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Covid-19, Environmental Engineering and the End of the World as We Know it

Koronawirus, inżynieria środowiska i koniec świata, jaki znamy

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Abstract

Covid-19 stopped the World. When all humanity is worried about their health, is there still any room for technical sciences and environmental engineering? In this work, It will be proved, that the answer is yes. Major challenges, such as climate change, are still valid. In addition, being in a quarantine still we have access to clean water and electricity. Without these goods, our lives in these conditions would be much harder. Investments in renewable energy sources are still being carried out.

Covid-19 will not bring the end of the World as such, but the end of the World as we know it. Some sectors of the economy (tourism, public transport, in particular air transport) may cease to exist and the service sector will face a deep recession. This means a gigantic economic crisis and retraction of the World development many years back.

Key words: coronavirus, Covid-19, epidemic, environmental engineering, global crisis

Streszczenie

Koronawirus zatrzymał świat. Gdy wszyscy martwią się o swoje zdrowie, czy jest tu jeszcze miejsce dla nauk technicznych i inżynierii środowiska? W tej pracy udowadniam, że tak. Główne wyzwania, takie jak zmiany klimatyczne, są nadal aktualne. Poza tym przebywając na kwarantannie cały czas mamy dostęp do czystej wody i energii elektrycznej. Bez tych dóbr nasze życie w tych warunkach byłoby trudniejsze. Inwestycje w odnawialne źródła energii także nie uległy zatrzymaniu.

Covid-19 nie przyniesie ze sobą końca świata jako takiego, ale nastąpi koniec świata, jaki znamy. Niektóre sektory gospodarki (turystyka, transport publiczny, w szczególności lotniczy) mogą przestać istnieć, a sektor usług czeka głęboka recesja. Oznacza to gigantyczny kryzys ekonomiczny i cofnięcie rozwoju świata o wiele lat.

Słowa kluczowe: koronawirus, inżynieria środowiska, kryzys globalny

1. Introduction

Covid-19 (coronavirus disease of 2019) stopped the World, as for the last few months millions of people were staying at home in a quarantine. In such conditions, when looking for a vaccine is a priority, it would seem that technical sciences, like environmental engineering, are becoming less important. It will be proved that technology still matters, however first let's deal with changes that epidemics bring to our life.

2. Epidemics in history

Epidemic is nothing new, 10 biggest such cases in the history are presented in table 1.

One of the biggest epidemic in history was Black Death, which took about 200 million lives. The World Population were at that time at the level of around 450 million people. So, the plague took 45% of the entire human race! After The Black Death it took 200 years to rebuild the population again (MPH, 2020).

Table 1. Epidemics in history (from more recent to the oldest), source: MPH, 2020, changed

No	Name	Date	Death toll	Comment
1	Covid-19	2019-?	Unknown, 346 000 as for the May 2020	Cause: virus. It begun in China around December 2019, then spread around the globe.
2	AIDS Pandemic	1976-?	32 million so far	Cause: HIV virus. It was identified in 1976 in Democratic Republic of the Congo. Then it has become global. At initial stage it was touching homosexually oriented people, later it was touching also heterosexuals. Now there are more than 30 million of people infected with HIV virus, however there are new medicines that help to live longer. 21% of infected are unaware of that they are carriers of HIV virus.
3	Flu Pandemic (The Hong Kong Flu)	1968	1 million (half of them in Hong Kong).	Cause: influenza (H3N2 type). It begun in Hong Kong, but soon was reported in Singapore, Vietnam, Philippines, India, Australia, Europe and the United States.
4	Asian Flu	1956-1958	2 million	Cause: influenza (H2N2 subtype). It begun in China, then spread across Singapore, Hong Kong and United States.
5	Spanish Flu Pandemic	1918-1920	20-50 million	Cause: influenza. It begun in France, then spread among many other countries, including Spain. This was the global pandemic with 500 million people infected.
6	6 th Cholera Pandemic	1910-1911	More than 800 000 in India alone	Cause: Cholera It begun in India (as all other Cholera Pandemic), then spread across Middle East, North Africa, North America and Eastern Europe (with Russia).
7	Flu Pandemic (Asiatic Flu or Russian Flu)	1889-1990	1 million	Cause: Influenza (subtype H2N2 or H3N8). It begun in the same time in 3 separate and distant locations: in Turkestan, Canada and Greenland. Then it has become global. The important factor was rapid growth urban population at that time.
8	3 rd Cholera Pandemic	1852-1860	1 million	Cause: Cholera. It begun in India, then spread across the Ganges River Delta, Asia, Europe, North America and Africa. During this pandemic (in 1854) British physician John Snow identified contaminated water as the means of transmission for the disease. Earlier they were unknown.
9	The Black Death	1346-1353	75 to 200 million	Cause: Bubonic Plague It begun in Asia, then spread across Europe, Africa and Asia. Marine transport was the means of transmission of the disease, to be exact fleas living on quite common on ships rats. Ports were at that time urban centres, so the disease could infect many people quickly.
10	Antonine Plague (Plague of Galen)	About 165	5 million	Cause: unknown. The disease was brought to Rome by soldiers coming back from Mesopotamia. In Europe countries mostly affected were Italy and Greece.

If Covid-19 could cause such mortality (taking into account that the current World population is 7.8 trillion), we would have to face 3.5 trillion deaths!

Epidemics do happen and it is just a matter of time, when we will have the new outbreak.
One of the most important factor is globalization.

Table 2. Covid-19 in 10 countries with the highest number of infected people as for the May 2020, source: Wikipedia, 2020

Country	Infected	Deaths	Recovered
USA	1 697 361	99 462	352 984
Brazil	376 669	23 522	153 833
Russia	362 342	3 807	131 129
United Kingdom	261 184	36 914	No data available
Spain	235 400	26 834	150 376
Italy	230 158	32 877	141 981
Germany	180 808	8 432	163 681
Turkey	157 814	4 369	120 015
India	145 380	4 167	60 491
France	145 279	28 432	65 199

This phenomena may be defined as *an integrated, world-wide social and economic system related to large corporations, characterized by supra-state (and supra-national) diffusion of capital and adoption of the free trade principle in the field of economic globalization and the assimilation of cultural models, especially in the mass form (cultural globalization)* (Gawor, 2008).

Globalization is connected with modern transport. Moving around the World has never been easier, than it is today. In case of aviation it is possible to get to the other side of the World in just over a dozen of hours. Unfortunately it applies not only to people or cargo, but also to the diseases.

In last few decades few potentially dangerous accidents did happen (WHO, 2020):

- In 2003 we witnessed SARS (SARS-CoV-1) epidemic with 8439 infected, and 812 deaths, mainly in China.
- In 2013 it was Bird Flu (Avian Influenza, Avian Flu, H5N1) epidemic with 861 cases and 455 deaths.
- In 2015 we witnessed Ebola Virus epidemic with 28 618 infected and 11 310 deaths in Guinea, Liberia and Sierra Leone.

One may say, that we were lucky (especially in case of Bird Flu, where mortality was very high – 53%), because none of the above viruses caused global epidemic. In case of Covid-19 the situation is unfortunately different.

3. Covid-19 – how this could happened?

As for the 26th May 2020 we have 5.5 million people infected with Covid-19 and more than 346 000 deaths (Worldometer, 2020). 10 countries with the highest number or cases are presented in Table 2.

This is the first global pandemic since Spanish Flu Pandemic from the years 1918-1919 (500 million infected and 50 million deaths, MPH, 2020). However in case of Spanish Flu mortality was at the level of 10%, in case of Covid-19 it is less than 1% and the most important factor is age. As an example, in the UK mortality among children is only 0.0016%, while among people older than 80 years it is 7.8% (Mahase, 2020). The worst situation, as for the May 2020, was noticed in Norway among people older

than 90 years – mortality among them reached 57.1% (Wikipedia, 2020).

Warnings, that global pandemic is possible, have been reported decades ago.

Joshua Lederberg, molecular biologist and Nobel laureate, once said: *The single biggest threat to man's continued dominance on the planet is the virus* (Henig, 2020). Even if, as Saleem Ali argues, *that only around 1% of all microbes can actually cause disease in humans* (Ali, 2020), it is still quite a lot.

In 2015 r. Bill Gates, founder of the Microsoft Company, warned, that *the World is simply not prepared to deal with a disease – an especially virulent flu (...) – that infects large numbers of people very quickly. Of all the things that could kill 10 million people or more, by far the most likely is an epidemic. But I believe we can prevent such a catastrophe by building a global warning and response system for epidemics* (Gates, 2015). Unfortunately, we did not build such infrastructure.

The biggest problem in case of spreading Covid-19 pandemic was not the virus itself, but... the politics. The epidemic began in Wuhan, China in the fall of 2019 (Ali, 2020). This is a country with very strong economy, but there is no democratic system, because all power belongs to the Chinese Communist Party. When the first reports from Wuhan appeared, the authorities disregarded the problem and, using their monopoly, forbade the doctors to provide any information outside. It was guarded by the People's Armed Police (as part of the so-called China Information Flow Control Policy). The Chinese admitted the epidemic only when it got out of control (Wasserstrom, 2020). Meanwhile millions of guests, who came to Wuhan to celebrate the new year, had already returned to their countries around the World.

The biggest present challenge connected with Covid-19 seems to be tracing the infected. Testing as many people as possible is a must, since a lot of people infected – from 25 up to even 80% – don't have any symptoms of the disease (Healthline, 2020). Such asymptomatic people can infect many others. And we must remember, that although we noticed 346 000 deaths caused by the virus, at the same time (between 1st January and the end of May 2020) 25 million people died for natural reasons, cancer, heart

diseases, in accidents, murdered, or starved to death (Wordometer, 2020).

4. Covid-19 and environmental engineering

4.1. The problematic of environmental engineering

In a Covid-19 pandemic, it seems that technical sciences, such as environmental engineering, are becoming less relevant. However, this is not the truth. According to an interesting definition, adopted by the Environmental Engineering Committee of the Polish Academy of Sciences, environmental engineering is a technical science based on the use of engineering methods (Pawłowski, 2011):

- ✓ For preserving, rationally shaping and using the external natural environment (e.g. water resources, waste management, air protection, soil protection).
- ✓ For preserving and shaping the internal environment of buildings and structures (devices and installations).

In these areas, environmental engineering implements environmentally-friendly initiatives, modifies the technical conditions and technologies to maintain the optimum biological balance of the environment, neutralizes the effects of natural disasters (floods, droughts, or water, air, and soil pollution), and eliminates or reduces the negative environmental impacts of the industrial activities of humans.

What's more, environmental engineering is also very important from the perspective of sustainable development – the central idea of both United Nations, and the EU's legislation.

According to the most widely used definition, *sustainable development it is development that meets the needs of the present without compromising the ability of future generations to meet their own needs* (WCED, 1987). It includes basic human needs, like access to water, food and shelter, but also to electricity.

Environmental engineering plays an important role in implementing the idea of sustainable development. It shapes the conditions in which a person lives, also refers to the raw material aspect, which in turn determines the satisfaction of material needs both of the present and future generations. It also fulfills many Sustainable Development Goals, introduced by the United Nations in 2015. Among them:

- Goal 6: Clean water and sanitation.
- Goal 7: Affordable and clean energy.
- Goal 8: Decent work and economic growth.
- Goal 9: Industry, innovation and infrastructure.
- Goal 11: Sustainable cities and communities.
- Goal 13: Climate action.
- Goal 14: Life below water.
- Goal 15: Life on land (UN, 2015).

What about being an engineer during Covid-19 epidemic?

4.2. Internal environment

In the above definition of environmental engineering it is worth to underline the care about the internal environment. The quality of indoor air and climate have a major impact on our health. And this is especially important during epidemic quarantine, when we are spending much more time at home than usually. Being in a quarantine is also much easier when we have constant access to water or electricity – and these are also engineering issues.

4.3. Access to water

In case of water, people in the Western World are lucky, because they live in countries, where this resource generally is available.

From the World's perspective, the lack of access to any water affects about 1 billion people, and another billion has access to water of poor quality (WHO, 2017). Polluted water is the cause of up to 80% of diseases in developing countries and causes about 3 million victims annually, which is more than in the case of infection with the HIV virus, and of course much more than in case Covid-19. So, still there is great amount of work that should be done.

4.4. Access to electricity

The demand for energy is growing everywhere. In 2040 it will double, comparing to the year 2010 (Gore, 2017). Now as much as 87% of people have access to electricity (UNDP, 2017).

In a quarantine, thanks to electricity, we use the Internet, not only in the aspect of distance learning or entertainment, but also in everyday life. We can easily order any goods that the courier will safely deliver to our apartment.

The problem is however not only how to produce electricity, but also in which way to produce it, since there are different ways, with different environmental consequences.

The worst pollution of the atmosphere is from coal burning power plants, which still are responsible for 38.3% of the World's gross electricity production (IEA, 2019). The most important polluter is carbon dioxide, which contributes to the global warming, and is responsible for 50% of the greenhouse effect. The global CO₂ emissions in 2017 reached 37,077,404 Mt, which was almost twice as much as in 1990 (EPA, 2019). Main polluters are China (10.8 Gt), the USA (4.8 Gt) and the European Union (2.9 Gt). The good news is that in the case of the USA and the EU, the emissions have started to fall down. Unfortunately, this is not the case of China, the impressive industry of this country has its price. But there are also renewable sources of energy. They are responsible for 26.5% of the World's gross electricity production (EIA, 2019), and the biggest share in the market is for hydropower (see table 3).

Table 3. Renewable electricity generation by energy use, source: EIA, 2019

No.	Source of energy	Electricity generated [TWh]	Share in the market [%]
1	Hydropower	4 049	69%
2	Wind	958	16%
3	Bioenergy*	467	8%
4	Solar	83	6%
5	Geothermal	1	1%

*Bioenergy includes solid biofuels, biogas, renewable municipal waste, liquid biofuels

So, renewables even now are a huge part of the energy market, which means they provide jobs for millions of people. According to the UNDP, the renewable energy sector in 2017 gave employment to as many as 10.3 million scientists and workers (IRENA, 2018).

4.5. Covid-19 and air pollution

We must be aware, that all the known environmental threats still exist around us, and Covid-19 epidemic should not limit our care for the environment, also on the level of environmental engineering.

It is true, that in case of big cities the quality of air significantly improved, while people were staying at their homes. After introducing lock down in California, the air quality in Los Angeles in early April 2020 become one of the best in the world. Feat impossible to be achieved in normal conditions, with huge car traffic on the streets (IQ Air, 2020). Since the outbreak of the pandemic, Copernicus Sentinel-5P satellite has seen a decrease in air pollution, especially nitrogen dioxide concentrations, across Europe at least by 25% (Sobuniewska, 2020). The examples from countries heavily touched by Covid-19 pandemic are presented in table 4.

Table 4. Decrease in NO₂ concentrations in the air during Covid-19 pandemic in chosen cities of Italy and Spain, source: EEA, 2020

City	Country	Changes in NO ₂ concentration (March 2020)
Milan	Italy	24% decrease
Bergamo	Italy	47% decrease
Rome	Italy	30% decrease
Barcelona	Spain	40% decrease
Madrid	Spain	56% decrease

Unfortunately this is a temporary effect, so long-term thinking, how to make the situation stable better, is a must.

One of the biggest challenges for the air quality in cities is smog, which is one of the oldest pollution of the atmosphere known. Yet as early as 1542, the Spanish sailor Juan Rodriguez Cabrillo, observed a layer of fog as high as 300 m around Los Angeles, caused by the smoke from Indian campfires (Wojciechowski, 2006).

