in administration of minerals (Mohanty and Goyal, 2012). Deployment of advanced technological solutions (such as hydraulic mining by replacing hand held drills with hydraulic and jumbo drills), Public disclosure on sensitive issues like sustainability, transparency, community participation, internal audits by the individual big companies, ISO (International Organizations for Standardization) certifications such as 14001 – for managing, assessing environment, audit reports by the Comptroller and Auditor General (CAG), EIA (Environmental Impact Assessment) have lead path towards sustainable mining. There is still lots of challenges, like the existing and rising social dissatisfaction, local conflicts and unrest, gherao by locals, non-conformities and ignorance, long pending and pertinacious resettlement issues, limited community development as a mere compliances require a more closer view, pro-environmental, long term feasible deliberation and introspection by changing perspective of the industry (Pressend et al., 1995).

Prospect of Sustainable Mining

A Theoretical Analysis through Ecofeminism: establishment of deep connection between nature and women.

Women images and roles are keep changing over era's; since mythology to contemporary, depending on the male dominance, circumstances, social needs and others. One of the concepts aroused out of environmental problems such as rising level of pollution, climate change during 1980, at the end of World War-II, when the participation of women towards protecting environment and their ecological restoration concerns were recognised across globe and termed as eco-feminism. Some highly recognised women laid movements in India are like Chipko

Movement during 1970, Ecological movement by the Bishnois, anti-arrack movement in Andhra Pradesh are the major drivers for conceptualising eco-feminism.

The term *ecofeminism* was first reckoned by Francoise D'Eaubonne (A French feminist) with a concept that women's oppression and the destruction of nature have the same origin: the patriarchal perspective, which exerts control and power over both and reason for their subjugation. She tries to establish deep connections between women and environment and patriarchy as the reason for all global environmental problems. The new perspective of ecofeminism was much talked, recognised that women's rights and environmental rights cannot be left altogether and its practical impact towards survival and recreation of mother earth was felt during end of 90's.

Biological roots

This perspective conceptualises as Nature creates lifeforms and made efforts for possible survivals. Likewise women also give birth to new lives on earth and make all possible efforts towards caring, nurturing, development of lives. These *motherhood traits* of care, nurture, softness towards nurturing is a common base for establishing deep connection between women and nature. *Motherhood Effect* increases environmental concern for women (Blocker and Eckberg, 1989; Greenbaum, 1995; Davidson and Freudenburg, 1996). Mother's moral responsibility of care and concern for their child and family initiated their active participation in movements that they perceive as an environmental threats (Nelkin, 1981; Levine, 1982; Hamilton, 1985). Organismic theory viewed earth as a nurturing female, lay at the centre of a cosmology in which nature and society were dynamically interconnected (Leach 2007).

Social roots

Beyond reproductive roles, histories have shown that how men went outside in order search for food, haunting, involved in rapid war whereas women restricted themselves with collecting dry leaves, fallen woods, collecting water and managing with nearby resources for fulfilling needs of their family (Hoskins, 1982; Rocheleau, 1991; Agarwal, 1992). It was found that difference in the intensions of men and women towards same environment (Leach, 2007). Moreover likewise earth which makes our survival on earth possible, women are creators of live forms. So virtues of care, nurture, balance, management, social adjustments and finding substitute in scarcity are imbibed by their mere acts performed, in day today affairs. Such practices based on requirements of life also gave them deep and extensive knowledge and experiential expertise, more than men (Dankelman, 1989). Moreover, women are con-

sidered towards rebuilding ecological cycles and ones that will ensure and nurture planet health (Köhler-Rollefson, 2018). The suggestion that *women are involved in community managing work undertaken anywhere to everywhere from urban and rural contexts as well* (Moser, 1989).

Ideological roots: psychic structure

Ecofeminism is a concept that maintains connectivity and togetherness between human and non-humans without dissolving individual's subsistence in conceptual terms also. It establishes integral relationships between self and other directly to the nature, thus maintains interdependence and autonomy (Mathews, 1994). It is all about equality not domination, it may be towards women, men or nature (Gaard and Gruen, 1993). It was well established that women and nature are used as a means to satisfy goals of patriarchy. Ecofeminists believe that human beings are not separate from nature but they are a part of the natural world (Jackson, 1993). Thus, the concept of Eco-feminists considers that all life on earth is intertwined with each other. Ecosystems are likely to benefit different domains of men's and women's wellbeing differently, some researcher says that women emphasised relational aspects of wellbeing (Abunge et al., 2013). It is perceived by some authors that biological, physiological and neurological differences between male and female results their significant thinking differences, their emotional quotients, behaviour pattern and thought process. Women in general are attributed towards higher into wellbeing domains, emphasising on household consumption over commercial/sales, plant use and gatherers, custodian of seeds, etc. (Reyes-García et al., 2010; Yang et al., 2018).

Reinvestigating role of women in Mining and Feminist Mining

Indian history of minerals is very old and rhetoric towards building and shaping strong nation's. However, mining industry development is very nascent in terms of inculcating better ethical practices, gender parity in specific. After various exploitation under colonialism and turmoil like world war, Indian mineral industries brought the concept of CPSE's (Central Public Sector Enterprises) and PSU's (Public Sector Enterprises), wherein control of exploration and exploitation of majority of minerals rests with the central and state government with a view of *welfare balance* of society over profitability. The very purpose and spirit of these enterprises (good practices defined by the equality of opportunities) dissolved then and there as the industry prohibited and restricted employment of women.

Despite females played major role in building civilizations, studies have shown the same vulnerable stature of women in mines in India and around the globe.

This Women's status plight is not *natural* and is not due to biological differences rather it is created by social, cultural, historical and economic factors. Previous research have explored few majorly identified factors like sexual exploitation and harassment, gender-power relations, difficulties balancing family and work responsibilities, responsibility towards reproductive roles, social norms surrounding female workers, education, traditionally *male/hard/masculine* associations to mining, etc. (Yount, 1991; Pattenden, 1998; Gibson and Scoble, 2004). In extractive industries, women role is largely under-recognised, under-theorised and under-investigated (Jenkins, 2014). It is found that, there are no physiological reasons as to why women cannot perform the same tasks as men, only if they wish to do it. In Sierra Leone, many interviewees noted that mining is wrongly considered as physical/masculine activity assigned solely for men (Rickard et al., 2017). Early histories of organised mining and artisanal mining in India also depicts that women have worked alongside men equally sharing loads for livelihood even in mining industry (Hove and Hlongwana, 2015). For India, it took long way almost 70 years to understand the gendered division of mining industry. As per Gazette Notification No. 393 (S.O. 506(E)) dated 29 January 2019, the Central Government exempted the deployment of women above or below ground (any mine) from the provisions of Section 46 of the Mines Act, 1952, subject to certain conditions, namely:-

(a) For employing women in any open cast mines, i.e. above ground:

The restrictions on engaging women between 7pm to 6 am in any mines on surface(open-cast) is waived-off seeking written consent from the concerned female employee with not less 3 women in a single shift. While on duty, every female should be provided sufficient facilities and safety, security at workplace. The Standard Operating Procedure (SOP) shall be framed and implemented on the basis of guidelines of Chief Inspector of Mines, beforehand for engaging women.

(b) The restrictions on employing women in any underground mines is waived-off by allowing women employment underground with limiting hours i.e. between 6 am and 7 pm in any type of technical, supervisory and managerial work where continuous presence may not be required, keeping other clauses same as detailed for open cast female engagements.

This amendment in the Mines Act, 1952 is not just a mere change in Act but can be recognised as breakthrough in *stereotyped mining* by providing opportunity, acting ethically towards sustainable development, taking into rights, dignity and capabilities of other half of the world's population (Ministry of labor and employment, 2019).

Today's scenario, Mining as a discipline is not only concerned with *Mining/Extraction* rather to holistic mines plan which require visionary thought process,

permits, clearances, persuasion, empathetic view towards community. Women with more emotional outlook towards their environment, community, family, friends will always take decisions prioritising such considerations and are more prosperous in long term (Ward, 2010; Bauhardt, 2014; Spectrum, 2018). Thus this is a new thought process with *shift-in-masculinity*, which means changing old, partial, masculine mind-set and new consensus to the mining industry. For example: Some researcher establishes that integrating women will develop better community relations and will drive production with innovation and redefine development through empowering women (Ahmad and Lahiri-Dutt, 2006; Rickard et al., 2017). Another example is the group of women in Ayacucho refused to sign an agreement with a company for Tambogrande would not be developed as a mine because they said that they could see no overall benefit for their community in doing so (Ward, 2010).

The preponderance of women in mining will enable the primary caregivers to bring their individual feminist traits like care, nurturing, balance, multi-tasking, etc to organisational level that will be a remodelling of mining practices facilitating holistic change into the overall culture and functioning of an organisation including financial performances, productivity, profitability, improve corporate governance, lower cost of finance, reduce corporate fraud, etc (Yang et al., 2018).

Although, women are employed in mining sector but their number is very less that to limited to peripheral jobs. However, by increasing their participation in core Mining and Administrative roles as well, will provide a double check system in itself. In one way, at administrative and decision making policy-front, they check policy formulation and if there is any ignorance or unforeseen harm, female at technical front while performing actual mining work will check in ecological prospects at the time of actual mining.

This concept does not view gender equity as essential to economic change but infusing feminist traits into every aspect of mining industry through increasing participation of women. Women-men smart partnerships in mining produce more gains than when the two sexes operate in homogeneous syndicates (Hove and Hlongwana, 2015) infuses new and different perspectives to patriarchy mining.

Globally, women are recognised as relatively untapped sources of skill, energy and on the job talents (Mihail, 2006). Realising the same globally other countries pro-actively changed their workforce pattern, emphasised on gender equality. It has been argued at large by researchers that women are pre-occupied by their home responsibility, care of family and children, gender-defined responsibilities (Salinas and Romani, 2014). However, it can be seen as an opportunity that it takes at least half of work life to get board level positions that makes around

age group of 45 and above. At this age of life, where women are more or less free with their basic family responsibility, at this juncture, women can take leap of faith to proof their worth in such a critical industry. Years of experience will give advantage in shaping their pro-environmental vision. It is only their early carriers that need to be taken care of by facilitating them by providing crèches at workplace, first-aid, rest rooms, health and hygiene, toiletries, etc.

Women will not just understand mining but they will apply their virtuous soft skills into mining, empathise with environment, people in order to make it economically viable. It is said that 4Ms of production: Man, Machine, Material and Money, Human is the most challenging factors to handle. Women reports to experiencing higher emotions than men across the life span. Women reports greater overall warmth, emotional expressiveness and concern for other than do men (Grossman and Wood, 1993). Several studies have shown that female participation, saves cost of corporate by taking better care of equipment in a responsible way, follow safety protocols, work more safely (IFC, 2013). For example: In Mexican Mining Industry, women participation is accessed highly beneficial in terms of their loyalty, responsibility, careful and protective attitudes towards self and machinery, less oblivious.

Thus, increasing presence of women will be helpful towards changing practices and attitude that will lead the *inherently unsustainable mining* towards sustainable mining in a better way. It is imperative from histories that women do things different than men and are better planners because they do not only think of present given situation but also plan for next and work accordingly. Be it planning at work or household works, Studies have also shown women can perform multiple task at a time in a better way, however men can only focus on limited things at a time, difficulty in switching jobs frequently and reaction time is also fast in men (Sayer, 2007; Mayes and Pini, 2010; Offer and Schneider, 2011; Stoet et al., 2013).

Conclusion

The study assessed the extent of participation of women and gendered nature of Indian mines. Available evidence indicates that neither industry nor biologically women were discriminated rather it is society and their different protective, male centric and dominant arguments that shaped mining as *only male industry*. This paper has established that industrial patriarchy brought masculine characteristics into industry in the form of aggressive mining, harsh expansion decision, pursuit of progress and profit figures with least environmental concern brought environmental degradation beyond its threshold limit. The mining by its inherently polluting nature and adding to this patriarchy industrial enterprises supported by Government regulatory framework took

least concern, careless attitudes towards environment and nature brought us much earlier at an alarming stage to the multiple environmental, social, individual problems. The oppression of women within the socio-cultural context and flagrant environmental changes are further theorised in this paper as ecofeminism may be used to restore and nurture nature. We have reinvestigated how participation of women into core mining beyond peripheral works and accepting, bringing feministic traits in every aspect of mining will be a sustainable move to the male tradition and prolonged old age practices of mining. In light of these findings the paper recommends that the formation of gender inclusive cooperatives as one of the priority in mining industry, raising the participation of more women at all the level will go beyond the empowerment of women, bringing social parity and most likely to step-up sustainability in the sector considering ecology and mining trade management together.

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Trade Openness, Foreign Direct Investment and Sustainable Agriculture in Africa

Otwartość handlu, bezpośrednie inwestycje zagraniczne i zrównoważone rolnictwo w Afryce

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Abstract

This study applied a panel data of 37 African countries in examining the impact of trade openness and foreign direct investment on sustainable agriculture towards the attainment of the United Nation (UN) Sustainable Development Goals (SDGs), especially, SDG-2, with the aim of ending extreme hunger, achieve food security and improve nutrition and promote sustainable agriculture. Data for the study was sourced from the Country Policy and Institutional Assessment (CPIA) and World Development Indicators (WDI) of the World Bank, for the period 2005 - 2019. To control for endogeneity, the study engaged the system Generalised Method of Moments (GMM). The result shows that FDI and trade openness have significant negative impact on agricultural sustainability in Africa. This result implies that, increase in FDI may decrease agricultural sustainability by 0.00294%, while increase in trade openness may lower agricultural sustainability by 0.430066 %. Therefore, the study concludes that while trade openness is negative, policy to raise local production towards export promotion should be encouraged. In addition, FDI should be encouraged to augment local employment and investment towards increasing output and productivity in the Africa region.

Key words: agriculture, sustainability, trade liberalisation, sustainable development

Streszczenie

W artykule wykorzystano dane panelowe z 37 krajów afrykańskich w badaniu wpływu otwartości handlu i bezpośrednich inwestycji zagranicznych na zrównoważone rolnictwo i osiągnięcie Celów zrównoważonego rozwoju ONZ, zwłaszcza SDG-2, który ma za zadanie wyeliminowanie skrajnego głodu, osiągnięcie bezpieczeństwa żywnościowego oraz promowanie zrównoważonego rolnictwa. Dane do badania pochodzą z Country Policy and Institutional Assessment (CPIA) oraz World Development Indicators (WDI) Banku Światowego i obejmują lata 2005-2019. W celu kontroli endogeniczności w badaniu wykorzystano system Generalized Method of Moments (GMM). Wyniki pokazują, że Bezpośrednie Inwestycje Zagraniczne (FDI) i otwartość handlu mają znaczący negatywny wpływ na zrównoważony rozwój rolnictwa w Afryce. Wynik ten implikuje, że wzrost FDI może obniżyć zrównoważenie rolnictwa o 0,00294%, podczas gdy wzrost otwartości handlu może obniżyć zrównoważenie rolnictwa o 0,430066 %. Z tego wynika, że chociaż otwartość handlu jest negatywna, należy zachęcać do polityki zwiększania produkcji lokalnej w kierunku promocji eksportu. Ponadto należy zachęcać do FDI w celu zwiększenia lokalnego zatrudnienia i inwestycji w celu zwiększenia produkcji i produktywności w Afryce.

Słowa kluczowe: rolnictwo, zrównoważoność, liberalizacja handlu, rozwój zrównoważony

1. Introduction

Developing countries, especially Africa, have over the years witnessed a continuous inflow of economic resources from developed economies (Osabohien et al., 2021a; Adegboye et al., 2020a; Asiedu, 2003). This inflow of economic goods can be referred to as Foreign Direct Investment (FDI). It is the decision of a government or an organisation to acquire a business inform of full ownership or part ownership of business concerns in countries other than their own (Adegboye et al., 2020b). This can assume the form of fresh set-up or acquiring existing ones. Investments such as this enables investors spread investment reach to enterprises outside their countries of origin (Asiedu, 2003a; Osabohien et al., 2020). FDI is considered crucial to economic development as it is known to provide non-debt servicing foreign exchange, create employment, enhanced foreign relations, influence technology transfer, imitation, and licensing agreement and also enhance trade openness (Alfaro, 2006 ; Asiedu, 2013; Forster & Toth, 2015; Osabohien et al., 2020; Matthew et al., 2021). Factors such as higher level of openness, economies with better infrastructures, depreciated local currency among others, have been found to attract FDI, especially in Sub-Saharan Africa [SSA] (Jaiblai & Shenai, 2019; Eiji, 2017; Osabohien et al., 2020). Trade openness refers to condition of free flow of trade without hindrances, occasioned by tariffs and other official barriers to trade. It can equally assume the form of reduced tariff regime. Developing countries adopt trade liberalisation to foster economic expansion and development (Adegboye et al., 2020a). Africa and its sub-regions have risen to the urgent demand for all-inclusive development of the continent by rectifying couple of continental and regional economic, trade and developmental integrations. For instance, The African Continental Free Trade Area (AfCFTA) saddled with the responsibility of engendering regional cooperation within the continent to ensure that the primary sector which is the main stay of her economies are positioned to compete effectively in the global market. Also, the New Partner-

ship for African Development (NEPAD) was birthed to attract FDI into the continent to bridge annual resource gap of \$564b which is needed to achieve the eradication of abject poverty from Africa (Aderemi et al., 2021; Asiedu, 2003a). Virtually, all the regions of the continent have one form of Regional Economic Community (REC) or the other. The West African Sub region has the Economic Community of West African States (ECOWAS) as her own REC. ECOWAS was set up primarily to facilitate trade within the sub region by removing barriers to trade. FDI to the continent over the past 10 years has grown by 11% to US\$46b. However, the West African sub-region witnessed a decline of 15% to US\$9.6b, with Nigeria and Ghana topping the losers with 43% to US\$2b and 8% to US\$3b respectively (United Nations Conference on Trade and Development, 2019). This is irrespective of her richness in natural resources which has been spotted as one of the key influencers of FDI (Anyanwu & Nadege, 2015). The continent is a net exporter of primary produce which are products of mining and agriculture. Agriculture not only forms bulk of her stock in trade, but also provides employment, food security and poverty alleviation (Osabuohien & Efobi, 2011). To ensure that the region thrives in agricultural trading, the ECOWAS Trade Liberalization Scheme (ETLS) and ECOWAS Regional Agricultural Program (ERAP) were established in 1990 and 1995 respectively. This is done with the intent to achieve among other things, Goal two of the Sustainable Development Goals, which aim to end hunger, achieve food security and improve nutrition and promote sustainable agriculture (Bamiro, 2018).

Consequent on the fact that scholars have over the years been deliberating on the healthiness or otherwise of trade openness and FDI in fostering agricultural performance in the West African sub-region, they have however failed to align to a particular stand on this subject matter. This is not unconnected with variation in methodologies, variables, timeframe and other vital information

used in such studies. Also, the side of the argument whether from the importing or exporting side, that is supply or demand side has also added to the differentials in study outcomes. Given the above background, this study contributes to the extant literature by examining the impact of trade openness and foreign direct investment on agricultural sector sustainability in African. The study adopt the panel data technique to explicate on this relationship for 37 countries in Africa, sourced from the Country Policy and Institutional Assessment (CPIA) and World Development Indicators (WDI) of the World Bank for the period 2005-2019. This study is divided into five sections. Following this introduction is literature review, Methodology, Presentation of findings and discussion, recommendations and conclusion in that order.

2. Materials and Method

In this section, the works most relevant to the study are briefly discussed and thereafter the data used for the analysis are described.

2.1. Literature Review

Studies have been carried out to examine the direction of the impact of trade openness and FDI on agricultural performance in the ECOWAS region. However, concerns about the opportunities, and otherwise of trade openness which is mostly anchored on liberalisation of trade and FDI on agricultural sector performance is not peculiar to ECOWAS sub-region. This is because; scholars have raised concerns for and against the duo. To provide a valid discuss, this study undergoes empirical review of the literature under the following subtitles.

2.2. Trade Openness and Agricultural Sector Sustainability

Studies on the relationship between trade openness and agricultural sector performance have resulted in inclusive outcomes. For example, Sotamenou & Nehgwelah, (2018) De Silva, Malaga, & Johnson (2013); Potelwa, Lubinga, & Ntashangase (2016), Laiprakobsup (2014) supported the argument that trade openness positively impacts on agricultural sector performance.

Using annual data for a period of 35 years, Sotamenou & Nehgwelah (2018) applied the Fully Modified Ordinary Least Squares (FMOL) to examine the effect of trade openness on agricultural output in Cameroun. The result revealed among other things, that trade openness in Cameroun gave rise to free movement of agricultural products, thereby encouraging and increasing agricultural production. Similarly, in Ghana, Awunyo-Vitor & Sackey (2018) employing the Error Correction Mechanism (ECM), Granger Causality test on secondary data on Ghana's agricultural sector and economic growth,

found a proportional significant relationship between economic growth and FDI which was proxied for trade openness to agricultural sector. The study suggests flexible trade policies to attract more FDI. In another study, Potelwa, Lubinga, & Ntashangase (2016) studied factors that influence the growth of South Africa's agricultural export, and affirms that agricultural export enhancement positively impacts on economic performance. Applying Gravity Model for data on export growth between 2001 and 2014, the study confirms that trade agreement positively impacts on agricultural performance in South Africa. In Asia, De Silva, Malaga, & Johnson (2013) investigating the impact of trade liberalisation on agricultural performance in Sri Lanka, using data between 1960 - 2010, employing the OLS and Multiple regression method, found that trade openness leads to improvement in agricultural productivity in Sri Lanka. Also, that trade openness, interest rate, free trade agreements among other factors, are accountable for the growth in agricultural sector in Sri Lanka. On the contrary, findings from Shobande (2019) indicates that trade openness has strong negative effect on the performance of agricultural export in selected West African Countries. Using OLS the Gravity Model on annual time-series data for periods between 1970 to 2016, the study posits that export side of agriculture is not favoured by trade openness. It suggests the adoption of common currency to mitigate the varying exchange rates in the region as well as aggressive agricultural extension and research on economic efficiency in the agricultural sub-sector to enhance performance. Djokoto (2013) found a negative relationship between trade openness and agricultural output in the short-run, while the long-run indicates that there is no relationship between the variables. This followed the study on the correlation between openness and agricultural performance in Ghana, using a 14-year data and adopting the ARDL method of analysis. On the strength of the findings, the study recommends selective FDI in the agricultural sector to reduce its negative impact.

Miljkovic & Shaik (2010), studied the impact of trade openness on the technical efficiency in U.S. agriculture and found that trade protectionism leads to decrease in agricultural import and so enhances technical efficiency in agriculture. The study strongly discourages trade openness in order to ensure sustained technical efficiency in agriculture for concerned countries. This they achieved using stochastic frontier analysis (SFA) with data from 1948 to 2006. However, a study by Nin Pratt, Diao, & Bahta (2009), applying dichotomy between exporting and importing nations on agricultural output confirms that there is no direct benefit for importing nations, whereas countries with effective comparative advantage in exporting agricultural produce stands to benefit immensely. This revelation was a product of partial equilibrium analysis of 193 agricultural firms in 14 countries of South Africa.

Trade protectionism and barriers have been said to be necessary for the protection and encouragement of infant industries, especially, agro-based industries in Least Developed Countries (LDCs) (Matsuyama, 2019; Bond et al., 2012). This argument was favoured by observations by Shobande et al., (2018a), Beyene (2014) that agricultural sector performance in Africa especially, the West African sub-region has underperformed owing to trade openness amongst other factors such as poor funding, neglect, knowledge gap within the sector (Guei & Le Roux, 2019) submitted that these negative impacts are evident due to the failure of policy makers to study the terms of agreement before rectifying such agreements, stressing that selective trade bilateral agreements is key for the survival of the ECOWAS economies.

2.3. Foreign Direct Investment and Agricultural Sector Performance

It has been argued that trade openness does not impact on FDI (Alfaro, 2006). On the other hand, Osabohien et al. (2020) pointed that trade openness impact on FDI and employment level in Africa. Alfaro (2006) and Olokoyo (2012) pointed that the reason why trade openness does not impact on FDI is owing to the fact that many other key economic considerations such as the viability of the institutions of state, corruption, government involvement in business either encourage or discourage FDI. The ECOWAS subregion, and the agricultural sector has not been a favourable destination for FDI. This is because of security concerns and other factors earlier mentioned (Asiedu, 2013; Olokoyo, 2012; Posu, Soile, & Sangosanya, 2021)

However, studies have confirmed that despite obvious concerns, the impact of FDI when finally attracted outweighs that of trade liberalization (Forster & Toth, 2015). This is due to many benefits accruable from FDI which includes increased access to global market, employment creation (Osabohien et al., 2021), technology transfers, manpower training, bridging of income gap, rich source of non interest foreign exchange, access to improved technology and market, improved skill set for improved quality control, enhanced international relations amongst others (Glick & Hutchison, 2013; Asiedu, 2006; Alfaro, 2006). Nevertheless Krugman (1991) is of the view that the application of the principle of pareto optimality underscored these many benefits accruable from FDI.

In specific study by Oloyede (2014), employing time-series data spanning from 1981- 2012, using ADF test for stationarity and granger causality test confirms that FDI positively impacts agricultural performance both in the short run and long-run. The study maintained that for this to be sustained, an enabling environment has to be created by the political class. Edeh, Eze, & Ugwuanyi (2020) in a study of the impact of FDI on agricultural sector in Nigeria

established that there is a significant positive impact of FDI on agricultural sector. Having employed quarterly timeseries data for 37 years and using the tools of Autoregressive Distributed Lagged (ARDL) model, FMOLS and the Dynamic Ordinary Least Squares (DOLS), on the strength of their findings recommended the extension of the existing tax holidays for foreign investors from 3 to 6 years to attract more FDI in necessary.

Studying the effect of FDI on agricultural sector performance in Nigeria, using data from the Central Bank of Nigeria (CBN) for period 1986-2015, and applying Augmented Dickey Fuller (ADF), Johansen test and ECM, Akinwale, Adekunle, & Obagunwa (2018) found that FDI and bank credit had direct positive significant effect on agricultural performance in Nigeria. The study recommends adequate provision of infrastructure especially in the rural areas to encourage the flow of FDI. Also, Agba, Adewara, Nwanji, Yusuf, Adzor, & Abbah, (2018) examine the impact of FDI on agricultural performance in Nigeria, and found a positive, but insignificant effect of FDI on agricultural sector performance in the short-run and a significant positive effect during the long-run. The study suggests stabilisation of exchange and interest rate in order to attract foreign investors.

Investigating the impact of FDI on general economic growth (Mahmoud, 2015) using quarterly data from 1976 to 1995 which was evaluated using multiple regression model, OLS, unit root test and granger causality test found that a significant and positive relationship exists between FDI and economic growth. It advocates for policies to reduce government involvement in business and that will attract more FDI. This position has been confirmed by Gherghina, Simionescu and Hudea (2019); Bleaney & Wakelin (2002); Abdul & Nazia (2020); Olayiwola, Osabuohien, Okodua, & Ola-David (2015).

In contrast, numerous studies have found negative effects of FDI on agricultural sector performance, as well as the general economic wellbeing of the country. Akinlo, (2004) examined the impact of FDI on economic growth in Nigeria using data spanning between 1970 – 2001 found that FDI has little or no impact on enhancing economic growth in Nigeria. Using ECM, it confirmed that FDI did not favour the extractive industry which agriculture is part of as much as it favoured the manufacturing industry. Rather labour force and human capital advancement positively impacted the extractive industry. It therefore suggests expansion of labour force and human capital development to ensure sustainable growth of the extractive industry. This position was revalidated in a recent study by Posu, Soile, & Sangosanya (2021) Foreign direct investment and Nigerian economic growth: A Sectoral Analysis. The study which aims at uncovering the individualised impact of FDI on various sectors of the country's economy employing time series data from 1970-2003 and

adopting OLS method of analysis found that FDI flows was not significant in the agricultural sector as it was in other sectors such as mining, communication and transportation.

Iddrisu, Immurana, & Halidu (2015) in an empirical study of the impact of FDI on agricultural performance in Ghana carried out with data from 1980-2013. The study applied the Johansen cointegration test, found that FDI impacted agriculture in Ghana negatively in the long run, while the short run saw positive impact. The study therefore recommended stabilisation of the local currency as well as Ghanaian authority harnessing trade relation to ensure that FDI flows into the country is not toxic. Convincingly, very many empirical works have studied the individual as well as joint impacts of trade liberalisation and FDI on agricultural performance and by extension economic outcomes of various economies. But no consensus has been reached as to the exact direction of the impacts of these variables or the magnitude of such impacts. These variations can be explained by the different dataset, methodology, time-frame and geographical consideration adopted for these studies. It is then the desire of this work to provide insight into the joint impact of foreign direct investment and trade openness on agricultural sector performance in West African sub-region, using the 2SLS regression.