Smog is created when the concentration of pollutants (nitrogen oxides, sulphur oxides) in the air is high and when there are specific weather conditions (e.g. no wind, presence of sun, humidity), as well as climatic and topographic conditions hindering the dispersion of pollutants (a valley rather than an open area, Pawłowski, 2011).

Preventing the formation of smog at the industrial level means not only the installation of filters on chimneys, but rather modifications in the production processes (through the implementation of e.g. cleaner production).

Much also depends on us. In the case of so-called London smog, quite common in the World, important source of pollution is the emission from old furnaces in households.

Table 5 presents 10 most polluted cities in the World. None of them lies in Europe or North America. The all represent Asia and the following countries: India, Pakistan and China. Many other cities from these countries are just below the Top 10.

Table 5. 10 most polluted cities in the World, average results for the year 2019, source: IQ Air, 2020)

No.	Name of the City	Name of the country	Average PM 2,5
1	Ghaziabad	India	110.2
2.	Hotan	China	110.1
3.	Gujarnwala	Pakistan	105.3
4.	Faisalabad	Pakistan	104.6
5.	Delhi	India	98.6
6.	Noida	India	97.7
7.	Gurugram	India	93.1
8.	Raiwind	Pakistan	92.2
9.	Greater Noida	India	91.3
10.	Bandhwari	India	90.5

4.6. Covid-19 and the global warming

We must also not forget about global threats, like the climate change. One of the consequences of the global warming is connected with tropical cyclones, which are becoming stronger and much more devastating. On 20th May 2020, when the World was still in a quarantine, super cyclone Amphan struck India and Bangladesh. It was the most devastating cyclone in this area ever! Millions of people need help, since whole cities were destroyed, and Covid-19 pandemic is still there (Chowdhuri, 2020).

One of the most important challenges in fighting the global warming is connected with lowering the pollution of the atmosphere with so-called greenhouse gases. The most important such gas is carbon dioxide, but there are others, like: methane, chlorofluorocarbons, ozone and nitrogen oxides (EPA, 2019). Unfortunately the list of GHGs is not closed. In 2013, a new greenhouse gas was found in the atmosphere – perfluorotributylamine (PFTBA), the warming potential of which is 7100 times higher (!!!) than that of CO₂ (Science Daily, 2013). This gas is needed for the production of liquids being heat transfer agents in electronic equipment. Unfortunately, no

action was taken to decrease the emissions of PFTBA to the atmosphere after the discovery, despite the extremely high warming potential. It cannot be ruled out that man has created many other substances equally dangerous to the climate, only this side of their action has not been recognized yet. This is a very important field of work for scientists and engineers.

5. Covid-19 and the end of the World as we know it

One of the most commented books of the 1990s was the work *End of History* by Francis Fukuyama, published in 1992. The author presented the development of social systems, claiming that liberal democracy is the highest form of political system in history. After the fall of communism, democracy has become the dominant and virtually non-competitive political system in the World, which also means the end of history because other systems will not be formed. The book perfectly fitted into the stream of optimism that prevailed at that time in the World. The fall of communism ended the Cold War era, and humanity would henceforth live in peace.

However, the terrorist attack on New York on September 11, 2001 showed that the time of wars was not over.

What's more, liberal democracy seems to be now in crisis. As prof. Felix Unger, president of the European Academy of Science and Arts, said: *when we read the news, when we observe the frustration of people voting the old political parties, when new parties appear without any program, then you feel a new stream of perception of politics is on the way. Most people cannot identify themselves with the political system, which is aggravated by the whole financial crisis. (...) The people in Europe are no longer willing to support banks instead of the people. The main problem is to see that all the political managers have departed from the people and follow only their own interest. The system in Brussels is questionable too. In Brussels they are also far away from the people who, in reality, pay with their taxes everything they are doing. This is deconstruction of our democracy on the way. (...) We all have to serve life not money (...). Life is the highest value and all we have to do is to serve life* (Unger, 2013).

Covid-19 pandemic showed, that this life is endangered. It also showed, that political system does matter: China is not a democratic country which, as it was already said, made it easier to hide the threat connected with the virus.

What about democratic countries? Fighting with Covid-19 looks different in different areas. There are two basic strategies:

- First one is to introduce lock-down, closing most business, limiting possibilities for

travel and contact for people, which means obligation to stay at home in a quarantine. Most of the countries of the world introduced this solution.

- Second one is to do basically nothing, hoping that the population will get the so-called herd immunity. This strategy was introduced, among others, in the USA, Great Britain and Sweden. However in case of the first two countries this decision provoked protests, as a result, with some delay, lock down was introduced. In case of Sweden there are only suggestions. Swedish Foreign Minister Ann Linde said recently: *we advised that everybody should stay at home on Easter and 96% of people followed it. Our government is acting with suggestions, not prohibitions* (Anadolu Agency, 2020).

How will it end? Are we going to face Armageddon? Well, maybe – but for sure not because of the Covid-19. The whole biosphere is out of balance, due to *business as usual* practises, extreme deforestation and pollution of the environment. We must be much more successive in protection of what is left and counteraction major environmental threats, for our own sake. Environmental engineering plays a significant role there.

Covid-19 pandemic will not end the World as such. It will end the World as we know it. First off all the virus already caused gigantic economic crisis, much bigger than the previous crisis from the years 2007-2009. Some sectors of the economy may cease to exist and the service sector will face a deep recession. This means high unemployment and possible high inflation.

There is a prognosis for the USA (the biggest economy in the World), according to which the unemployment in 2020 is going to be the highest in the history of the country, bigger than during The Great Depression from the 1930s of the 20th century – reaching 32.1%, which means that 46 million (!!!) American citizens will lose their jobs (Roper, 2020) – see figure 1. In case of weaker economies the problem may be even bigger.

Sectors of the economy, that appeared to be extremely vulnerable in the face of Covid-19 pandemic, are: tourism, public transport, in particular air transport, service sector, cinema and entertainment industry. It showed that the World economy was not so strong, as we thought. After two months of lock down it has been severely damaged.

The worst situation is in tourist sector. For many decades, in many countries, this sector was a primary source of income. Investing in tourism infrastructure (hotels, restaurants, ski resorts) in popular areas was perceived as safe, because for decades it was giving steady income. After just two months of quarantine many of these objects are broken or almost broken.

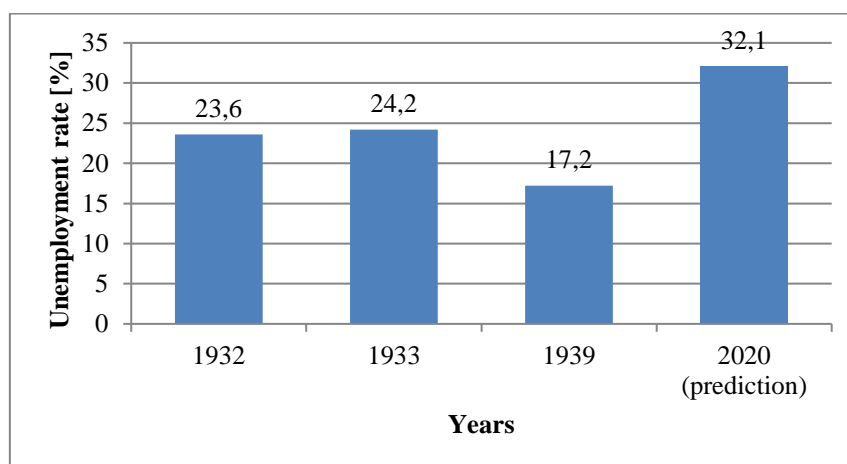


Figure 1. Unemployment in the USA: The Great Depression versus Covid-19, years 1932, 1933, 1939 and 2020, source: Roper, 2020, changed.

Weakening of our economy means also, that some ambitious goals, like climate and energy policy of the European Union, may be endangered, since problems with financing them are almost certain. As for the end May 2020, because of the Covid-19, we can expect the highest in history plummet in the global energy sector – by 20% (in comparison to the year 2019, IEA, 2020).

The present horizon of the EU's climate and energy policy is covering the time to the year 2030, and it includes the following goals (EC, 2018):

- Improvement in the energy efficiency, which should be higher by 32.5%.
- Reduction of the greenhouse gases emissions (40% by the year 2030, in relation to the level of emissions from 1990).
- Achieving the level of 32% of energy production from renewable sources.

Some of the European countries achieved, at least partly, these goals already. For example, in Norway almost all electricity is produced by hydropower stations (Salay, 1997), but for many other countries it is going to be a real challenge, mainly because of the economic crisis, which has already begun.

Also industry suffers from Covid-19 pandemic. As we know, the second biggest economy of the World is China. In the first quarter of 2020, China's GDP went down by 6.8%. This was the first decrease from 1992 (Nagarajan, 2020)!

All of this means a gigantic economic crisis and retraction of the World development many years back. Governments are aware of the crises and are trying to help the economy by loosening the restrictions connected with lock down. Let's hope that it will not increase significantly the number of infected, because in such case another full lock down could be a must.

6. Conclusions

Many people thought that global pandemic, as known from the past, in our modern World is not

possible. Unfortunately they were wrong. Fighting with Covid-19 we cannot however forget, that there are many other problems, which are also responsible for the death of a lot of people.

Our planet is ecologically out of balance, and global threats, such as global warming, may take much more lives, than Covid-19. Although environmental engineers cannot create vaccine for the virus (it is the duty of medical sciences), they are still needed, since state of the environment is also crucial to our health, and they have the right technologies for protection of the environment.

Underlined in the title of this paper phrase: the end of the world as we know it relates to the economy. Most of us will survive Covid-19, but we may lose our jobs, and the global economy is going to be in a very deep crisis, much deeper than even the tragic Great Depression from the 1930s. We are in the middle of the pandemic now, and future is unpredictable, however it can be assumed, that economic recovery will take much more time, than the epidemic itself. But there is another important factor, which can change the situation. Covid-19, as any virus, mutates randomly. One of the next mutations can make it harmless. One of the next mutations can make it more dangerous. Let's hope that the first option will happen.

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Between Economy and Security. Dilemmas of Sustainable Development in the Covid-19 Era – an Example of Great Britain

Między ekonomią a bezpieczeństwem. Dylematy zrównoważonego rozwoju w erze koronawirusa – przykład Wielkiej Brytanii

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Abstract

The coronavirus Covid-19 pandemic has disrupted social stability in many countries around the world. This has consequences for sustainable development. In a situation of stability, two competing pillars of sustainable development: the economic and the environmental one, are in the lead – as long as the basic needs of most people are satisfied. In the conditions of instability, the social pillar begins to dominate, pushing the economic and environmental pillars to the background. The fight against the pandemic is or has been carried out in different countries in different ways. We can talk about the Chinese, Taiwanese, or European models, among others. In the United Kingdom, the laissez-faire model was used for a short time. This was an interesting strategy (though a very risky one) that attempted to reconcile different pillars of sustainable development in the face of crisis, seeking a compromise between health considerations, social situation, and the requirements of the economy. However, this approach was quickly rejected under the influence of public opinion, the media and scientific authorities. In the situation of impending crisis, the social pillar began to dominate. The dilemma *economy vs. security* was resolved according to the hierarchy of needs (with security being a more basic need). This is a tip for the future – for social policy and planning in times of stability. In a situation of deep *biological* crisis (as opposed to economic crises), the social factor comes to the fore in the end, at the expense of all others. Within the social factor, the hierarchy of goals will be established according to the hierarchy of needs.

Key words: coronavirus, Covid-19, epidemic, pandemic, Wuhan, Great Britain, China, Taiwan, security

Streszczenie

Pandemia koronawirusa zaburzyła stabilizację społeczną w wielu krajach świata. Ma to konsekwencje dla zrównoważonego rozwoju. W warunkach stabilizacji prym wiodą konkurujące ze sobą filary rozwoju zrównoważonego: ekonomiczny i środowiskowy – o ile zaspokojone są podstawowe potrzeby większości społeczeństwa. W warunkach braku stabilizacji zaczyna dominować filar społeczny spychając filar ekonomiczny i w jeszcze większym stopniu środowiskowy na plan dalszy. Walka z pandemią przebiega lub przebiegła w różnych krajach w różny sposób. Można mówić o modelu chińskim, tajwańskim, europejskim, itp. W Wielkiej Brytanii przez krótki czas postawiono na model liberalny. Był ciekawą propozycją (choć bardzo ryzykowną), pogodzenia filarów zrównoważonego rozwoju w obliczu kryzysu, szukania kompromisu między względami zdrowotnymi, sytuacją społeczną i wymogami gospodarki. Został on jednak dość szybko odrzucony pod wpływem opinii publicznej, mediów i autorytetów naukowych. W sytuacji nadciągającego kryzysu dominować zaczął filar społeczny. Dylemat ekonomia vs. bezpieczeństwo został rozwiązany zgodnie z hierarchią potrzeb (potrzebą bardziej podstawową jest

bezpieczeństwo). To wskazówka na przyszłość – dla polityki społecznej i planowania w czasach stabilizacji. W sytuacji głębokiego kryzysu o źródłach *biologicznych* (w odróżnieniu od kryzysów ekonomicznych) w ostatecznym rachunku dochodzi do głosu przede wszystkim czynnik społeczny, kosztem wszystkich innych. Zaś w obrębie czynnika społecznego hierarchia celów zostanie ustanowiona zgodnie z hierarchią potrzeb.

Słowa kluczowe: koronawirus, Covid-19, epidemia, pandemia, Wuhan, Wielka Brytania, Chiny, Tajwan, bezpieczeństwo

Introduction

On 31 January 2020, two members of a family of Chinese nationals staying in a hotel in York, became the first confirmed cases of Covid-19 in the UK. Upon confirmation, they were transferred from Hull University hospital to the specialist Infectious Diseases Unit in Newcastle. On 5 March, the total number of confirmed cases in the UK exceeded 100, on 15 March – it reached almost 1400, and on 20 March – almost 4000, with most cases recorded in London and in the central part of the country.

The growth in the number of infected people during the first week (measured from the day when the number of cases exceeded 100) was relatively low (460) – lower than in Germany (800), France (653), Spain (674), let alone Italy (1,128). However, in absolute numbers it reached 5,000 cases fairly quickly (after another 10 days).¹

The measures adopted by the UK government gave rise to widespread discussion on whether the British approach to handling the disease was appropriate. The reason was that the strategy proposed by the British government was not typical and differed significantly from the one adopted in Asia or from the measures that were being (or had been) taken by other European governments at that time. After some time, pressed by the public opinion, the UK government changed its strategy, adopting standards used by most other European countries.

This situation and in particular the radical change of the strategy to suppress the spread of the epidemic, is an extremely interesting issue that can be considered from the perspective of dilemmas of achieving sustainable development goals.

Health and security as sustainable development goals

The social environment (customs, culture, spirituality, interpersonal relationships, and living conditions) can become degraded just as the natural environment can. It is worth remembering that the social environment should ensure the basis for an individual's existence (Pawłowski, 2008).

The International Covenant on Economic, Social and Cultural Rights states that the enjoyment of the highest attainable standard of health is one of the funda-

mental rights of every human being regardless of their race, religion, political beliefs, economic or social conditions. The full enjoyment of the right to health is critical for the enjoyment of other human rights. Good health is thus an end in itself and plays an integral role in the development of human capabilities and the well-being of society. Health is central to all three pillars of sustainable development, as it is the beneficiary of and contributor to development. It should be noted that health is a value in itself, but it is also an integral part of human well-being. In order to protect and promote public health, it is necessary to take into account the health implications of policies and programmes in all sectors, for example in energy, transport, agriculture, and as part of broader policies concerning labour rights, trade liberalization, intellectual property and environmental protection, among others. Health can therefore serve as an indicator of whether development and sector policies benefit individuals and their families in ways that are tangible and easily understood (TST Issue Brief ..., 2014).

Health is therefore an important input to sustainable development. Without health, there is no sustainable development; healthy people are better able to learn, work and contribute positively to their economies and societies (Health, Environment ..., 2013).

Health can be considered in individual terms and also in group terms when we deal with the mass threat to health and life. In the latter case, health is very closely related to a sense of security in the macro-social dimension. One of the goals of sustainable development is *peace and order*, which means that communities coexist peacefully and protect their members from crime and violence (Prescott-Allen, 2001). However, this goal can be understood more broadly as the freedom from feeling threatened – also by an epidemic or pandemic. Both have a common foundation, which is the fear that reduces the quality of life, fear for one's own health and life and for the health and life of close friends and relatives. It should also be mentioned that a pandemic in its extreme form leads to crime, as it was for example during the influenza pandemic after World War I.

Let us now take a closer look at the issue of security. Society can survive on its own when the conditions are favourable, but we speak about the security of society only when it is ensured by the state. There is

¹ Data based on www.worldometers.info. At the time when the article was submitted for publication, the number of

coronavirus cases in Great Britain stood at 206 715. Fatalities included 30 615 persons (7.05.2020).

no organizational structure to ensure the security of the human species, hence one cannot speak about the security of the human species. On the other hand, when we refer to public security, we mean the security of some society living in a state, not of any society, for example one that lives in an anarchy (Skarżyński, 2017).

Security can also be viewed as the need to ensure physical security for oneself and one's relatives and friends, and to satisfy basic material needs, such as food, home, etc. (Wolska-Zogata, 2018). When this need is not fulfilled, it is damaging for an individual or a group, as it destabilises their functioning. This motivates individuals to resist adverse changes and use protective measures to restore their sense of security (Kukułka, 1995).

Security is most commonly associated with the alleviation of threats to cherished values and therefore it is best understood as *survival plus*, the *plus* being some freedom from life-determining threats. To simplify, it is possible to identify two prevalent ways of understanding security. This distinction is commonly reflected in the ideas of *freedom from* and *freedom to* (Williams, 2008). Thus, in relation to a pandemic, it is the freedom from the risk of getting ill or dying, and freedom (right) to maintain life and health.

How is the threat to security (in this case, in the face of the pandemic) connected with sustainable development? Firstly, the spread of the disease poses a direct threat to the health of people, which is to be protected by the state, and for the first time in perhaps half a century, this includes the populations of Western states. Secondly, a pandemic may cause social disruption and threaten the stability of a state: confidence in the state may be reduced if it cannot provide a basic level of protection against disease; social inequalities may be highlighted as the rich or privileged have access to better drugs or healthcare, potentially leading to public disorder; if many people die or are unable to work, public services may be placed at risk, threatening the functioning of a state; violence may appear if the authorities become unable to cope and if groups feel they have nothing to lose. In this way, a state may begin to fail, threatening its own security. Thirdly, a large-scale epidemic may also bring about economic downturn by: forcing increased government spending on health as a percentage of GDP; reducing productivity due to worker absenteeism and the loss of skilled personnel; reducing investment (internal and external) due to a lack of business confidence. For the state involved, the costs may be very significant, and in a globalized world the effects may be felt worldwide. The macroeconomic effects of a pandemic may therefore be very significant, which in turn will affect the ability of states to ensure their citizens safety and well-being (McInnes, 2008).

Models of handling the coronavirus Covid-19 epidemic

The outbreak of the coronavirus Covid-19 in Asia met with a very decisive response from many governments and very disciplined behaviour of citizens. Asian countries quickly decided to introduce severe travel restrictions. Moreover, they started to build modern hospitals with isolation units, produce face masks on a mass-scale, and use advanced technology to minimize losses. Model measures were implemented by Taiwan. Let us enumerate them in a chronological order, focusing only on those taken at the early stages, as time was of great importance here:

- 31 December 2019 – mass screenings of passengers coming on inbound flights from Wuhan began;
- 23 January 2020 – ban on entering Taiwan;
- 24 January 2020 – export of surgical masks was suspended and the government requested the private sector to increase production;
- 25 January 2020 – travels to China were suspended;
- 31 January 2020 – the private sector was banned from hoarding supplies and using exploitative pricing;
- 6 February 2020 – Chinese citizens were banned from entering Taiwan; a new purchasing policy was introduced to facilitate the purchase of scarce goods (especially face masks) and to prevent people from making mass purchases.

Moreover, Taiwan promptly set up a unified command centre, led by the Ministry of Health and Welfare, to manage resources, hold daily briefings, and inform the public. The cases were mapped to show the sources of infection, the media campaign was launched to educate the public on the risks of the disease and precautions to take, and data was used for analysis and developing platforms to inform people where masks were currently available and where the infected people had been.

It is worth emphasising that Taiwan introduced a travel ban very early (from the beginning of February), and this ban is effective only if introduced at the outset of an epidemic. The Taiwanese model can be called a radical one.

In China, the preventive measures of this type were implemented too late. Also other countries reacted too slowly: South Korea banned its citizens from travelling but as long as until March this ban concerned only the Chinese province of Hubei; Japan banned visitors from Hubei and Zhejiang and suspended visas for the Chinese on 9 March 2020, and Chinese tourists already in the territory of Japan were required to quarantine for two weeks. As a re-

sult, South Korea and Japan were not as successful as Taiwan in combating the spread of the coronavirus Covid-19. Measures similar to the ones in Taiwan were also introduced in Macau and Singapore.

In general, the response of the authorities in Asia was relatively speedy and radical, and most often met with social approval (it should be remembered that these were the first experiences with the coronavirus Covid-19 and it was not known yet whether an epidemic or pandemic would break out).

Europe failed to implement the radical strategy. This failure was mostly due to the delays in introducing restrictions, sometimes it resulted from inconsistent actions or long-standing problems in the healthcare system. It was not only the policy of governments that did not pursue the radical approach, but also the behaviour of many societies. Another thing is that the dynamics of the virus in Europe was different from country to country. Certainly, the Taiwanese approach to coping with the coronavirus Covid-19 stands in stark contrast to the Italian approach, which was characterized by disregarding the threat, delayed government actions, and lack of discipline on the part of Italian society. Learning from the Italian experience, other European countries such as Germany, France and Spain attempted to introduce restrictions and other measures to limit the spread of the virus but these actions were taken too late and lacked the determination typical of the Taiwanese model. Some European countries (for example, Poland, the Czech Republic, or Slovakia) were in a better position, as the virus appeared there later. Consequently, they could learn from the mistakes of those that had been hit by the epidemic earlier, and take more stringent action earlier and with more understanding on the part of their societies.

It would seem, therefore, that one can speak of two policies regarding the pandemic: the radical policy on the one hand, and all those that differ – to a lesser or greater extent – from it, on the other hand. This contradistinction, however, is only apparent. In fact, there is just one policy modelled on the Taiwanese approach. The difference is whether this policy was implemented almost in its entirety (as in Taiwan), in a form close to it (as in China), in different forms but with the same goal (as in most European countries), or in a completely unsuccessful way (as in Italy). In fact, the aim had always been the same, but in some countries it was achieved and the radical model was implemented, while in others the measures were not so successful, or they failed completely.

The goal was to win the battle against the virus by introducing (sooner or later) specific measures, such as restrictions on the movement of people, social distancing, isolating places that were the focal points of the coronavirus Covid-19 outbreak, etc.

As far as the ways (not goals) are concerned, three approaches to fighting the coronavirus Covid-19 can be distinguished. The first is the Chinese model – eradicating the disease to zero: complete paralysis of

life in the infected zone, significant restrictions on freedoms in other places, isolating the sick, and controlling the movement of people. The Chinese model, which turned out to be quite effective, cannot be replicated in Europe, not only for cultural and political reasons (society is much less disciplined), but also because European states do not exercise such strict control over their citizens. The second model, chronologically speaking, is the Taiwanese one, which has been described above. The third, European model is based on restricting large sections of economic and social life, including closing schools, self-isolation, etc. Slowing down the number of cases and extending the epidemic in time will probably lead to overloading the capacity of intensive care units and huge economic costs. The real threat of a deep economic recession can be seen.

British laissez-faire model

Britain's approach was different from that of other countries, but eventually it was abandoned under the pressure from public opinion and the media. Originally, the British model assumed lower economic losses, but greater social costs, in particular: (a) high mortality and acceptance of high fatality rates (breach of social solidarity), (b) psychological losses – intensified panic, (c) a large margin of uncertainty as to the effectiveness of actions taken and sacrifices to be made.

Professor Ian Donald, a psychologist at the University of Liverpool, explained the assumptions of the UK's government by stating that they were potentially very effective but much more risky than those adopted by most European countries. The government assumption was that up to 80% of the population in the UK would become infected no matter what measures were taken. So since it was impossible to stop infections, more emphasis should be placed on treating the sick. Great Britain wanted to stop the coronavirus Covid-19 infection, but only in the group of people at higher risk of health complications. Having many lower risk people infected would be beneficial because it would increase the overall immunity to this disease in society. This explains why schools were not closed in the initial stage of the epidemic. However, this approach is quite risky, as it may turn out that the number of infected people that require hospitalization will exceed the National Health System capacity. The key, therefore, would be to minimize the risk of infection for those for whom the virus may be fatal. Thus elderly people were to be quarantined for up to several months at home or in senior centres. They would have food and medicines delivered free of charge. The rest of society would be subject to only necessary restrictions to prevent the rise in infection rate. They would work or go to schools as normally as possible. This model focused on saving the country's economy (Donald, 2020).

In mid-March 2020, the Guardian published fragments of a British government secret report. It revealed that (a) the epidemic would last until spring 2021, (b) up to half a million Britons could die at that time, (c) in the worst-case scenario almost 8 million people may require hospitalization, (d) an estimated number of people that may die at that time was between 300,000 and 500,000, (e) the peak of the epidemic was forecast for the turn of April and May, then the situation would calm down slightly, but the virus would resurge in November (The Guardian, 2020).

The document prepared by the government agency *Public Health England* detailed how the healthcare system was not prepared for an epidemic of this scale. One of the problems was lack of medical equipment. Great Britain had far too few ventilators needed to control such a widespread epidemic. If in fact 80% of the British people were infected with the virus, that would mean over 50 million sick people. Assuming optimistically that the mortality rate is at 1% only, that would still mean that 500,000 people in Great Britain could die in one year (Health & Social ..., 2020).

Despite that, the UK government decided that more radical measures might be implemented at some later stage, as introducing them too early could result in British people ignoring the new rules, which in turn would weaken the government's ability to keep the situation under control. According to government experts, the epidemic would not reach its peak in the UK in many weeks, and by that time people might stop complying with the regulations. According to government officials, the ban on organizing mass events would be pointless at this stage. On the other hand, severe restrictions would seriously affect the labour market and economy.

This policy of the British government met with public opposition. Over 229 scientists wrote an open letter to the government calling for stricter measures to prevent the spread of the disease (Public Request ..., 2020). The signatories believed that the UK's approach would put NHS at an even stronger level of stress, risking many more lives than necessary. They also criticised the comments made by Sir Patrick Vallance, the government's chief scientific adviser, about managing the spread of the infection to make the population immune, and questioned the view that people would become fed up with restrictions if they were imposed too soon. In the open letter, the group of scientists argued that stronger *social distancing measures* would *dramatically* slow the rate of growth of the disease in the UK, and would spare *thousands of lives*. The group specializing in many disciplines ranging from mathematics to genetics stated that the current measures were *insufficient* and *additional and more restrictive measures should be taken immediately*, as was happening in other countries. In the open letter, the scientists wrote: *Going for 'herd immunity' at this point does not seem a vi-*

able option. They concluded that *radical behaviour change* could have a *much better* effect and could *save very large numbers of lives* (BBC News, 2020). According to Professor Willem van Schaik from Birmingham University, the major downside of *herd immunity* is that this will mean that in the UK alone at least 36 million people will need to be infected and recover. He believes that *it is almost impossible to predict what that will mean in terms of human costs, but we are conservatively looking at tens of thousands of deaths, and possibly at hundreds of thousands of deaths*. Professor van Schaik also notes that the UK is the only country in Europe that is following what he describes as its *laissez-faire attitude to the virus* (BBS News, 2020).

A report released by Imperial College was another important voice in the discussion. It stated that epidemic suppression was the only viable strategy currently, although the social and economic effects of the measures which were needed to achieve this policy goal would be profound. It also noted that many countries had already adopted such measures, but even those countries at an earlier stage of their epidemic (such as the UK) would need to do so immediately (Ferguson et al. 2020).

The British society could express their opinion on this matter in social surveys. *Opinium* interviewed 2,005 adults from the UK on 12-13 March 2020. The surveys show that 44% of the British considered closing schools to be necessary, 73% believed that work from home was necessary, 73% were worried about the coronavirus Covid-19 (with 23% very worried), and 41% believed that the government was not doing enough in the way it was handling the pandemic. These numbers show that the UK government did not have sufficient public support for its *radically liberal policy towards the virus* (Opinion, 2020).

Retreat from the laissez-faire model

Faced with new information, as well as harsh criticism coming from scientists and the media, the British government gave up the laissez-faire strategy for fighting the pandemic, and on 20 March ordered to shut down all pubs, clubs, restaurants, cinemas, museums, gyms and leisure centres as soon as possible, in order to stop the spread of the coronavirus Covid-19. At the same time, it announced another package of support for the economy, which aimed primarily to save jobs. Prime Minister Boris Johnson explained that it was necessary to step up the fight against the coronavirus. He announced that compliance with new regulations would be rigorously monitored and businesses failing to comply would risk the loss of licence. Three days later, further restrictions were introduced: British people were only allowed to leave their home for shopping, medical needs, travelling to and from work, but only where this was absolutely necessary and could not be done from home, and for

one form of exercise a day – for example a walk or outdoor workout. On Monday, the UK Foreign Office urged all British citizens on holiday or on business trips abroad to return home immediately, while they still had that opportunity. In this way, Great Britain joined the countries actively combatting the coronavirus Covid-19 epidemic. However, this was done too late.

Anthony Costello, a doctor and researcher associated with University College London and the World Health Organization, publicly asked why the UK Prime Minister was taking decisive steps so late. Costello wondered whether this resulted from the influence of a group of government advisors led by clinical scientists with no experience in controlling large-scale epidemics, or perhaps from the British sense of uniqueness and disregard for the Chinese and Korean experience with the pandemic (Costello, 2020).

The fact is, however, that Britain changed its strategy to the *European* one, with all its consequences – both positive and negative.

Implications for sustainable development

It can be assumed, although it is a somewhat simplified assumption, that in a situation of social stability and as long as the basic needs of most people are satisfied, two competing pillars of sustainable development are in the lead: the economic and the environmental one. When a situation becomes unstable, the social pillar begins to dominate, and pushes economy and environment to the background (with environment being less important than the economy). One might even ask whether speaking about sustainable development in the period of destabilization still makes sense. This question is certainly justified when destabilization is deep and lasts for a long time. However, in its initial stage – which we experienced in March 2020 – a link with the idea of sustainable development has not yet been cut. For example, as far as the economy is concerned, the hope for growth (even a very weak one) has not yet been completely overshadowed by the vision of recession (although there is a growing pessimism). In this extremely important stage, key decisions in the field of epidemiology, economy, social policy and law were made, setting out further directions for how the situation would develop.