2.4. Model Specification and Estimation Techniques

The study employs three techniques to achieve its objectives. The methods are; The Pooled Ordinary Least Squares (Pooled OLS), the Fixed Effects and the systems Generalised Method of Moments (GMM). Hence, following the study by Anser et al., (2021), Osabohien et al., (2021a) and Nhamo and Mukonza, (2020), the Pooled OLS and fixed model can be expressed as (equation 3)

$$ISA_{it} = b_0 + b_1 FDI_{it} + b_2 TOP_{it} + b_3 X'_{it} + e_{it} \quad (1)$$

Where, SA is sustainable agriculture (proxied by agriculture value added), with b_0 as the constant term, FDI captures Foreign direct investment, TOP, measures trade openness, X'_{it} is a vector of control variables such as arable land, social protection and gross fixed capital formation. Equation (1) is estimated using the Pooled OLS and fixed effect regression. Before deciding on the use of fixed effect, the Hausman test was conducted.

In Pooled OLS, the individually specific effects are not taken into consideration. This is as a result of a lot of basic assumptions like orthogonality of the white noise are violated. However, the Random effects resolve this issue by executing an individual specify intercept in the model, which is expected to be random, which may lead to exogeneity. This verified with the Hausman-Test.

The results from the Hausman test showed that the fixed effect is preferred to the random effect analysis. The Hausman test result for the benchmark regression is $\chi^2=11.35$ ($p=0.0781$), showing that the assumption that a model using random effects is preferable is clearly rejected. However, given the fact that the Pooled OLS and Fixed effect analysis may have some iota of endogeneity, the Generalised Method of Moments (GMM) is chosen. This is because, unlike the Pooled OLS and fixed effects, in the presence of endogeneity, it produces the best consistent estimates (Arellano & Bond, 1991; Wooldridge, 2010). Following literature such as Anser et al., (2021); Baltagi (2008), the GMM model is specified in equation (2)

$$ISA_{it} = b_0 + \theta ISA_{it-1} + b_1 FDI_{it} + b_2 TOP_{it} + b_3 X'_{it} + e_{it} \quad (2)$$

Where, ISA_{it} measures agricultural sustainability for country i ($i = 1, 2, \dots, N$) at time t ($t = 2, 3, \dots, T$), b_0 is the constant term, ISA_{it-1} is the lagged dependent variable, with its coefficient θ , FDI_{it} is foreign direct investment with its coefficient b_1 , TOP_{it} is trade openness, with coefficient b_2 , X'_{it} covariate of the independent variables with the coefficient b_3 ($b_3 = 1, 2, 3 \dots N$). To handle the problem of endogeneity, the study applied the system GMM. The study treats the endogeneity problem by using a two-step system GMM for the estimation of dynamic unbalanced panel data. For the case with a strong endogeneity,

2.5. Data Sources and Description of Variables

The study engaged a panel data obtained from the World Development Indicators (WDI), and Country policy and Institutional Assessment (CPIA) for a period ranging from 2005 to 2018, with 37 African countries listed in International Development Association (IDA) of the World Bank.

The variables used for the analysis are; agricultural sustainability (measured by food agricultural value added), social protection (captured by overall social protection coverage), arable land (hectare), employment in agriculture (% of total employment); trade openness (% of the GDP); gross fixed capital formation (% of the GDP). The variables and their respective measurements are presented in Table 1.

3. Results and Discussion

This section of the study presents the results obtained from the estimated model and discusses it. The analyses begin with the summary statistics of the variables, which is presented in the next section.

3.1. Summary Statistics

We examined the features of the variable through the descriptive analysis which shows the summary statistics of the variables and their measures. This subsection indicates the statistical analysis of the variables used in the study-SA, Arbland, SOP, Agric E,

Table 1. Variables, Measurement and Sources, source: Authors' compilation

Symbol	Variable Name	Measurement	Source	Expectations
SA	Sustainable Agriculture	Value added per worker	WD	Not Applicable
GFCF	Gross fixed capital formation	It is essentially net investment (% of the GDP)	WDI	Positive
SOP	Social Protection	policies for social coverage (scale: 1=low to 6=high)	CPIA	Positive
Arbland	Arable Land	Hectare	WDI	Positive
FDI	Foreign direct investment	Foreign direct investment, net inflows (% of the GDP)	WDI	Positive
TOP	Trade openness	Summation of export receipts and import expenditure divided by gross domestic products	WDI	Positive
Agric E	Agricultural employment	Employment in agriculture (% of total employment)	WDI	Positive

Note: CPIA means country policy and institutional assessment, FAO means Food and Agricultural Organisation and WDI means World Development Indicators.

Table 2. Descriptive statistics of the variables, source: Authors'

Variables	Mean	Std. Dev.	Min	Max
Sustainable Agriculture	1417.6	1284.22	196.08	5950.56
Arable land (hectare)	5035188	6610136	1000	3.70e+07
Social Protection	3.221468	.4830563	1.5	4.3
Agricultural employment	55.47553	17.42301	10.6	90.3
Trade Openness	69.54906	40.14656	16.66853	347.9965
Foreign direct investment	-6.63e+08	1.46e+09	-1.08e+10	8.75e+09
Gross fixed capital formation	22.26763	9.247498	2.0004	79.46179

Table 3. Correlation Matrix, source: Authors'

Variables	SA	Arbland	SOP	AgricE	TOP	FDI	GFCF
SA	1.0000						
Arbland	0.3148	1.0000					
SOP	-0.0106	0.0435	1.0000				
AgricE	-0.7129	0.0523	0.0398	1.0000			
TOP	-0.1619	-0.3989	-0.1215	-0.2896	1.0000		
FDI	-0.2092	-0.5609	-0.1679	0.0226	0.0573	1.0000	
GFCF	-0.0168	0.0046	0.2601	-0.2172	0.4123	-0.137	1.0000

TOP, FDI and GFCF. It also presents the mean value which is the sum of all values in the group data divided by the number of observations, median is the middle value of each variable in the data set, standard deviation is the square root of the variance; minimum value is the lowest number in the set of data; maximum value is the highest number in the set of data, and the range is the difference between the maximum and minimum values, as presented in Table 2.

Table 2 shows the summary statistics for each variable use in the analysis. Sustainable Agriculture has an average value of 1417.6, and its value ranged between 196.08 and 5950.56 during the study period (2000-2018). The result also showed that the dispersion of sustainable Agriculture around its mean value is 1284.22. The average value of arable land is 5035188 and its value ranged between 1000 and 3.70e+07. The average value of social protection is 3.221468 and it ranged between 1.5 and 4.3. The dispersion of social protection around its mean value is 6610136. The mean value of Agricultural employment is 55.47553, and it ranged between 10.6 and

90.3. The result showed that the dispersion of Agricultural employment is 0.4830563; this is an indication that the series is closely clustered around its mean value, Agricultural employment of the selected countries over the study period clustered around its mean values. The mean value for trade openness is 55.47553 which ranged between 10.6 and 90.3. The result also showed the dispersion of trade openness around its mean value was 17.42301. The average value of trade openness (TOP) during the years under review is 69.54906 and it ranges from 16.66853 and 347.9965. The result also showed the dispersion of trade openness around the mean values was 40.14656. Foreign Direct Investment (FDI) has an average value of -6.63e+08 and it ranged between -1.08e+10 and 8.75e+09. The results also showed the dispersion of foreign Direct Investment and its mean value was 1.46e+09. The average value of Gross Fixed Capital Formation (GFCF) during the study period was 22.26763, and it ranged between 2.0004 and 79.46179. The result also showed the dispersion of GFCF around its mean value as 9.247498.

Table 4. Regression Results (Ln SA), source: Authors'

Variable	Dependent Variable: Ln SA		
	Pooled OLS	Fixed Effect	System GMM
Ln SA(-1)	-	-	0.3886*
	-	-	(0.001)
Ln Arbland	-0.234**	-0.1081	0.197*
	(-0.049)	(0.523)	(0.000)
Ln SOP	-0.3182	0.5128**	1.398*
	(0.170)	(0.039)	(0.000)
Ln Agric E	-0.138*	-0.9418*	-1.08
	(0.000)	(0.000)	(0.000)
Ln TOP	-0.3146**	-0.2503*	-0.4307
	(0.003)	(0.026)	(0.000)
Ln FDI	-0.0004	-0.0004	-0.0029
	(0.801)	(0.792)	0.002
Ln GFCF	-0.0224	-0.0455	0.2513*
	(0.627)	(0.317)	(0.000)
Constant	14.111**	12.781*	5.357*
	(0.000)	(0.000)	(0.000)
R.sq.	0.61	0.57	-
Groups/Obs.	27/144	27/144	25/144
Wald chi2(6)	103.58*	-	-
F test	103.58*	9.05*	-2.78*
	(0.000)	(0.000)	(0.005)
AR (1)		-	-3.98*
		-	(0.000)
AR (2)		-	(1.57)
		-	(-0.115)
Hansen test		-	0.6
		-	(-0.742)

Note: The p-values are in the parentis (), *, **, and ***, means that the coefficient is significant at 1%, 5% and 10% level respectively

The results of the correlation matrix presented in Table 3 showed that there is a very little correlation among the variables in the model. According to Gujarati (2009), if the pairwise correlation between two variables exceeds 0.8, this indicates high level of multicollinearity. Hence, the overall results indicate absence of multicollinearity.

3.2. Econometric Results

The econometric result from random effects, pooled OLS and system GMM for the 31 Africa countries for the period (2005-2019) are shown in Table 4. The table contains the estimated parameter and the probability values obtained from the regression equation, in which sustainable Agriculture is the dependent variable. The system GMM proposed by Arellano and Bond's dynamic panel data estimator was used to investigate the impact of FDI and trade openness on sustainable Agriculture in Africa. The model is practically useful for linear functional relationship that is dynamic, in the case of missing data and simultaneity bias. Generally, GMM estimators are known to produce coefficients that are consistent and asymptotically normal. For robust discussion, we also estimated the traditional pooled estimator such as the random effects model and the pooled OLS. The exogenous variables employed comprise log of Arable land, log of SOP, Log of Agricultural

employment, log of trade openness, log of foreign direct investment and log of gross fixed capital formation. The statistics from the Hausman (1978) using a fixed effects instead of a random effects model. The Hausman test result for the regression is $\chi^2 = 17.25$ when $p = 0.0158$, that is the assumption that a model using random effects is rejected.

The estimates obtained from the fixed effect model are presented in Table 4. From the results as presented in Table 4, if all things are made to be equal, sustainable Agriculture will be equal 12.781%. It shows that a 1% rise in SOP will cause agricultural development to rise by 0.5128%. Also, a 1% in Agricultural employment will result in 0.9418% increase in sustainable Agricultural. Similarly, a 1% rise in trade openness will cause agricultural development to decline by 0.2503%. The result also shows that a 1% rise in foreign direct investment will cause sustainable Agricultural to decline by 0.0004%. Furthermore, a 1% rise in gross fixed capital formation will result in 0.0455% decline in sustainable Agricultural.

The system GMM result is presented in Table 4. The diagnostic tests are impressive. The Hansen test accepts the null hypothesis of valid research instruments. Furthermore, the first-order autocorrelation tests accept the presence of autocorrelation, while the second rejected it. The one time-lagged depend-

ent is both positive and significant. This justifies the use of dynamic GMM in our analysis, and also indicates that sustainable Agriculture adjusts to changes in the explanatory variables with a gestation lag across the estimation structure.

The estimated parameters are presented in Table 4. The result showed that a 1% rise in foreign direct investment will cause sustainable Agriculture to decline 0.00294%. This implies that FDI has not positively influence sustainable Agriculture. Similarly, trade openness has negative impact on sustainable Agriculture. A 1% rise in trade openness will cause sustainable Agriculture to decline by 0.43066%. This finding is in conformity with the report made by Shobande (2019). This result is not surprising given that African is still a net importer of agricultural product and other non-Agricultural products. The result however contradicted the report made by Wamboye et al., (2016a, 2016b) in their study which advocated for free market and push strongly for the integration of Africa into the global financial system in order to attract foreign direct investment and achieve economic development.

The exogenous variables are also important in explaining the level of agricultural productivity among the 37 countries. Social protection has the potential to influence sustainable Agricultural; hence a 1% rise in social protection will cause agricultural development to rise by 1.3982%. Gross fixed capital formation has positive impact on sustainable Agricultural hence a 1% increase in gross fixed capital formation will cause agricultural development to increase by 0.2513%. Arable land has significant positive impact on sustainable Agricultural. For instance, a 1% rise in arable land will cause agricultural development to rise by 0.1970%. Finally, sustainable Agricultural has significant negative impact on sustainable Agricultural. For instance, a 1% rise in Agricultural employment will cause sustainable Agricultural to decline by 1.0804%.

4. Conclusions

From the results of this study, it was found that foreign direct investment and trade openness have significant negative impact on sustainable Agriculture for countries of Africa for the period 2005-2019. This is contrary to experience in other developing countries in Asia, the likes of India, China, Iraq and Lebanon; where globalization by encouraging foreign direct investments positively influenced technology, infrastructural development enhance growth and improve living standard (Siddiqui, 2017). For the selected SSA countries, globalization may not have influence on sustainable Agriculture due to low absorption of low technology and infrastructure. The interaction between FDI and sustainable Agriculture on one hand, and sustainable Agricultural and trade openness on the other hand are negative, and hence

explanation for low rate of sustainable Agriculture for the selected countries in the Africa region.

The study recommends that, as globalization opportunities are being explored by countries of Africa, protective policies should be used to encourage inflow of foreign direct investments into the agricultural sector, and not only the extractive industry as it has been the case. This is evident from the negative interaction that exists between sustainable Agriculture and trade openness on one hand and with foreign direct investment on the other hand. The implementation of policies that will encourage foreign direct investment into the real sector and agricultural sector will invariably bring a turnaround in from the negative interactions. Foreign direct investments that transfer technology and skills to the agricultural sector should be encouraged. It is imperative to put in efforts to attract foreign direct investment into the region particularly this era where the COVID-19 pandemics have resulted in fall in domestic resources and affected most household income. It is only through foreign direct that the fall in domestic resources can be complemented.

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Systematic Review on Urban Ecosystem Services in South-East Asia: Asean Countries

Przegląd usług pełnionych przez ekosystemy miejskie w Azji Południowo-Wschodniej

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Abstract

Urban ecosystem services refer to all the benefits of nature especially to the urban community and economy for maintaining human well-being. This concept links to the economic, community and environmental aspects and shows how nature conservation is important for human and economic principles. However, the view of urban ecosystem services assessment based on essential categories with current urban development is provided. So, this paper reviews the aim to analyze the types and assessing the categories of urban ecosystem services and the methodological used in ASEAN countries. Furthermore, understanding studies about urban ecosystem services are important in long-term studies for monitoring purpose. As a result, 8 out of 10 ASEAN countries excluding Laos and Brunei have studied urban ecosystem services. In this context, the result also shows the most studies specify the significance of the ecosystem services given by the urban as regulating (waste absorption, climate regulation, water purification, flood regulation, and disease control) and followed by cultural (tranquility, social relations, and recreation). Thus, exploring urban ecosystem interaction in current ASEAN countries may have added benefits in terms of improving the urban ecosystem services to streamline the urban area planning. Finally, we conclude that all the ASEAN countries should play an important role to make sure the countries maintain sustainable and more livable with the right policies and guidelines like can fit in Paris Agreement especially in Climate Strategies and plans.

Key words: urban ecology, urbanization, Paris Agreement, sustainable development; environmental management

Streszczenie

Usługi ekosystemów miejskich odnoszą się do wszystkich korzyści płynących z natury, zwłaszcza dla społeczności miejskiej i gospodarki, wspomagając utrzymanie ludzkiego dobrostanu. Ta koncepcja łączy się z aspektami ekonomicznymi, społecznymi i środowiskowymi oraz pokazuje, jak ważna jest ochrona przyrody dla ludzi i ekonomii. Dokonano oceny usług ekosystemów miejskich w oparciu o podstawowe kategorie przy obecnym rozwoju miast. Dokonano przeglądu celów analizy rodzajów i oceny kategorii usług ekosystemów miejskich oraz metodologii stosowanych w krajach ASEAN. Należy podkreślić, że zrozumienie badań dotyczących usług ekosystemów miejskich jest ważne w długoterminowej perspektywie, do celów monitorowania. Okazuje się, że 8 na 10 krajów ASEAN, z wyjątkiem Laosu i Brunei, zbadało usługi ekosystemów miejskich. Większość badań określa znaczenie usług ekosystemowych świadczonych przez miasto jako regulujących (pochłanianie odpadów, regulacja klimatu, oczyszczanie wody, regulacja przeciwpowodziowa i kontrola chorób), a następnie kulturowych (spokój, relacje społeczne i rekreacja). W związku z tym badanie interakcji ekosystemów miejskich w obecnych krajach ASEAN może przynieść dodatkowe korzyści w postaci poprawy usług ekosystemów miejskich w celu usprawnienia planowania obszarów miejskich. Wszystkie kraje ASEAN powinny odgrywać ważną rolę w zapewnieniu, że kraje te wspierają zrównoważony rozwój i będą bardziej przyjazne do życia dzięki odpowiednim politykom i wytycznym, takim jak mogą zmieścić się w Porozumieniu Paryskim, zwłaszcza w strategiach i planach klimatycznych.

Słowa kluczowe: ekologia miejska, urbanizacja, Porozumienie Paryskie, zrównoważony rozwój, zarządzanie środowiskiem

1. Introduction

The Millennium Ecosystem Assessment (MEA) (2005) defines ecosystem services as the benefits people obtain from the ecosystem and its surroundings. Ecosystem services are the goods given to humans throughout the conversions of environments such as water and vegetation into a flow of necessary services and goods such as food and clean air (Constanza et al., 1997). Urban ecosystems indicate an area with constructed infrastructure that deals with a substantial percentage of land area (surface) including green and blue spaces e.g., parks, urban allotments, urban forests, wetlands, and ponds (Gomez-Baggethun et al., 2013). In other words, urban ecosystem services can be defined as all-natural areas in the city including green and blue space. From a point of view, urban ecosystem services that are either directly produced by ecological structures within urban areas or peri-urban regions (McGranahan et al., 2005; Gutman, 2007; Jansson, 2013). For example, Singapore as an important country for urban ecosystem services study was experiencing rapid urban development and a 100% urban population (Friess, 2016).

The ecosystem service concept can be adapted to urban ecosystems because the services are for various inhabitants which were important and needed (Tratalos et al., 2007; Ahern J., 2007). In this case, urban planning and activities often associated with the development potential of ecosystem services. Furthermore, urban ecosystem services were also interconnected with biodiversity aspects in an area. In this context, if the ecosystem has been declined in quality, for example, loss of biodiversity, then the ecosystem services will also decrease. This is because an urban ecosystem will be worthless if it were unable to provide any basic benefits and humans needs. Schewenius et al. (2014) argue that the elements of a sustainable city require a consolidate social-ecological approach in policymaking, city governance, management, and planning. They introduced the Urban Ecosystem Services (URBES), Biodiversity Project and the Scientific Foundation of Biodiversity Outlook (CBO) that contribute as a new social-ecological to urban durability and the practice and research of ecosystem services. To incorporate ecosystem services and biodiversity in urban design, development and governance appliance, these projects were functional as tools in the context of planners and decision-makers.

Elmqvist et al. (2015) conducted a study related with urban ecosystem services and found that the ecological investment in urban areas, including the ecosystem's preservation and conservation such as urban forests and urban rivers, not only affected in ecology but lead to social impact as well as the impact on modern and traditional economies. Investing in recovery, care and empowerment of urban ES and green infrastructure gave an ecological and social

desire, besides in the form of economic diversity. The findings were also useful in land-use matters in urban areas as well as it provided many benefit in urban landscape management, architects, legislators and also in the private sector. Therefore, the urban ecosystem services are very important for each country, especially in South-East Asia (ASEAN) to ensure the cities are habitable, livable and sustainable for current and future generations.

ASEAN is the most suitable region to study habitable, livable and sustainability of the ecosystem. Investopedia (2017) defined ASEAN or The Association of Southeast Asian nations as an organization with 10 countries that inspired the development of economic, cultural and political in the province. Furthermore, ASEAN was formed in 1967 to stop the spreading of communism ideology and to calm the tensions between its members and formally it comprises 10 countries including Singapore, Brunei Darussalam, Malaysia, Indonesia, Cambodia, Vietnam, Myanmar, Philippines, Laos, and Thailand (Heather 2006). Hence, recent studies propose that exploring the cultural priority and perceptions toward UES can be practical to recognize many pertinent services to the people

Therefore, the United Nations (UN) has developed the Sustainable Development Goals (SDGs) to carry immediate action to battle climate change and its effect while verifying that nobody left behind (UN, 2015b). Hence, it is important to learn the united response of UES to human interests and activities, besides the relationship between environmental and development to achieve the targets and goals. European Union (2015) stated that to bear more aspiring and more competent in biodiversity conservation policies, the concept of development should be done immediately by the conservationists. From another point of view, we still need to be emphasized and informed to all the goals and targets of urban ecosystem services in the ASEAN region especially with the world policies and agreement. For example, The Paris Agreement (December 2015) aims to take action about climate change under the United Nations Framework Convention on Climate Change (UNFCCC) specify that parties will follow efforts to control temperature rise (1.5°C) by pre-industrial extent by 2050 (Scarano, 2017). Therefore, the agreement is suitable to use for the ASEAN Countries and enables the countries to keep sustainable especially with climate strategies and plans.

Several scientific studies identify, classify and provide knowledge on the evaluation of UES that relevant and importance to the countries such as ASEAN e.g., Yen, et al., 2017; Vollmer et al., 2016; Chalcharoenwattana and Pharino, 2016; Clark and Nicholas, 2013; But, the number of studies in evaluating the ASEAN perspectives on specific urban ecosystem services were still in small numbers.

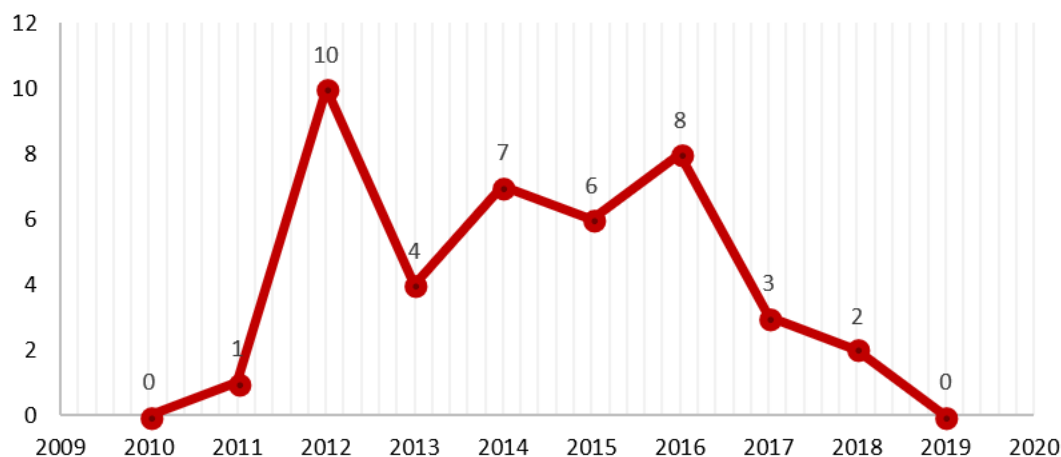


Figure 1(a). The Number of ASEAN's Urban Ecosystem Services Papers Between 2010-2019

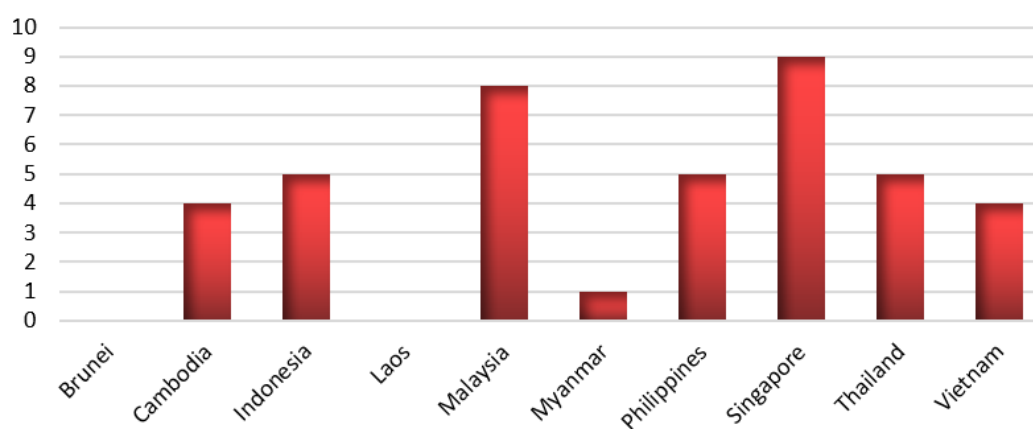


Figure 1(b). Urban ES in the Context of Geographic Dimension

Therefore, we will proceed with a review and overview of current research and this research purpose and aims to fill the research gap in understanding the ASEAN's urban ecosystem services. We hoped the study will complement the existing policy and help to design a better conservation plan for urban ecosystem services in ASEAN countries. Then, we also discuss the methodology and approach that we used and also the results based on the study, discussion, and conclusions. Hence, we conclude this study by a brief overview role to make sure the ASEAN countries maintain sustainable and more livable with the right guideline in the present and future.

2. Methodology

The methodology for this study was based on the scientific articles published in the SCOPUS database. SCOPUS is a digital platform that provides much-related research from superiority data and all-embracing content as a systematic tool to detect, analyzing and conceptualizing a research study. Firstly, a publication of certain periods from 1960 to January of 2019 in the *TOPIC* part with the *phrase ecosystem service* was searched and resulting in the identification of 37,634 articles. Next, we proceed of find all

the publications in particular terms that were: (i) ecosystem AND services AND urban, (ii) urban AND ecosystem AND service, (iii) urban AND ecosystem AND valuation, (iv) urban AND ecosystem AND services, (v) urban AND ASEAN AND region which yield 898 of open access articles and the terms generally cover the search of urban ecosystem services. We then coordinate a comprehensive review of all the 898 papers and thus the topic of each paper was analyzed for significance and relevant aspects. We removed irrelevant studies that aren't focusing on the urban ecosystem services such as the papers about the non-ASEAN region and the papers about the ecosystem's business (Abas et al. 2020).

As a result, the final and ultimate sample from the structured review comprised of 41 urban ecosystem services for ASEAN papers. Then we only analyzed the abstract that was used in developing our review. Point of view, it highlighted issues such as the classifying and valuing of UES, benefits, and advantage of reinstating ES in urban areas, a long period case study of UES and the assessment and evaluation of ES for urban livable and resilience as listed in the supplemental material (Table 1). Furthermore, these methodologies were adapted from Yang et al. (2018) which made a study on ecosystem services based on

Table 1. Overview of results for UES in ASEAN

UES CATEGORY	UES TYPE	Represented Countries and References
Provisioning	Food	Philippines (Clark & Nicholas, 2013).
	Water	Singapore (Vincent et al., 2014).
	Timber	Springate-Baginski et al. 2014 have done their study on valuing timber in Myanmar.
	Medicines and health	Only a country discussed on medicines and health which was Singapore.
Regulating	Waste absorption	Thailand and Indonesia (Challcharoenwattana et al., 2016; Suwarno et al., 2014).
	Disease control	Thailand (Koyadun et al., 2012).
	Climate regulation	Thailand, Vietnam, Singapore, and Cambodia (Silva et al., 2012; Davies et al., 2015; Li & Norford, 2016).
	Flood regulation	Vietnam and Cambodia (Ziegler et al., 2012; Depietri et al., 2012).
	Water purification	Indonesia, Malaysia, and Philippines (Vollmer et al., 2016; Yule et al., 2015; Mahazar et al., 2013; Bueno et al., 2016).
	Attenuation of extreme weather events	Indonesia (Achmada et al., 2015).
Cultural	Tranquility, calm, relaxation	Philippines, Indonesia, Cambodia, Philippines, and Singapore. (Lizuka et al., 2017; Arifin & Nakagoshi, 2011; Yen et al., 2016; Yen et al., 2017; el-Baghdadi & Desha, 2016; Tan & Ismail, 2014).
	Social relations, sense of place	Vietnam and Singapore (Mohri et al., 2013; Newman, 2014).
	Recreation, tourism, aesthetic and educational functions	Malaysia and Thailand (Baharuddin et al., 2014; Karuppannan et al., 2014; Nath & Han, 2015; Intasen et al., 2016).
	Cultural, intellectual, spiritual inspiration	Singapore (Thiagarajah et al., 2015).
Supporting	Photosynthesis and primary production	Thailand and Malaysia (Islam & Siwar, 2012; Vivithkeyoonvong & Jourdain, 2016).
	Soil formation	Philippines (Estoque & Murayama, 2015; Pham et al., 2014).
	Maintaining Biodiversity & sustainability	Malaysia, Indonesia, Singapore, and Philippines (Shay-Wei & Han-Hwa, 2016; Saadatian et al., 2012; Arifin & Nakagoshi, 2011; Fries, 2017; Karuppannan et al., 2014; Uy & Shaw, 2013).
	Hydrological cycle	Indonesia (Danielaini et al., 2018).
	Biogeochemical cycle	Singapore (Fries et al., 2016).

gendered outlooks and perspectives. Then, the articles were analyzed using the assessment criteria which was developed based on issues that unique to urban systems such as the country of the case study, the specific UES were explored and the valuation techniques or indicators were applied in the studies. Furthermore, we concede that this methodology gives particular limitations and restraints, such as the focal point on irrelevant findings, most of the previous studies on urban ecosystem services were implemented in Europe, plus there were several of publications that are not in open access. So, we chose to use the ResearchGate as an alternative to searching for the scientific and relevant publications and also to search the papers that were not in Scopus.