The rejection of the British model is crucial here. The attempt to reconcile different pillars of sustainable development in the face of crisis, seeking a compromise between health considerations, social situation and the economy (with the environmental pillar being in a state of *constans*), ended in a fiasco. With an impending crisis, the social pillar began to dominate. It is worth noting that this can be compared to *a revolution devouring its own children*. Determined protection of social goals (health, house-

holds and household incomes) must bring about lowering of the quality of life in the future. So the hierarchy of needs had the final say in the end, with basic and more immediate needs coming to the fore.

From the perspective of sustainable development, this is a dilemma that is difficult to solve and it does not only concern the long-known conflict between the requirements of economic growth and social goals, or between the economy and the environment. We are faced with a completely new dilemma within one pillar – the social one; i.e., is it more important to meet immediate needs (with high costs for the future), or is a long-time perspective more important, even at the cost of making sacrifices today? To refer to the situation of the pandemic: is it more important to protect the health and life of all members of society even if this means lower quality of life in the future, or perhaps it is better to take the risk of bearing social costs today so that the quality of life in the future will not deteriorate dramatically.

This dilemma, as mentioned above, was solved in accordance with the hierarchy of needs, which may be a tip for the future – for social policy and planning in times of stability. In the situation of deep *biological* crisis (as opposed to economic crises), the social factor will ultimately have the final word at the expense of all other factors. Within the social pillar, the hierarchy of goals will be based on the hierarchy of needs (with basic needs at the top).

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The Impact of Air Quality on Population Migration

Wpływ jakości powietrza na migracje ludności

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Abstract

Based on annual panel data of OECD countries from 1995 to 2014, this paper analyzes the impact of air quality (including per capita CO₂, PM2.5, and SO emissions) on the immigrant population through a panel fixed-effect model, while employing control factors such as GDP, unemployment rate, and education level. Overall, we provide evidence that air quality is a key determinant of immigration in the selected countries, and in particular the host country's emissions have a negative impact on immigrants. Greater emissions imply fewer immigrants, while fewer emissions denote more immigrants. Our findings provide countries with a way to more accurately estimate migrant inflow and offer an idea for OECD members on how to attract immigrants via an improvement in environmental quality.

Key words: immigration, air quality, emissions, OECD

JEL Codes: F22, Q53, C23

Streszczenie

Na podstawie rocznych danych panelowych krajów OECD za lata 1995-2014 w niniejszym artykule dokonano analizy wpływu jakości powietrza (w tym CO₂ per capita, emisje PM2,5 i emisje SO) na populację imigrantów za pomocą panelu, biorąc pod uwagę czynniki, takie jak PKB, stopa bezrobocia i poziom wykształcenia. Dostarczamy dowodów, że jakość powietrza jest kluczowym czynnikiem determinującym migrację w wybranych krajach, a emisje z kraju przyjmującego mają negatywny wpływ na imigrantów. Większe emisje oznaczają mniej imigrantów, a mniej emisji oznacza więcej imigrantów. Nasze ustalenia pomogą poszczególnym krajom na dokładniejsze oszacowanie napływu migrantów, a zarazem wskazują członkom OECD, że poprzez poprawę jakości środowiska można przyciągnąć więcej emigrantów.

Słowa kluczowe: imigracja, jakość powietrza, emisje, OECD

1. Introduction

With the publishing of *The Silent Spring* (Carson, 1962), environmental issues for the first time became the focus of attention throughout society. While studies on environment and population mainly reflect the relationship between environment and population size, pollution and mortality, population and economy (Lamsal et al., 2013; Ghanem, 2018), few papers look at the correlation between environment and population mobility.

Our research contributes to this strand of the literature in several aspects. In the beginning, we first in-

vestigate the potential relationship between air quality and immigration, thus enriching the research on immigration and expanding the area of research concerning the environment. The second contribution is that we analyze the impact of air quality on immigration in some OECD countries (since most of the selected sample countries are developed countries, it can be regarded as the relationship in developed countries). Moreover, the samples we use consist of updated panel data covering 24 countries between 1995 to 2014, instead of focusing on one country or a small number of countries. Finally, we also test the impact of air quality on immigration in the sample

countries at different time periods, among geographically densely distributed sample countries, and under the intervention of different political parties, thus proving the robustness of the model.

Our hypothesis is that air pollution has a negative impact on immigrants, which may come from the following two channels. The first channel of effect is through the industrial structure and income channel. For developed countries and some developing countries, higher air quality often represents a greater level of industrial structure (Huang, 2009; Mi et al., 2015). Many studies in the literature have showed a stable relationship between industrial structure and economic development (Gan et al., 2011; Zhang et al., 2014). Countries with a reasonable industrial structure tend to have a higher level of economic development and higher per capita income, which lead to positive immigration inflows.

The second channel of effect is health factors. A large amount of literature has indicated that air pollution poses a great threat to health, and people's health needs are usually one of the main factors to be considered when choosing migration destinations (Khereis et al., 2017; Zheng et al., 2019). Therefore, air pollution affects people's preferences for making migration decisions in a way that threatens human health, thus affecting immigrant inflows.

Some recent papers have discussed the relationship between environment and migration, but in their discussions, migration often seems to be defined as a problem or a threat. Myers (2002) estimated that until 1995, about 25 million people worldwide were displaced by environmental changes. This figure was subsequently cited in *the Stern Review on the Economics of Climate Change* (2007) and adopted by many campaigns and advocacy groups. According to the push-pull theory of population migration, we believe that if environmental refugees are *pushed* by their own harsh environment, then natural migration is *pulled* by the two channels assumed in this paper. The rest of this research runs as follows. Section 2 reviews the literature on environment and population, summarizes the theoretical perspectives of international migration and environment, and puts forward the hypotheses to be tested. Section 3 introduces the data and empirical methods used in greater detail. The results are discussed in Section 4 and summarized in Section 5.

2. Literature review

Research on the environment and population mainly focuses on the change in population quantity, especially the impact of population size and growth on the environment. The earliest IPAT model proposed by Ehrlich and Holdren (1972) is representative of this field.

Jorgenson and Clark (2010) used panel data from 1960-2005 to examine the temporal stability of the

population/ environment relationship, finding that the temporal stability generally holds for both developed countries and less-developed countries. On the basis of previous literature, Harper (2013) discussed the impact of population aging and population migration on the environment and considered that there is an interactive relationship between them.

Some scholars have also studied the impact of environmental changes on population. Kumm and Varis (2010) finding that less than 1/8 of the human population live south of the equator while around 50% of the population dwell within the area between 20°N and 40°N, where also most of the world's development and poverty-related problems are located. Ceur et al. (2016) explored the experimental design provided by Turkey's natural gas expansion and found that air quality improved by the conversion of coal to natural gas, significantly reducing infant mortality.

A few papers have dealt with the relationship between environment and other aspects of population, such as environment and population structure as well as environment and population mobility. Studies on the relationship between environment and population mobility have some limitations, such as the selection and methods of data samples. In order to overcome the limitations of previous studies, we collate the panel data of OECD countries from 1995 to 2014 and use the annual inflow of immigrants to represent the population flow index and employ annual per capita CO₂, PM_{2.5}, and SO emissions to represent the air quality index. The fixed effect model allows us to verify the relationship between environment and population flow, which fills the gap in the literature on this issue.

3. Data and methodology

3.1. Data

Compared with traditional cross-sectional data or time series data, panel data increase the degrees of freedom and reduce the collinearity between explanatory variables, thus improving the effectiveness of empirical estimation (Hassan et al., 2011; Dimitrova et al., 2015). Therefore, based on panel data of 24 OECD countries from 1995 to 2014, we analyze the impact of air pollution on the inflows of immigrants. Most data come from the OECD official database and the World Bank's World Development Indicators System. Table 1 gives a detailed description of variables and data sources.

3.1.1. Dependent variable

Following studies such as Hatton and Williamson (2005), we use immigration (inflows of foreign population by Nationality, in tens of thousands of people) as an indicator of population mobility. Normally, the national estimate of this indicator is based on population registration or residence permit data.

Table 1. Definitions of variables and data sources

Variable	Definition	Source
Immigration	Inflows of foreign population by nationality (tens of thousands of people)	OECD official database
CO ₂ emissions	Metric tons per capita / year	OECD official database
PM _{2.5} emissions	Metric tons per capita / year	OECD official database
SO emissions	Metric tons per capita / year	OECD official database
Unemployment	Unemployment, total (% of total labor force) (modeled ILO estimate)	World Bank. World Development Indicators
Log (GDP)	GDP per capita (constant 2010 US\$)	World Bank. World Development Indicators
Education	Government expenditure on education, total (% of GDP)	World Bank. World Development Indicators
Medical	Numbers of physicians (per 1,000 people)	World Bank. World Development Indicators
Urbanization	Urban population (% of total)	World Bank. World Development Indicators
Political stability	External conflict	ICRG Historical Data by PRS Group

3.1.2. Explanatory variables

Because the purpose of this study is to examine the relationship between air quality and immigration population, we take CO₂, PM_{2.5}, and SO emissions as three key independent variables. Specifically, while the dependent variable is immigration, in order to maintain consistency and comparability of data, CO₂, PM_{2.5}, and SO emissions (metric tons per capita / year) are taken as specific explanatory variables in the model. The following control variables are included in our study.

Unemployment: On the basis of previous studies (Mete, 2007), we use unemployment rate indicators to reflect the employment situation of the labor force in various countries.

Per capita GDP: GDP usually reflects the overall level of a country's economic development (Boubtane et al., 2013; Vargas-Silva, 2017). we use the logarithmic form of per capita GDP (constant 2010 US\$) to evaluate the economic growth of various countries.

Education: Improvement in education level, especially higher education, helps reduce labor exports and increase labor imports (Lewer and berg, 2008; Jackson, 2015). Due to data availability, we choose the proportion of government investment in education to GDP to reflect the level of education.

Medical: Sundquist (2001) and Moreno et al (2016) pointed out that an important driver of international migration is the level of health care in the target country of immigration. Therefore, following Cebula (2010) and others, we use the number of physicians per one thousand people as an indicator of the medical level of a country or region.

Urbanization: Some scholars believe that urbanization increases the attraction of migrants (Vij, 2012). Therefore, on the basis of these studies, we use the

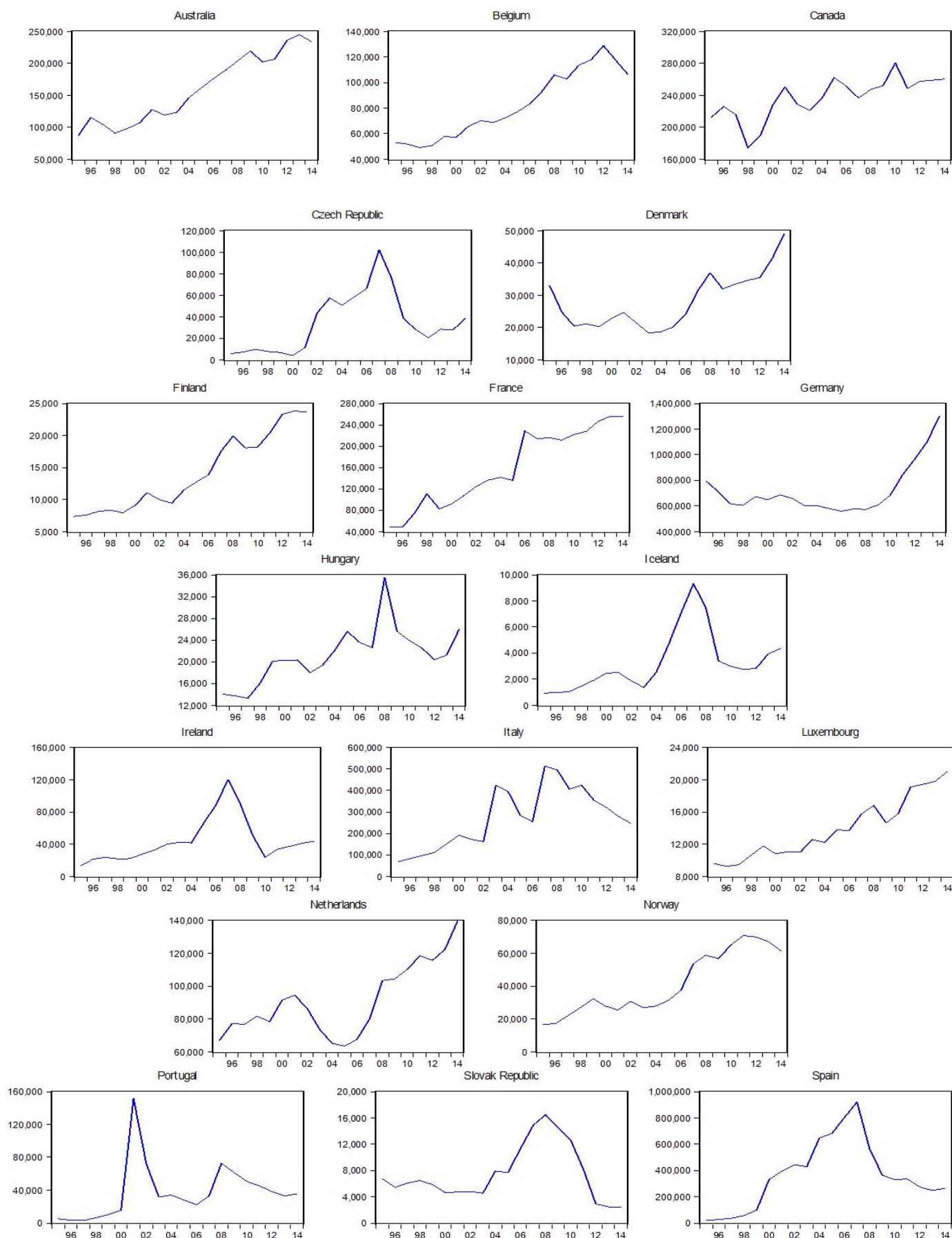
proportion of urban population to total population to reflect the urbanization rate.

Political stability: Through the research of some scholars (Essuman-Johnson, 2006), We believe that individuals tend to have a more stable political environment when making immigration decisions. This paper uses the external conflict index for a period of time to measure the stability of a regime.

3.2. Descriptive statistics

Table 2 gives the descriptive statistics of the variables. We can see that the mean value of Immigration is 16.068, the standard deviation is 24.786, the minimum value is 0.925, and the maximum value is 134.253, indicating that all sample countries are inflow countries, and the migration gap between countries is very large. The explanatory variables are CO₂, PM_{2.5}, and SO Emissions. The mean values of these variables are 9.652, 0.006, and 0.026, the standard deviations are 4.486, 0.010, and 0.041, the minimum values are 3.538, 0.00008, and 0.0001, and the maximum values are 24.824, 0.062, and 0.264, respectively. This shows that although the air pollution emissions of OECD member countries are generally low, the internal differences are still not low. Figure 1 shows the trend of migrant inflows from 1995 to 2014. Except for the Slovak Republic, the annual migration of residents in most sample countries has been on the rise since 1995, peaking around 2006 to 2008 and then declining in some countries. In 2014, the overall annual migration of residents is still greater than that in 1995, which shows that the sample countries have a sustained attraction for migrants.

Figure 2 shows the trend of total immigration and total CO₂, PM_{2.5}, and SO emissions in all sample countries from 1995 to 2014. We can see that the to-

Figure 1. Plots of *IM* for OECD countries, 1995-2014, part I

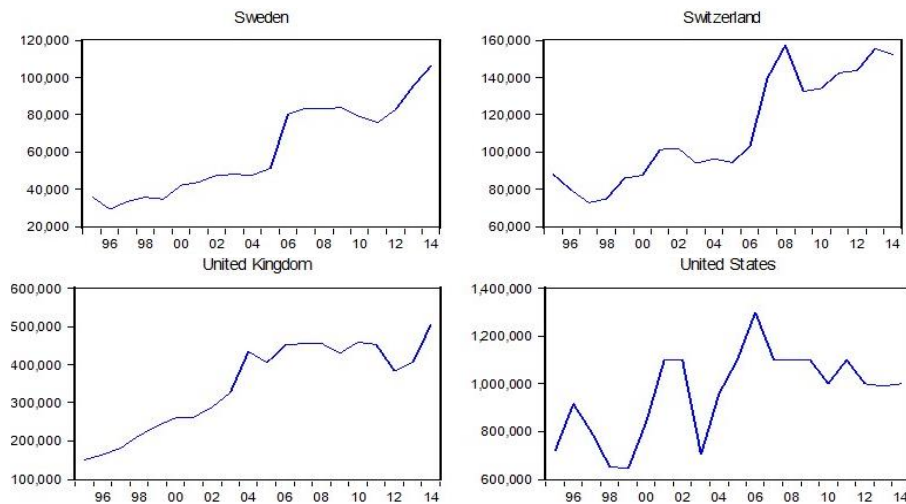
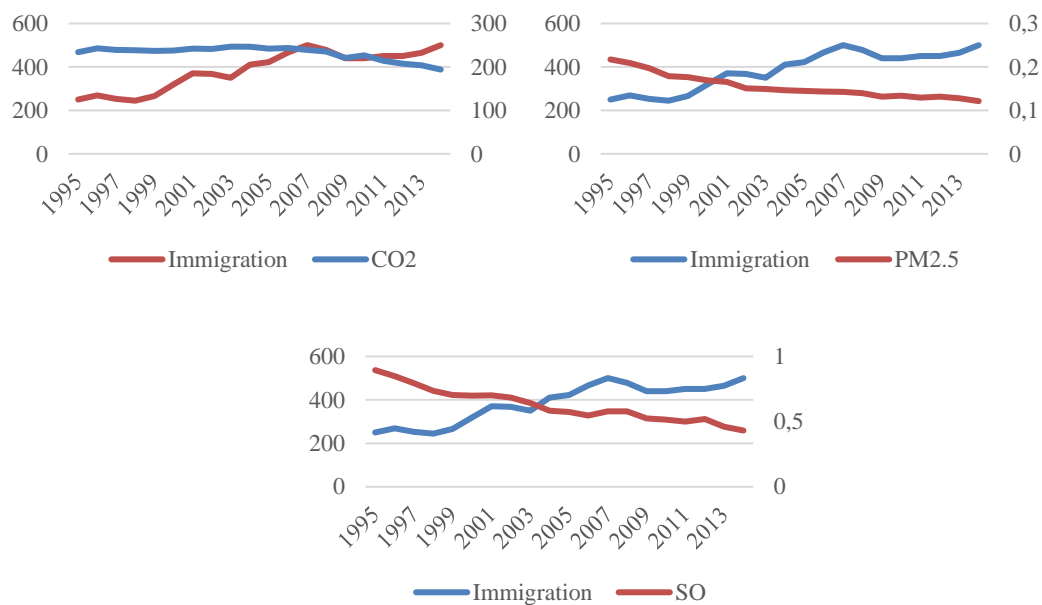
Figure 1. Plots of *IM* for OECD countries, 1995-2014, part II

Figure 2. Trend of Migrant Population and Emission

Table 2. Descriptive statistics of the model's variables

Variable	Observations	Mean	Std. Dev	Min	Max
Immigration	480	16.068	24.786	0.092	134.253
CO_2 emissions	480	9.652	4.486	3.538	24.824
$PM_{2.5}$ emissions	480	0.006	0.010	0.00008	0.062
SO emissions	480	0.026	0.041	0.0001	0.264
Unemployment	480	7.532	3.871	1.8	26.090
Log (GDP)	480	10.481	0.587	8.925	11.625
Education	480	5.305	1.151	2.973	8.559
Medical	480	3.149	0.684	1.2	4.857
Urbanization	480	77.740	10.526	51.109	97.833
Political stability	480	10.642	1.352	4.380	12

tal immigration trend of 24 OECD countries in this period is rising, while the emissions of CO_2 , $PM_{2.5}$, and SO are decreasing in this period. We thus can

make the hypothesis that there is a negative correlation between them in our sample countries.

3.3. Empirical methodology

Owing to the main purpose of our study is to investigate the impacts of air quality in a country on the inflows of immigration population by nationality and considering the huge difference of the various variables, we take the natural logarithm of GDP in the actual estimation process. Therefore, the panel data model is:

$$IM_{i,t} = \alpha_0 + \alpha_1 EM_{i,t} + \gamma Z_{i,t} + \mu_i + \nu_i + \varepsilon_{i,t} \quad (1)$$

In equation (2), IM stands for immigration, which measures the number of immigrants. EM , including CO_2 , $PM_{2.5}$, and SO emissions, respectively, are the main independent variables. Z is a vector that affects the control variables of immigration, μ_i and ν_i are fixed effect variables of time and region, respectively, and $\varepsilon_{i,t}$ is the error term.

4. Empirical results

4.1. The panel fixed-effect model

Tables 3, 4, and 5 list the results of the three different emissions' effects on immigration in the fixed effect model from the panel data, respectively. In the process of regression analysis, we incorporate control variables into the model respectively.

First, in Table 3, The estimation results confirm that the coefficient of CO_2 emissions is negative and significant at the 10% level regardless of adding any control variables, proving that immigration rises under lower CO_2 emissions and declines under higher CO_2 emissions. In some sense, this confirms the view that population is related to CO_2 emissions (Jane et al., 2009; Jiang and Hardee, 2011). Interestingly, unlike population size, which has a positive impact on CO_2 emissions, CO_2 emissions have a negative impact on mobile populations. This result validates the previous hypothesis about the influence of environment on industrial structure and income channels.¹

Table 4 and Table 5 are consistent with Table 3, and so we add the same control variables in order. Table 4 shows that the coefficient of $PM_{2.5}$ emissions is negative and significant at the 1% level regardless of adding any control variables, proving that $PM_{2.5}$ emissions have a strong negative impact on immigration; with an increase of $PM_{2.5}$ emissions, the migrant population is significantly reduced. This result confirms another channel for environmental impact migration, as the environment affects the decision over immigration by influencing people's health.²

The results listed in Table 5 are similar to those in Table 4, we speculate that the similarity of the results may be due to the similarity between $PM_{2.5}$ and SO in some sources (coal and oil burning) and per capita emissions.

In terms of control variables, by observing the estimated results of Tables 3, 4, and 5, we find that the coefficients of all control variables, including *unemployment*, *GDP*, *education*, *medical*, *urbanization*, and *political stability* are significant at the 5% level. Among them, *unemployment* has a negative impact on *immigrants*, which is consistent with the results of Mete (2007); *GDP* has a positive impact on *immigrants*, which is consistent with the results of Boubtane et al., (2013) and Vargas-Silva (2017). Moreover, *education* has a positive impact on *immigrants*, which is consistent with the results of Lewer and berg (2008) and Jackson (2016). *Medical* treatment has a positive impact on *immigrants*, which is consistent with the results of Sundquist (2001) and Moreno et al (2016). *Urbanization* has a positive impact on *immigrants*, which is consistent with the results of Vij (2012). Finally, because the *political stability* index we choose is a negative indicator, the results show that *political stability* has a negative impact on *immigration*, which is consistent with Es-suman-Johnson (2006).

4.2. Robustness

To further check the robustness of the results, we use three different sub-samples in Table 6; the sub-samples of the 10-year window (1998-2007) in all samples, OECD European member countries, and non-right-wing party countries. First, we chose 1998-2007 because this decade was the time when the Tokyo Protocol came into force and greenhouse gas emissions became the legal obligation of developed countries. Therefore, we believe that these 10 years can better reflect the air quality changes in the samples of OECD countries. Second, we select all sample countries in Europe as sub-samples to test whether there are different impacts between environment and immigration in countries with high geographic densities. Neumayer (2003) made an empirical analysis of the party system and pollution level in 21 OECD countries, presenting results show the non-right-wing political system has a positive impact on the corresponding countries' environment. Therefore, we choose non-right-wing party countries as sample subsets to examine the model's robustness.³ The results of these three different subsamples appear in columns (1)/(2)/(3), columns (4)/(5)/(6), and columns (7)/(8)/(9) of Table 6, respectively. It can be seen that the sub-sample results of the 10-year window in columns (1), (2), and (3) show that all explanatory variables are significant at least at the 10% level. It can be roughly explained during the 10-year period that the immigrant population of the sample countries decreases with the increase of emissions. The results in columns (4), (5), and (6) of the sub-sample countries in Europe are consistent with those

¹ The first channel's details are on page 3.

² The second channel's details are on page 3.

³ The non-right-wing party countries defined in this paper are those in which the left-wing party or the neutral party has been in power for more than half of the time from 1995 to 2014.

Table 3. Estimation results: panel fixed effect model (CO_2 emissions)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
CO_2 emissions	-1.602*** (0.000)	-0.955** (0.018)	-0.789* (0.054)	-0.858** (0.034)	-0.815** (0.042)	-0.721* (0.070)
Unemployment	-1.595*** (0.000)	-1.289*** (0.000)	-1.346*** (0.000)	-1.703*** (0.000)	-1.532*** (0.000)	-1.555*** (0.000)
log(GDP)		0.178*** (0.000)	0.162*** (0.000)	0.113*** (0.004)	0.063 (0.119)	0.021 (0.622)
Education			1.829** (0.027)	1.554* (0.059)	1.184 (0.149)	1.407* (0.084)
Medical				3.735*** (0.002)	2.332* (0.061)	2.307* (0.062)
Urbanization					0.873*** (0.001)	0.784*** (0.002)
Political stability						-1.582*** (0.002)
Constant	0.435*** (0.000)	-1.519*** (0.000)	-1.463*** (0.000)	-1.041** (0.011)	-1.130*** (0.005)	-0.461 (0.308)
F-test (p-value)	44.86***	40.00***	31.49***	27.66***	25.61***	23.84***
R^2	0.165	0.209	0.218	0.235	0.255	0.271
Observation	480	480	480	480	480	480

Notes: The values in parentheses denote the standard errors. *indicates significance at 10%. ** indicates significance at 5%. ***indicates significance at 1%.

Table 4. Estimation results: panel fixed effect model ($PM_{2.5}$ emissions)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
$PM_{2.5}$ emissions	-1.099*** (0.000)	-0.701*** (0.001)	-0.797*** (0.000)	-0.761*** (0.000)	-0.691*** (0.001)	-0.698*** (0.001)
Unemployment	-1.436*** (0.000)	-1.252*** (0.000)	-1.385*** (0.000)	-1.379*** (0.00)	-1.533*** (0.000)	-1.573*** (0.000)
log(GDP)		0.133*** (0.001)	0.0955** (0.021)	0.056 (0.129)	0.017 (0.700)	-0.031 (0.503)
Education			2.545*** (0.002)	2.301*** (0.005)	1.905** (0.019)	2.107*** (0.009)
Medical				3.351*** (0.005)	2.084* (0.092)	2.076* (0.089)
Urbanization					0.806*** (0.001)	0.711*** (0.005)
Political stability						-1.665*** (0.001)
Constant	0.340*** (0.000)	-1.099** (0.011)	-0.819* (0.061)	-0.506 (0.25)	-0.652 (0.142)	-0.098 (0.842)
F-test (p-value)	56.20***	42.03***	34.61***	29.74***	27.00***	25.32***
R^2	0.199	0.218	0.235	0.248	0.265	0.283
Observation	480	480	480	480	480	480

Notes: same as Table 3.

of the sub-sample countries in the 10-year window. All explanatory variables are significant at least at the 10% level. For the results of the sub-sample of non-right-wing party countries shown in columns (7), (8), and (9), the explanatory variables except CO_2 are significant at least at the 5% level, and the coefficient symbols are consistent with the results of the first two sub-samples. This means that the model has passed three robustness tests, solved the endogenous problem of the model, and confirmed our important conclusion again that the immigrant population of OECD sample countries is affected by the air quality of the host country.

We note that the CO_2 emission results of the three sub-sample countries deviate from those of the whole sample. The positive coefficients in columns

(1) and (4) mean that CO_2 emissions have a positive impact on immigrants, while column (7) shows that there is no sufficient reason to believe that CO_2 emissions are related to immigrants. We speculate that the reasons for this result may be the insufficient sample size or the fact that CO_2 emissions do not have a significant impact on human health and do not attract much attention from immigration. The detailed reasons are not discussed in this paper and need to be further studied.

5. Conclusion and policy implications

In order to analyze the relationship between the environment and immigrants, we employ panel data of 24 OECD countries from 1995 to 2014, using CO_2 ,

Table 5. Estimation results: panel fixed effect model (*SO* emissions)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<i>SO</i> emissions	-1.061*** (0.000)	-0.711*** (0.002)	-0.809*** (0.001)	-0.816*** (0.000)	-0.729*** (0.002)	-0.688*** (0.003)
Unemployment	-1.417*** (0.000)	-1.193*** (0.000)	-1.316*** (0.000)	-1.319*** (0.000)	-1.473*** (0.000)	-1.507*** (0.000)
log(GDP)		0.172*** (0.000)	0.140*** (0.000)	0.093** (0.017)	0.052 (0.204)	0.009 (0.833)
Education			2.505*** (0.002)	2.265*** (0.005)	1.872** (0.021)	2.037** (0.011)
Medical				3.636*** (0.002)	2.362* (0.056)	2.345* (0.056)
Urbanization					0.793*** (0.002)	0.710** (0.005)
Political stability						-1.564*** (0.002)
Constant	0.295*** (0.000)	-1.537*** (0.000)	-1.320*** (0.000)	-0.931** (0.018)	-1.043*** (0.008)	-0.368 (0.405)
<i>F</i> -test (<i>p</i> -value)	47.75***	41.53***	34.12***	29.72***	26.91***	24.96***
<i>R</i> ²	0.173	0.215	0.231	0.247	0.264	0.280
Observation	480	480	480	480	480	480

Notes: same as Table 3.

Table 6. Robustness analysis using possible endogeneity concern: ten-year window, restricted data, and partial samples.

	Ten-year dummy (1998-2007)			Restricted data (EU)			Partial samples (non-right parties)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>CO</i> ₂	0.001* (0.070)			0.001*** (0.004)			-0.0004 (0.139)		
<i>PM</i> ₂₅		-1.134*** (0.001)			-0.563* (0.069)			-0.473*** (0.005)	
<i>SO</i>			-0.112** (0.020)			-0.042* (0.065)			-0.111** (0.010)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>F</i> -test (<i>p</i> -value)	7.99*** (0.000)	8.67*** (0.000)	8.20*** (0.000)	10.42*** (0.000)	10.06*** (0.000)	10.07*** (0.000)	8.26*** (0.000)	9.26*** (0.000)	9.06*** (0.000)
<i>R</i> ²	0.378	0.398	0.384	0.447	0.438	0.438	0.194	0.212	0.208
Observations	264	264	264	380	380	380	260	260	260

Notes: same as Table 3. We do not list the results of all the control variables. The table uses *Yes* to represent all the control variables that passed the test.