3. Results

3.1. The Temporal Dimension of ASEAN's Urban Ecosystem Services

Figure 1(a) displays the temporal dimension of the 41 unique studies. Point of view, the studies were published after 2010 and the finding began in 2005 as section of the MEA or Millennium Ecosystem Assessment. This study considered the significance of

conservation, protection, preservation, and restoration in the urban area, making this study the previous paper in context the 41 papers analyzed and reviewed. Furthermore, the figure shows a fluctuating number of papers that the researchers keep focusing on ASEAN's urban ecosystem services. For instance, the highest number of papers was in the year 2012, then in 2016, followed by 2014 and 2015 and the lowest number of papers was in 2011 which only one paper published. Hence, we need to understand that this figure only displays results from 2010 until January 2019, because this review paper was written around February 2019 and there were few papers also had been published after February 2019.

Figure 1(b) displays the geographic dimension of the studies related to ASEAN. Furthermore, Figure 2 shows that 22% of the studies were represented in Singapore, 20% of studies in Malaysia, 12% studies in Indonesia, Philippines, and Thailand, except Laos and Brunei that no research has been conducted. Elmqvist et al. (2015) explained that urban ecosystem services are normally classified by a high potency of demand precisely to a very sizable number of urgent local recipient, compared for the sample to ecosystem services produced in rural areas. Point of

view, ASEAN countries where many various ecosystems tend to apply their country into anything that can give benefits to the urban such as green spaces, urban forests and blue spaces including lakes and ponds. Furthermore, the ASEAN countries such as Singapore generally developing their country based on their urban ecosystem's framework. Henderson (2012) explained that the government in cities has critics, yet Singapore's competency, safety, economic successes besides security are impractical to contradict.

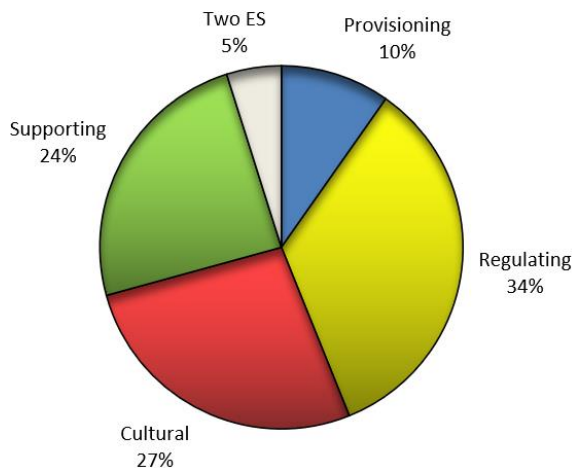


Figure 2(a). Urban ES Analyzed Based on the Categories

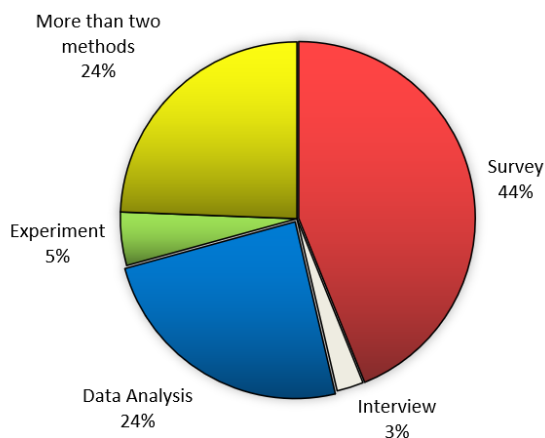


Figure 2(b). Urban ES Paper in the Context of Methods Applied

3.2. The Contextual Aspects of ASEAN's Urban Ecosystem Services

Point of view, we will discuss the category and the number of urban ecosystem services analyzed and the kind of methods used for all 41 unique papers. Fig. 2(a) displays the number of urban ecosystem services classified and analyzed. Hence, most of the studies that we reviewed focus on single urban ecosystem services (41 in total). There were only 2 papers (5%) out of 41 studies that concentrated on two categories of urban ecosystem services. For the single studies on urban ecosystem services, the majority of them (39 papers) were analyzed. Point of view, out of 41 studies which concentrated on single ecosystem services, 14 papers of them examined regu-

lating urban ecosystem services including water purification, climate and also flood regulation, followed by the studies on cultural (11 papers) urban ecosystem services including recreational and green space, then supporting ecosystem services including maintaining biodiversity, habitat restoration, and nutrient cycling, with 10 papers and provisioning urban ecosystem services including timber and food with 4 papers. Besides that, Fig. 2(b) displays the main methods applied in each study and paper. Based on this, the survey method was the most common used with 18 papers followed by data analysis method and more than two methods which 10 in total respectively. While the other 2 papers used the experimental method and the interview method has only a paper in this review.

41 papers have been analyzed and categorized based on various types of ecosystem services. So, Table 1 shows all the primary categories of ecosystem services in the initial column and the varying types of services reviewed in the next column. Then, the next column gives a brief outline of the represented ASEAN countries with references. Point of view, the main focus based on the content to prepare an overall illustration in the context of intersects between the urban ecosystem and the ecosystem services towards the Paris Agreement that has been joined by countries including the ASEAN countries. The Paris Agreement that has been introduced at the Convention, involves all countries and nations into a regular cause to deal with aspiring efforts to take action on climate change and adapt to its impacts with increased support to help developing countries as a beginning (Paris Agreement, 2015). Hence, the following parts indicated a detailed explanation of each study related to the categories of urban ecosystem services and its linkage among ASEAN's region.

3.3.1. Provisioning

Provisioning services include all the substance outputs that ecosystems have been provided. For example, water, food, medicinal plants, water and other resources (Haase et al., 2014). Furthermore, it's has been analyzed, in all the 41 Urban ES ASEAN papers, hence we found that the usual studies made for this subject are: Water supply, food and Medicine/Health.

3.3.1.1 Food.

Generally, every country in the world has its unique food and privileges that may not be the same as other countries. Based on this, the study on the Philippines has concluded that the connection between consuming food as a cultural plus social practice, besides the universal implications of food utilization has less explored (Chakraborty et al., 2016).

3.3.1.2. Water Supply

Traditionally, water and supplies are very important to all users especially to humans that can get the

source either naturally or vice versa. In this context, the urban ASEAN countries such as Singapore are using freshwater only for a necessary purpose and the country needs to keep finding many alternatives to increase water supply specially to fulfil the human needs. The search for freshwater from other optional resources including water reclamation and also sea water desalination indicates energy consumptive technologies, for example, reverse osmosis (Vincent et al., 2014). Thus, water supply is very important especially in the urban ecosystem circle either in the past, present and also in the future.

3.3.1.3. Timber

Timber can be defined as a type of wood then divided into two categories which are hardwoods and softwoods. Myanmar had conducted a study that related to valuing and assessing the forest process and policies. Hence, the export of timber commerce has been played a critical role in deciding the policy of forest section besides truly has utilized as an important influence on all national politics consequently the beginning of the colonial era and rolling nowadays (Springate-Baginski et al., 2014).

3.3.1.4. Medicine/Health

Generally, medicines and health are important and for addressing health problems and to measure the human health level that they can be improved for a better quality of life. Singapore has studied that urban people are better in various ways in linkages with nature every day, yet there have some urban green spaces that generate health goods and health risks. Hence, social and cultural have different responses that differ from urban green spaces and urban nature (Douglas, 2012).

3.3.2. Regulating

Regulating services maintains and conserves all functions including disease control, flood regulation and the quality of air (Haase et al., 2014). It obtained benefits from the urban ecosystem services processes such as waste absorption, disease control, climate regulation, flood regulation, water purification and attenuation of extreme weather events. so, this review paper will focus on those indicators.

3.3.2.1. Waste Absorption

Thailand had conducted a study about waste which was to measure the WTP or the willingness to pay among the community to recycle services in different types of settlements. Based on that study, Chalcharoenwattana et al. (2016) found that the monthly analysis of WTPs rises nonlinearly around 0.73 USD in the slightest urbanized regions, then the urbanized regions around ~1.96 USD) and the most urbanized regions around ~1.65 USD. Besides that, Suwarno et al., 2014, in their research on waste in Indonesia estimated that nutrients including phosphorus (P) and nitrogen (N) sewage inputs to almost

every Indonesian water body such as rivers from 1970 till 2050 and on future progression will be related with four outlines of MEA.

3.3.2.2. Disease Control

Countries like the Philippines and Thailand have conducted and focused on the ways their urban sector can prepare to regulate the disease and disaster in their countries. For example, Koyadun et al. (2012) have highlighted the association in urban regions (Chachoengsao province, Thailand) among various aspects including the ecologic of household-level and also the sociodemographic determinants of individual-level and the dengue transmission. Hence, it also recommends many programs that focus to control the dengue in an urban ecosystem or somewhere else principally through an economic crisis when there was a small financial plan and budget for such agendas (Koyadun et al., 2012).

3.3.2.3. Climate Regulation

Three countries especially Thailand, Vietnam, and Singapore have done their study on climate regulation. Which were Silva et al., 2012; Sa, 2017; Thiagarajah et al., 2016. The studied were related to urban climate vulnerability and then a system approach as a regulation aspect to assembly climate change (challenges) in urban areas. In Cambodia, a certain disease that has been focused on was water-borne in adopting for climate change and extreme events of weather including diarrheal illness (Davies et al., 2015). So, the studies are important to be used in analyzed urban systems in certain countries related to global issues (climate change).

3.3.2.4. Flood Regulation

The researchers from Vietnam and Cambodia have done their study on flood regulation (Depietri et al., 2012; Irvine et al., 2015). From a point of view, a phenomenon of floods including flash floods is one of the phenomena that so dangerous that the incident is unpredictably risky that would hit the main city. For example, landslides and flash floods have killed 15 victims in the north of Vietnam's mountainous in June 2018 and also hit the city in Cambodia in July 2018. Hence, the parties should take action and precautions to reduce the surface flash flooding with the technologies that are more eco-friendly and give low side effects (Irvine et al., 2015). Besides evaluating how to differ each city has tried to organize related ecosystem services while also to tie the conclusions of policy-relevant (Depietri et al., 2011).

3.3.2.6 Water Purification

Three countries which were Malaysia, Indonesia, and the Philippines have done their study on water purification (Vincent et al., 2015; Vollmer et al., 2016). Water purification is a process to remove unnecessary materials including solid and gases from the water. Water purification is very important in-

cluding related to rivers and forests so that the water is safe for use by various parties, especially the human community in urban cities and keep urban ecosystem services benefited.

3.3.2.6. Attenuation of Extreme Weather Events

Countries like Indonesia have conducted a study related to urban that can give services to reduce extreme events like hurricanes, storms, and tsunami. So, consequently, with that event, Banda Aceh, Indonesia in the context of urban development was express after the tragedy of tsunami (2004) and also give analytical challenges in the planning of sustainable and systematic development time by time.

3.3.3 Cultural

Point of view, cultural services including the direct uses of non-material (Sarukhan and White, 2003) also causes bad qualifications and consolidation in management terms (de Groot et., 2005). With this point, we conducted a few regular focusing on analyzing the 41 UES studies in ASEAN.

3.3.3.1. Tranquility, Calm, Relaxation

There were 7 research done on tranquillity, calm, and relaxation such as landscapes and its services in Thailand, Myanmar, Malaysia, Philippines, and Indonesia involving (Intasen et al., 2016; Khaing, 2015; Bak et al., 2016; Barau & Qureshi, 2015; Kanniah, 2017; Lizuka et al., 2017; Arifin & Nakagoshi, 2011). Hence, it showed the most relevant urban ecosystem service.

3.3.3.2. Recreation, Tourism, Aesthetic and Educational Functions

The studies analyzed that urban ES in ASEAN was more supportive of recreational interests and activities including the need for urban green areas and spaces. Furthermore, ASEAN is initially popular along its urban landscape and green area's uniqueness. Hence, many interests and activities can be implemented and estimated that would enticing communities around the world. So, these UES provided more benefits and goods for the higher parties by raising the annual earnings/incomes (Baharuddin et al., 2014; Karuppannan et al., 2014; Nath & Han, 2015; Intasen et al., 2016).

3.3.3.3. Cultural, Intellectual, Spiritual Inspiration

Point of view, cultural ES including concern on many aspects such as people and location, then it usually would transform from a rural location to urban location (Thiagarajah et al., 2015).

3.3.4. Supporting

Point of view, to give the space and maintain flora and fauna diversity and also the habitat of organisms, the support from the UES is important (Haase et al.

2014). These services showed in most studies compared to other services and out of 41 UES in ASEAN papers, it provided habitat restoration and biodiversity maintenance.

3.3.4.1. Photosynthesis and Primary Production

Two countries (Thailand and Malaysia) have studied primary production which more to the agriculture sector as an attraction for the urban ES. (Vivithkeyoonvong & Jourdain, 2016; Pham et al., 2016; Islam & Siwar, 2012). The urban agriculture in Malaysia become an important tool to sustain all the development that can produce any food and others especially in urban areas (Islam & Siwar, 2012) and also to provide the product of foods that can maintain the social welfare and policy-makers (Vivithkeyoonvong & Jourdain, 2016).

3.3.4.2. Soil Formation

Thailand and the Philippines have studied on soil formation and land change and its services. Point of view, it is important to study the loss and to predict the implications of urbanization that connected to urban growth in rural and urban agriculture (Pham et al., 2014). Thus, they run research to understand the changes of land functions and soil formation of agricultural land in Hanoi.

3.3.4.3. Maintaining Biodiversity & Sustainability

Four countries in ASEAN (Malaysia, Indonesia, Singapore, and the Philippines) have conducted and analyzed the benefits provided from the urban ecosystem services in the aspect of habitat and maintaining biodiversity/sustainability. (Shay-Wei & Han-Hwa, 2016; Saadatian et al., 2012; Arifin & Nakagoshi, 2011; Fries, 2017; Karuppannan et al., 2014; Uy & Shaw, 2013). Based on this, maintaining biodiversity is essential for achieving sustainable development in each country. For example, based on the results, we recommend the importance of community health's actions with the encouragement and support of Malaysia's green space (Karuppannan et al., 2014).

3.3.4.4. Hydrological Cycle

Only one country has done the study on hydrological and its services in urban ES that is Indonesia. The several elements including urban physical and social landscapes will determine various cycles such as water availability and stormwater process (Danielaini et al., 2018).

3.3.4.5. Biogeochemical Cycle

Only one country (Singapore) has done the study about biogeochemical which was *carbon and its services in that country*. Understanding about regulating UES including carbon deposits using many tools to estimates the carbon stocks of mangrove in Singapore (Fries et al., 2016).

4. Discussion

4.1. Filling the Gap in The Context of UES (in ASEAN)

Overall, we will make a summary of all aspects related to the ASEAN studies including the limitations and the concerns of current studies related to urban ecosystem services. Furthermore, we also attempt to focus on filling the research gap with all the papers that we have analyzed. For the problem and limitation aspects, most of the previous research and studies on urban ecosystem services were handle in large continents especially in Europe, so the studies in ASEAN countries are limited including there are several countries with no study about UES, for example, Brunei Darussalam. Thus, for future research, we suggest the researchers in ASEAN or other conduct studies primarily in less or zero study countries related to urban ecosystem services especially in valuing each category of urban ecosystem services. Based on this, the attempt to generate a liveable and sustainable city that complete with all the good infrastructures, social activities and interests, green landscapes, human security, social safety and protection, residents, public health, education, and social work; shows the sustain process and usually need enhancement (Kartini, 2016). Brunei is one of the countries that has its uniqueness to do a study because the majority of the population that lives around the capital and it is also a vibrant and livable city. Besides, Brunei has its water village known as the 'Venice of Asia' or 'Venice of the East' that place around 39,000 people and most of the houses there have access to basic human living and needs. So, this country is quite interesting to study especially related to urban ecosystem services such as the UES valuation of the water village. Furthermore, oil and natural gas industries are the biggest sector and the important income/source of Brunei's development since a few centuries ago (McLellan & Deterding, 2016). Hence, the research on urban ecosystem services in ASEAN countries should be carried out continuously as each country has a unique and livable city including Brunei Darussalam and Laos.

Besides, we have found that the most common studies are related to monetary approaches. These ecosystem services will typically be measured using a monetary-based approach (Mononen et al., 2016). For instance, the existing studies mostly focusing on valuing and measuring the understand and demand/request of community concerning the eco-friendly spaces in urban, examining demand for urban river rehabilitation and the cost of water purification, the water independence (energy price), next the cultural ecosystem services values that related with historical and contemporary, WTP for waste recycle and WTP for water quality restoration in ASEAN region. View the point, the non-monetary studies still less in number and maybe no researcher focused on that aspect. This is an issue that needs to

be highlighted and noted because the non-monetary ecosystem services are also important in the urban ecosystem cycle although they are not directly involved in the area. Furthermore, the ES valuation including non-monetary approach is important to the prevalence of methodological procedures to extract the value of ES such as the component assessments in terms of ES supply, without generating on a constant framework (Kelemen et al., 2014; Chan et al., 2012a; Kenter, 2014).

Thus, maintaining and increasing the providing of various ES, are relevant and significant in both perspectives of human living and economics such as non-marketed and non-monetary services (Rodríguez-Loinaz et al., 2015). For example, Malaysia's natural resources are indispensable for economic growth, but this growth has also been a significant cost among humans, social and physical surroundings. So, as the efforts to achieve the Sustainable Development Goals (SDGs) that comprise 17 goals, Malaysia needs to perform a variety of systematic strategies to achieve these goals as well as a real connection among the urban ecosystem, then its services such as SDG's goals. To fill the research gap, an expanding body of presently appearing literature efforts to explain the human request and demand on non-monetary assessment methodology of ES (Langemeyer, 2015). Consequently, it is important to understand the reaction and response of UES to daily human activities and we should begin by putting more effort into valuing urban ecosystem services by non-monetary approaches for maintaining the livelihood of the urban and the sustainability in present and for the better future.

4.2. Urban Ecosystem Services in ASEAN: Committing to Paris Agreement Towards Livable City

The associated of urban planning and urbanization activities with development capability was often studied in UES. Urban ecosystem services are usually connected with biodiversity aspects and if the ecosystem experiences had a reduction in quality, such as losing an amount of biodiversity, then the ecosystem services will also decrease in quality. Consequently, in efforts and steps to enhance the quality of UES and to ensure the city to be more livable and habitable, all countries have taken various efforts including ratifying and committing to multi-lateral environmental agreements between various countries. For instance, the ASEAN's countries have committed to multi-lateral Paris Agreements (2015) to build up the universal response to combat climate change by maintaining a global temperature increase, less than 2°C in the context of pre-industrial levels, besides to follow the efforts and steps to control the temperature rise uniformly to 1.5°C (Paris Agreement 2015). So, climate change is a universal, global and complex issue because it can suffocate the harmony and dynamics of the city which involve many dimensions such as economy, social, politics

and ethical issues. The hazards and risk of comprehensive scales climate change become a focus issue that will be facing in all countries (Henderson et al., 2018).

Hence, the agreement such as the Paris Agreement among the countries especially ASEAN's countries should be noted on all aspects that have been agreed upon in 2015. Out of total (10 members of ASEAN countries), nine of them have approved the Paris Agreement, except for Myanmar and is expected to be involved in the future (Wijaya & Idris, 2017). Depend on this, every country, especially the ASEAN countries that mostly involved in the Paris Agreements, should have a specific solution in reducing climate change issues which can bring various impacts to humans, non-humans and others. For example, Malaysia has its targets which are 45 percent reduction by 2030, with 10 percent conditional on having a switch technology and also financial support especially from the developed countries (Mustafa, 2017). Besides that, based on this paper's results, there were few countries which were Thailand, Vietnam, Singapore, and Cambodia that have done their study on climate regulation to protect their urban ecosystem in each country including to solve and decrease the global climate change time by time. From Malaysia, challenges as one of the developing countries, the implementation of policy to reduce greenhouse gasses emissions will way point of view a lot of technologies, economic, social and institutional (Mustafa, 2017). It is necessary to ensure that a city is primarily sustainable, livable and secure especially in ASEAN, without having to sacrifice a different and various natural resource and its UES. So, SDG's goals as planned will be achieved if all countries comply with the Paris Agreements and the standard of urban ecosystem services allow to enhance in the future.

5. Conclusion

It is important to highlight the urban ecosystem services that can be changed with rapid development especially in the ASEAN city. Then, this study has given an overview of urban ecosystem services that related to a variety of benefits provided by the environment especially to the community and economy for maintaining human well-being in ASEAN. Furthermore, we have conducted these studies with the latest year of publications from 2010 to 2019. These papers also analyzed several aspects, for example, the types of urban ecosystem services have been reviewed and also the method applied. Overall, based on the result and our studies on the literature review had most of the papers discussed on the significance of the urban ecosystem services provided by classified them, including regulating (water purification, climate regulation, disease regulation, flood regulation, and waste absorption) then followed by cultural (tranquillity, social relations, and recreation). For fu-

ture research, we suggest the researchers in ASEAN or others conduct studies primarily in less or zero study countries related to urban ecosystem services especially in valuing each category of urban ecosystem services. Finally, we conclude that all the ASEAN countries should play an important role to make sure the countries were sustainable and more livable with the right policies and guideline like can fit in Paris Agreement especially in Climate Strategies and plans.

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Financial Development and Sustainable Competitiveness in Arctic Region: A Dynamic Panel Data Analysis

Rozwój finansowy i zrównoważona konkurencyjność w regionie Arktyki: analiza dynamiczna danych panelowych

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Abstract

The present study investigates the effect of financial development on sustainable competitiveness and its components (natural capital, resource intensity, and social cohesion) in the Arctic region. We employed bank-based, stock-market based, and composite indexes to measure financial development. To deal with endogeneity bias, system GMM is utilized. The results show a positive and significant effect of financial development on sustainable competitiveness. The estimates also assert that financial development encourages resource efficiency and social cohesion in the region. In contrast, we found the negative effect of financial development on natural capital. This suggests that overexploitation of natural resources may provide short-term benefits to the local and regional communities but it may threaten the long-term sustainability of the Arctic. Thus, the financial sector should be guided to support financing and investing activities in alternative eco-friendly technologies and ventures for reducing excessive natural resource utilization.

Keywords: sustainable competitiveness, financial development, social cohesion, resource intensity, natural capital

Streszczenie

W niniejszej pracy zbadano wpływ rozwoju finansowego na zrównoważoną konkurencyjność i jej komponenty (kapitał naturalny, zasobochłonność i spójność społeczną) w regionie Arktyki. Do pomiaru rozwoju finansowego stosujemy indeksy bankowe, giełdowe i złożone. Aby poradzić sobie z błędem endogenności, wykorzystywany jest system GMM. Wyniki pokazują pozytywny i znaczący wpływ rozwoju finansowego na zrównoważoną konkurencyjność. Szacunki potwierdzają również, że rozwój finansowy sprzyja efektywnemu gospodarowaniu zasobami i spójności społecznej w regionie. Z drugiej strony dostrzegamy negatywny wpływ rozwoju finansowego na kapitał naturalny. Sugeruje to, że nadmierna eksploatacja zasobów naturalnych może przynieść krótkoterminowe korzyści społecznościom lokalnym i regionalnym, ale może zagrozić długoterminowej stabilności Arktyki. Sektor finansowy powinien zatem kierować się wspieraniem finansowania i inwestowania w alternatywne technologie

przyjazne dla środowiska oraz przedsięwzięcia mające na celu ograniczenie nadmiernego wykorzystania zasobów naturalnych.

Słowa kluczowe: zrównoważona konkurencyjność, rozwój finansowy, zasobochłonność, spójność społeczna, kapitał naturalny

1. Introduction

Economic activities and development are essential for the prosperity of human civilization. Besides, the demand for fresh air, raw material, energy, and food by humans from Mother Nature has emerged. These dramatic changes in demand deteriorated the ecosystem by depleting natural resources, loss of biodiversity, land degradations, and increased waste and pollution emissions (Lan, Malik, Lenzen, McBain, & Kanemoto, 2016). Currently, the earth is in an Anthropocene phase where human greed is deliberately deteriorating nature and creating threats for their current and future generations (Gough, 2017). Consequently, global economies are finding adequate ways to be commercially competitive without compromising environmental quality and social welfare to avoid further socio-ecological crises (Thore & Tarverdyan, 2016). The notion of sustainable development harmonized the institutional development, technological orientation, financial investment, and exploitation of resources to meet both present and eventual needs of human survival (Thore & Tarverdyan, 2016).

The universalization of capital markets through globalization exhibits both scale and wealth effects of the economy (Dauvergne, 2010). Researchers have also observed that environmentally cleaner countries usually have efficient and more developed financial markets (Al Mamun, Sohag, Shahbaz, & Hammoudeh, 2018; Dasgupta, Laplante, & Mamingi, 2001). Increased level of accessibility to wealth by financial development advances living standards, attract energy-efficient green technologies and mitigate environmental degradation (Du, Wei, & Cai, 2012; Hsueh, Hu, & Tu, 2013; Zafar, Saud, & Hou, 2019; Zaidi, Zafar, Shahbaz, & Hou, 2019). Strong financial systems have more lenient and low cost credit policies for eco-friendly projects (Dasgupta et al., 2001; Tamazian & Rao, 2010). On the other hand, the critics of the finance-environment nexus found adverse consequences of financial development on the environment. More access to finance and credit increases industrial activities that may lead to environmental degradation and more carbon emissions (Sadorsky, 2010; Shahbaz, Mallick, Mahalik, & Loganathan, 2015).

This study focuses on the Arctic region to further explore the relationship between financial development and sustainable competitiveness. The fluctuation in temperature of the Arctic region is more significant compared to other regions on the earth. A World Bank report predicts around a 4°C to 8°C in-

crease in the Arctic Ocean along with a complete meltdown of ice packs by the year 2025 (Schellnhuber et al., 2012). Ocean acidification has increased by 30% in the past few years due to the increase in CO₂ emissions (Qi et al., 2017). Natural resources remained largely untapped despite their abundance in the region. Along with the risks of major disasters, the cost of oil exploration, gas drilling, and mining is very high. Despite global warming and ecological emergency in the Arctic region, melting ice is in favor of economic outlooks with respect to tourism, trade and exploitation of natural resources. Thus, investigating the role of financial development in the region to facilitate natural capital, social capital, resource intensity and overall long-term sustainable competitiveness is important for prospective policy implications.

The contribution of the present study to the existing literature is fourfold. Firstly, this study examines the association between financial development and sustainable competitiveness in the Arctic region. Owing to the major climatic changes and environmental degradation issues in the region, this study will help regulatory bodies to design an optimal policy to expedite economic growth with depleting natural and social capital. Secondly, we have investigated several individual and aggregate indexes of financial development on sustainable competitiveness to evaluate the scale and efficiency effects of financial development. Thirdly, besides composite measures, we also investigated the effect of financial development on the dimensions of sustainable competitiveness including social capital, natural capital, and resource intensity to evaluate a more holistic view. Fourthly, considering the limitations of data availability, we used several advanced statistical tools to deal with omitted variables bias and endogeneity issues.

The rest of the paper is organized as follows. Section 2 discusses the notion of sustainable competitiveness along with its relationship with financial development. Section 3 is related to data sources, measurement of the variables, and the empirical model of the study. Section 4 discusses the estimation results and discussion. We concluded the study in the final section along with policy implications and future recommendations.

2. Literature Review

The concept of sustainable development in economics emerged after the expeditious degradation of natural, social, and human capital despite economic growth. Currently, researchers and policymakers

have incorporated United Nation's seventeen sustainable development goals (SDGs) in their agenda-setting to achieve global sustainability by fostering innovation, reducing poverty, protecting the planet, providing quality education, ensuring peace and prosperity, promoting inclusive industrialization, building resilient infrastructure (Thore & Tarverdyan, 2016). Previously, sustainable growth was linked to innovation, the labor force, and natural resources. Later, classical economic theorists introduced capital to the construct as all other production functions remain futile without capital accumulation (Paun, Musetescu, Topan, & Danuletiu, 2019). Thus, sustaining natural capital, social capital, and human capital along with economic growth is important to achieve sustainable competitiveness.

Previous studies argued that financial sector development is conducive to sustainable economic development especially in the long-run (Durusu-Ciftci, Ispir, & Yetkiner, 2017; Paun et al., 2019). However, it is still an underexplored phenomenon that how financial development impedes (facilitates) natural capital, social capital, resource intensity, or overall sustainable competitiveness, especially in the Arctic region. A wide strand of studies mainly focused on two components of sustainable competitiveness, i.e., environmental quality and economic growth. It is argued that economic and financial development is a protracted process that may promise a good standard of comfort but also degrade environmental quality (Zhang, 2011).

Initially, the debate between environmental quality and financial development was established after Grossman and Krueger (1995) proposed the Environmental Kuznets curve (EKC). According to the EKC hypothesis, economic development may deteriorate environmental quality but economies thrive to take steps to control environmental degradation once they reach a GDP's threshold level. This hypothesis is tested by various researchers at the country and region level (Apergis & Ozturk, 2015; Carson, 2010; Jebli, Youssef, & Ozturk, 2016). Nonetheless, omitting financial development from the environmental degradation function may lead to spurious estimates (Tamazian, Chousa, & Vadlamannati, 2009).

Financial development may influence the environmental quality or air pollution through wealth effect (efficient stock markets), business effect (elevating investment activities), and scale effect (domestic output expansion). Developed financial markets may allocate funds efficiently, reduce finance costs, facilitate the acquisition of energy-efficient technologies to mitigate environmental pollution (Tamazian et al., 2009). On the other hand, Tamazian and Rao (2010) argued that financial development may reduce environmental degradation in the presence of strong institutions only in transactional economics. Similar results were purported by Ntow-Gyamfi, Bokpin, Aboagye, and Ackah (2020) in the African region.

Lee, Chen, and Cho (2015) investigated this relationship in OECD countries using Fully Modified Least Square (FMOLS). Using domestic credit to the private sector as a measurement of financial development, they found its negative effect on environmental degradation. Besides the advocates of financial development, researchers have also revealed its adverse effects on the eco-system (Al-Mulali, Ozturk, & Lean, 2015; Sadorsky, 2010; Shahbaz, Shahzad, Ahmad, & Alam, 2016; Zhang, 2011).

Shahbaz et al. (2016) investigated the effect of financial development on environmental degradation in Pakistan using quarterly data. They argued that bank-based financial development impedes environmental quality by increasing energy demand. Developing countries generally meet the energy demands using all available resources including non-renewable energy. Based on the Keynesian theory of consumption, Zhang (2011) posited that the development of financial intermediation boosts the consumption of household items that exuberate air pollution emissions. Using the panel data of European countries, Al-Mulali et al. (2015) also find a positive effect of financial development on CO₂ emissions. Nonetheless, natural capital is not only related to sustaining air quality, it is a wider concept that delineates the country's capability to self-sustain through mineral resources, energy, food production, biodiversity, climate, water and land.

Although studies have shown mixed evidence on the effect of natural capital abundance on financial development (Khan, Hussain, Shahbaz, Yang, & Jiao, 2020; Zaidi, Wei, et al., 2019), we highlighted and explored the role of financial development on replenishing or depleting natural resources of Arctic region. Likewise, studies have investigated the impact of social capital in developing financial markets. Social capital is the sum of the well-being and social stability of the entire population. It engenders consensus and social cohesion which in turn protect human capital, over exploration of natural resources, and promote a stable macroeconomic environment. Societies with high social capital are generally less likely to use informal credit, have higher access to institutional credit, invest their savings in stocks, and use checks for financial transactions that facilitate financial development (Elkhuizen, Hermes, Jacobs, & Meesters, 2018; Guiso, Sapienza, & Zingales, 2004). Even though there is a scarcity of literature related to the effect of financial development on a composite index of social capital, studies favor financial development in facilitating the health system (Chireshe & Ocran, 2020), income equality (Gharleghi & Jahanshahi, 2020), voter turnout at referenda and blood donations (Guiso et al., 2004).

Financial development is also capable of stimulating the financial and resource efficiency of a country. It allows FDI flows, reduces information asymmetry between borrowers and lenders, reduces the cost of

loans, and promotes banking activities that eventually affect fixed investment and energy demands (Mukhtarov, Humbatova, Seyfullayev, & Kalbiyev, 2020). Using the provincial panel data, spatial measurement, and generalized least squares methods, Xu and Tan (2020) found a positive effect of financial development on natural resource utilization efficiency by upgrading industrial infrastructure. A higher level of financial development efficiently allocates resources and improves the flow of capital toward industry, making them more competitive and productive. Furthermore, companies transform themselves to cleaner production for avoiding higher environmental governance costs (Zameer, Wang, & Yasmeen, 2020). Thus, based on the aforementioned debate, we posit that financial development plays a vital role in improving sustainable competitiveness and its components.

3. Research Methodology

3.1. Sample and Measurement of Variables

To estimate the dynamic and causal relationship between financial development and sustainable competitiveness, the panel data of 8 countries within the Arctic circle (Iceland, Denmark, Canada, United States, Russia, Finland, Sweden, and Norway) are selected over the period 2012 to 2019. Sustainable competitiveness is the dependent variable of this study. Previously, studies have measured the competitiveness of a country through its GDP or other individual proxies but they do not systematically express a national balance sheet. GDP only measures the monetary value of a country but ignores the environmental and social interconnections that lead to sustainable development. To measure the long-term financial and non-financial sustainability of the country, we adapt the sustainable competitiveness index¹ developed by SolAbility. There are five pillars of sustainable competitiveness including natural resources (agriculture, biodiversity, water, resources, and pollution), resource intensity (energy, water, and raw material), government efficiency (government cohesion, infrastructure, business environment, corruption, and financial stability), intellectual capital (education, R&D and new business) and social cohesion (health, equity, crime, satisfaction, and freedom). Nonetheless, to investigate the effect of financial development on sub-indexes of sustainable competitiveness, we have considered three pillars, i.e. natural capital, resource intensity,

and social cohesion due to their consistency in all reports².

There are several measures available in prior literature to assess financial development. Relying on the commonly used bank-based and market-based measures of financial development, we used bank concentration, domestic credit to the private sector (DCPS), S&P Global Equity Indices, stock market returns, and financial market development index. The data of bank concentration is collected from the Financial Structure Dataset which is measured through the ratio of total assets of the three largest banks to total banking industry assets in each country. On the other hand, the data of domestic credit to the private sector (% of GDP), S&P Global Equity Indices (annual % change), and stock market return (% , Year-On-Year) are accessed through World Bank Database. We extracted the data of the composite financial market index from the global competitiveness index (GCI). Financial market development is the eighth pillar of GCI and its index is developed based on efficiency, trustworthiness, and confidence in the financial services of the country.

To minimize the omitted variable bias, we consider several control variables including military expenditures, tax revenue, trade openness, and inflation. A higher level of military expenditures may impede economic growth (d'Agostino, Dunne, & Pieroni, 2019), elevate income inequality (Raza, Shahbaz, & Paramati, 2017), and may increase pollutant emissions (Gokmenoglu, Taspinar, & Rahman, 2021). Similarly, it is believed that tax avoidance is a barrier to sustainable development (Bird & Davis-Nozemack, 2018) while an increased level of tax revenue boosts economic growth (Takumah & Iyke, 2017). Inflation is incorporated in the model due to its noticeable role in affecting the finance-growth nexus. Financial development may adversely influence sustainable development if inflation is higher than a certain threshold level (Bandura, 2020). Last but not the least, trade openness is employed as a control variable because it promotes the usage of eco-friendly technologies (Yahya & Rafiq, 2019) and facilitates economic growth (Huchet-Bourdon, Le Mouél, & Vijil, 2018).

3.2. Model Specification

Initially, we assume that financial development positively influences sustainable competitiveness and its pillars. Thus, the baseline static model is specified as below:

$$SC_{it} = \beta_0 + \beta_1 FD_{it} + AX_{it} + \mu_t + \varepsilon_{it} \quad (1)$$

¹Although several measurements of sustainable competitiveness are available in prior studies, the Global Sustainable Competitiveness index (GSCI) is a comprehensive index based on 116 quantitative indicators. The first annual report of GSCI was developed in year 2012. Although the data over the period 2012 to 2020 is available for sustainable competitiveness and its components, the financial de-

velopment indicators data is available till 2019. Thus, we restrict the time-series from 2012 to 2019 after considering the data availability of financial development indicators.

²Initially, four pillars were developed to measure sustainable competitiveness index, i.e. natural capital, resource intensity, sustainable innovation and social cohesion. However, sustainable innovation was replaced by government efficiency and intellectual capital in later reports.

Table 1. Descriptive Statistics, source: Authors' calculations

	Minimum	Maximum	Mean	S.D.
Sustainable Competitiveness	43.900	62.800	54.000	5.002
Natural Capital	42.900	67.600	57.225	5.452
Resource Intensity	28.400	59.200	35.673	17.415
Social Cohesion	34.400	78.300	56.173	15.421
DCPS	43.914	190.949	107.547	58.090
Bank Concentration	28.794	100.000	72.045	26.534
S&P-GE-Indices	-48.983	48.733	7.209	17.302
SM-Return	-14.200	31.680	9.401	10.469
Financial Market Development	3.192	5.565	4.821	0.750
Military Expenditures	0.000	5.452	1.810	1.414
Tax-Revenue	9.183	37.934	20.714	8.349
Trade Openness	26.514	104.268	70.671	23.241
Inflation	-0.208	15.534	2.228	2.675

SC is the sustainable competitiveness index, FD is the financial development, X_{it} is the vector of control variables namely: tax revenue, inflation, and financial openness, ε_{it} is the error term, i is the individual dimension of the panel, and t is the temporal dimension.

It should be noted that pooled ordinary least squares are generally biased and produce inconsistent estimates of the parameters in the presence of reverse causality. Although the fixed-effect estimator may reduce the issue of omitted variable bias, the two-way causal relationships can be dealt with some instrumental variables methods (Anderson & Hsiao, 1981). Nonetheless, the instrumental variable estimator developed by Anderson and Hsiao (1981) does not account for the differenced structure of the new error terms and does not utilize the moment conditions, thus, yield inefficient estimates for short panels. To deal with the measurement errors, endogeneity, and omitted variable bias, we take into account the system generalized method of moments (GMM) proposed by Arellano and Bover (1995) and Blundell and Bond (1998). This method uses both levels and differenced equations to evaluate valid instruments. Difference estimators generally produce asymptotic imprecision and latent biases in finite samples due to which system GMM is a preferred tool (Blundell & Bond, 1998). The system GMM neither intensity the strength of measurement error nor discard cross-country variation. Accordingly, a revised dynamic model is specified in equation 2:

$$SC_{it} = \beta_0 + \beta_1 SC_{it-1} + \beta_2 FD_{it} + AX_{it} + \mu_t + \varepsilon_{it} \quad (2)$$

In system GMM, additional moment conditions can be introduced by incorporating the lagged differences of the explanatory variables as instruments for the level equations and the level equations to the first-differenced equations. Even though economies with a higher level of financial development may lead to economic growth but there could be certain omitted variables that drive sustainable competitiveness. Additionally, it is also possible that natural capital depletion, resource intensity, and social cohesion boost the demand for financial services and thereby enhance financial development. Thus, valid instrumental variables (correlated with financial develop-

ment but no relation with error term) may mitigate the reverse causality issue. Furthermore, we use the standard Sargan-Hansen test of over-identifying restriction to test the validity of the instrumental variables and the existence of serial correlation through AR (2) test for second-order serial correlation of the differenced residuals.

4. Empirical Findings and Discussion

The descriptive statistics of the dependent, independent, and control variables are shown in Table 1. The mean value of sustainable competitiveness is 54.00 showing better sustainable performance of the Arctic region compared to other regions with Russia at the lower end and Denmark at the upper end. The overall mean scores of natural capital ($M = 57.23$) and social cohesion ($M = 56.17$) are also indicating natural resource abundance and satisfactory connectedness among the societal environment in the region. Nonetheless, the mean score of resource intensity ($M = 35.67$) is low compared to other SC indicators with the lowest value of Russia and the highest value of Sweden. Despite resource abundance in the Arctic region, the efficiency of resource use is not reasonable. From the perspective of explanatory values, the standard deviation values of bank-based financial development indicators (DCPS and bank concentration) are very high, indicating significant regional differences. The financial development of Russia stands lowest in the region while the most domestic credit to the private sector is provided by the USA and Iceland has the most concentrated banking system. The stock market-based indicates that the region provides around 7% to 9% to the investors. Overall, the financial market of Russia is the least developed while Finland has the most efficient and trustworthy financial market.

Table 2 reports the correlation matrix of the underlying variables of the study. The results show a positive and significant relationship of financial development (FMD and BC) with sustainable competitiveness while military expenditures and inflation impede sustainable development. Similarly, financial development indicators are positively associated

Table 2. Correlation Matrix, source: Authors' own calculations

	SC	NC	RI	SC	DCPS	BC	S&P	SMR	FMD	MILX	TAXR	TROP
SC	1											
NC	.094	1										
RI	.458**	.013	1									
SOC	.751**	-.084	.209	1								
DCPS	.198	-.427**	.072	.181	1							
BC	.728**	.036	.137	.708**	.156	1						
S&P	.254	-.182	.486**	.136	.251	.035	1					
SMR	.064	-.306*	-.169	.170	.328*	.150	.246	1				
FMD	.379**	.293*	.105	.372**	.232	.284	.163	.009	1			
MILX	-.730**	-.123	-.147	-.735**	.058	-.664**	.109	-.085	-.253	1		
TAXR	.676**	-.133	.166	.619**	.439**	.535**	.086	.237	.063	-.649**	1	
TROP	.693**	-.062	.164	.700**	.080	.706**	.036	.196	-.063	-.717**	.743**	1
INF	-.448**	-.135	-.144	-.414**	-.292*	-.323*	-.122	-.062	-.670**	.530**	-.380**	-.267

Note: SC = Sustainable competitiveness, NC = Natural capital, RI = Resource intensity, SOC = Social cohesion, DCPS = Domestic credit to private sector, BC = Bank concentration, S&P = S&P-GE-indices, SMR = Stock market returns, FMD = Financial market development index, MILX = Military expenditures, TAXR = Tax revenue, TROP = Trade openness, INF = Inflation. **, * indicate significant at 1% and 5% levels, respectively

with social capital and resource efficiency. On the other hand, financial development (DCPS and SMR) may deplete the natural resources of the Arctic region. The results also show that trade openness and tax revenues improve the sustainable performance of the countries especially by cultivating social wellbeing in the society.

Initially, we analyzed the effect of financial development indicators on sustainable competitiveness and its sub-indexes using pooled OLS estimations. The results shown in Table 3 and 4 indicate a positive effect of financial development on sustainable competitiveness and social cohesion. On the other hand, we found a significant and positive effect of only stock market-based proxies on resource intensity while the negative effect of DCPS and SM returns on natural capital. Nonetheless, the pooled OLS estimates are generally criticized for generating *upward biased* estimates (Basu, 2020; Yahya & Rafiq, 2020). In contrast, the fixed-effect estimations produced *downward biased* estimates for our models (see Table 5 and 6) despite their ability to control omitted variable bias. To control omitted variable bias and reverse causality simultaneously, we relied on the estimations of system GMM. Hausman test of endogeneity is utilized to test the endogeneity of variables. The results³ warranted reverse causality and threatened the reliability of static models (i.e. fixed-effect or pooled OLS estimations). Before applying the system GMM, we also confirmed the stationarity of the variables. The unit root test by Levin, Lin, and Chu (2002) is employed to test if the time series is free of unit root to avoid spurious regression estimates. The LLC test results show that all variables are stationarity at level form except military expenses which is stationary at the first-order difference.

We used lagged values of financial development indicators as possible instruments in the system GMM

as we were able to gather exogenous variables to instrument these indicators. For all the underlying models, the null hypothesis for the Sargan test is not rejected proving the validity of instruments used by system GMM (see Table 7 and 8). Correspondingly, the insignificant p-values of AR(2) test statistic also specify the absence of second-order serial correlation which further validates the accuracy of all estimated models. The results of sys-GMM show a significant and positive effect of all financial development indicators on sustainable competitiveness except S&P GE indices. Consistent with prior studies, it is argued that financial development is conducive to the sustainable development of the Arctic region (Busch, Bauer, & Orlitzky, 2016; Durusu-Ciftci et al., 2017; Haider & Adil, 2019; Paun et al., 2019). Financial development has made these countries commercially competitive and simultaneously encourage social welfare and environmental protection (Thore & Tarverdyan, 2016). Possibly, the banks and stock markets in the region are encouraging socially responsible investments (Ganda, 2019).

In contrast, we find evidence that financial development is increasing the consumption of natural resources as bank concentration and stock market returns are negatively associated with natural capital. We partially endorse the previous studies that financial development elevates energy demands (Al-Mulali et al., 2015; Sadorsky, 2010; Shahbaz et al., 2016) which are generally met by natural resources including oil, coal, natural gas, etc. Nonetheless, our results are not asserting the detrimental effect of financial development on environmental quality because our estimates also support the positive effect of financial development on resource efficiency (in line with, Xu & Tan, 2020). Although financial markets and institutions play a prominent role in increasing natural resource consumption, the Arctic region

³ Except DCPS, SMR and INF, the p-values of all other variables were significant confirming endogeneity issue.

The results are not reported for brevity purpose, however, can be provided on demand.

Table 3. Pooled OLS Estimations (Effect of Financial Development on Sustainable Competitiveness and Natural Capital)

Variables	DV = Sustainable Competitiveness					DV= Natural Capital				
	1	2	3	4	5	1	2	3	4	5
Domestic Credit	0.100 (0.012)					-0.059*** (0.017)				
Bank Concentration		0.087*** (0.023)					0.008 (0.044)			
S&P (GE-Indices)			0.091*** (0.026)					-0.041 (0.049)		
SM-Return				-0.031 (0.047)					-0.136*** (0.075)	
FMD					2.800*** (0.847)					2.286 (1.520)
Military Expenses	-1.873*** (0.810)	-1.553*** (0.673)	-2.592*** (0.739)	-1.594*** (0.776)	-1.091* (0.710)	-0.443 (1.193)	-1.690 (1.271)	-1.276 (1.357)	-1.423 (1.233)	-1.237 (1.275)
Tax Revenue	0.132 (0.150)	0.286*** (0.107)	0.235*** (0.108)	0.213*** (0.121)	0.172* (0.108)	0.277 (0.221)	-0.152 (0.203)	-0.173 (0.198)	-0.130 (0.193)	-0.188 (0.195)
Trade Openness	0.011 (0.062)	-0.0841* (0.057)	-0.049 (0.056)	0.003 (0.061)	0.058 (0.057)	-0.123 (0.092)	-0.0627 (0.109)	-0.0315 (0.103)	-0.038 (0.097)	-0.006 (0.103)
Inflation	-0.063 (0.263)	0.020 (0.224)	0.125 (0.237)	-0.135 (0.253)	0.335 (0.266)	-0.484 (0.388)	-0.098 (0.423)	-0.228 (0.435)	-0.152 (0.402)	0.263 (0.477)
Intercept	52.857*** (3.841)	50.524*** (3.427)	56.382*** (3.571)	52.791 (3.860)	34.005*** (6.697)	68.497*** (5.661)	67.460*** (6.472)	66.163*** (6.561)	66.855*** (6.137)	52.209*** (12.022)
R-Squared	0.613	0.703	0.691	0.611	0.688	0.293	0.109	0.123	0.172	0.154

Table 4. Pooled OLS Estimations (Effect of Financial Development on Resource Intensity and Social Cohesion)

Variables	DV= Resource Intensity (Pooled OLS)					DV= Social Cohesion (Pooled OLS)				
	1	2	3	4	5	1	2	3	4	5
Domestic Credit	0.004 (0.066)					0.065** (0.037)				
Bank Concentration		0.017 (0.147)					0.220*** (0.079)			
S&P (GE-Indices)			0.539*** (0.143)					0.162** (0.093)		
SM-Return				0.376* (0.254)					0.088 (0.151)	
FMD					2.382 (5.162)					9.680*** (2.630)
Military Expenses	0.938 (4.444)	1.049 (4.216)	-4.475 (3.923)	1.792 (4.140)	1.511 (4.330)	-6.026 (2.509)	-4.372*** (2.264)	-6.302*** (2.562)	-4.823*** (2.471)	-2.679 (2.206)
Tax Revenue	-0.000 (0.824)	0.046 (0.675)	0.199 (0.574)	0.111 (0.647)	0.001 (0.663)	0.271 (0.465)	0.411 (0.362)	0.260 (0.374)	0.190 (0.386)	0.089 (0.338)
Trade Openness	0.142 (0.342)	0.120 (0.362)	-0.155 (0.298)	0.180 (0.326)	0.187 (0.349)	0.231 (0.193)	-0.058 (0.194)	0.067 (0.195)	0.145 (0.194)	0.358*** (0.178)
Inflation	-0.844 (1.445)	-0.841 (1.405)	0.614 (1.259)	-0.979 (1.351)	-0.478 (1.621)	-0.069 (0.816)	-0.105 (0.755)	-0.030 (0.822)	-0.452 (0.806)	1.117 (0.826)
Intercept	25.331 (21.076)	24.904 (21.466)	45.402*** (18.963)	23.043 (20.593)	9.240 (40.813)	49.453*** (11.901)	44.064*** (11.529)	56.351*** (12.382)	50.871*** (12.295)	-15.306 (20.794)
R-Squared	0.039	0.039	0.282	0.086	0.074	0.609	0.646	0.609	0.584	0.683

is using these resources efficiently to attain sustainable competitiveness. Thus, opposed to prior studies (Asif et al., 2020; Manzano & Gutiérrez, 2019), our study also does not support the *resource curse hypothesis* for the Polar region.

Finally, our results also reveal that financial development promotes social cohesion and social wellbeing. The banking efficiency, stock market efficiency, and the trustworthiness of financial markets in the Arctic region may facilitate their health system (Chireshe & Ocran, 2020), income equality (Gharleghi & Jahanshahi, 2020), and improve the connectedness among groups in society. The region has substantial deposits of precious metals, around 30 percent of undiscovered gas, and 13 percent of the world's oil reserves (Trump, Kadenic, & Linkov, 2018). Despite the rapid exploration of these natural resources by private companies, the human activity in the area is increased which is expediting economic

and social development (Becker & Pollard, 2016). From the perspective of control variables, the results show expected signs in all models, however, the significance level differs across the estimated models.

5. Conclusion and Implications

This paper investigated the effect of bank-based and stock market-based indicators of financial development on the sustainable competitiveness of the Arctic region using the system GMM estimator. Furthermore, the effect of financial development is examined with the components of sustainable competitiveness including natural capital, social cohesion, and resource intensity. After controlling for military expenses, tax revenues, inflation, and trade openness, the results show a significant and positive effect of financial development on sustainable competitiveness. It is also posited that financial develop-

Table 5. Fixed Effect Estimations (Effect of Financial Development on Sustainable Competitiveness and Natural Capital)

Variables	DV = Sustainable Competitiveness (Fixed Effect)					DV= Natural Capital (Fixed Effect)				
	1	2	3	4	5	1	2	3	4	5
Domestic Credit	0.046 (0.081)					0.110 (0.130)				
Bank Concentration		0.015 (0.061)					-0.412 (0.097)			
S&P (GE-Indices)			0.084*** (0.023)					-0.056 (0.428)		
SM-Return				-0.420 (0.043)					-0.083 (0.068)	
FMD					-1.530 (3.137)					3.312 (4.993)
Military Expenses	0.824 (1.665)	0.802 (1.712)	-1.468 (1.543)	1.070 (1.681)	0.635 (1.656)	4.322* (2.669)	3.995* (2.728)	5.751*** (2.807)	5.032** (2.663)	4.418* (2.636)
Tax Revenue	-0.069 (0.222)	-0.030 (0.398)	-0.137 (0.179)	-0.112 (0.206)	-0.131 (0.212)	0.334 (0.356)	-0.206 (0.634)	0.038 (0.326)	0.023 (0.327)	0.061 (0.337)
Trade Openness	0.227 (0.204)	-0.206 (0.200)	-0.263 (0.264)	-0.189 (0.197)	-0.248 (0.221)	-0.650** (0.327)	-0.629** (0.320)	-0.601** (0.313)	-0.621** (0.313)	-0.541* (0.352)
Inflation	0.191 (0.320)	0.254 (0.307)	0.381 (0.264)	0.240 (0.302)	0.270 (0.308)	-0.080 (0.513)	-0.838 (0.489)	-0.156 (0.481)	-0.082 (0.478)	-0.116 (0.491)
Country Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	64.615 (18.390)	66.108*** (20.093)	76.688 (14.708)	67.660*** (16.796)	79.897*** (28.434)	93.589*** (29.483)	101.918*** (32.012)	89.290*** (26.752)	92.480*** (26.612)	70.524* (45.249)
R-Squared	0.411	0.532	0.376	0.555	0.611	0.020	0.023	0.015	0.027	0.031

Table 6. Fixed Affect Estimations (Effect of Financial Development on Resource Intensity and Social Cohesion)

Variables	DV= Resource Intensity (Fixed Effect)					DV= Social Cohesion (Fixed Effect)				
	1	2	3	4	5	1	2	3	4	5
Domestic Credit	0.071 (0.568)					0.182 (0.257)				
Bank Concentration		-0.315 (0.421)					0.069 (0.192)			
S&P (GE-Indices)			0.593*** (0.162)					0.062 (0.086)		
SM-Return				0.448* (0.296)					-0.029 (0.139)	
FMD					-7.974 (21.828)					4.081 (9.937)
Military Expenses	4.888 (11.619)	2.442 (11.811)	-10.580 (10.659)	8.691 (11.466)	4.379 (11.524)	-7.818* (5.255)	-7.807* (5.412)	5.702 (5.661)	7.579 (5.386)	7.472 (5.246)
Tax Revenue	-0.668 (1.551)	-2.486 (2.748)	-0.905 (1.240)	-0.726 (1.410)	-0.829 (1.475)	0.218 (0.701)	0.429 (1.259)	0.027 (0.658)	0.046 (0.662)	0.093 (0.671)
Trade Openness	-1.110 (1.426)	-0.959 (1.385)	-1.510 (1.188)	-0.947 (1.348)	-1.315 (1.541)	0.490 (0.645)	0.570 (0.635)	0.548 (0.631)	0.603 (0.633)	0.720 (0.701)
Inflation	0.097 (2.234)	0.521 (2.117)	1.127 (1.829)	0.099 (2.061)	0.302 (2.147)	0.225 (1.010)	0.474 (0.970)	0.545 (0.971)	0.440 (0.968)	0.384 (0.977)
Country Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	111.231 (128.321)	173.188 (138.597)	173.576** (101.585)	105.939 (114.550)	175.674 (197.819)	-17.282 (58.044)	-13.245 (6.514)	4.860 (53.950)	-1.823 (53.816)	-30.774 (90.056)
R-Squared	0.026	0.030	0.011	0.020	0.033	0.031	0.143	0.102	0.035	0.265

ment is depleting the natural capital but stimulating the social cohesion and resource efficiency of the Arctic region.