*PM*_{2.5}, and *SO* emissions as explanatory variables to express air quality and inflows of immigration population and set up the panel data fixed effect model. The results show for the 24 OECD sample countries that *CO*₂, *PM*_{2.5}, and *SO* emissions have a negative impact on immigration. We propose two hypotheses about the reasons for this relationship. First is the channel of industrial structure and income, and second is the channel of health.

Nordheim (2004) forecasted over the next three decades in Europe, the number of people in the 20–29 age band will fall by 20%, while the number in the 50–64 age group will increase by 25%, labor force participation rates may drop to just 1/3 of those of

prime age workers. This huge labor gap means strong demand for immigrants, especially skilled migrants, across Europe. In order to attract more immigrants in the future, we suggest countries should pay more attention to improving their environment, because people with a higher quality of talent demand higher environmental requirements.

This paper further uses the sub-sample sets of 10-year window, European countries, and non-right-wing party countries to test the robustness of the model, and the results are almost the same as the whole sample. This proves the robustness of the model and further illustrates the reliability of the relationship between environment and immigration.

Interestingly, we find that the results of the robustness test using sub-sample sets of right-wing party countries denote that we are not sure about the influence of the environment on immigration, meaning that the party system of the sample countries does have an impact on the domestic environment.

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Clean and Green – The Volkswagen Emissions Scandal: Failure of Corporate Governance?

Czysty i zielony – oszustwa emisyjne Volkswagena: klęska, czy ład korporacyjny?

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Abstract

In 2014, a scandal involving fraud and power shook the Volkswagen Group with far-reaching consequences that are yet to be fully revealed. This article examines the Volkswagen emissions scandal in terms of corporate governance failure. After a chronological review of the events that led to this extraordinarily damaging revelation, the main differences between the American and the German board system are described. Although Germany's two-tier board is often considered superior to the American board system, weaknesses in the area of corporate ethics and culture that led to the crisis in the Volkswagen case are identified. The particular constellation within the Volkswagen group and its ownership structure reveals failures in management ethics that led to a certain kind of behaviour among employees that was not explicitly mandated by the management but was, nevertheless, in its interest in regard to achieving company goals.

Key words: Volkswagen, emissions scandal, corporate governance, board systems, corporate culture

Streszczenie

W 2014 r. skandal wstrząsnął Grupą Volkswagen, przynosząc daleko idące konsekwencje, z którymi firma boryka się do dzisiaj. W tym artykule przeanalizowano skandal związany z fałszowaniem danych o emisji zanieczyszczeń w Grupie Volkswagen, pod kątem niepowodzenia ładu korporacyjnego. Omówiono w porządku chronologicznym wydarzenia, które doprowadziły do ujawnienia fałszerstw i jego poważne konsekwencje, wskazując na główne różnice między funkcjonowaniem zarówno amerykańskiego, jak i niemieckiego systemu zarządzania. Choć niemiecka dwupoziomowa rada zarządu jest często uważana za lepszą od amerykańskiej, zidentyfikowano słabości w obszarze etyki i kultury korporacyjnej, które doprowadziły do kryzysu. Szczególny układ w grupie Volkswagena i jej struktura własności ujawnia błędy w etyce zarządzania, które doprowadziły do pewnego rodzaju zachowań wśród pracowników, które choć nie były wyraźnie nakazane przez kierownictwo, to jednak leżały w jego interesie i służyły osiągnięciu celów firmy.

Słowa kluczowe: Volkswagen, skandal emisyjny, ład korporacyjny, systemy zarządzania, kultura korporacyjna

Introduction

In times of growing environmental awareness and also increasing demands on environmentally friendly products, it is becoming more and more important for companies to profile themselves as sustainable producers. Not only do consumers want environmentally friendly products out of real conviction, in addition, government regulations are becoming

increasingly stringent to deal with growing pollution problems. The entire automotive industry in Germany achieved sales of over € 420 billion in 2018. This corresponds to approximately 12.6% of the GDP (Statistisches Bundesamt, 2019). At the same time, the transport sector is also responsible for 22% of CO₂ emissions and 26% of NO_x emissions in Germany (Umweltbundesamt, 2019). As a result,

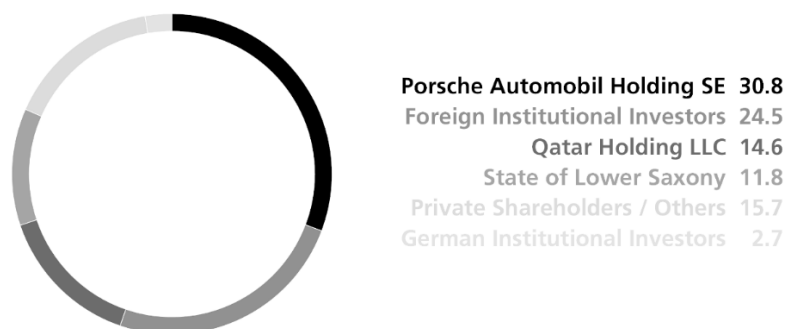


Figure 1. Volkswagen AG: Distribution of Shares

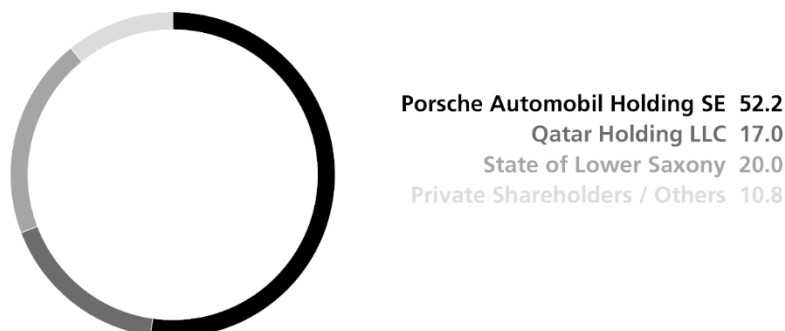


Figure 2. Distribution of Voting Shares (December 2018)

this industry offers a lucrative environment for fraudulent activities.

In 2015, the most expansive and costly scandal in the history of the company became public for Volkswagen AG – at that time one of the largest vehicle producers worldwide. Again, a car company attempted to circumvent US environmental regulations in order to gain a market advantage and increased sales through green marketing (Li et al., 2018), and again, these fraudulent activities were revealed. How could malfeasance of this magnitude go unnoticed by corporate management – if, indeed, it actually was unnoticed – for so long? How could a number of engineers install *defeat devices* in 11 million cars worldwide without the management's knowledge (Arbour, 2016)? And furthermore, if the management board was aware of the fraud, why didn't the supervisory board intervene? After all, with the supervisory board, the German two-tier system should have acted as a powerful controlling body vis-à-vis the Management Board.

The aim of this article is to summarise the chronology of the scandal and to critically examine the alleged advantages and limitations of the German two-tier system compared to its Anglo-American counterpart.

Volkswagen AG

According to the corporation's website, the Volkswagen Group ranks among the leading automakers globally and is the largest in Europe. Volkswagen cars are available in 153 countries and

are manufactured by more than 665,000 employees in 31 countries around the world. Currently, 12 brands belong to the Volkswagen Group: Volkswagen Pkw, Audi, SEAT, ŠKODA, Bentley, Bugatti, Lamborghini, Porsche, Ducati, Volkswagen Nutzfahrzeuge, Scania and MAN. VW's earnings after taxes amounted to 12.2 billion euros in the financial year 2018.

Today's Volkswagen Group originated from the development of the *Volkswagen* or *Kraft durch Freude Wagen* by Ferdinand Porsche, grandfather of the late CEO, Ferdinand Piëch, who died in August 2019. After the Second World War, the factory that produced the cars was rebuilt as *Wolfsburg Motor Works* by the Control Commission for Germany (British Element) under the supervision of Major Ivan Hirst. Two years later, the official company name was changed to *Volkswagen*. Beginning in 1949, the company was transferred to the leadership of the federal state of Lower Saxony, and the legal organisational form was changed to *Volkswagen GmbH*. In 1960, the business form was transferred to a joint-stock company and has been officially named *Volkswagen AG* since 1985 by resolution of the annual general meeting.

In 2017, the company's pre-tax profit was 17 billion euros, and the subscribed capital of Volkswagen AG amounted to € 1.28 billion. The distribution of shares is presented in Figure 1. Even more important for the balance of power within the corporation is the distribution of voting shares. In December 2018, 52.2% were held by Porsche Automobil Holding SE, Stuttgart; 20% belonged to the federal state of Lower

Saxony; and Qatar Holding LLC held 17.0% (Figure 2). The remaining 10.8% belonged to others (Volkswagen Konzern, 2018). Porsche's subscribed capital comprises 50% ordinary shares and 50% non-voting shares. The voting shares belong exclusively to the Piëch and Porsche families (Porsche SE, 2019). Thus, one can say that Volkswagen is mostly an Austrian family business.

In December 2007, Volkswagen launched its ambitious *Strategy 2018*, with its main goal being that, *In 2018, the Volkswagen Group aims to be the most successful and fascinating automaker in the world* (Volkswagen AG, 2010).

Chronology of the Emissions Scandal

The scandal uncovered in 2015 does not represent the first time Volkswagen was involved in fraudulent activity. In 1974, the corporation was found guilty of having manipulated the emission systems of the T2 transporter by installing defeat devices. The Environmental Protection Agency (EPA) and Volkswagen reached an agreement in the dispute. With a penalty of only \$120,000, the punishment was relatively benign (Klauder, 2015).

The legal dispute over the alleged secret betrayal by former Opel manager José Ignacio López in 1996 had been considerably more annoying. López joined Volkswagen in 1993 with seven close associates from Opel (SPIEGEL ONLINE, 1993). After the German courts failed to reach a definitive conclusion, the dispute escalated to the extent that US President Bill Clinton and German Chancellor Helmut Kohl had to intervene. Ultimately, Volkswagen was required to pay a 100-million-dollar penalty to General Motors (GM), Opel's parent company, and obliged to buy components from GM for \$1 billion. In 1996, López was pushed by Piëch to resign. The criminal case against López was suspended for a payment of 400,000 DM.

Finally, the EPA was able to prove to seven manufacturers that the manipulation with defeat devices had occurred. Without a lawsuit, Renault Trucks, Volvo Trucks, Caterpillar, Cummins Engines, Detroit Diesel, Mack Trucks, and Navistar reached an agreement with the EPA on a one-billion-dollar fine (Doll et al., 2015). At that time, at least, every company should have clearly understood the risks involved in deceiving American authorities.

Although VW stopped selling diesel vehicles in the US in 2005 because the company realised that the impending emission limits would not be met, the corporation initiated a re-entry to the American market two years later. To reach this goal, VW developed its *Passat* model, which was not only less expensive but also larger and better equipped than the European pendant. To attract US consumers, VW had to produce larger cars, but for US laws, especially California's environmental regulations, emissions had to be reduced – a difficult challenge to

overcome (Appel, 2019). At that time, Toyota was the leading automaker worldwide, and Ferdinand Piëch was Chairman of the Supervisory Board of Volkswagen AG. He was a strong advocate of the diesel engine, and VW specialised in this technology. Diesel engines promised significantly more-economical fuel consumption and, thus, lower carbon dioxide (CO₂) emissions than petrol engines with the same power but, unfortunately, higher nitrogen oxide (NO_x) generation. Thus, it should have been clear to upper-level and top management that only two of the three potential advantages, i.e. power, low emissions, or fuel efficiency, would be possible.

Volkswagen returned to the American market and, indeed, seemed to have convinced US consumers of the advantages of diesel cars. In 2008, the *VW Jetta TDI* was introduced to the US market, and in 2009, the *Green Car Journal* awarded it the title of Green Car of the Year, confident that it represented *clean diesel*.

In 2014, researchers from the International Council on Clean Transportation (ICCT), a non-profit organisation, wanted to investigate why some European car models met the strict American NO_x emission limitations while, in Europe, the same cars had higher emissions. In cooperation with the University of West Virginia, the ICCT road-tested several models and found that they exceeded the limits by up to 35 times (Arbour, 2016; Siano et al., 2017). This process is complicated and expensive; therefore, cars are usually tested under laboratory conditions. Since laboratories for testing trucks are large, scarce, and even more expensive, these vehicles are usually tested on roads. Thus, in these tests conducted jointly by the ICCT and the university, some diesel trucks were found to emit less NO_x than diesel cars. On May 15, 2014, the ICCT published its results.

In accordance with the Clean Air Act, the ICCT informed the Environmental Protection Agency (EPA) in Washington and the California Air Resources Board (CARB) in Los Angeles of its findings in spring 2014. The CARB conducted tests under laboratory conditions and, in contrast to the on-road tests, found no deviations from the standards (Blackwelder et al., 2018; Geoghegan, 2015). However, in the summer of 2014, the CARB managed to outsmart the defeat device under controlled conditions and, indeed, the emissions now exceeded the limits in the laboratory.

In December 2014, US authorities reached an agreement with VW that resulted in the automaker recalling about 500,000 vehicles to fix the emission problem by installing a software update. However, on-road testing conducted by the CARB revealed no improvement compared to the results before the recall. Instead of solving the problem, VW had updated the defeat devices and continued to lie to both authorities and customers.

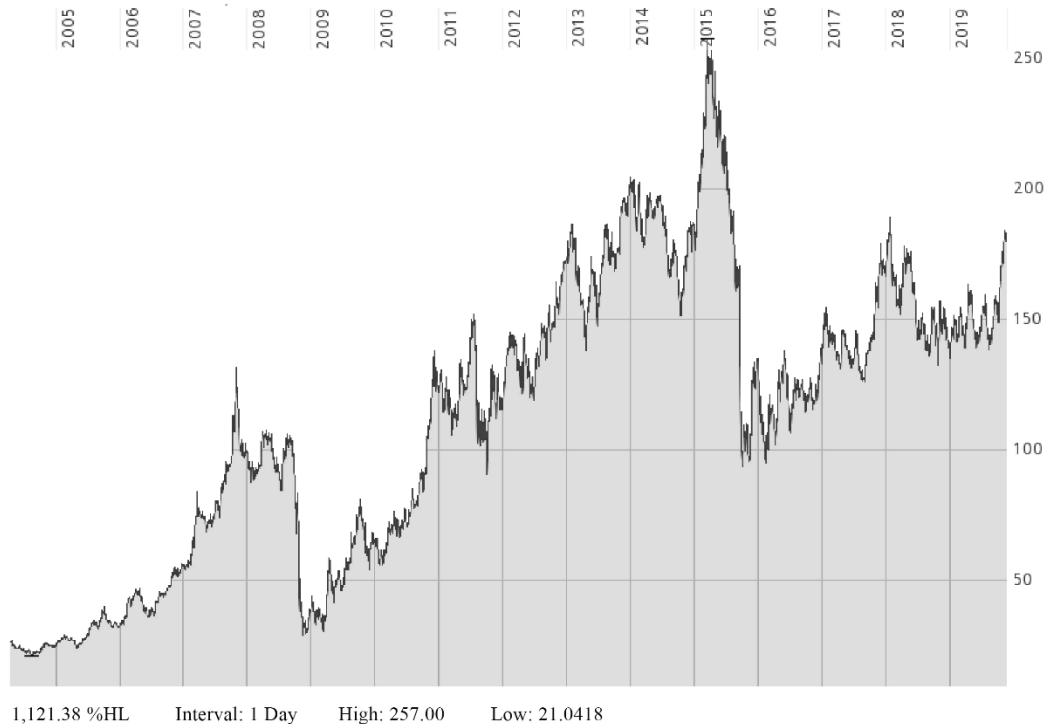


Figure 3. Performance of Volkswagen's Market Share, 2005-2019, source: www.comdirect.de

On September 23, 2015, the former CEO of Volkswagen AG, Martin Winterkorn, had to resign after engineers admitted to having implemented the defeat devices. These were originally software codes that could detect whether the car was running under real-world or laboratory conditions, and in the latter case, the NO_x reduction system was activated. Thus, the cars were, indeed, equipped with the ability to reduce NO_x – but it was usually deactivated. The company's stock market value fell by almost two-thirds (Figure 3).