Banks and financial markets are playing a complementary role in promoting sustainable economic growth in the region by improving the use of financial functions and the rate of return on investment. Especially in the short-run, efficient capital accumulation from financial development is offsetting the negative impact of overexploitation of natural resources. Since our study estimated short-run (dynamic) relationships, we are not able to assert if the positive link between financial development and sustainable competitiveness can be retained in the long-

run. Various ecologists and environmental councils have raised concerns over the sustainable development of Polar Regions that current industrial and economic activities are yielding only short-term benefits. In the long-run, over-exploitation of natural resources may pose serious threats to the social, environmental, and economic development of the regional and local communities (Mikkelsen & Langhelle, 2008; Trump et al., 2018).

Energy consumption is conducive to economic growth and natural resources facilitate this link. However, long-term sustainability should not be compromised through overexploitation of natural resources. Currently, diesel is the major source of elec-

Table 7. System GMM Estimations (Effect of Financial Development on Sustainable Competitiveness and Natural Capital)

Variables	DV = Sustainable Competitiveness (SGMM)					DV= Natural Capital (SGMM)				
	1	2	3	4	5	1	2	3	4	5
Lagged DV	0.720*** (0.111)	0.958*** (0.073)	-0.624 (0.507)	0.342*** (0.121)	0.583*** (0.127)	0.816*** (0.159)	0.783*** (0.094)	0.707*** (0.140)	0.656*** (0.134)	0.901*** (0.162)
Domestic Credit	0.042*** (0.017)					0.024 (0.051)				
Bank Concentration		0.375*** (0.062)					-0.200** (0.090)			
S&P (GE-Indices)			0.097 (0.018)					0.251 (0.058)		
SM-Return				0.118*** (0.047)					-0.037* (0.071)	
FMD					0.088** (0.056)					0.084 (0.063)
Military Expenses	-1.992 (0.549)	-1.833 (0.691)	-2.095 (0.526)	-1.937 (0.682)	-2.127 (0.703)	-0.933 (0.587)	-1.082 (0.489)	-1.122 (0.705)	-1.243 (0.622)	-0.916 (0.870)
Tax Revenue	1.816 (0.438)	4.216 (0.633)	0.293** (0.140)	1.166 (0.508)	1.317 (0.269)	-0.240 (0.173)	1.400 (1.083)	0.107 (0.771)	0.122 (0.516)	0.557 (0.714)
Trade Openness	0.452* (0.110)	1.826** (0.247)	1.049*** (0.325)	0.021 (0.099)	0.273** (0.065)	0.179 (0.134)	-0.467 (0.379)	0.200 (0.280)	0.323 (0.209)	-0.094 (0.187)
Inflation	-6.142** (1.053)	-8.654* (1.842)	-3.490 (0.803)	-3.761** (0.668)	-6.715* (1.212)	-0.960 (1.934)	-1.785** (0.935)	-0.668 (0.433)	-2.606 (2.267)	-0.958 (1.841)
Country and Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	7.094* (0.955)	8.193 (0.893)	7.714** (0.960)	8.068* (0.912)	9.127** (0.701)	3.773 (0.834)	3.821 (0.662)	3.612 (0.625)	4.392 (0.705)	3.618 (0.830)
AR(2)	0.663	0.724	0.233	0.652	0.612	0.238	0.814	0.446	0.620	0.265
Sargan test	0.273	0.533	0.293	0.427	0.773	0.994	0.849	0.891	0.943	0.996

Table 8. System GMM Estimations (Effect of Financial Development on Resource Intensity and Social Cohesion)

Variables	DV= Resource Intensity (SGMM)					DV= Social Cohesion (SGMM)				
	1	2	3	4	5	1	2	3	4	5
Lagged DV	0.024 (0.055)	0.113 (0.083)	-0.132** (0.058)	-0.267*** (0.070)	-0.005 (0.079)	0.171 (0.151)	0.240 (0.251)	0.140 (0.227)	0.208 (0.227)	0.406*** (0.131)
Domestic Credit	-0.034 (0.092)					0.081*** (0.021)				
Bank Concentration		0.130*** (0.044)					0.322*** (0.068)			
S&P (GE-Indices)			0.601*** (0.090)					0.080*** (0.032)		
SM-Return				1.070*** (0.112)					0.061 (0.082)	
FMD					0.833 (0.096)					2.481*** (0.953)
Military Expenses	-3.311*** (6.752)	-2.181 (3.118)	-1.386*** (2.833)	-2.346*** (5.501)	-3.133*** (5.486)	-1.362 (1.093)	-1.339 (1.132)	-1.002 (0.094)	-1.212 (1.117)	-2.308 (0.998)
Tax Revenue	13.552*** (1.315)	0.427* (0.241)	9.016*** (1.216)	9.576*** (1.066)	13.667*** (1.177)	0.334 (0.522)	1.436*** (0.451)	0.137 (0.352)	0.443 (0.329)	-0.932 (0.756)
Trade Openness	4.975 (0.426)	0.242 (0.094)	3.232 (0.405)	3.187 (0.323)	5.012 (0.449)	0.587*** (0.104)	-0.286 (0.294)	0.587*** (0.114)	0.398*** (0.156)	0.489** (0.225)
Inflation	-3.499** (4.963)	2.579 (0.565)	-4.578 (2.401)	-4.810** (5.016)	-1.953*** (6.631)	-0.020 (0.146)	4.435** (2.268)	-0.049 (0.662)	1.693** (0.832)	3.768*** (1.616)
Country and Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	39.107** (2.103)	37.334* (2.760)	34.538** (2.737)	31.732* (2.230)	48.225*** (2.836)	3.081 (1.846)	7.321 (2.157)	4.826 (1.772)	3.248 (1.195)	5.245 (1.644)
AR(2)	0.752	0.309	0.684	0.415	0.588	0.620	0.403	0.745	0.692	0.498
Sargan test	0.982	0.993	1.000	0.997	0.879	0.294	0.908	0.995	0.741	0.896

tricity generation (up to 80%) in the Arctic which is the renowned cause of greenhouse gas emission. Black carbon from burning diesel also reduces the albedo effect, leading to the rapid melting of ice and snow (Quitoras, Campana, & Crawford, 2020). Thus, the financial sector should be guided and supported to promote alternative eco-friendly technologies to meet energy demands. Although we have tried to opt for an optimal statistical technique to deal

with statistical biases for the available panel data, the estimates should be considered with caution.

While the employed index of sustainable competitiveness is comprehensive and backed by quantitative methodologies, the limited time-series constrained us to test more advanced statistical techniques. Future studies may extend the time-series using alternative composite indexes developed in the existing literature to test co-integration or possible

non-linearity between financial development and sustainable competitiveness in the Arctic. For an enlarged version of the index, more regional socio-ecological data should be added. Additionally, future studies should also test the intervening role of technology, energy consumption, and innovation between financial development and sustainable development.

This study is also limited to the pre-COVID-19 period due to the unavailability of financial indicators data for the year 2020 or onward. However, it opens the door for future studies to fill the gap with relevant COVID-19 factors. The COVID-19 pandemic substantially disturbs financial activities as the global lockdown negatively influences the performance of ongoing projects and investors were reluctant to start new financial investments (Anser et al., 2021; Yahya, Shaohua, Abbas, & Waqas, 2021). Accordingly, ensuring progress toward SDGs and sustainable development decelerated for most of the countries in the absence of additional support (Barbier & Burgess, 2020). After the pandemic, researchers are redefining sustainability and utilizing green finance that offers an incentive to fund sustainable items leading to industrial growth initiatives and digital mobilization of renewable energy (Hakovirta & Denuwara, 2020). It is believed that the current COVID-19 stimulus packages including the exploration of non-renewable energy resources in the Arctic region will pave the path for environmental degradation. Therefore, we recommend that future studies should include the effect of COVID-19 while exploring the relationship between financial development and sustainable competitiveness for a more holistic view.

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Green Energy in the Caribbean: Influence on Tourism and Economic Development

Zielona energia na Karaibach: jej wpływ na turystykę i rozwój gospodarczy

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Abstract

The green energy agenda has become one of the most important issues in international relations. Many island states of the Oceania have taken the course of green economy construction. The Caribbean states are in some way similar to the Oceania ones and have also made several steps towards greener future. Some of these states are tightly connected with international tourism, leading to the high dependence of their economies from touristic revenues. The article examines this interconnection, including economic component in the analysis. The major question of the article is how does (or doesn't) tourism influence the development of green energy in the Caribbean states. The two major economies examined in the region are Cuba and Dominican Republic as the two examples of the totally different economic systems and approaches to the development of the green energy. The key findings of the article include such conclusions as the possibility of synergetic interdependence between tourism, economy and green energy and the positive effects this interdependence has. The other finding is that the Cuban method of introducing green energy is less effective than the Dominican one. The novelty of the article includes the comparison of the two economic models in the Caribbean and the development of strategies for the green energy proliferation in the countries.

Key words: Caribbean, Cuba, Dominican Republic, green energy, strategy, barriers, drivers

Streszczenie

Agenda zielonej energii stała się jedną z najważniejszych kwestii w stosunkach międzynarodowych. Wiele wyspiarskich stanów Oceanii przeszło na kurs budowy zielonej gospodarki. Państwa karaibskie są w pewien sposób

podobne do krajów Oceanii i również poczyniły kilka kroków w kierunku bardziej ekologicznej przyszłości. Niektóre z tych państw są ściśle powiązane z turystyką międzynarodową, co prowadzi do silnego uzależnienia ich gospodarek od przychodów z turystyki. W artykule przeanalizowano to powiązanie, uwzględniając w analizie komponent ekonomiczny. Głównym pytaniem artykułu jest to, w jaki sposób turystyka wpływa (lub nie) na rozwój zielonej energii w krajach karaibskich. Dwie główne gospodarki badane w regionie to Kuba i Dominikana jako dwa przykłady całkowicie odmiennych systemów gospodarczych i podejść do rozwoju zielonej energii. Do kluczowych ustaleń artykułu należą takie wnioski, jak możliwość synergicznej współzależności między turystyką, gospodarką i zieloną energią oraz pozytywne skutki tej współzależności. Drugim wnioskiem jest to, że kubańska metoda wprowadzania zielonej energii jest mniej skuteczna niż dominikańska. Nowością artykułu jest porównanie dwóch modeli gospodarczych na Karaibach oraz opracowanie strategii proliferacji zielonej energii w tych krajach.

Słowa kluczowe: Karaiby, Kuba, Dominikana, zielona energia, strategia, bariery, czynniki sprawcze

Introduction

The Caribbean sea is a very attractive region for tourism, as it provides the major components of the touristic attractions – it has the beautiful nature, rich history since the Spanish conquest of the region, the developed touristic infrastructure and significant potential in the all-year-round tourists arrivals (Sole, 2021). All in all, the region consists of 25 countries and 3 territories, but the major touristic attraction centers are Cuba and Dominican Republic (Sole, 2021). The attention in this article is concentrated on them, as the other countries of the region are less representative in the sphere of green energy development and tourism.

Tourism is known as one of the energy intensive industries, especially taking into account the service character of the industry. As a result, tourism has the high impact on the demand for energy in the countries, which generate the majority of their profits from touristic activities, such as the Caribbean ones. The green energy agenda and the responsibility in energy efficiency and greenness are significant influence factors on every industry, and taking into account the recent growth of the public concern on green energy, this sphere needs to become more energy efficient in case it wants to preserve its current position in the economy of the countries, depending on it.

In addition to the mentioned economic effects, both tourism and green energy can be analysed from the view of sustainable development. The UN Sustainable Development Goals (SDGs) provide the basis for the greener future, especially in the sphere of energy, and are obviously aimed at the more sustainable and effective development of the national economies. In this regard, sustainability is the important factor, which includes both tourism and green energy development, hence the article encompasses sustainability issues too. The SDGs in general sense give recommendations on the actions to be taken by the countries in order to achieve the UN Agenda, but this document doesn't give region specific recommendations, which is necessary for the more effective development of the countries. The article is devoted to the formulation of these region specific recommendations, based on the framework, given in UN SDGs.

The two countries have different economic systems and different approaches to the green energy development – while Cuba is a command economy with the high influence of industries on the economy of the country, Dominican Republic (DR) is a market economy with extremely high influence of tourism on the economy, and the developed services sector. As a result, the approaches to the development of the green energy in the two countries differ a lot. While Cuba forces its industries to the green energy transition by combining price and command methods (Martínez, 2020), DR follows the economic trends and sticks to the idea that tourism has the opportunity to control the economy of the country because of its high influence on it, hence the green energy transition is conducted under the pressure of tourism requirements (Goffi, et al. 2020). The article aims at revealing the major characteristics of the green energy development models of the two countries and figuring out the extent interdependence of the countries in the Caribbean region. This allows to give conclusions and recommendations on the further development of the green energy in the region in whole and in the named countries in particular.

The major finding of the article is the proof of the possibility of interconnection between the green energy development and tourism through economic and social benefits.

Literature review

The literature on the green energy development in the Caribbean can't be named vast. Many of the works cover the region partially, only touching its problems. For instance (Ahmed, Shimada, 2019) covers several regions and states, that the Caribbean states have to depend on conventional energy sources. The other paper (Singh, Ephraim, 2016) states that green energy is the new key agenda for the Caribbean, but has several major issues, such as finance, technology and sustainability in the local weather conditions. The work (Shah, Niles, 2016) focuses on the Caribbean in general and gives interesting institutional solutions, especially in the context of the partnership of the Caribbean states, but misses out the fact that this leads to the dangers for the island states' own policy and national security.

At the same time, the other work (Mundaca, Markandya, 2016) states that the current state of being is far from the one to be achieved in order to comply with the green agenda goals. When speaking of Cuba, the only paper found in Scopus on the relevant theme is (Lorente, et al. 2020) which lies in the basis of the analysis, given hereinafter. The other article (Donastorg, 2020) gives major conclusions, used hereinafter for the DR, the assessment of the feed-in tariffs, mentioned later is given in (Jacobs, et al. 2013).

The overall conclusion on the sources on the green energy transformation in the Caribbean is their national orientation (each source mainly covers the situation in one country) and lack of comparative analysis on the development of green energy in the countries of the region. In this regard it's necessary to compare the green energy development models in the region and put forward propositions on each of the revealed models.

Methodology

The article is based on the following logic process. First of all, the authors search for the drivers of the green energy development in the countries researched. Such drivers bear economic and social character, then these drivers are weighted by the barriers, the character of which differs and can be political. Based on these drivers and barriers, the authors put forward a characteristic of the green energy development model of the country by the following parameters: a) the character of green energy transition, b) the economic basis of green energy development, c) the legal basis of green energy development, d) the social influence of green energy, e) the overall driver/barrier ratio. The last is calculated by the simple formula:

$$DBR = Qd / Qb$$

where Qd and Qb is the quantity of drivers and barriers. Thus, the overall complexity of the sphere can be estimated in figures.

The second step of the research is to provide cross-variable correlation analysis. This allows to figure out is the development of green energy in the country autonomous from other spheres or it has interconnections with them and synergetically develops with them. The analysis of correlation is based on the correlation formula:

$$correl = \frac{\sum(x - m_x)(y - m_y)}{\sqrt{\sum(x - m_x)^2 \sum(y - m_y)^2}}$$

where x and y are the two variables, m_x and m_y are the means of the variables.

If the correlation is high ($>0,9$) the interdependence is strong, if average ($0,5 < correl < 0,9$) then moderate, if low ($<0,5$), then there is no interdependence. The cross correlation includes the analysis of two correlation values at the same time. If both of them are

high or average, there is intercorrelation and synergetic effect is present, if not, the opposite is true.

Based on the performed analysis the authors provide strategies, based on either synergetic effect of the three variables, or on the supposition of linear development of green energy in the country.

Cuban model of green energy development

The development of green energy on Cuba has begun in the 2005, but the framework for its further development was given only in 2014 when the country adapted a new Green energy plan (Alberto Arrastía-Avila, Glidden, 2017). The major decisions of this paper are discussed in the named source, so we won't concentrate on them here. As a result, the green energy industry in Cuba is one of the most rapidly growing in the Caribbean. At the same time, we can't avoid mentioning, that Cuba is forced to seek new sources of energy, as the conventional ones are too expensive.

The development of green energy in the country is stimulated by the following major drivers:

- 1) High price for the conventional energy resources. The country imports oil and gas from Venezuela (Cederlöf, Kingsbury, 2019), and this import is a rather expensive one. The average customer on Cuba spends 125-140\$ a month on electric energy (Yao Zhao, 2017), taking into account the low disposable income of the citizens of the country, this figure influences the social situation significantly.
- 2) The need to create a stable energy system. Due to the high volume of tourists and the high revenues of the state budget from their visits to the country, Cuba has to provide the best touristic experience possible, which is impossible in the current conditions of the unstable energy grid and high energy prices. In this paragraph it's necessary to mention that Cuba has less problems with energy infrastructure construction than Dominican Republic, as the territory of the latter is more exposed to the natural disasters because of the small territory of the island. In addition to that, the high share of the military infrastructure on Cuba along with the urge to preserve the constant function of the force institutions, such as the police, makes the development of the green infrastructure, based on the well-protected infrastructure of the military character easier. The other important factor is the relatively big territory of the island and longer electricity lines, and higher share of industry in the GDP of the country, which contributes to the other infrastructure structure, making it less diversified and more centralized.
- 3) The necessity to preserve the national security. The country depends from imports of the energy resources, that's why it needs to secure itself from the market volatility and from the political

pressure on the exporters, taking into account the long-run political tensions with the USA, a major influencer in Latin America, Caribbean and South America (Kaláshnikov, Kodzóev, 2018; Arazoo, 2013).

- 4) The abundancy of the natural riches, that are to be preserved. Clean air and water are necessary for the future development of the island, especially taking into account tourism. But even with no regard to this economic sphere, green agenda is extremely important for any island state, as it can't neglect the bad ecology because of the small territory and no way to recover the previous state of being without extremely big financial losses.
- 5) Excellent natural conditions for the green energy introduction. Cuba is one of the sunniest places on Earth, has the potential for wind energy generation and has already developed a sustainable system of the bioenergy production, especially in the field of fuel for vehicles and small powerplants.

All these drivers lead to the current situation, when Cuba forces the development of its green energy industry to comply with the ambitious goal of 24% of renewable energy in energy balance by 2030. Still, there are several barriers for the development of green energy in the country:

- 1) The two-currency tariff. The country has two official currencies – the convertible Peso and the Cuban Peso, hence the monetary system of the country is rather complicated (Fernandes, 2018). This causes the issue of the foreign trade with Cuba in energy sphere – the tariffs are collected in Cuban Pesos, so how are they to be converted in convertible Pesos?
- 2) The significant legal issues with private property. In many developed countries of Europe green energy has started from the private initiatives in green energy development. How will Cuba manage to coordinate plan economy and private initiative? The issue is very important, as the rapid growth of green energy production in Europe started from the private sector, but transformed into general initiatives on the EU level, aimed at economic stimulation through the methods of green financing and green energy development. Hence, the green energy has become an institutional issue. In the plan economy the only way an initiative can become institutional is the convergence of the centrally planned actions and positive social attitude towards them. The Cuban issue is that the government can be less supported by the society than it supposed.
- 3) Lack of financial resources. Cuba has little or no possibilities to attract the financial resources from the developed countries and isn't a member of the international financial institutions. The major investor in the green energy of the

country is China (Steve Hanley, 2017), so will the investments from PRC be enough for the sustainable development of Cuba?

In addition to that, the country is isolated from the international technological markets, which leads to the ability of Cuba to develop the green energy infrastructure, based on the local technologies. The low quality of education (Margarita, 2011), followed by the high barriers for the educated workforce to leave the country for the professional development lead to the lack of human capital and the significant issues with the technology development in the country.

In addition to that, the maintainable of the already existing infrastructure is rather weak because of the same reasons. The major difference of the maintenance of the green energy infrastructure from the maintenance of the road infrastructure for instance, is the need for qualified personnel and the high standards of quality, which Cuba lacks.

The overall lack of resources in Cuba makes the development of green energy in the country a matter of high importance, but little prospects for international help and cooperation. The country has to rely on its own.

These barriers form significant problems for the future development of the Cuban energy industry, based on the green energy, so the country has to solve them in order to comply with the national green energy development plan.

The overall characteristic of the Cuban model of green energy is that it is a forceful model, the economy of the country is forced to conduct green energy politics in order to avoid severe losses, green energy is developed centrally, no private initiatives are present, the legal basis is rather not developed and bears a character of statements, green energy has moderate social influence, but it's not enough for the massive public support. At the same time, the DBR equals to 1,66, pointing on the high potential for the green energy development in Cuba.

Dominical green energy development model

DR is another center of tourism in the Caribbean. But it has another model of green energy development than the one, Cuba has. Green energy development in the country is regulated by the Law 57-07 (IRENA, 2016), which regulates the major spheres of green energy use in the country.

At the same time, nearly 60% of the demand for energy in the country is supported by hydrocarbons' imports. The major drivers, leading to the development of the green energy in the country are the following:

- 1) High prices for the hydrocarbons. Just as in Cuba, the country faces severe problems with the imports of hydrocarbons.
- 2) The excellent natural conditions for the green energy generation. The abundancy of sun and

wing make the best possible conditions for the green energy production.

- 3) The growing energy market. The active tourism and the industrial development of the island leads to the necessity to develop new ways of energy production, especially taking into account the high burden of conventional energy production costs.
- 4) The availability of external financial resources for the green energy development in Dominican Republic. DR doesn't have technologies for green energy development, but its partners, such as the USA and EU do, and taking into account the good economy development forecasts (Reyes, Useche, 2019) and the tight relationships with the finance donor countries, DR can have a cheap and fast introduction of green energy technologies in the next years.
- 5) The necessity to create a green environment for the development of tourism. The territory of the country is smaller than the one of Cuba, but the tourist inflow and the demand for energy from the industry is significant, which leads to the faster degradation of the natural environment, than the one on Cuba. In addition to that, the high influence of the marine transport on the environmental conditions of the country force it to introduce stricter regulations and higher energy standards in order to preserve the major source of the budget – tourism revenues.

These are the main drivers for the development of the DR energy market, but there are several barriers too:

- 1) The legislative framework is still quite misty. The Law 57-07 has to be extended in the sphere of attracting investments in the green energy sphere and stimulating private initiatives. In addition to that, it's necessary to make the system of the energy regulation easier, as today there are discussion on who controls the development of the energy system of the country (Alexander, et al. 2015).
- 2) The energy grid of the country is rather weak. The current energy grid isn't suitable for massive green energy production due to the lack of two-way exchange possibilities (The Economist, 2015). The other important issue is the lack of energy storage facilities, which are quite expensive and require high investments in security and ecological safety – the leakage of heavy metals from the batteries can cause significant damage to the water resources and wildlife of the nearby region. In case such leakage happens massively (for instance, because of the malfunction due to the bad weather conditions, or human factor, including terrorist attacks, the damage to the nature of the island will be significant).
- 3) The necessity to prove the effectiveness of the current measures to the population. The current green energy transfer is to be supported by the

private initiatives of the population, otherwise it won't have the planned effect. Today the population of the country isn't secure of the future of green energy in DR, so the support to such initiatives is rather low.

In addition to the mentioned, the necessity to provide a secure and stable source of energy will lead to the inevitable overkill in energy supply of the Dominican Republic. In case of the intense international trade in energy this will lead to a higher export values of the country, but in case of the Caribbean, where the overall density of international electricity network is very low, the international trade in energy is unlikely. In case the international trade in energy model doesn't work for the country, the extensive production facilities will cost significant amounts of financial resources, but their return on investments will be low or even negative. This leads to the growth of costs of green energy transfer in the country and to the ineffective use of the acquired investments in the sphere. Due to the barriers mentioned earlier, the ineffective use of financial resources will lead to the low outcomes of the green energy transformation in the country.

The other important factor to mention is the regular character of the natural disasters. Taking into account their devastating nature, the construction of the green energy infrastructure should be based on the principles of the defense of the first from the negative impacts, which will rise the costs of infrastructure construction significantly. In addition to that, the storages of energy, which are represented by batteries of different kinds, should be protected from water, which will add on the costs of the green energy development.

This is a significant problem, as the main consumers of energy in the country are tourist facilities, which are located majorly on the coast, which is affected most significantly by the natural disasters.

The overall characteristic of the Dominican green energy development model is the following. Green energy in DR develops because of the need from the private and public sector, based on the market demand for the more efficient energy source, the legal framework is developed, despite the need for modernization and provides enough opportunities for the green energy initiatives, the social influence of the green energy is moderate to high, because of both cheaper energy and higher incomes from tourism. The overall DBR equals 1,33, demonstrating a high potential for future green energy sector growth.

The assessment of the interconnection of tourism, economic development and green energy in the countries

The interconnection between tourism and energy sector comes from the high demand for energy in tourism. This, in turn, happens because of the ineffective spending of the energy resources by the tour-

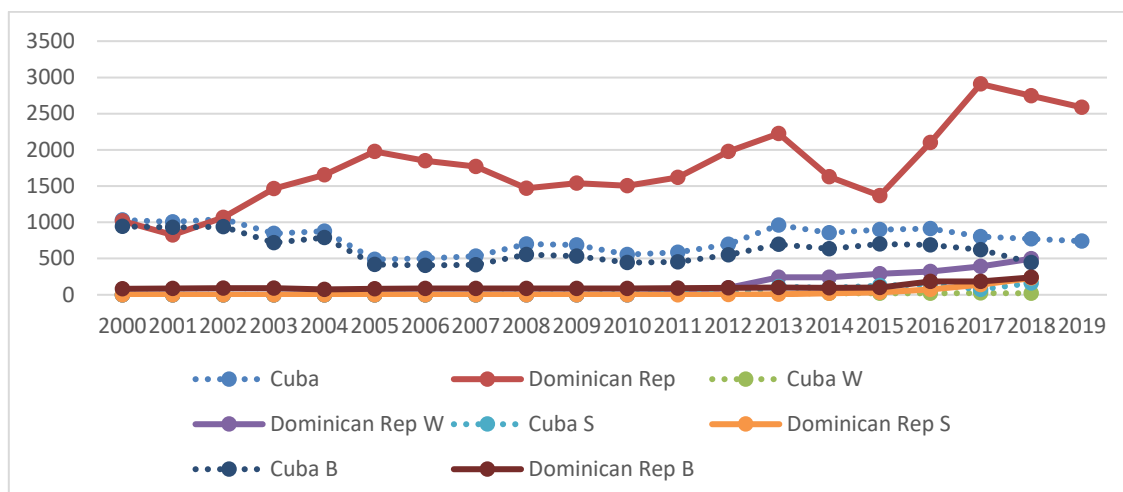


Figure 1. Green energy production by sources (w – wind, s – solar, b – bioenergy), GWh, created by authors, based on (IRENA, 2018).

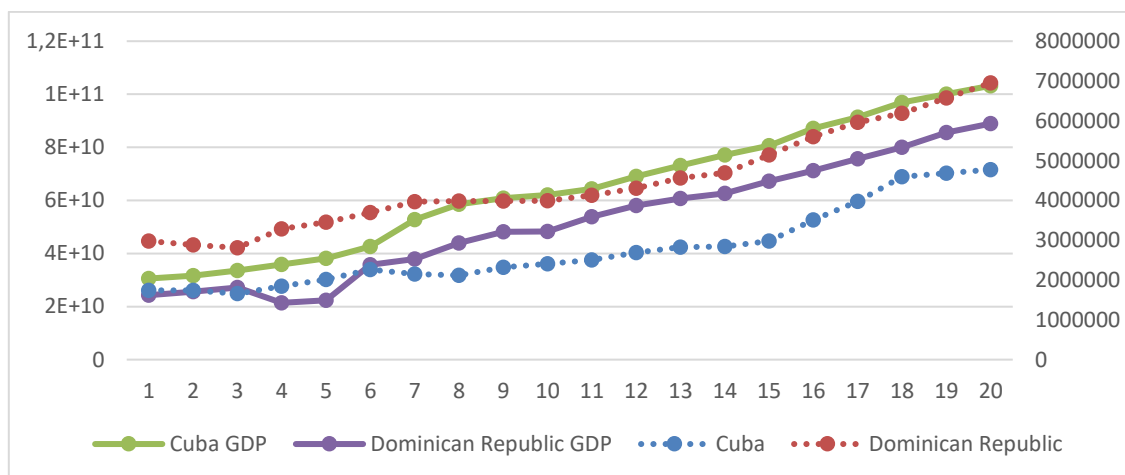


Figure 2. GDP and tourist arrivals in the countries, US\$ and persons, created by authors, based on and (The World Bank, 2019).

ists and by the touristic infrastructure, aimed at the fulfillment of the wishes of tourists, which are chaotic and hardly predictable with high preciseness. The optimization of energy consumption in this regard is nearly impossible.

In order to figure out the interconnection between tourism and green energy production, let's refer to the green energy production trends in both countries, presented on Figure 1.

The data on figure 1 demonstrates the substitution of bioenergy in Cuba by the solar energy and the significant influence of the hydroenergy on the energy balance of Dominican Republic. The other important notice is that Cuba has less developed green energy sector than DR, despite having similar ambitious plans. We observe a rapid growth of solar energy use in DR, just as in Cuba and quite humble growth of wind energy.

This effect can be a result of technical limits of the use of wind energy, for instance, wind generators produce noise, they are rather big and spoil the landscape and their maintenance requires higher quality specialists and is more expensive than the one of the

solar panels, especially when they are mounted in private sector, where their maintenance lies entirely on the costs of citizens, who installed them.

The decrease in the biofuels use in Cuba can be connected with the gradual modernization of the vehicle park of the country, and their higher fuel efficiency. As a result the demand for biofuels from the automobile sector falls, while the demand for them from the electricity generation facilities hasn't grown yet because of the time lag and a not clear economic efficiency of their use in the sector.

Let's refer to figure 2, depicting GDP growth of the countries and the number of tourists arriving.

Figure 2 demonstrates a stable growth of GDPs of the countries and a stable growth of tourists flow to Cuba with a slowdown in DR. This situation reflects the tendencies in the product life cycle, referring to the necessity to modernize the touristic infrastructure and services in DR.

The interconnection between the three variables can be assessed through the correlation analysis, presented in table 1.

Table 1. Correlation analysis (t – tourism, c – green energy capacity, p – green energy production, e – gdp)

	T/C	T/P	T/E	P/E
Cuba	0,6941363	-0,02364217	0,941187624	-0,12276587
Dominicana	0,9365757	0,809388595	0,964191028	0,745754726
Total	0,79919613	0,767337754	0,559399201	0,062930561

The table is colored according to the correlation strength. As a result of the correlation analysis, we have come to the following results:

- 1) Tourism influences the economy of both countries significantly, as it provides high financial benefits for the countries' budgets. The Caribbean region economy is moderately affected by tourism.
- 2) Tourism has a significant impact on the green energy production in DR, but no impact on the Cuban green energy. Its impact on the overall green energy development in the Caribbean region is moderate.
- 3) Tourism has a very high impact on the green energy capacity in DR, while its impact on the same parameter in Cuba and in the Caribbean is moderate.
- 4) Only DR has the direct connection between tourism, economy and green energy production, while Cuba and the Caribbean region don't have it.

The results of the correlation analysis prove the fact, that the Dominican model of the economic development and the green energy framework is much more effective in terms of green energy production than the one in Cuba. The changes in DR come from the private initiative, while Cuba relies on the state regulation and has no social framework, suitable for the sustainable green energy development.

In the current conditions of COVID-2019 pandemic tourism suffers a lot. Both countries have faced negative effects of this situation, but when referring to EU, pandemic has given the boost for the green energy development. In the Caribbean COVID-2019 has led to a significant restoration of the wildlife due to the lower quantity of tourists, but the green energy sector has faced no significant boosts. This has happened due to the fact, that in the EU the recovery program is based on the EU Green Deal, involving the green energy financing, when in Cuba and Dominican Republic such programs haven't been introduced.

Discussion

As it follows from the results, the Cuban model of green energy development doesn't provide synergetic effect nor has it from the economy or tourism, while the Cuban economy depends on tourism. The Dominican republic has the synergetic effect, so the proposed strategy of green energy development for it can be based on measures, connected with tourism.

In this regard, we propose the following strategy for the greener energy sphere in DR.

The first step is to enhance the legal framework of green investments. As we have mentioned above, the Law 57-07 doesn't stimulate foreign investments to the necessary extent. The major possibilities in this sphere are the following: a) the tax reform in order to provide tax benefits for the foreign investors in the green energy projects, b) the concretization of the green energy projects characteristics and the formation of the basic principles of the green finance, c) the government stimulation of the private initiatives in the green energy sector by both taxes and subsidies, d) the development of the long-run plan for the green energy development for a period from 2030 to 2050.

The second step is the cooperation with the international institutions and investors, for instance, the creation of the Dominican Green Energy Investment Fund, based on the bilateral agreements with the international companies and institutional investors.

Third step is the modification of grid. In order to do that, the country can attract the financial support from the World Bank Group or from the other development banks, for instance, the New Development Bank of BRICS or the Interamerican Development Bank.

The fourth step is the promotion of green energy production among the citizens of the country by using the special tariffs and returns for the ones, who sell energy to the grid.

The fifth step is the creation of the extensive tourism revenues fund, which can be used to promote green energy development in the country by financing the local projects in the most tourism attractive zones. In addition to that, the fund can be used for the modernization of touristic infrastructure and making it greener.

The sixth step is to develop and promote internationally the new way of tourism – the green tourism. The main way to do that is to form the major principles of zero carbon trace and zero nature influence of such kind of tourism and assess the concrete tours in accordance with such principles. These principles are to be introduced for hotels, transfer, excursions and food, so if the tour complies with these characteristics, the tourist can apply for a partial refund of tour price when leaving the country. The promotion of such tours is to be organized on international level through touristic agencies.

The seventh and one of the most important steps is to create a clear framework for the ESG institutions

and initiatives. In this context it's necessary to develop a system of indicators for the green finance development, especially for the green bonds. This will allow to attract new financial resources to the country, especially from the countries, which are highly involved in the green transformation, such as the EU countries and the USA, taking into account the green energy plan of Biden 9 (Fulton, 2020).

Taking into account the will of Dominican Republic to develop the green energy infrastructure, it is a good idea to join the initiative of zero-plastic and zero-waste society and tourism. It will contribute to the overall decrease of the hydrocarbon-active industries, especially those, which involve polymers production. In turn, this step demonstrates the high involvement of the country in the green initiatives, attracting new investors and green institutions to the country. When speaking of green institutions, it can be a significant attractiveness factor to introduce zero taxes for the institutions, which are of green character (this step involves the prior development of the standards for the green institutions). As a result the coverage of the Dominican green initiatives will be much better and the country will be able to attract more investments in the green energy.

This strategy will lead to the high openness of the country to foreign initiatives in the sphere of green energy and will be able to provide new possibilities for the local entrepreneurs, aimed at the green energy development.

When speaking of Cuba, the country can't boast the synergetic effect of economy for green energy. The strategy for its development of green energy is the following.

The first step is to encourage the private initiative in this sphere. In order to do that, the country can apply special energy tariffs for those, who produce green energy, the special trade tariff policy, which will stimulate the imports of the cheap green energy facilities' components, etc. The stimulative measures like subsidies aren't to be applied as the misuse of the financial resources is highly possible.

The second step is the tight partnership with those countries, which can support the Cuban energy sphere. For now, it's China, which provides massive investments in Cuban green energy for political reasons first of all.

The third step is to boost the production of biofuels for the needs of electricity generation. At the current stage, the major consumer of biofuel in Cuba is the automobile sector, so in order to boost green energy, the Cuban government should introduce the double tariff for fuel – the lower one for biofuel electricity generation and the higher one for automobile owners.

The fourth step is promotion of green energy among the citizens, so they can support the development of the sector both financially and by volunteering.

The fifth step is to develop the major guidelines for the industry. One of the major industries in Cuba is

the tobacco industry (Wikle, 2015) which has been generating a significant inflow of capital to the country. In the era of massive green energy transformation, the new strategy for the greener energy in the country is the gradual transfer of tobacco industry to the green energy, or the introduction of compensations tax for the industry in case it refuses to comply with the new standards of the greener energy and new technologies of cleaner future.

As a result of introduction of such strategy, Cuba can have a significant growth in green energy development in the next 5-7 years due to the formation of the tight bond between the social importance of the green energy development and its economic effects.

Conclusion

The development of green energy in the two countries is a very difficult goal, which needs weighted, but rapid decisions. The analysis of the green energy sphere in Cuba and Dominican Republic allows to figure out the two major paths of the green energy development in the Caribbean.

The first path is the Cuban one, which is proved to be less effective. It's the path from the central power to the local decisions. This path is less effective due to the issues with the financial regulation on Cuba, the difficulties with private property and private initiatives realization and the unclear future of the private projects on the island. The other negative side is the lack of external financial resources and the low availability of financial mechanisms for the green energy development.

The second path is the Dominican one. It includes the numerous market initiatives, the dependency of green energy development on tourism and the significant inflow of capital from foreign investors. It's based on the clear regulative framework and provides guaranties for the investment in the green energy.

The Dominican path also has a significant bonus – the development of green energy is synergetic with tourism and economic development. In this regard, the process of greening the energy sphere of the country will go automatically in case the country economy grows and the inflow of tourists rises too. Based on these two paths and the barriers, put forward by authors, the strategies of the green energy development were formed. These strategies use the synergetic effect for DR and aim at the structuration of the Cuban chaotic green energy initiatives. The results of these strategies' implementation are higher, if the measures, mentioned in them are taken in complex.

The authors have proved that in the Caribbean green energy can be interconnected with tourism and the development of one can boost the other, but in order this to be true, such interconnection is to be based on the economic and social benefits, that the countries and their population can receive from green energy.

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Samkhya Philosophy, Deep Ecology and Sustainable Development

Filozofia Sankhja, głęboka ekologia i zrównoważony rozwój

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Abstract

Samkhya philosophy is one of the oldest philosophies in the Indian philosophical system. This philosophy is independent in origin and mainly known for its evolution theory. Samkhya philosophy has accepted the two ultimate and independent realities, Nature and pure Consciousness. This paper is an attempt to comprehend the notion of deep ecology from the Samkhya's evolution theory perspective. In this paper, firstly, we have elucidated the Samkhya philosophy of suffering and the solution to the problem. In the second part of the article, we have argued that how Samkhya's philosophical notion of Nature demonstrates our embeddedness in Nature. Therefore, the idea of deep ecology is always there in one or another form in Samkhya philosophy. It has also connections to the idea of sustainable development.

Key words: Samkhya philosophy, deep ecology, ethics, religion, sustainable development

Streszczenie

Filozofia Sankhja jest jedną z najstarszych filozofii indyjskiego systemu filozoficznego. Ma niezależne pochodzenie i znana jest głównie z teorii ewolucji. Filozofia sankhji zaakceptowała dwie ostateczne i niezależne rzeczywistości: Naturę i czystą Świadomość. Niniejszy artykuł jest próbą zrozumienia pojęcia głębokiej ekologii z perspektywy teorii ewolucji Sankhji. Po pierwsze, wyjaśniamy filozofię cierpienia Sankhji i pokazujemy rozwiązanie problemu. W drugiej części artykułu dowodzimy, że filozoficzne pojęcie Natury stosowane przez Sankhję ukazuje nasze zakorzenienie w Naturze. Dlatego idea głębokiej ekologii jest zawsze obecna w tej czy innej formie w filozofii sankhji. Ma ona także powiązania z ideą rozwoju zrównoważonego.

Słowa kluczowe: filozofia Sankhja, głęboka ekologia, etyka, religia, rozwój zrównoważony

Introduction

The term deep ecology coined by philosopher Arne Naess (Edelglass 2009, p. 435). This concept is a fundamental and significant shift to see natural resources. An environmentalist is concerned with the decreasing condition of Nature, but they see the environment or natural world as different from the agent. Therefore, we exploit Nature to fulfill our desire for comfortable adaption, which has shaped the situation like global warming (Singh 2019, p. 57). One does not pay the attention to the ecosystem and

its significance. Because we have alienated ourselves from Nature. As a result, there are not enough natural resources are left for the future generation. In other words, we have reached to such point from there we are confused to proceed future as Nature has started giving dangerous sign which is a threat to human existence. The notion of deep ecology argues for our embeddedness in Nature. It means that we are not different from this Nature, and therefore, we will have to treat Nature equally. We have to understand the relationship between the natural world and hu-

mans from an ecocentric perspective (Prakash 2018, p. 218).

In India, many human actions are guided by religion. Again, there is an argument that Indian religion does not argue for Nature or sustainable development. Many scholars have argued that Indian religion is mainly for human suffering and its solution. Primarily, the ultimate reality or ultimate goal of life is discussed in Indian philosophy (Prakash 2018). In this paper, we will be discussing the Samkhya philosophy, which is one of the oldest philosophical systems in India and also independent in origin (Hiriyanna 2009, p. 267). It is said that this philosophy is as old as *Upanisads* (Hiriyanna 2009, p. 267; Sharma 2003, p. 149). Samkhya philosophy elucidates the number as the word *Samkhya* means number. This philosophy accepts the ontological dualism and argues for 23 categories to explain the universe.

In this paper, we have argued that Samkhya's philosophy of evolution supports the notion of deep ecology. Therefore, we have demonstrated that Samkhya philosophy does argue for the natural world and suggests for the balance behavior. If people are morally aware, then people can make a better world based on their wise action. Here philosophy and ethics are needed in the field of Sustainable Development. This paper is an attempt to elucidate that there is a need for philosophy and ethical teaching for sustainable development from a different religious point of view. We have taken Samkhya ethics for the analysis. Since Samkhya philosophy is the oldest system; therefore, the ethical and philosophical elucidation of the Samkhya is very significant for the contemporary debate on sustainable development.

The theory of evolution in the Samkhya philosophical system

Samkhya philosophy is the oldest philosophy of the Indian philosophical system, which is propounded by Kapila. However, Samkhya's philosophical text, namely *samkhyakarika* (350-450 AD), is the earliest authentic text available to Samkhya philosophy. This philosophy elucidates like other Indian religions, the main problem or, more precisely, the leading cause of human suffering and its solution. The feeling of sorrow is one of the most penetrating and challenging feelings in human life. Basically, for most of the Indian religion, life is the sum of countless sufferings. There are many different causes of this sorrow. Therefore, the human being has always sought ways to overcome or overcome this suffering. The various Indian philosophical ideas originate through this paradigm. *Samkhya* Philosophy is no exception. However, *Samkhya* philosophy is independent in origin. According to *Samkhya* philosophy, liberation is the extinction of happiness-sadness-ignorance. This emancipation is called *kaivalya*, and this is the supreme or absolute object of human pursuit. Accomplishing the happiness is the summum bonum of life

in *Samkhya* philosophy. This philosophy accepts the matter or nature (*Prakrti*) and pure consciousness (*Purusa*) as ultimate reality (Hamilton 2001, p. 117). However, both reality alone cannot produce the world. Because Nature is not intelligent, so it cannot create the world. And again, the pure Consciousness does not have a matter, so it cannot produce something which does not belong to it. Therefore, Nature needs the influence of pure Consciousness. This can be understood with a simile mentioned by Buddhist monk Buddhaghosa in his work. Buddhaghosa gives the analogy of a man who is blind by birth and a stool crawling or lame. Both of them wanted to go somewhere but they cannot go outside, since blind man cannot see and lame cannot walk. The blind man said to the person who cannot walk 'look, I can do what should be done by legs, but I have no eyes with which to see where is rough and smooth'. The crippled also express his problem and said 'look I can do what should be done by eyes, but I have no legs with which to go and come'. The blind man was delighted, and he made the cripple climb upon his shoulder. Sitting on the blind man's shoulder the cripple instructs him the path. Here the blind man has no efficient power to travel by his active power or by his strength. Again, the disabled person also has no active ability to move by his efficient power or by his strength. But there is nothing to prevent, their going when they support each other. (Nanamoli 1956, XVIII: 35). The same way, matter, and pure Consciousness are the leading cause of evolution. But Nature cannot produce the universe because it is not intelligent. And again pure Consciousness does not have matter. However, *Samkhya* philosophy has given independent status to both. Therefore, there is a debate over the starting process of this evolution. Because there is an argument that if both entities are independent than who compel them to come together for evolution. How it all started. However, we are not going to elucidate this here because this is the out of scope of this paper. Here it is significant to understand the nature of the matter in *Samkhya* philosophy. Nature (*Prakrti*) is comprised of the three substance or in other words matter is the equilibrium position of the three *gunas* namely, *sattva*, *rajas* and *tamas*. However, it is significant to note that they are not qualities but substance (Sinha 2015, p. 13). These three substances are significant in understanding the nature of the world and the cause of human suffering. The first quality, *sattva*, is the cause of pleasure, love, and joy. The second substance, *rajas*, produces all forms of grief, and finally, the third substance, *tamas*, is the cause of all kinds of delusion, laziness, and sleep (Sinha 2015, p. 13). Since the world is the manifestation of matter and the pure Consciousness, therefore, all three substance is present in every object of the world, and we perceive the object differently due to above mentioned three different substances. Now, it is significant to elucidate the evolution process. As we have discussed above,

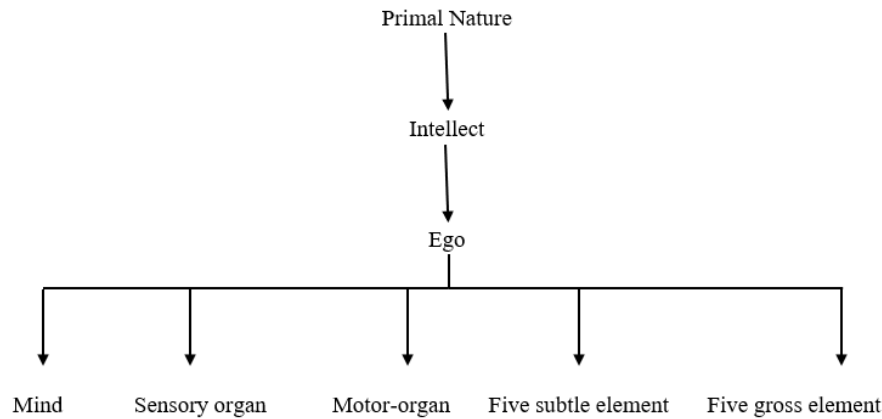


Figure 1. The evolution process

that Nature and pure Consciousness produce the universe, but how both realities come together is debatable. However, after the influence of pure Consciousness, Nature creates the world. The evolution process can be understood by the figure 1.

As we have shown in figure 1 that Primal Nature produces intellect and then ego. Here it is significant to note that Primal Nature is an equilibrium position of above mentioned three substance. However, ego function is the leading cause of ignorance, and these ignorances lead us to the cycle of birth and rebirth. It is significant to elucidate the notion of suffering in *Samkhya* philosophy. This suffering and attachment of the soul with the body is called bondage in *Samkhya* philosophy. Ignorance is the main cause of suffering. For *Samkhya* philosophy, human beings suffer in three different ways. Firstly, human emotion and passion caused physical disorder or mental agitation. Intra-organic, it is due to physical, mental, includes all kinds of bodily and mental suffering. Disease, anger, hunger, etc.. Second is called extra-organic caused by external influences, other human beings, animals, insects, birds, etc. And the last kind of suffering is caused by supernatural causes; this suffering is also due to external influences, but extraordinary causes like starts, earthquake, flood etc. (Sinha 2015, p. 73). The cessation of these three types of suffering is liberation in *Samkhya*. People have been searching for and inventing ways to get rid of this triple misery. It is said that although temporarily relieved of pathological grief in medicine, it does not eliminate pain. The grief comes to an end, but it does not mean that it is over. In the stimulation, that suffering begins again. Various philosophical communities have sought ways to end this suffering forever. In that case, many philosophers consider the theory to be the only way of salvation.

Though Indian philosophers thought liberation or liberation is the ultimate goal of life, they could not agree on the nature of liberation. *Samkhya*, philosophers believe that after attaining salvation, the creature has no doubts. But many philosophers also believe that salvation or liberation is not a state of happiness. Because happiness and sorrow are relative

terms, where there is no sorrow, there can be no happiness. There are two aspects to salvation.

On the one hand, salvation means liberation. On the other hand, many philosophers think of salvation as a state of happiness and sorrow. However, *Samkhya* philosophy argues for the right knowledge for the ultimate happiness. Ultimate happiness can be attained through realizing the Nature of pure Consciousness, and it is only possible through the right knowledge (Sharma 2003, p. 163).

So far, we have been discussing the *Samkhya* philosophy of Nature and pure Consciousness. In the next section, we have argued that how *Samkhya* philosophy has supported the western concept of deep ecology.

Samkhya Ethical Teaching, Deep Ecology and Sustainable Development

The main aim of this section is to argue for deep ecology from *Samkhya*'s perspective. As we have mentioned in the introduction that Indian religion is known for human suffering and its solution. In Indian philosophy, elucidation of the external world and Nature of humans are only stepping stones because the highest end of the philosophy is to guide the human for ultimate reality. Therefore, right thought and right action is a significant to all the religion. In this section, we have argued that *Samkhya* philosophy ethical teaching has great implication for sustainable development. We would like to pinpoint our argument as following:

(1) The word *Prakriti* can be understood in the western term 'nature' (Nath 2015, p.130). In this philosophy, as we have discussed, everything, for instance, mind, sense, organ subtle, and the gross element, is the product or evolve form Nature (Nath 2015, p.130). This is shown in figure 1 that sensory organs, motor organs five gross element and five subtle element are physical. Mind is also physical in character (Hiriyanna 2009, p. 274). Therefore, we as human being is the part of this ecosystem and that is very analogous to notion of the deep ecology. This philosophy had defended the very sense of ecology and

has argued that Nature is the cause of everything, and knowledge of this fact can lead us to happiness. In other words, if one is aware that he is not different from Nature but part and parcel of it, then he may not be able to exploit or extinguish the natural resources. Because abolishing natural resources means destroying oneself.

(2) *Samkhya's* ethics is intellectualistic (Sinha 2015, p.101). Moral life should be based on reasoning or knowledge. It argues that one has to understand or dispel the non-discrimination, and one has to act without the desire of its fruit (Sinha 2015, p.101). It is significant here to elucidate the nature of the action in *Samkhya's* ethics. For this philosophy, desire always forces us to perform certain activities, and actions produce the inclination towards something. Therefore, if one wants to break the chain and achieve happiness, then he has to act without the desire for any result. It means that one has to make sure that he is not going to perform any evil action. Here lousy action can be understood as harming other's life. Many other living beings is dependent on the natural world for their survival. Therefore, destroying natural resources means killing dependent living beings.

(3) As we have elucidated that Nature and Pure Consciousness is the main cause of the world. It means that the natural world is also the product of the same cause, and we are also part of the same chain. Therefore, alienation of ourselves from the natural world is not a precise model that is precisely analogous to the notion of deep ecology. Thus, the idea of deep ecology was always in *Samkhya* philosophy in one or another form.

(4) *Samkhya* philosophy believes in the cycle of birth and rebirth. This philosophy has argued that ignorance is the main cause of this problem. Due to ignorance and our ego function, our desire always lead us to the wrong action. For instance, we are using natural resources not only for basic needs but also for our extravagant life. This philosophy argues that our desire causes physical suffering. We are misusing natural resources to accomplish our desire, and this led to abolishing the stability of the natural world. As a result, human existence is in danger now. Therefore, one has to understand that rational thinking is significant before any act, and this logical thinking is always should be beyond our desire.

(5) For this system of philosophy, due to ego function, we believe that we are performing this action, or we are enjoyer (Zimmer 2005, p. 319). In other words, due to ego function, we believe that we are different for another living being. *Samkhya* philosophy argues that these are phenomenal experiences, and we are not separate from each other. Therefore, one has to always think of other pleasures and the significance of other's life.

(6) The practitioner of the system is in such a mental state where he does not think of his pleasure and pain. In other words, a person who is wise and does

not bothered by unpleasant events and is not over-powered by joy. It only means that he will not be harming any other living being for his pleasure and pain.

(7) *Samkhya* philosophy offers a complete practical solution to human suffering. One should control his desire because it creates an illusion and can impair the intellect. This philosophical system argues that an examination of thought is needed to purify the thought and take a significant step towards happiness. Pure happiness comes only with a wise act, and prudent action will not license for exploiting the Nature.

(8) *Samkhya's* philosophical analysis of the universe has demonstrated that ancient Indian philosophy has specified a substantial place to the Nature. This philosophy has acknowledged that primal Nature is the ultimate reality. Therefore, one cannot abandon the Nature or in other words, exploiting the natural resources can be hazardous for human existence. Because we are part of the natural world.

Conclusion

In this paper, we have argued that *Samkhya's* philosophy, the oldest philosophical system, of Nature is very similar to the notion of deep ecology. We have argued that there is an significant implication of this philosophy on sustainable development. This philosophy has demonstrated how Nature is the cause of everything. Therefore, we are part and parcel of this Nature. One cannot alienate himself from the Nature. We have also argued that how ego function led us for self-centric action and that is the main cause of our suffering. So if one wants happiness than he has to treat others in more rational way. In this paper, we have shown how Nature has got a significant place in the oldest Indian philosophical system. Therefore, we have to consider our action very seriously before the act. Since happiness is the main goal of our life, therefore, it is essential to treat natural resources in a controlled way, and we have to understand the significance of the Nature in our life. In concluding remarks, we can argue that the notion of deep ecology is always there in one or another form in *Samkhya* philosophy.

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Reproduction of Human Capital as a Strategic Priority for Sustainable Development of Regions

Wzrost kapitału ludzkiego jako strategiczny priorytet zrównoważonego rozwoju regionów

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Abstract

The main wealth of the country, its main strategic resource that can ensure political, economic, environmental, and spiritual growth, is human capital. Its intellectual, entrepreneurial, and productive potential, the ability to create and accumulate knowledge, implement it in the production of goods and services, develop unique technologies, invent new types of energy, materials, information, etc., is the engine of scientific and technological progress and innovative restructuring of the economy. Investment in human capital, in intelligence, in the health of the nation, in education and science, and in creating conditions for the normal functioning of everyone is a prerequisite not only for improving the quality of life of the people, but also for achieving the *Millennium Goals* and *Sustainable Development Goals*, advancing the country's development, and its social and political stability.

The research is aimed at developing theoretical, methodological, and practical provisions for the formation of strategic priorities for sustainable development of territories based on the reproduction of human capital. The theoretical basis was the available scientific works, certain provisions of normative legal acts, international framework documents, in particular from United Nations: *Agenda 21* and the report *Our Common Future*, as well as local studies like the Decree of the President of Ukraine Strategy for Sustainable Development *Ukraine-2020*.

The generalization of various scientific points of view regarding the category of human capital allowed us to establish that it is an integral part of its carrier, and therefore, it is proposed to understand as such a set of personal qualities of a person formed, developed, accumulated and preserved as a result of investments in productive abilities, personal qualities and motivational behavior of an individual, as well as the ability to develop and accumulate the necessary qualities that are in his property, which he uses in economic activities and which provides him with a corresponding income.

The article substantiates the value of the category human capital for sustainable development. The territorial features of the reproduction of human capital are determined, based on which it is proposed to consider the region as space. It is proved that the reproduction of human capital occurs in the relationship and interdependence with the general periods of the life cycle of the generation, which served to distinguish the four phases of the reproduction of human capital. The architectonics of determining the strategic priorities of sustainable development of territories based on the reproduction of human capital, which is aimed at solving theoretical, methodological, and applied problems, is proposed.

Key words: ecology, economy, society, sustainable development, human capital, reproduction, strategic priorities

Streszczenie

Głównym bogactwem kraju, jego głównym zasobem strategicznym, który może zapewnić rozwój polityczny, gospodarczy, środowiskowy i duchowy, jest kapitał ludzki. Jego potencjał intelektualny, przedsiębiorczy i produkcyjny, zdolność do tworzenia i gromadzenia wiedzy, wdrażania jej w produkcji towarów i usług, rozwijania unikalnych technologii, wynajdywania nowych rodzajów energii, materiałów, informacji itp. jest motorem postępu naukowo-technicznego i innowacyjności restrukturyzacji gospodarki. Inwestowanie w kapitał ludzki, w inteligencję, w zdrowie narodu, w edukację i naukę oraz w tworzenie warunków do normalnego funkcjonowania wszystkich jest warunkiem nie tylko poprawy jakości życia ludzi, ale także osiągnięcia *Celów Milenijnych* i *Celów zrównoważonego rozwoju*, w celu rozwoju kraju oraz wzrostu jego stabilności społecznej i politycznej.