On October 8, 2015, Volkswagen's US manager Michael Horn was called to testify before a commission of inquiry and admitted that just a *couple of software engineers* had invented the defeat devices, without the knowledge of the management board. But after US authorities had steadily increased pressure on Winterkorn, an indictment followed against the former top manager on May 3, 2015. US Attorney General Jeff Sessions stated, *If you try to deceive the United States, then you will pay a heavy price* (U.S. Department of Justice, 2018).

Volkswagen had to set aside 6.5 billion euros to prepare the cars to comply with emission criteria, and while this amount is huge, it was only about half of the automaker's annual profit at the time (17.1 billion euros in 2018, 17 billion in 2017). To estimate the global scale of the scandal, one has to realise that the US market accounted for only 6% of sales, while the European and Russian markets accounted for 40% (Ewing, 2015). Thus, if European government regulations had been as strict as those of the US, this would have been far more expensive for Volkswagen. In fact, while Volkswagen was sen-

tenced to pay 25 billion dollars in fines, penalties and restitution in the US, the corporation paid not a single euro in European government penalties (Parloff, 2018).

Unitary vs. Two-tier Board System

A unitary or one-tier board system is mainly used in the United States and England *and in jurisdiction under the influence of these systems, for example Canada, Australia, New Zealand and South Africa* (Du Plessis et al., 2017). In contrast, the two-tier or dual board system is common in continental European states.

The US unitary or one-tier board system: Board of Directors

Corporations in the US have one-tier boards, also called a board of directors. This body combines the functions of the management board and supervisory board of a German stock corporation, namely leadership and control. Thus, it is expected to be not only more independent but also less controllable than a German company's top management. As, traditionally, the main purpose of US corporations is to maximise shareholder wealth, there is no need for an authority that represents the interests of employees or other stakeholders (Glaub, 2009). The board is represented by its chief executive officer (CEO), and most listed companies have boards comprising 8 to 12 members. Historically, the board represents a selected group of shareholders as, in the US, investors traditionally are heavily leveraged. Thus, the board

stands for the *separation of ownership and control* (Berle & Means, 1932).

Due to its compact structure and combination of managerial and supervisory tasks, the single-tier board is thought to be faster in regard to decision-making and the flow of information (Jungmann, 2006). Obviously, this is also the main reason for its major disadvantage: The unitary board monitors its own decisions.

The German dual or two-tier board system

German companies are subject to a whole series of governance codes: the German Stock Corporation Act (Aktiengesetz), the German Codetermination Act (Mitbestimmungsgesetz), the German Corporate Governance Code (Deutscher Corporate Governance Kodex), and the German Act on Employee Involvement in a European Company (Sharpe, 2017). As a consequence of the German Stock Corporation, all limited companies are required to have a management board (Vorstand) and a supervisory board (Aufsichtsrat), which is called a two-tier structure. Instead of focusing only on shareholder value, the two-tier board system also takes into account the interests of the stakeholders, namely codetermination and managerialism (Calkoen, 2015). In theory, the dual board structure is superior to the unitary system because of checks and balances, but in the real world, as well as in the German model, there is the possibility of egoistic decision-making in favour of shareholders' or one's own wealth maximisation (Sharpe, 2017).

The Management Board

The members of the management board, called executive officers, make strategic decisions regarding the operations of the business. They represent the corporation and are appointed and dismissed by the supervisory board. Corporations with more than three million euros in share capital must have at least two management board members; corporations with more than 2,000 employees must have a labour director, according to the Codetermination Act. Volkswagen's management board consists of eight members (Volkswagen Group, 2018).

The Supervisory Board

The supervisory board can comprise from 3 to 21 members, depending on corporation size and capital. Until an amendment to the law in 2015, the number had to be divisible by 3. The members are appointed by the shareholders during the annual meeting and also by the employees, depending on codetermination and the size of the corporation. The task of the supervisory board is not only to control the management board's decisions *ex post* but also to be the bal-

ancing force between all stakeholders in the corporation (Block & Gerstner, 2016). According to its corporate website, the Volkswagen Supervisory Board is *responsible for monitoring the Management and approving important corporate decisions. Moreover, it appoints the Members of the Board of Management*. The Volkswagen Supervisory Board has 20 Members (Volkswagen Group, 2018).

Implications for Corporate Governance

The corporations involved in the infamous scandals of the 2000s – Enron, WorldCom, Tyco and Adelphia – were all American companies (Calkoen, 2015). Investigators were able to identify senior managers who acted egoistically and fraudulently (Crête, 2016). Thus, it could be suspected that the American board system, lacking checks and balances, would lead to such malfeasance. But regardless of the size of the corporation or the control instances, it's a people's business. Management decisions are dependent on individual values, relations and connections. If individual preferences conflict with the common good or the interests of the company, then there is no guarantee that its decision makers will not act based on self-interest (McKay et al., 2015). A study by *Forbes* magazine in 2011 revealed that only 30–80% of top management believed that a corporation should not only act in favour of shareholder value but should also benefit society (The Economist, 2011). Problematic against this background is the substantial exchange of personnel between industry and politics in the German auto industry. A prominent example is former Transport Minister Matthias Wissmann, who, immediately after leaving the German Bundestag, became president of the German Association of the Automotive Industry and had the opportunity to lobby intensively in an area for which he was able to set the course in his previous position (Müller, 2007).

To imagine the type of working environment and corporate culture that prevailed at VW, one should take note of the extraordinary and powerful position of Ferdinand Piëch. In the made-for-television documentary *Die Akte VW – Geschichte eines Skandals* (The VW Files – Story of a Scandal), automotive expert Ferdinand Dudenhöffer remarked that if an engineer did not meet Piëch's expectations during a test drive, he found a one-way ticket on his desk that suggested he be fired (Wimmer et al., 2016). This example demonstrates how employees may act in opposition to their own values and corporate social responsibility guidelines to fulfil the goals of an enterprise if there is enough pressure on them stemming from a company's ambitious goals and authoritarian leadership style (Crête, 2016; Weinstein, 2013).

As the head of the supervisory board, on one hand, and patriarch of the majority owner family, on the other, Ferdinand Piëch was able to establish a work-

ing environment that would not tolerate contradiction or failure. As a consequence of the Porsche/Volkswagen takeover, more than half of the management positions of the supervisory board were filled by members of the Porsche and Piëch families. The remaining 10 employee representatives, according to the Codetermination Act, were not just workers but also held management positions. Thus, Piëch had no serious opposition among the supervisory board, and the management board was appointed by them. CEO Martin Winterkorn had worked with Piëch for more than 30 years. He described their relationship as follows: *He makes the innovations, I secure them* (Frankfurter Allgemeine Zeitung GmbH, 2015). In other words, no more and no less than whatever Piëch wanted would be implemented. In Volkswagen's press release of December 10, 2015, the corporation admitted: *The starting point was a strategic decision to launch a large-scale promotion of diesel vehicles in the United States in 2005. Initially, it proved impossible to have the EA 189 engine meet by legal means the stricter nitrogen oxide requirements in the United States within the required timeframe and budget* (Volkswagen AG, 2015). Thus, it was clear – and should have been obvious to the complete management hierarchy – that the fraud was a means to an end: It was impossible at that time to build an engine with the desired capabilities at the specified cost. In economic terms, one could say that the corporation was unwilling to internalise external costs. This is a global issue and the core problem of the climate change debate: Companies and private actors are causing external (environmental) costs in the present, and the costs for repairing the damages will be transferred to society in the future (Arbour, 2016). Even if damage-prevention rules already exist, they can be bypassed, and the costs of any fraudulent activities detected would be priced in (although, instead, the costs for avoiding or repairing damages should be priced in).

Summary and Conclusion

In the aftermath of the emissions scandal, the focus of many automobile tests was of course on the emission values of diesel vehicles. And just as self-evident, the manufacturers made every effort to meet the required values. The German Allgemeine Deutsche Automobilclub e.V. (General German Automobile Club, ADAC) could confirm that for example the BMW X2 xDrive20d Steptronic, the Peugeot 308 SW 2.0 BlueHDi 180 EAT8 and the Volvo XC60 D5 AWD Geartronic were able to significantly undercut the strict 6d-TEMP limits, both on the test bench and on the road (ADAC, 2018). Thus, one could assume that this progress is due to the uncovered fraud. But not the diligence of Californian researchers should have ensured this, but laws and regulations in the producing countries.

The aim of this article was to shed light on the Volkswagen emissions scandal against the background of corporate governance. This issue is not specific to VW alone because other automakers have also been suspected of having engaged in fraudulent activities. However, it would be short-sighted to conclude that there is a systemic failure of the two-tier board structure. It would be an impossible task to establish independent, external controls and regulatory authorities to oversee corporations. Wherever hierarchical structures are present and immense amounts of money are involved, egoistic behaviour cannot be ruled out. Instead, employee representatives should be encouraged to report criminal activities of the corporation that are detrimental to society without being legally liable to the company. Future research should investigate whether corporate values align with the values of management and employees or if they are intended only as lip service for marketing purposes.

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How Does Indonesian Scientific Production on Renewable Energy Successfully Support the Policy Design? A Journey Towards Sustainable Energy Transition

W jaki sposób rozwój indonezyjskiej nauki w zakresie odnawialnych źródeł energii skutecznie wspiera projektowanie polityki? Podróż w kierunku zrównoważonej energetyki

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Abstract

The aim to achieve the target of a 23% share of sustainable energies in the total Indonesia's primary energy supply requires enormous amounts of works. Indonesia's scientific knowledge production can support a successful transition to renewables. However, policy makers struggle to determine how the transition benefits from the scientific production on renewable. A bibliometric study using scientific publication data from the Web of Science (WoS) is used to probe how Indonesian scientific knowledge production can support the policy design for transition to sustainable energy. The seven focused disciplines are geothermal, solar, wind, hydro, bio, hybrid, and energy policy and economics. Based on the data from the above-listed disciplines, a deeper analysis is conducted, and implications to the policy design are constructed. The study reveals that bio energy is the focus of the research topics produced in Indonesia, followed by solar and hydro energy. Most RE research is related to the applied sciences. The innovation capability in the form of technology modifiers and technology adapters supports the transition to sustainable energy in Indonesia. The research on bio energy, however, is characterized by higher basic knowledge than research on solar and hydro energy. This suggests low barriers to the access to the resources and to the completion of bio research in Indonesia. Designing Indonesian energy policy by comprising discriminatively specific sustainable energy sources in the main policy instruments can therefore accelerate the sustainable transition and development.

Key words: bibliometrics, sustainable energy, Indonesia, energy policy

Streszczenie

Cel polegający na osiągnięciu 23% udziału odnawialnych źródeł energii w całkowitym zaopatrzeniu Indonezji w energię pierwotną jest bardzo trudnym zadaniem. Rozwój wiedzy naukowej może pomóc w pomyślnej jego realizacji. Decydenci mają jednak trudności z ustaleniem, jak wiele w tym procesie faktycznie zależy od nauki. Badanie bibliometryczne, z wykorzystaniem danych o publikacjach naukowych z bazy Web of Science (WoS), pozwalają wykazać, w jaki sposób rozwój indonezyjskiej wiedzy naukowej może wesprzeć projekt polityki przejścia na zrównoważoną energię. Siedem ukierunkowanych dyscyplin to polityka geotermalna, słoneczna, wiatrowa,

wodna, bio-, hybrydowa oraz energetyczna i ekonomiczna. Na podstawie danych z wyżej wymienionych dyscyplin przeprowadzana jest głębsza analiza i konstruowane są implikacje dla polityki. Okazuje się, że bioenergia jest głównym przedmiotem badań prowadzonych w Indonezji, a następne miejsca zajmują energia słoneczna i wodna. Większość badań nad odnawialnymi źródłami energii dotyczy nauk stosowanych. Ponadto wspieranie innowacji wspiera przejście do zrównoważonej energii. Badania naukowe nad bioenergią mają bardziej podstawowy charakter, niż badania odnoszące się do energii słonecznej i wodnej. Sugeruje to łatwy dostęp do zasobów i znaczące zaawansowanie badań nad bioenergią w Indonezji. Opracowanie indonezyjskiej polityki energetycznej, uwzględniającej odnawialne źródła energii i ich specyfikę, może zatem przyspieszyć transformację energetyczną, zgodną z ideą zrównoważonego rozwoju.

Słowa kluczowe: bibliometria, zrównoważona energia, Indonezja, polityka energetyczna

Introduction

Indonesia pledged at UN's COP 21 Paris Agreement to participate in the global scientific and political movement to combat climate change by maintaining the global average temperature below 2°C and even pursuing the necessary efforts further down to 1.5°C. In the same time, the Government of Indonesia (GoI) is progressing to institutionalize the implementation of Sustainable Development Goals (SDGs) to support this green movement. GoI has set the national goal to include a 23% share of renewable energy (RE) in the total primary energy supply by 2025. The target requires enormous efforts from the stakeholders in the energy sector, as the current total primary energy supply reached only 6% by 2016 (REN21, 2018). Negro et al. (2012) and Rizzi et al. (2014) identify that policy interventions are important in fostering the role of scientific knowledge production in the energy transition by diffusing and implementing renewable energy technology (RET). On the other hand, scientific knowledge production influences the quality of public regulations (Costa et al., 2016; Desmarais et al., 2014). Policy design for scientific knowledge production on sustainable energy affects the production of scientific knowledge. The policy outcomes influence the quality of public regulation related RET.

Such a jump in the RE share from 7% to 23% in Indonesia will not be accomplished in the absence of integrated and transition strategies in form of public regulations. This includes the contributions of scientific knowledge from public and private sector. Private sector (industries) will then develop the knowledge to enable commercial technologies to penetrate the market in such a competitive way. Energy transition strategies are essential to protect both public and private interests on the energy sector, especially in emerging economic countries like Indonesia, where the flux of private capital is still important in developing infrastructures. Hence, technological innovation at the firm level (either public or private entities) is deemed important so that the country's goal for energy transition can be achieved at the national level. An understanding of the interactions between innovations and markets is critical, given the recent acceleration of energy market dynamics (Zweifel, Praktijnjo, & Erdmann, 2017).

Kungl & Geels (2018) concluded that German energy transition (*Energiewende*) caused industrial destabilization following the downfall of incumbent energy providers.

Scientific knowledge productions have been widely used to probe the trends and patterns of the scientific research and served as one of the inputs in the formulation of science policy for most OECD countries (Thomas, 1992). There is no doubt that the development of the new emerging scientific knowledge requires special attention to support the growth of scientific production in terms of funding or policy intervention (Leydesdorff et al., 1993; Leydesdorff & Gauthier, 1996). Law et al. (1988) argued that science indicators are important tools for triggering scientific discussion, not cutting off or rationalizing particular preconceived positions, in the structure of policy making. Ultimately, policy makers benefit from using such observations regarding scientific capability when designing their policies.