Badania mają na celu wypracowanie teoretycznych, metodologicznych i praktycznych zapisów dla kształtowania strategicznych priorytetów zrównoważonego rozwoju terytoriów w oparciu o wzrost kapitału ludzkiego. Podstawą teoretyczną były dostępne opracowania naukowe, niektóre zapisy normatywnych aktów prawnych, międzynarodowe dokumenty ramowe, w szczególności ONZ: *Agenda 21* i raport *Nasza Wspólna Przyszłość*, a także opracowania lokalne, takie jak Dekret Prezydenta Ukrainy Strategia na rzecz zrównoważonego rozwoju *Ukraina: 2020*. Uogólnienie różnych naukowych punktów widzenia w odniesieniu do kategorii kapitału ludzkiego pozwoliło ustalić, że jest on integralną częścią jego nosiciela, a zatem proponuje się rozumieć jako taki zespół cech osobowych ukształtowanej osoby, rozwijane, gromadzone i utrwalane w wyniku inwestycji w zdolności produkcyjne, cechy osobiste i zachowania motywacyjne jednostki, a także zdolność do rozwijania i gromadzenia niezbędnych cech znajdujących się w jej własności, którą wykorzystuje w działalności gospodarczej oraz co zapewnia mu odpowiedni dochód.

Artykuł uzasadnia wartość kategorii kapitału ludzkiego dla zrównoważonego rozwoju. Określone są terytorialne cechy reprodukcji kapitału ludzkiego, na podstawie których proponuje się traktować region jako przestrzeń. Uodwodniono, że reprodukcja kapitału ludzkiego zachodzi w relacji i współzależności z ogólnymi okresami cyklu życia pokolenia, co posłużyło do wyodrębnienia czterech faz reprodukcji kapitału ludzkiego. Zaproponowano architekturę wyznaczania strategicznych priorytetów zrównoważonego rozwoju terytoriów w oparciu o reprodukcję kapitału ludzkiego, która ma na celu rozwiązywanie problemów teoretycznych, metodologicznych i aplikacyjnych.

Słowa kluczowe: ekologia, ekonomia, społeczeństwo, zrównoważony rozwój, kapitał ludzki, reprodukcja, cele priorytetowe

1. Introduction

Modern processes of development of society, and, consequently, the main components of its life activity, to a significant extent, depend on the implementation of the concepts of sustainable development. The development and dissemination of innovative (digital) technologies become an inevitable and necessary process, the result of which is manifested in the creation of new, progressive means of production and technologies. This, in turn, leads to the intellectualization of all spheres of human economic activity. As the world experience shows, the innovative development of the economic and social territorial space, first of all, depends on the quality of the available human capital, which becomes the main component of the *knowledge economy*. Modern trends in the creation and accumulation of new knowledge in all areas of science and technology provide not only a high educational, qualification, and cultural level of the individual, but also radically change his position in social production and social life, the basic model of which is the reproduction of human capital. Thus, the issues of the reproduction of human capital, as one of the main strategic priorities of sustainable development of territories, are relevant and require the development of a scientifically based mechanism.

2. Methodology

The theoretical and methodological basis of the article proposed for consideration was made up of early studies of scientists from different countries, generations, and areas of scientific interest since the theory and methodology of sustainable development are multifaceted and endless. Thus, the works of regional scientists and demographers were used in the formation of conceptual provisions regarding human capital and its development in the future.

In particular, the authors' opinions about the current priorities of socio-economic development are based on the research of N. G. Belopolsky under the scientific editorship of Academician of the National Academy of Sciences of Ukraine A. I. Amoshi, who proposed a new concept for the development of the world environ. (Belopolsky, 2020).

Scientific developments of the staff of the National Academy of Sciences of Ukraine N. Briukhovetska, L. Ivanenko, they determined the allocation of the values of the category human capital for sustainable development (Briukhovetska, Ivanenko, 2020). The work of the personnel of the Research Center for Industrial Problems of Development of the National Academy of Sciences of Ukraine allowed us to identify the main elements of the territorial space in the context of sustainable development.

The dependence of the reproduction of human capital with the general periods of the life cycle of the generation was established thanks to the scientific foundation of the fundamentalists Solow (Solow 1974), J. Hartwick (Hartwick, 1977), T. Page, I. Y. Blam, T. Titenberg, R. K. Turner, D. Pierce, G. Atkinson, N. Georgescu-Roegen, etc. whose works are the basis of the modern resource approach to the consideration of the problems of the development of socio-economic systems and contemporaries I. Bakhov, E. Boychenko, N. Martynovych, N. Streltsova, 2014, the articles of which raise the issues of the formation of the socio-cultural, educational levels of the individual in modern society. In particular, the research of N. Streltsova allowed us to identify the main phases of the reproduction of human capital, and the works of I. Bakhov (Bakhov, 2020), E. Boychenko (Boychenko, 2015), N. Martynovych (Martinovich, 2019) to establish the relationship between the economic, environmental and social components, the phases of the reproduction of human capital and the goals of sustainable development. The practical application of the proposed architectonics allowed us to display the grouping method, which involves the distribution of many units of the studied population: (the EU countries and Ukraine) into groups by the priority feature for each group.

The main conclusions regarding strategic priorities and prospects for sustainable development were made thanks to the fundamental research of P. Senge (Senge, 2008), A. Pawlowski (Pawlowski, 2015), A. Skowronski (Skowronski, 2003), as well as international framework documents, in particular: *Agenda 21* (Environment & Society Portal, 1987) and the report *Our Common Future* (WCED, 1987) prepared by the International Commission on Environment and Development of the United Nations.

The purpose of this study is to develop theoretical, methodological, and practical terms for the formation of strategic priorities for sustainable development of territories based on the reproduction of human capital.

3. Findings and Discussion

The results of the conducted research give grounds to assert that the essence of human capital is expressed in the following.

Firstly, it is a set of personal qualities of a person, which it is advisable to include his physiological characteristics: gender, age, level of health; intellectual characteristics: level of education, knowledge, professional skills and work experience, ability and motivation to receive additional education, professional skills, related specialties, etc.; cultural: the general level of personal culture, professional culture and ethics, and so on. Secondly, the formation, development, and preservation of the aggregate personal qualities of a person occur as a result of investments and the accumulation of a certain stock of

them. Thirdly, the use of human capital by its owner takes place to obtain a corresponding income (salary), depending on its quality. Fourthly, the development and preservation of human capital determines the growth of labor productivity, encourages further investment in human capital, and contributes to the growth of personal income (wages).

When defining the essence of the concept of human capital, it is important to understand that it is an integral part of its carrier. This feature has important theoretical and practical implications. Thus, for ordinary capital, there are two types of prices in the market: the assets and the flows of services that it provides. Human capital can only be rented (by hiring an employee), the person himself cannot be the subject of purchase and sale. Thus, it can be argued that there is only one rental price of human capital – wages. In all other respects, human capital is similar to physical capital, which is a boon of long-term use, but with limited service life.

Based on the above, human capital is understood as a set of personal qualities of a person formed, developed, accumulated, and preserved as a result of investments in productive abilities, personal qualities, and motivational behavior of an individual, as well as the ability to develop and accumulate the necessary qualities that are in his property, which he uses in economic activities and which provides him with an appropriate income.

The value of the category human capital for sustainable development is explained by the following reasons:

- ✓ in the concept of human capital, a person is considered in the unity of economic, social, and environmental aspects;
- ✓ looking at human health, knowledge, and abilities as income-generating capital, scientifically justify and proves the necessity and economic feasibility of investing in a person in various areas and at all levels;
- ✓ the concept of human capital characterizes a free person who is an equal agent in the labor market;
- ✓ the concept of human capital is the economic basis for the general humanitarian concept of sustainable development (Briukhovetska, Ivanenko, 2020).

The formation, use, and development of human capital in the context of the knowledge economy should be considered as the most important factor in the implementation of the concept of sustainable development, on the one hand, and the other, as a factor in the development of human capital itself, as a structural element of the economy.

Considering the territorial features of the reproduction of human capital, it should be noted that its formation and use in each territory takes place in the conditions of national, ethnic, religious, cultural and other traditions (Bakhov, 2020), (E. Boychenko, 2015), (N. Martinovich, 2019). The main elements

of the territorial space include: 1) territorial integrity, which in turn is considered through conglomeration (accommodates the mechanical connection of heterogeneous objects and objects) and potential (the possibilities of using available resources), and 2) the development of the territory, which involves the reproduction of potential, saturation with economic objects and connections, human resources, involvement in social production.

It should be noted that the territorial space determines the parameters of the geographical contour of the region, the structure of population settlement (territorial differentiation), the organization of the economy, infrastructure, and so on. Thus, the reproduction of human capital takes place in a certain territory, due to the natural and climatic habitat of its inhabitants.

At the same time, the territory is understood as a set of spatially coinciding parts of economic, social, natural resource, recreational, demographic, and other potentials. Territorial features of the reproduction of human capital with their specific conditions (geographical, natural and climatic, historical, economic, social, environmental, demographic, cultural, educational, etc.) affect the formation of the economic complex of the territory, which is a combination of industry, functional and territorial structure. It is the specific features of the economic complex that determine the structure of socio-economic relations of the reproduction of human capital.

The reproduction of human capital occurs in interrelation and interdependence with the general periods of the life cycle of a generation. It should be noted that a generation is a collection of people born in the same period (year). When considering a generation, it is important that all persons belonging to the generation in question experience physiological development, personality formation, and socialization simultaneously. It is advisable to consider the reproduction of human capital from the point of view of the following stages: natural reproduction of the population at a certain time, in a certain territory; accumulation of natural abilities, including the level of physical and mental health, intelligence, culture, morality, motivation, etc.; acquisition of the necessary educational, professional and qualification skills, knowledge and skills (Streltsova, 2014)

Based on all that has been said by the authors, a rendering of the relationship between the reproduction of human capital and the strategic priorities of sustainable development of territories is proposed in (Fig. 1).

The figure shows that the X, Y, and Z axes represent the components of sustainable development, in particular, the X-axis is the economic component of sustainable development, the Y-axis is the social component of sustainable development, and the Z-axis is the environmental component of sustainable development. All three axes are placed in

space, and allow you to display the territory (city, region, country) as space.

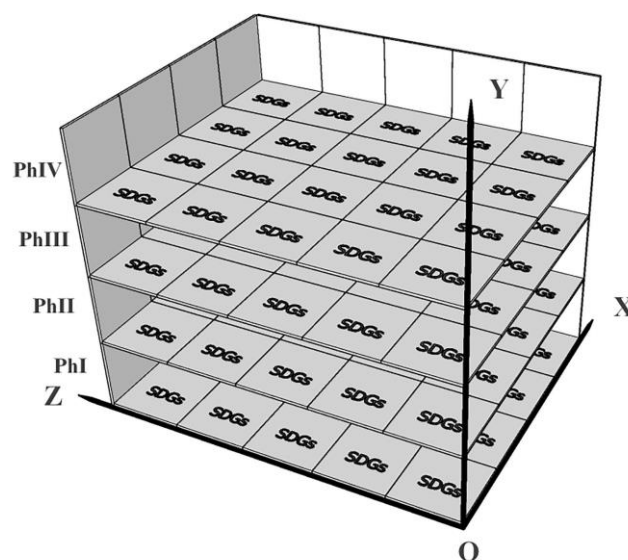


Figure 1. Architectonics of strategic priorities for sustainable development of territories, Author's development

On each axis of the components of sustainable development (economic, social, environmental), the phases of human capital reproduction are represented, which are indicated in the figure as PhI, PhII, PhIII, PhIV. These phases allow us to outline strategic priorities for the development of the territory based on the formation of priorities for the development of human capital since after a certain period (life cycle), priorities change. This is evidenced by the fact that before 2015 there were eight United Nations Millennium Development Goals, and after 2015 there were 17 Sustainable Development Goals (Official portal of the United Nations, 1987). It is possible that in the future, both the number and content of these goals will change, which in turn will affect the content of the strategic priorities and objectives of sustainable development of the regions of Ukraine. Relying on the current Millennium Goals, we concluded that the strategic priorities for the sustainable development of the regions of Ukraine should be aimed at achieving the following main objectives:

1. At the PhI formation phase:

- ✓ an increase in the birth rate, which will neutralize negative changes in the structure of the population, will stop the processes of depopulation and create conditions for its rejuvenation;
- ✓ reducing the outflow of the working-age population outside the territory, by improving the quality of life of the population, which will preserve the most competitive, educated, professional part of the population;
- ✓ increasing the coverage of children in extracurricular education is a prerequisite for intellectual, creative, and cultural development;

- ✓ improving the quality of general and vocational education by increasing its funding and adapting it to the needs of the labor market;
 - ✓ reform of the vocational education system based on the principle of justifying the need for specialists in the relevant professions and the level of education, which should be based on the prospective needs of the labor market.
2. In the PhII usage phase:
- ✓ creation of new jobs, which is the key to improving the quality of life of the population and the effective use of human capital;
 - ✓ creating conditions for professional mobility, which will allow to diversify the flow of specialists between sectors of the economy and provide employment for the population;
 - ✓ the creation of activities that will promote and motivate the self-employment of the population, solve the problem of jobs, increase the possibility of obtaining a stable income and economic development;
 - ✓ improving working conditions and jobs.
3. In the PhIII accumulation phase:
- ✓ creating conditions for lifelong learning, which is the basis for improving labor productivity;
 - ✓ creating conditions, promoting motivation to invest in the professional development of human capital at the personal micro-and macro-level.
4. In the PhIV conservation phase:
- ✓ creating conditions, promoting and promoting the motivation of the population to support a healthy lifestyle, physical activity, and disease prevention;
 - ✓ development of measures to reduce workplace injuries and occupational diseases;
 - ✓ development of social insurance (life, medical, and pension provision).

Before going directly to the sustainable development goals, their role and place in architectonics, as well as their relationship with other elements of the spatial model of territorial development (Figure 1), we will focus in more detail on the category of sustainable development itself. In the course of the study, it was found that the concept of sustainable development was first mentioned in 1987 in the report *Our Common Future*, which was prepared by the UN International Commission on Environment and Development under the leadership of Brundtland. The document notes that *sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs* (WCED, 1987).

At the same time, the analysis of the scientific points of view of various authors, regarding the interpretation of the concept of sustainable development, gives grounds to assert that the majority of scientists, the classical definition of sustainable development is not the interpretation of the International Commission on Environment and Development of the United Nations, but what is presented in the UN

Framework Document *Agenda 21: sustainable development is a model of the movement of humanity forward, in which the needs of the current generation of people are met without depriving future generations of this opportunity* (Environment & Society Portal).

In the Sustainable Development Strategy *Ukraine-2020*, the interpretation of the category is as follows: *this is the process of state development based on the coordination and harmonization of social, economic and environmental components to meet the needs of modern and future generations* (Official portal of the Verkhovna Rada of Ukraine, 2015).

Thus, based on the presented definitions, as well as taking into account the phases of human capital reproduction, it can be stated that the complex nature of these elements does not allow us to consider them separately from the sustainable development goals, as well as the fact that they are strategic priorities for the sustainable development of the territory. This thesis is reflected in the agenda for the twenty-first century, where it is stated: *that ensuring the reproduction of human capital (territorial community) is primarily the responsibility of the national government and requires the development of an appropriate national program and policy*.

All of the above explains the presence in the architectonics of the reproduction of human capital of the presence of the Sustainable Development Goals, which in (Fig. 1) are designated as:

- ✓ SDGs1 – Overcoming poverty in all its forms around the world,
- ✓ SDGs2 – Stopping hunger, achieving food security, improving nutrition, and promoting sustainable agriculture,
- ✓ SDGs3 – Ensuring a healthy lifestyle and promoting the well-being of people of all ages, ...
- ✓ SDGs17 – Reinvigorating and strengthening the global partnership for sustainable development

It is important to note that the positions of these goals may change depending on the characteristics of the regions, as well as the stages of the generation life cycle. The same applies to the density of connections, which can then weaken, then strengthen. To display the practical use of the proposed scientific and methodological tools, we will group the EU countries and Ukraine by individual indicators, namely: the level of population growth (decline), % (Pg/d); Life expectancy at birth, female (years) (LEBf); Life expectancy at birth, male (years) (LEBm); Labor force participation rate, female (% of female population ages 15-64) (LFPRf); Labor force participation rate, male (% of male population ages 15-64) (LFPRm); Unemployment rate, % to the economically active population (UReap); Average monthly salary (AMS); Gross Domestic Product Per Capital (GDPpc). This list of indicators allows you to group countries according to the priorities of sustainable development.

Pg/d	LEBf	LEBm	LFPRf	LFPRm	URcap	AMS	GDPpc
Pg/d 1	LEBf 1	LEBm 1	LFPRf 1	LFPRm 1	URcap 1	AMS 1	GDPpc 1
-1,4 – (-0,68)	76,73-78,38	66,7 – 69,19	56,2 – 60,47	71,3 – 73,55	19,3 – 16,4	267,1 – 1252,4	17,1 – 29,34
Lithuania (-1.4) Latvia (-0.9)	Ukraine (76.73)	Ukraine (66,7)	Italy (56.2) Poland (59.3) Romania (58.8) Greece (59.6)	Croatia (71.3) Poland (72.0) Belgium (72.1) Luxembourg (72.9) Ukraine (73.4)	Greece (19.3)	Ukraine (267.1) Romania (819.4) Lithuania (948.3) Hungary (1045.2) Latvia (1046.1) Hungary (1122.5) Croatia (1219.2) Slovakia (1242.7)	Ukraine (17.1) Croatia (21.4) Bulgaria (21.5) Greece (25.1) Romania (26.3) Hungary (26.4) Poland (26.6) Portugal (27.3) Slovakia (27.6) Latvia (28.0)
Pg/d 2	LEBf 2	LEBm 2	LFPRf 2	LFPRm 2	URcap 2	AMS 2	GDPpc 2
-0,68 – 0,04	78,38-80,03	69,19 – 71,68	60,47 – 64,74	73,55 – 75,8	16,4 – 13,5	1252,4 – 2237,7	29,34 – 41,58
Romania (-0.6) Bulgaria (-0.7) Romania (-0.6) Ukraine (-0.4) Italy (-0.2) Greece (-0.2) Italy (-0.2) Portugal (-0.2) Croatia (-1.0) Poland (0,0) Estonia (0,0)	Bulgaria (78.6) Romania (79.2) Hungary (79.6) Latvia (79.7) Slovakia (80.8)	Latvia (70.1) Lithuania (70.9) Bulgaria (71.5)	Ukraine (62.1) Croatia (62.3) Malta (63.6) Belgium (64.0) Hungary (64.1) Luxembourg (66.5)	France (74.0) Italy (74.8) Bulgaria (75.7) Cyprus (76.1)	Spain (15.3)	Czech Republic (1285.6) Estonia (1379.4) Portugal (1604.3) Greece (1632.1) Cyprus (2137.6) Slovenia (2230.9)	Estonia (30.0) Czech Republic (30.6) Lithuania (30.6) Italy (31.3) Spain (32.3) Cyprus (32.9) Slovenia (33.1) France (35.8) Finland (37.7) Malta (37.8) Belgium (39.9) Germany (41.1)
Pg/d 3	LEBf 3	LEBm 3	LFPRf 3	LFPRm 3	URcap 3	AMS 3	GDPpc 3
0,04 – 0,76	80,03-81,68	71,68 – 74,17	64,74 – 69,01	75,8 – 78,05	13,5 – 10,6	2237,7 – 3223,0	41,58 – 53,82
Slovakia (0,1) Slovenia (0,1) Czech Republic (0,2) Spain (0,2) Finland (0,2) France (0,3) Belgium (0,4) Germany (0,4) Austria (0,6) Netherlands (0,6) Denmark (0,7)	Lithuania (80.7) Croatia (81.5)	Romania (71.7) Hungary (72.7) Poland (73.7) Slovakia (73.9) Estonia (74.0)	Slovakia (66.2) Bulgaria (67.1) Ireland (67.1) France (67.4) Spain (68.5) Cyprus (68.5)	Greece (76.8) Romania (77.3) Hungary (77.3) Slovenia (77.8) Portugal (78.0)	Italy (10.6)	Spain (2642.0) Italy (2750,2)	Denmark (41.9) Austria (43.0) Sweden (44.1) Netherlands (46.3)
Pg/d 4	LEBf 4	LEBm 4	LFPRf 4	LFPRm 4	URcap 4	AMS 4	GDPpc 4
0,76 – 1,48	81,68-83,33	74,17 – 76,66	69,01 – 73,28	78,05 – 80,03	10,6 – 7,7	3223,0 – 4208,3	53,82 – 66,06
Cyprus (0.9) Ireland (1.1) Sweden (1.4)	Poland (81.7) Czech Republic (82.0) Estonia (82.7) Denmark (82.9) Germany (83.3)	Czech Republic (76.2) Croatia (74.9)	Czech Republic (69.6) Austria (71.3), Slovenia (71.9), Portugal (72.1)	Spain (78.3) Ireland (78.7) Lithuania (78.8) Finland (78.8) Latvia (78.9) Slovakia (79.0) Austria (79.6)	France (9.1) Ukraine (8.8) Croatia (8.4) Cyprus (8.4) Latvia (7.4) Finland (7.4)	France (3541.8) Germany (3713.6) Finland (3906.1) Sweden (3990,4) Austria (4034,2) Belgium (4127,2)	Ireland (57.3)
Pg/d 5	LEBf 5	LEBm 5	LFPRf 5	LFPRm 5	URcap 5	AMS 5	GDPpc 5
1,48 – 2,20	83,33-84,98	76,66 – 79,15	73,28 – 77,55	80,03 – 82,28	7,7 – 4,8	4208,3 – 5193,6	66,06 – 78,3
Hungary (1.5)	Netherlands (83.4) Belgium (83.9) Ireland (84.1) Austria (84.1) Sweden (84.3) Slovenia (84.4) Greece (84.4) Portugal (84.5) Finland (84.5) Luxembourg (84.6) Malta (84.6) Cyprus (84.8)	Portugal (78.3) Slovenia (78.5) Germany (78.6) Denmark (79.1) Greece (79.3)	Germany (74.0) Latvia (74.4) Denmark (75.1) Netherlands (75.1) Lithuania (75.9) Finland (76.3) Estonia (75.7)	Denmark (80.8) Estonia (82.0)	Portugal (7.0) Slovakia (6.5) Sweden (6.3) Lithuania (6.2) Belgium (6.0) Ireland (5.8) Luxembourg (5.5) Estonia (5.4) Bulgaria (5.2) Denmark (5.1) Slovenia (5.1) Austria (4.9)	Netherlands (4401.6) Ireland (4435.6)	
Pg/d 6	LEBf 6	LEBm 6	LFPRf 6	LFPRm 6	URcap 6	AMS 6	GDPpc 6
2,20 – 2,92	84,98-86,63	79,15 – 81,64	77,55 – 81,8	82,28 – 84,5	4,8 – 1,9	5193,6 – 6974,1	78,3 – 90,54
Luxembourg (2,2) Malta (2,8)	Italy (85.6) France (85.9) Spain (86.3)	Finland (79.1) Austria (79.4) Belgium (79.4) France (79.7) Luxembourg (80.1) Netherlands (80.3) Malta (80.4) Ireland (80.5) Spain (80.7) Cyprus (80.9) Sweden (80.9) Italy (81.2)	Sweden (81.0)	Czech Republic (83.2) Netherlands (83.4) Germany (83.4) Malta (84.3) Sweden (84.4)	Romania (4,2) Poland (3,9) Netherlands (3,8) Malta (3,7) Hungary (3,7) Germany (3,4) Czech Republic (2,2)	Denmark (5487.1) Luxembourg (5988.8)	Luxembourg (88.2)

The number of groups (n) was determined by the Sturges formula (formula 1):

$$n = 1 + 3,322 \cdot \lg N, \quad (1)$$

where N – the number of units of the population.

Based on the grouping of the EU Member States and Ukraine has formed six groups (table. 1).

The length of the interval (i) in the groups was determined by (formula 2):

$$i = \frac{X_{\max} - X_{\min}}{n}, \quad (2)$$

where X_{\max} – the maximum value of the attribute in the aggregate;

X_{\min} – the minimum value of the attribute in the aggregate.

Presented in Table 1 analysis, allows you to determine the priorities of sustainable development. Such details can be made separately for each component of sustainable development, as well as for each goal within the framework of programs for implementing sustainable development in the region (country).

Thus, the architectonics presented in Figure 1 allows us to visualize the main conceptual provisions of the author's vision regarding the relationship, interdependence, and interaction of such elements as the economic, environmental, and social components of sustainable territorial development, the goals of sustainable development, and the phases of human capital reproduction. Also, the author's development makes it possible to present the territory as space. This approach, according to the authors, is the most appropriate in the current conditions of the development of the regional economy. The proposed architectonics is aimed at solving several problems at once, both theoretical and methodological and applied.

4. Conclusion

The overall strategic priority of the socio-economic development of any territory should be the creation of conditions for the comprehensive development of a person, improving his well-being, ensuring a long and healthy life, since it is by the level of human capital development that one can judge the level of socio-economic development of the country as a whole.

It is proved that the establishment of deadlines for the implementation of programs and strategies for the sustainable development of territories should take into account the specifics of the reproduction of human capital. Taking into account the fact that all the processes taking place a large time lag, when determining priorities for the implementation of programs and strategies for the development of territories for each of the phases of the reproduction of human capital, it is advisable to take into account the duration of the stages of the life cycle of the generation.

A theoretical and methodological understanding of the architectonics of human capital reproduction is proposed, which, unlike the existing ones, is represented by a triad of components, namely: elements of sustainable development (economic, environmental, social); phases of human capital reproduction (formation, use, accumulation, preservation) and

sustainable development goals, which, on the one hand, allows a comprehensive approach to the formation of strategic priorities for the development of Ukrainian regions, and, on the other, to integrate with other territories in the direction of global development. The conceptual provisions of the architectonics of human capital reproduction as a strategic priority of sustainable development of territories contributed to the substantiation of the methodological principles for assessing the strategic priorities of sustainable development of territories, which in turn allowed to form the structure of the methodology for assessing the strategic priorities of sustainable development of territories.

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Environmental Aspects of the European Experience in Landscape Planning

Środowiskowe aspekty europejskiego doświadczenia w architekturze krajobrazu

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Abstract

Understanding all the possibilities of environmentally oriented landscape planning will contribute to the effective environmental planning of the territory and nature management in general. Accordingly, the purpose of the study was to investigate the experience of the European countries towards the introduction of an effective system of environmentally oriented landscape planning and improvement of territories, as well as their protection. For this purpose, it is necessary to comprehensively study the strengths and weaknesses of existing developments in the field of environmentally oriented landscape planning in Europe. An analysis of the best practices of environmentally oriented landscape planning in such countries as Great Britain, France, Germany, the Netherlands, etc. has been conducted. The findings allowed to state that the effectiveness of development and implementation of substantial planning for landscape design depends not only on the volume and depth of research, but to a very large extent from their reasonable and productive organisation. The paper summarises that in environmentally oriented landscape planning, it is first necessary to determine the reasons for planning. Before choosing the object and territory of planning, it is necessary to find out: who are the potential customers and investors – their goals and motivation; what are the problem situations and conflicts in nature management in the area; what is the practical use of the results of landscape planning; the purpose of the territory, including cartographic; the availability of source information, and more. And then make decisions regarding the stages of landscape planning, taking into account the environmental component and, accordingly, the implementation of the idea of landscape planning.

Key words: landscape, natural areas, landscape planning, ecology, environmental protection

Streszczenie

Zrozumienie wszystkich aspektów architektury krajobrazu zorientowanej na środowisko przyczyni się do efektywnego planowania środowiskowego terytorium i ogólnie do zarządzania przyrodą. W związku z tym celem badania było zbadanie doświadczeń krajów europejskich w zakresie wprowadzenia efektywnego systemu architektury krajobrazu zorientowanej na środowisko i poprawy obszarów, a także ich ochrony. W tym celu konieczne jest kompleksowe zbadanie mocnych i słabych stron istniejących rozwiązań w dziedzinie architektury krajobrazu zorientowanej na środowisko. Przeprowadzono analizę najlepszych praktyk architektury krajobrazu w takich krajach jak Wielka Brytania, Francja, Niemcy i Holandia. Wyniki pozwoliły stwierdzić, że skuteczność opracowania i wdrożenia planowania merytorycznego do projektowania krajobrazu zależy nie tylko od zakresu i głębokości badań, ale w bardzo dużym stopniu od ich racjonalnej organizacji. Stwierdzono, że w planowaniu krajobrazu zorientowanego na środowisko najpierw należy określić przyczyny planowania. Przed wyborem przedmiotu i terenu planowania należy dowiedzieć się: kim są potencjalni klienci i inwestorzy – ich cele i motywacja; jakie są sytuacje

problemowe i konflikty w zarządzaniu przyrodą na danym terenie; jakie jest praktyczne wykorzystanie wyników planowania krajobrazu; cel terytorium, w tym opis kartograficzny; dostępność informacji źródłowych itp. Następnie należy podjąć decyzje dotyczące etapów planowania krajobrazowego z uwzględnieniem komponentu środowiskowego w celu odpowiedniej realizacji idei architektury krajobrazu.

Słowa kluczowe: krajobraz, obszary naturalne, architektura krajobrazu, ekologia, ochrona środowiska

Introduction

Landscape planning, including environmental, emerged in the field of landscape architecture in the last century, its principles and methods have become especially popular in conditions of aggravation of ecological situations and the need for their territorial and organisational solution (Kolbovskij, 2008; Lin et al., 2020). Today, environmentally oriented landscape planning is considered as a set of procedures and methods aimed at ensuring the territorial organisation of society in specific landscapes to achieve sustainable use of nature and preserve all the landscape functions. In accordance with the wording of the above, the object of this type of planning is a landscape, or a set of landscapes that are located in a certain area. In addition, territorial economic systems and infrastructure facilities located on it must be taken into account. A key feature of the importance of landscape planning is that it is performed based on special spatial planning, assessable methods that characterise the ability of landscapes to perform the outlined functions.

In this context, landscaping, including its environmental component, acts as an independent spatial planning process, which in certain conditions and, based on the objectives, can be integrated with spatial planning (Braga et al., 2020). In addition, certain criteria for successful landscaping, which are primarily focused on the protection and targeted use of landscapes, are included in territorial development projects and become mandatory in their implementation. An example is the experience of Germany, where spatial planning is carried out in conjunction with landscape planning. Landscape planning complements the territorial planning through landscape programmes at the public land level and general landscape plans at the regional and local levels. In different European countries, spatial planning is considered as environmentally friendly planning, a variety of which is landscape planning. In turn, it comes in the following forms: part of territorial planning; independent environmentally oriented land use planning; method of integration of environmental requirements in sectoral planning; combination of the listed forms.

The accumulated experience and specific models of landscape planning in European countries, despite the natural and socio-economic differences between them, show that this type of planning is aimed primarily at solving landscape and environmental problems and has a pronounced ecological orientation.

To date, there are still quite common opinions among experts in the field of territorial planning that the landscaping is concerned mostly with the land-use, using a landscape approach. This approach is to use landscape maps, structural and functional features of landscapes of different taxonomic rank, as well as the idea of landscapes as territorial complexes integrating natural and economic components. In this case, this refers not to a special landscape planning, but only the use of landscape approach when creating different plans for territorial development (Antipov, 2005). In each structural and information block of the territorial scheme, the functional roles of the landscape approach are ambiguous and differ significantly. Its main role is manifested in the study of the natural structure of territorial formation, spatial distribution of natural resources, development of tasks and measures for nature protection. In general, this is a natural block of the project, where the basic value should be given to the analysis of the landscape structure of the territory, which necessitates the use of a map. At the same time, landscape planning constitutes an independent type of territorial planning activity, where the basic object of planning are the landscapes, environmentally oriented planning, and ecological indicators of territories.

Landscape territorial organisation implies the accounting for the properties of a particular landscape in the development of nature and assessments of its resilience to a certain type of load, the degree of transformation, environmental resources, and ecological network, including protected areas. Its analysis is carried out on the basis of landscape information, which includes individual components and integral properties of landscapes through the consideration of various spatial models of the landscape – morphological, positional and dynamic, positional and genetic, biocentric, basin and landscape dynamics, visual and aesthetic, etc. Although the study focuses on the experience of European countries, as an example of such landscape planning the North American method METLAND can be considered, which is used in urban planning as well as the Australian method SIRO-PLAN and LUPplan. Among the European methods, there are Dutch method APA, Slovakian LANDEP, methods of landscape-adaptive agriculture used in Russia, Ukraine, Moldova, Belarus, as well as methods of landscape planning used in the organisation and functional zoning of protected natural areas and certification of forestry enterprises (Rod'kin et al., 2008).

A key feature of landscaping is that it is based on and carried out using a considerable amount of landscape information, which contains:

- analysis of the study of the spatial structure and condition of landscapes, their natural resource and aesthetic potentials;
- analysis of the resistance of landscapes to external anthropogenic influence, the effectiveness of their socio-economic, environmental and other functions;
- recommendations for changing, limiting, or expanding the above functions;
- recommendations for optimising the territorial structure of landscapes and preventing environmental hazards and threats to landscapes;
- recommendations for improving the use, transformation, reclamation, conservation, care and regulation of landscapes;
- search for optimal steps to resolve the conflicts of nature in different types of landscapes.

Thus, the understanding of all the possibilities of environmentally oriented landscape planning will contribute to the effective ecological planning of the territory and nature management in general. Accordingly, the purpose of the study was to investigate the experience of the European countries towards the introduction of an effective system of environmentally oriented landscape planning and improvement of territories, as well as their protection. For this purpose, it is necessary to analyse the strengths and weaknesses of the existing developments in the field of environmentally friendly landscape planning in Europe.

Literature Review

An important stage of the study is to consider the ideas of the leading experts on the issue of landscape planning, taking into account the environmental component of this process. Landscapes are closely related to human well-being, but they are undergoing rapid and fundamental changes (Plieninger et al., 2015). Understanding the social transformations underlying these landscape changes, as well as the environmental and social consequences of landscape transformation, are key areas for landscape research. Within the framework of the study, six important areas of landscape research in Europe were reviewed and findings were synthesised. These findings can contribute to the study of ecosystem and societal changes, as well as key thematic priorities. These are six categories, namely: the relationship between people and the environment in landscapes; the structure of the landscape and the degree of land use; the history of the landscape; the driving forces, processes and actors of landscape transformation; significance of landscapes; and landscape management. Notably, these areas of knowledge can contribute to the study of changes in ecosystems and society, given the embedded multi-scale dynamics of socio-ecological systems; management of these systems and their

ecosystem services; and the relationship between ecosystem services, human well-being, wealth and poverty. The synthesis method suggests that knowledge of past and present landscape models, processes, and dynamics provide guidelines for the development of support for sustainable management of socio-ecological systems in the future.

An integrated approach to landscape management is generally accepted, but its application is not at the desired practical level. Sectoral approaches to decision-making and planning processes still dominate. Izakovičová et al. (2019) deals with some aspects of integrated landscape management in Slovakia. The study reflects the current state of longstanding efforts and experience of the authors to integrate environmental knowledge into landscape management tools. The main methodological procedures required to achieve this goal is to analyse, compare, and confront the existing principles and tools used in the applied ecology of the landscape, as well as in legislation and planning practice. The landscape ecological base for the implementation of scientific advances in landscape management consists of two methods: landscape and ecological planning, and ecological network planning. These two methods have been introduced into nature protection legislation, territorial planning, watershed management, land use planning, forestry planning and flood prevention management. Such systematic landscape environmental norms in the practice of planning can be considered the basis of sustainable development.

Alizadeh & Hitchmough (2019) indicates that urban landscapes play a significant role in supporting municipal, ecological and social systems. In addition, valuable environmental services and urban greenery provide social and psychological services that are very important for the livelihoods of modern cities and the well-being of urban residents. Admittedly, green spaces in the city, the method of urban landscape design and access to urban greenery can potentially affect the health, happiness, comfort, safety and security of urban residents. The urban landscape plays an important role in providing wildlife habitats, and an important type of vegetation for this is the plant-rich herbaceous vegetation that provides pollen and nectar, as well as the physical natural environment for the local fauna. Any factor that affects the urban landscape (such as climate change) will affect people's lives directly or indirectly. There is a universal consensus that temperatures have risen in most parts of the world over the past century, so the purpose of the Norton et al. study (2016) is the impact of climate change on the urban landscape. Effective biodiversity planning in large cities is becoming increasingly important as urban areas and their populations grow both to achieve conservation goals and because environmental communities support the services on which people depend. Landscape ecology provides an important framework for understanding and conserving urban biodiversity both

within cities and in the regional context. It has played an important role in developing a significant and expandable body of knowledge about urban landscapes and communities. City-wide characteristics, including size, total greenery, age, and regional context, are important considerations for understanding and planning biotic assemblies across cities, but have received relatively little attention. The study of urban biodiversity is broader in scope and shows that long-standing principles on how the size of site, configuration, and composition affect biodiversity in urban areas. However, the subtle spatial scales in which urban areas are fragmented and the changed temporal dynamics compared to non-urban areas indicate the need to apply hierarchical multiscale models of landscape ecology to the urban environment. Transferring the analysis of urban landscape biodiversity into planning activities remains a challenge due to the requirements for urban green spaces to provide a variety of functions. An increasing set of tools is available for this problem, requiring environmentalists to work with planners to address biodiversity issues. Conserving and improving biodiversity is only one area of urban planning, but it is becoming increasingly important in a rapidly urbanising world. Janssen & Knippenberg (2012) emphasises that cultural landscapes are understood as a process aimed not only at protecting and preserving territories and natural resources. The new concepts and strategies for nature parks in the UK, France, and Germany propose to consider cultural landscapes in general and protected landscapes in particular, as well as a force to promote sustainable (regional) development. The concept of development and change is a key component of the very concept of sustainable development. This means preserving opportunities, as well as creating new resources for future generations. To implement sustainable territorial development, the emphasis in protected landscapes shifts from maintenance to development. As a result, landscape conservation strategies not only protect the cultural and natural heritage of cultural landscapes, but also enhance territorial dynamics that improve and reclassify territorial values such as (regional) identity and nature. Sustainability is increasingly positioned in the nature of changes, rather than in terms of any optimal state, model, or plan. Common historical roots, special landscape features, typical products, cultural traditions, as well as innovative projects are possible starting points for processes based on identity. In connection with the organisation of management, cultural landscapes can be recognised as arenas for sustainable development. As a result, cultural landscapes are not only goods and services that are of public interest and directly affect the social well-being of people, but also represent important assets for the development of cities and rural areas. Cultural landscapes are part of the capital of the region and the basis for the development of rural communities.

Considering the experience of landscape planning and environmental protection in European countries, Kartashov (2016) suggests that special attention should be paid primarily to areas that develop environmental democratic approaches. This is a combination of initiatives, mechanisms, funds, research programmes, and existing information to preserve the development of landscape and natural biodiversity; transparency of ecological information, and public participation in the decision-making process on issues related to environmental protection. Ustinova & Aylikova (2019) suggests that environmentally oriented landscape planning is a strategic mechanism of European landscape planning, which ensures the implementation of the principles of sustainable development in territorial policy. The importance of environmentally oriented landscape policy is emphasised in the Guiding Principles of Sustainable Spatial Development of the European Continent, which notes that successful territorial development requires inclusion of landscape development issues in territorial planning and sectoral programmes and implementation of integrated policies aimed at simultaneous protection, management, and planning of landscapes. Due to environmentally oriented landscape planning it is possible to optimise the relationship between the population of European countries and natural components within specific areas. Such areas, in turn, are considered as components of a multilevel spatial system population – environment at local, regional, national, and transnational levels.

Kyvelou et al. (2019) aims to consider various ideas about the landscape and also demonstrates the ways in which the European Landscape Convention (ELC) of the Council of Europe (CE) contributes to the impact on national territorial planning systems. The study, which is interested in considering the effectiveness of landscape policy from a territorial standpoint, summarises the perception and understanding of the landscape as a link between nature and culture and reviews the literature to support the perspective of the European landscape model. Ultimately, it critically examines the Greek government's approach to landscape planning and management, revealing the catalytic role of the Council of Europe in revitalising the landscape dimension in Greece. The results indicate that this process has given a new impetus to territorial planning in Greece, providing a tool for management and coordination and evacuation policy, positively influencing the evolutionary paradigm of territorial planning. In addition, a decentralised approach has been adopted, identifying landscapes of particular value at the regional level in order to give them priority in terms of implementing coordinated governance mechanisms and management actions. The handbook titled *Landscape planning and ecosystem services in Europe and beyond* (Wende, 2019) is relevant for landscape planners and architects. But it is also useful for environmentalists and geographers,

whether they are still studying or just starting their careers. This guide offers an extremely clear overview of the world of landscape planning and ecosystem services, gathering contributions from more than 45 international experts. It is noted that landscape planning and landscape policy play a significant role in Europe. Referring to the European Landscape Convention (2000), landscape planning should assess the natural and cultural resources and the cultural character of landscapes. It should identify and evaluate land use patterns, including the assessment of ecological and landscape aesthetic conflicts. Landscape planning should then define the quality objectives of the cultural landscape and establish conservation and development measures. Monitoring, public participation and communication on landscape issues are also important factors addressed by the European Landscape Convention. The results of landscape planning should be included in general strategic territorial planning tools, such as regional plans and/or local zoning plans. The main challenges for all countries that have signed and ratified the European Landscape Convention are to establish planning policies and tools as such, as well as to establish specific assessment methods. Here, the concept of ecosystem services can be useful in meeting the methodological requirements of the Convention on Landscape and Natural Resources Assessment.

Brus et al. (2015) covers the restoration of landscapes that have been degraded in due to the extraction of minerals. Surfaces that are directly affected by mining and post-mining operations have become prominent in the field of restoration ecology. It is important to have a deeper understanding of sustainable landscape management in lowland European cultural landscapes. Sand and gravel sites have been selected as study sites where mining has been a major factor in land use in recent decades. Recovery after mining for each mining site was planned in accordance with the legally imposed technical and biological recovery protocols, as well as a specific document called the Biological Action Plan (BAP). The financial costs of BAP for individual research sites were compared with the monetary value of habitats over three time periods. The economic assessment was based on the method of assessing the environmental damage, conducted in Hesse (Germany). The findings suggest that the ecological restoration of areas after mining can lead to a higher monetary value of restored habitats compared to the original habitats that were destroyed by mining. Maksymenko (2012) the estimation of a modern stage of development of landscape planning in Ukraine is carried out. Problems of landscaping are addressed. The possibilities provided by the implementation of landscape planning procedures for ecological landscaping are outlined.

Elizbarashvili (2019) focuses on environmentally oriented landscape planning in the countries of south-eastern Europe. Javakheti National Park is a

part of the plateau of volcanic origin, located between Georgia, Armenia, and Turkey. Javakheti is of particular cross-border importance due to its very high-altitude wetlands and high plateaus, which are the crossroads of bird migration routes between Europe, Asia, and Africa. According to international environmental standards, the Javakheti wetlands could potentially be included in the Ramsar Convention Area since Georgia signed the Ramsar Convention in 1996. Currently, Javakheti ecosystems need to be protected, maintained, improved, and developed, preferably based on sustainable development and environmentally oriented landscape planning. There are several existing or proposed protected areas in the Javakheti protected area, including Borjomi-Kharagauli National Park, Mtirala National Park, Nedzvi and Tetrobi Reserves, the proposed Machahela National Park, Arpi Lake National Park (Armenia) and others. The creation of new protected areas in Javakheti and their connection to other existing protected areas through ecological corridors would not only serve the purposes of regional and cross-border cooperation, but would also serve as a prerequisite for creating an integrated network of protected areas of different categories in the region.

Materials and Methods

Existing literature data on the experience of environmentally oriented landscape planning in the European countries was used as study materials. The methodological basis of the study included general scientific and geographical methods of inquiry. The methods and principles of geosciences were applied, such as genetic, cartographic, comparative methods, the principles of causation. General scientific methods include historical, logical, structural-functional, statistical analysis. The methodology is also based on the system and process approaches. It is necessary to make a brief description of the basic methods of research. When using the cartographic method, the basis is a map or a set of maps that allow analysing existing landscapes, as well as making important corrective elements to the new landscape planning. Mapping is often combined with mathematical approaches. The comparative method of landscape and ecological research in combination with the method causal relationships allow singling out the main effective mechanisms among many existing approaches. The structural-functional and system analysis allow structuring data into complex algorithms of effective environmentally oriented landscape planning.

In addition, when studying the issues of environmentally oriented landscape planning and solving corresponding specific problems, the following methods can be used: ecological and economic balance of the territory, which is based on the analysis of the land use; assessment of the anthropogenic load, where for each category of land a certain score is awarded de-

Table 1. List of European countries that have signed and ratified the European Landscape Convention

Countries that have signed the European Landscape Convention	Countries that have ratified or approved the European Landscape Convention
Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Greece, Ireland, Italy, Lithuania, Luxembourg, Malta, Moldova, Norway, Poland, Portugal, Romania, San Marino, Slovakia, Slovenia, Spain, Sweden, Switzerland, Armenia, Azerbaijan, the Republic of Macedonia, Turkey, Ukraine	Belgium, Norway, Denmark, Czech Republic, Croatia, Ireland, Poland, Slovenia, Lithuania, Moldova, Portugal, Romania, Bulgaria, San Marino, Armenia, Republic of Macedonia, Turkey

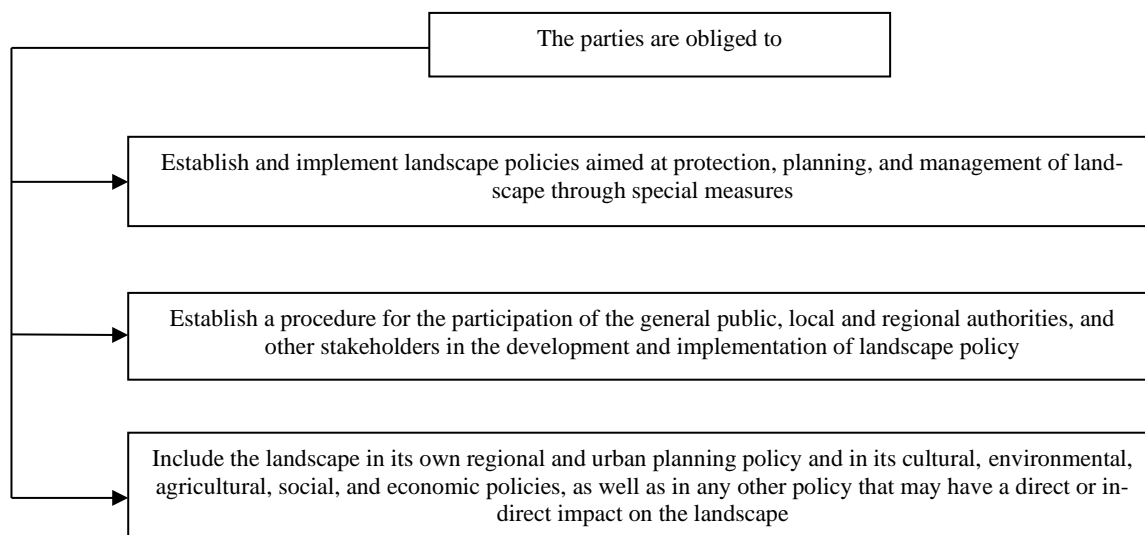


Figure 1. Obligations of each of the parties that have signed the European Landscape Convention

pending on the man-made impact; analysis of natural risks in which the frequency and intensity of the main types of natural risks are reflected; calculation of the ecological potential of the territory can be carried out by the territorial differentiation of the ratio of heat balance and humidity coefficient, etc.

The algorithm that is used in this study is aimed at analysing the existing experience of landscaping and environmentally oriented territorial planning in Europe. Therefore, in addition to the above methods, analysis and synthesis of information resources is necessary for the corresponding systematisation of the received information. European countries with high resource and natural potential and rich landscape diversity were selected for the study. Accordingly, the result of the study will be generalised recommendations for environmentally friendly landscape planning based on the best practices of the European countries. Dynamic changes in the landscape structure affect the number and distribution of organisms (Machar, 2020). Today, change in the land use is one of the main forces affecting ecosystem services in landscapes around the world. Human activity is transforming the earth faster and more than ever before in history. Human transformation of natural habitats and land use change is not only a local/regional phenomenon, but can be seen as one of the important global change factors. Some of the effects of global change on biodiversity can only be studied on a landscape scale, such as climate change in plant areas. The landscape perspective contributes to a multi-scale approach to sustainable landscape

management and landscape planning. In addition, the landscape scale is very useful for the innovative application of the general management paradigm for reusability in agriculture, forestry, and water management. Therefore, the need for sustainable landscape management and planning is urgent. Landscape conservation seems to be a new paradigm for biodiversity conservation.

Results and Discussion

First of all, it is necessary to note the contribution of the European Landscape Convention to the development of landscape planning in Europe. The member states of the Council of Europe have signed the European Landscape Convention (2020) to achieve sustainable development based on a balanced and harmonious relationship between social needs, economic activity, and the environment. 30 European countries have signed the European Landscape Convention, of which 17 have ratified or approved it. Table 1 lists the European countries that have signed and ratified the Convention.

The Convention states that the landscape plays an important social role in the cultural, environmental, and social spheres; is a resource for economic activity and its protection, planning; its management can help create new jobs.

Since the landscape is a fundamental component of the well-being of a person and the population of any country, the members of the Council of Europe, taking into account the rights and responsibilities of

each individual, adopted a number of fundamental points in the Convention:

- 1) *landscape* is a territory (in the sense of how it is perceived), the nature of which is the result of the interaction of natural and (or) human factors;
- 2) *landscape policy* is the expression by the competent authorities of general principles, strategies, and guidelines to enable specific conservation, landscape planning, and management measures to be taken;
- 3) *landscape planning* is a proactive and forward-looking activities to improve, restore, and create landscapes.

The main obligations of each of the parties that have signed this convention are indicated in the list which is shown in Figure 1. Environmentally oriented landscape planning in individual countries of the European continent has its own characteristics and specific features. Therefore, within the framework of the study, the experience of some countries will be considered to summarise their practices and trends in the development of landscape planning. Separate models and mechanisms of environmentally oriented landscape planning in different countries in most cases reflect the specific features of the political system, the problems of environmental protection of these states, as well as the specifics of territorial planning.

Landscape planning in Germany emerged in the late 19th century as a reaction to the industrialisation and destruction of nature. Thus, about 90% of Germany's forests are secondary, man-made forests. Admittedly, deciduous species were almost completely replaced by conifers. In the federal law of 1976, landscape planning was legally enshrined as a planning tool for landscape protection and care. This tool exists in practice not only at the federal but also at the regional level. Considering the main tasks of landscape planning, they are focused on assessing and identifying the functions and properties of the landscape, as well as in developing proposals for sustainable conservation of air, water, lithosphere, climate, plants and animals, and most importantly aesthetic features of the landscape. Sustainable development of landscape planning in Germany has led to the fact that 26.9% of the country's area is protected natural areas. This has a positive effect on the overall environmental situation in the country (Mo et al., 2021). The German experience of landscape planning is a component approach to landscape analysis (soil, water, climate, lithological basis, fauna and flora). The most valuable methods in it are the detection and analysis of conflicts of nature management and assessment of the landscape according to the criteria of significance and sensitivity.

Environmentally oriented landscape planning in the Netherlands, unlike in Germany, has no deep traditions. This area is the most advanced in the protection of sea coasts, which is for the Netherlands one of the most important tasks not only in the field of

ecology, but especially in the field of economic policy. Problems of air protection and climate change are solved through environmental protection programmes. The population and society in the Netherlands play a significant role in the development of landscape planning schemes. In the Netherlands, there are three levels of landscape planning: national, regional, and local. All three levels within their competence perform integrating functions and provide procedures for coordination of planning proposals. The national level is provided by the state. The National Spatial Planning Programme is divided into four basic categories of development: the *green course* is the protection of the environment and nature management; *yellow course* – aimed at agricultural development; *blue course* – a combination of environmental and economic characteristics of the state, *brown course* – associated with integrative processes between agriculture and other sectors of the economy. Due to the fact that there is no law on nature protection in the Netherlands, there are no legal definitions of a national park in national environmental practice. The protected area in the Netherlands is 5.7% of the country's area. The advantage of the Netherlands over Germany is that more specific national and regional projects are being implemented there. At the local level, there is a significant legal division of specific planning mechanisms within individual settlements and beyond. One of the features of the Netherlands is a high degree of integration of environmental requirements into sectoral planning. France, along with other countries, has its individual specifics. It is traditionally a strong centre. There is a division of powers between the centre, the regions, and the communes, but there are almost no connections between them. There is no developed system of landscape planning there. Projects are implemented on a case-by-case basis. The national level (centre) provides the formulation of general principles of territorial development. The regional level implements the plans for the organisation of the territory and development programmes. At the commune level, the land use plans are being developed. The principle of voluntariness is dominant in environmentally oriented planning. The centre's decisions are stimulated by financial support. The tasks of environmentally oriented landscape planning in France are divided between different tools. Description, assessment of the state of the environment is carried out by various environmental and monitoring programmes. An *environmental plan* is being developed nationwide, which defines concepts for individual components of nature. The area of specially protected areas in France is 13.5% of its total area. It is worth noting that landscape areas in France are seen as a landscape and perceived as an aesthetic element. Therefore, the task of improving the landscape is understood as improving the landscape environment.

The main tasks of landscape planning in the UK are specific and are considered on a case-by-case basis.

Protection of private property is the basic principle of this procedure. Considering areas that are subject to strict protection and other areas, the latter play a secondary role and the state may not control the degree of their protection. Notably, protected areas occupy 20.4% of the UK territory. Landscaping at the national level performs the tasks or functions of controlling the financing and handling of legal disputes. At the local level, the tasks are divided between the districts that develop strategic plans and the municipalities that make up the special land use plans. There is no such division in urban areas. Environmental planning is limited to the tasks of allocating protected areas. In Britain landscape acts as a visual and aesthetic category. Therefore, often landscape planning is reduced to mere appearance of the landscape and is not enshrined in law. Insufficient development of public management in nature law in British legislation and the strong position of private owners determine the conditions for the development of landscape planning in the UK. Landscape planning tasks are scattered across planning areas.

Within the framework of Spanish planning system, the concept of landscape planning does not exist as a single item. However, the tasks of landscape planning are largely performed by other mechanisms and methods. In general, there is a shift in views on the landscape not as an aesthetic category, but as a cultural and environmental value. Territorial planning in Spain is divided into sectors and levels. Regions have the right to spatial planning in cities. The main tools are regional and subregional plans for the organisation of the territory. However, there are difficulties between the centre and the regions in agreeing on the plans and interests of territorial planning. According to the national environmental law, the task of the state is to develop basic lines of nature protection. This task has not yet been completed. Some regions develop their own plans for territorial ecological development. At the local level, separate plans are being developed for communes within protected areas. Their area in Spain is 8.4%. But at the local level, its tasks in the field of landscape planning are not defined. Resource use plans take precedence over territorial and sectoral development plans. The peculiarity of resource use plans in Spain is that they are made mainly for protected areas, and especially for the largest.

Slovakia has an interesting practice in developing environmentally oriented landscape planning projects – LANDEP (LANDscape-Ecological Planning) project, the main principles of which are: *optimisation* – offering the most convenient location for activity in the social sphere in terms of landscape and environmental patterns and *the least danger* – minimising the conflict between nature and the economy without slowing down economic development. The design sequence is as follows: Compilation of environmentally oriented landscape map → Functional interpretation of landscape properties (availability,

humidity, nutrient requirement, insolation, dynamics of matter transfer, anthropogenic changes in vegetation, bearing capacity) → Estimation of importance of functional characteristics for selected species with regard to environmental impact → Assessment of the suitability of characteristics and constraints for the selected activity → Selection of appropriate areas and territories → Alternative proposals for the territory → Comparison of alternatives based on spatial conditions: size, neighbourhood, degree of similarity of proposals for neighbouring complexes, configuration of neighbouring complexes → Final proposal → Functional zoning → Detailed proposal with selection of sites for activities.

Conclusions

Summarising the experience in landscape planning, and especially environmentally oriented planning, it is possible to make certain generalisations that would further help to more clearly plan the relevant landscape processes. The complex of landscape planning by contributes to the improvement of the relationship between the requirements of environmental protection and socio-economic, cultural, and spiritual development and the interests of people. This in turn is an incentive to adhere to the postulates of sustainable development of countries and sustainable use of nature. Analysis of the experience of environmentally oriented landscape planning in countries such as the United Kingdom, France, Germany, the Netherlands, and Slovakia suggests that the effectiveness of development and implementation of environmentally oriented landscape planning depends to a large extent on its productive organisation. Talking about the tasks of planning, they will differ significantly depending on two main factors – the purpose and specifics of planning and the characteristics of the considered area. First of all, it is necessary to analyse the reasons for planning. This means that before choosing a planning object and territory, it is necessary to find out: who are the potential customers and investors – their goals and motivation; what are the problem situations and conflicts in nature management in the area; what is the practical use of the results of landscape planning; the purpose of the territory, including cartographic; the availability of source information, and more. And then make decisions about the stages of landscape planning, taking into account the environmental component and, accordingly, the implementation of the idea of landscape planning.

Further line of the study presumes the analysis of the Asian and North American experience of environmentally oriented landscape planning to obtain the most complete picture of the process of landscaping, taking into account its environmental component.

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