Several studies on scientific knowledge productions on sustainable energy have been performed at the geographical or technological level or the combination of both. Rizzi et al. (2014) investigated the trends of the worldwide scientific production, finding that most of the OECD countries showed diversification approaches of RET, while most emerging economic countries showed a specialization approach of RET development. The *paradox of choice* based on socio-economic situations determined how the country sets the pace through its energy policy. Manzano-Agüero et al. (2014) suggested that the availability of Renewable Energy Sources (RES) in one country did not positively influence the scientific knowledge production of a particular RET. At the EU level, at which its policy direction is regarded as the front runner in the supranational strategies and goals, Sanz-Casado et al. (2012) observed the impact of growth knowledge productions and wind generation. Furthermore, Celikatas et al. (2018) and Montoya et al. (2014) examine the growth of the scientific publications and citations in a country-specific case.

This paper is organized as follows: the paper is opened by providing an introduction regarding the importance of scientific knowledge productions in the sphere of the energy sector, Section 1 presents a general literature review on the sustainable energy, the country's energy landscape and regulatory

framework, Section 2 explains the main research questions and method used in this paper, Section 3 provides the results and discussions, and Section 4 delivers the conclusions and policy implications.

1. Literature review

1.1. Sustainable Energy in SDGs

In 1987, the Brundtland Commission published *Our Common Future* as a report describing efforts to link various issues of economic development and environmental stability. The report defines the definition of sustainable development (SD), as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The United Nations Conference in 2012 introduced the concept of SD Goals (SDGs) to replace the concept of the Millennium Development Goals (MDGs) (Chopra et al., 2017). On September 25, 2015, the United Nations General Assembly has set 17 Sustainable Development Goals (SDGs) and 169 sub-goals to achieve the SD target by 2030. These goals and targets are to balance three dimensions of sustainable development: economic, social, and environment.

Ensure access to affordable, reliable, sustainable and modern energy for all is the goal of SDG7. Energy is a very important sector to obtain almost all SDGs. This is due to energy having a role to eradicate poverty through advances in health, education, water supply and industrialization, to combat climate change. This role is in electricity, heat, and transportation as an energy sector segmentation (Hillerbrand, 2018). Providing energy to meet today's needs without reducing the ability of future generations to meet their needs is the meaning of sustainable energy (SE). In this case, SE is a force that can be recharge during human life and does not cause long-term damage to the environment. RES are the scope of SE, such as hydroelectric power, biomass, geothermal, wind, waves, tidal and solar energy (Hollaway, 2013). Meanwhile, nuclear is considered not to be included as a SE, because of its radioactive waste (Hillerbrand, 2018). Some researchers claim that RE sources are the most efficient and effective solution to address current environmental problems that are faced and require potential long-term action for SD (Dincer, 2000; Lund, 2007; Sadorsky, 2011). The goal of SDG9 to promote sustainable industrialization, innovation, and infrastructure development is essential for the development of RET. The EU, for example, has been much progressing on SDG9 to increase the share of renewables by increasing their R&D expenditures (Uğurlu, 2019). Thus, the practice of SE through the use of RE is a solution to achieve SDGs (Nerini et al, 2018).

1.2. Energy landscape and its regulatory frameworks

Fossil fuels dominate the focus of Indonesia's energy policy. The volatility of coal prices and on-going shale gas revolution provokes the question of the sustainability of Indonesia's energy policy based on exclusively on fossil fuels (Dutu, 2016). The challenging jump of RE share to meet the 2025 goal is real in the absence of a supportive regulatory environment and strong private investment. The government signed a contract to construct 68 renewable power plants from 2014 to December 2017 with a total generating capacity of 1,207 MW. The development capacity of the renewable power plant includes water (754 MW), biogas (17 MW), biomass (29 MW), solar (45 MW), geothermal (86 MW), and mini-hydro (276 MW) energy (MEMR, 2018). Based on information from the Ministry of Energy and Mineral Resources (MEMR, 2017), the realization of the electrification ratio for 2017 is 95.35%. This exceeds the electrification ratio target for 2017, which is listed in the Strategic Plan of the MEMR at 92.75% (MEMR, 2017). With the increase in renewable energy (RE) generation capacity, it is expected to realize the electrification ratio target for 2018 (95.15%) (Presidential Decree, 2017) and 2019 (99.9%) (Presidential Decree, 2018).

In accordance with Law UU No. 30/2017, Law UU No. 30/2009, National Energy Policy (KEN), General Plan of National Energy (RUEN), and National Electricity General Plan 2008-2027 (RUKN), electric companies must prioritize the use of RE as the main energy source to supply electricity to rural areas that do not have basic electricity infrastructure, including remote villages, rural borders, and small inhabited islands. The development of RE and energy conservation is also the first priority of the program designed to meet the national priority for energy security (Presidential Decree, 2017). The increasing utilization of RE as a target in the priority of RE development programs is also listed in the Government Work Plan for 2019 (Presidential Decree, 2018). This means that RE is a priority in achieving energy security in Indonesia.

1.3 Pushing the scientific knowledge productions

A good governance framework requires high-quality regulations (Jacobzone et al., 2007). High-quality regulations are the regulations that obtain public policy objectives and apply minimal costs to communities, stakeholders, the environment and the state (Jacobzone et al., 2007). Thus, they provide the same benefits to traders and consumers, both domestic and foreign (Basedow et al., 2016). Thus, high-quality regulations require Good Regulatory Practices (GRP) to realize regulations that are conducive to international trade and economic integration in general (Basedow et al., 2016). For this reason, Asia-Pacific Economic Cooperation (APEC) – Organization for Economic Co-operation and Development (OECD)

Table 1. Current public policy for scientific knowledge production on energies

Policy Strategy	Government Program	Upstream Specific Energy Technology				
		Generic	Fossil-Fuels	Nuclear	RE	Hybrid
R&D and implementations of energy technologies are directed to support national energy industries	Funding for R&D and implementation of energy technologies	•				
Central government and/or regional government drives the establishment of the supportive climate to the use of R&D results and implementations of energy technologies at the national level	The increasing use of the R&D results and implementations of energy technologies at the national level	•				
Central government and/or regional government fortify R&D activities and implementations of energy technologies	The increasing R&D activities, mastery, and implementations of energy technologies	•	•	•	•	•

has published a checklist of regulatory reforms, where Regulatory Impact Analysis (RIA) is a tool for measuring or evaluating GRP (OECD, 2003). Desmarais et al. (2014) detected that several agencies throughout the United States (US) federal government were producing RIA based on using peer-reviewed scientific research. Costa et al. (2016) also found that the use of scientific research in 101 RIA documents originating from 13 US government agencies during the period 2008-2012 played an important role in confirming public regulation. Therefore, scientific research plays an important role in designing policies thus pushing high-quality regulations in-place.

The importance of scientific research in sustainable energy has been recognized by the GoI in the National Research Master Plan (RIRN) and General National Energy Planning (RUEN). However, research and development (R&D) activities and implementations of energy technologies are part of the supporting national policy sets, not main national policy sets. Fossil, RE, nuclear and hybrid energy is one of the priorities of the national R&D planning. The mandated R&D on RE are geothermal, hydro, and biomass. Nuclear is not included as RE in accordance to the Law UU No. 30/2017.

Table 1 is recreated from the government regulation PP No. 22/2017 (RUEN) and shows that the specific technology related to the RE and hybrid is narrated only for the policy strategy to fortify R&D activities and implementations. The generic term in the table indicates that the detailed program activities do not exclusively mention an upstream specific energy technology. Thus, the activities may target all spectrums of energy technology.

2 Research question & methodology

2.1. Research question

The main research question in this study is thus:

How does Indonesian scientific knowledge production on renewable energies successfully support the policy design for sustainable energy transition towards renewables?

This interdisciplinary research question stimulates future dialogue between Indonesia's scientific societies and policy makers to better position the national interest in light of sustainable energy transition to renewables. The scientometric indicators in this study demonstrate the national capacity for the scientific knowledge productions on sustainable energy – the first-ever study for Indonesia as of August 2019. The scientific publications used in this study are limited only to Indonesia's authors. We recognize the limitation that the authors might be financed by foreign R&D funding, collaborate with the main authors from foreign countries as co-authors, or investigate the topic unrelated to Indonesia. For example, Sutrisno, Vennix, and Syaifudin (2015) investigate RES development in the Netherlands using the game's theory.

2.2. Methodology

To map the scientific knowledge productions, this study sourced the scientific publications from the databases of Web of Science (WoS). Being the world's oldest scientific literature database with high-quality scientific publications, the database has been used in many studies on scientific knowledge production (Boyle & Sherman, 2006; Chadegani et al., 2013). In

fact, the strong coverage of WoS in the area of natural and engineering sciences provides a better angle of attack for meeting the research objectives (Chavarro, Råfols, & Tang, 2018; Mongeon & Paul-Hus, 2016; van Leeuwen, Moed, Tijssen, Visser, & Van Raan, 2001).

We pulled the scientific publications for seven disciplines; six of them were specific RETs (geothermal, solar, wind, hydro, biofuel & biomass, and hybrid), and energy policy and economics. The keywords for these areas are presented in Table 2. Rizzi et al. (2014) explored the extant journals for their scientometric research, limited to fourteen (14) natural and engineering science journals. In our study, there were no limitations regarding the discipline of journals, as we try also to outreach the scientific publication on the area of energy policy and economics which we consider important to construct the institutional setup in light of the successful embarkation of energy transition. We observe that there are 5,709 scientific papers published from 2000 to 2018.

Table 2. Keywords for extracting the data in seven disciplines

Discipline	Key words
Geothermal	(geothermal AND energy) OR (geothermal AND electricity) OR (geothermal AND heating) OR (thermal AND water)
Solar	(solar AND energy) OR (solar AND thermal AND energy) OR (solar AND power AND photovoltaic*) OR (photovoltaic AND generator*) OR (photovoltaic module*) OR (photovoltaic system*) OR (solar cell*) OR (photovoltaic cell*) OR (solar collector*) OR (photovoltaic collector*) OR (solar thermal collector*)
Wind	(wind AND energy) OR (wind AND power) OR (wind farm*) OR (wind park*) OR (wind module*) OR (wind turbine*) OR (wind generator*) OR (wind AND turbine* AND generator*) OR (wind AND offshore) OR (wind AND onshore)
Hydro	(hydro AND energy) OR (hydro AND power) OR (ocean AND energy) OR (tidal AND energy) OR (hydro turbine*) OR (hydroelectric*) OR (tidal AND power*) OR (hydro AND generation*) OR (water AND power) OR (wave AND power)
Biofuel & biomass	(bio AND energy) OR (biomass AND power) OR (bio*diesel) OR (waste AND fuel) OR (waste AND alcohol*) OR (waste AND gas) OR (waste AND energy) OR (biogas) OR (bioethanol) OR (palm oil*) OR (soybean oil*)
Hybrid	(diesel OR storage) AND hybrid AND renewable AND (power OR battery OR solar OR wind OR hydro OR photovoltaic* OR PV OR bio*)
Policy & economics	renewable energy AND (policy OR economy)

A free software tool, VOSviewer, was used to analyze the extracted data to produce a network visualization map based on the most often-occurring terms, the most often-occurring journals that cited the scientific publications, and the most often-occurring institutions that produced the scientific literatures (van Eck & Waltman, 2010). We are interested to reveal the trends and patterns on scientific production on RE in Indonesia, given that this study focused on the policy implication of the production of scientific literatures on Indonesia's renewable energies.

The analysis produces a visualization map of the network of each attribute (occurred terms, co-citations, or institutions). For example, Fig. 3 is the visualization map of occurred terms on the scientific literatures. The often-occurring terms are, among the others, *Indonesia*, *degree*, *property* and *structure*. The map presents how the clusters of these attributes are placed and connected via lines representing groups of clusters. Attributes in the same cluster are displayed in the similar color. The connection line is displayed in the same color with the cluster, and the font size of the attribute represents the occurrence frequency. For example, the term *structure* and *efficiency* in Fig. 3 are displayed and connected in the blue color – meaning that both are in the same cluster. It implies that that most research discusses the term *structure* in parallel with *efficiency*. The clusters and network can be interpreted based on the research objectives. For example, Repanovici & Nedulcu (2018) study the collaboration research on 3D printing using bibliometric networks and interpret the clusters of institutions as the collaborative group based on the geographical proximity. The study finds that Huazhong University of Science and Technology collaborates strongly with Tsinghua University, both in China, with other European universities.

3 Results and discussions

3.1. High growth of total scientific publications with focused on applied knowledge

This study observes the rapid growth of scientific publication on renewable energies starting in 2012 (Fig. 1). The average annual production in the period of 2012 to 2018 is twenty-seven (27) times higher than the average annual production in the period of 2000 to 2011, respectively 766.14 and 28.83 scientific publications per year.

The first RUEN containing detailed policy strategies, government programs, and policy instruments for the national energy system was published in 2010. We suggest that the effect of the policy for scientific knowledge productions can be observed in 2012 by the sharp increase of Indonesia's annual scientific production on renewable energies. This time lag character through which the effect of the policy can be observed in the indicators are identified in various policy studies, thus suggesting that the lag is

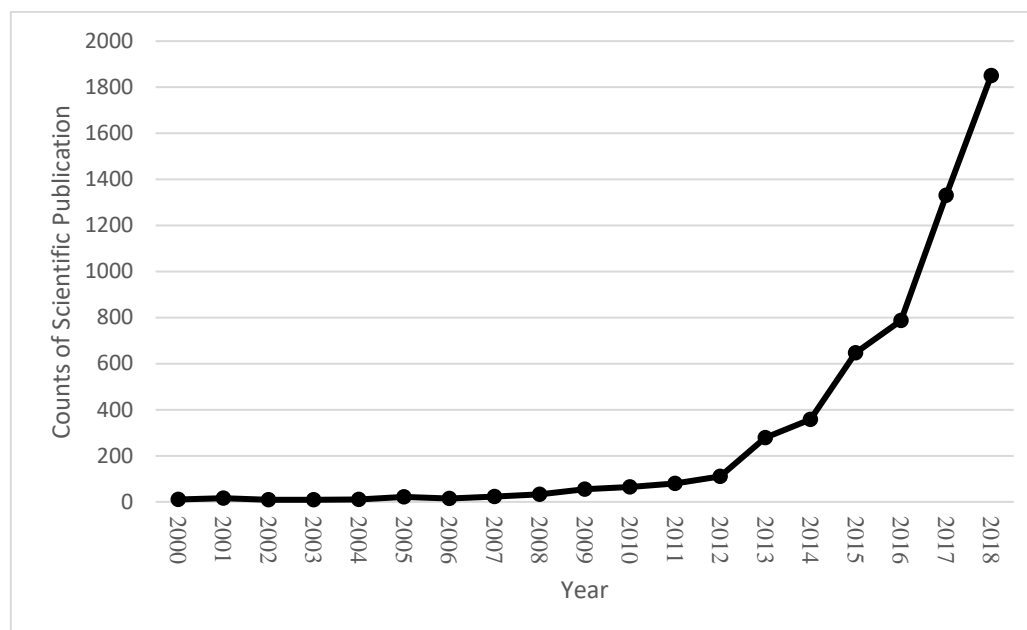


Figure 1. Aggregated RET scientific knowledge productions between 2000 and 2018.

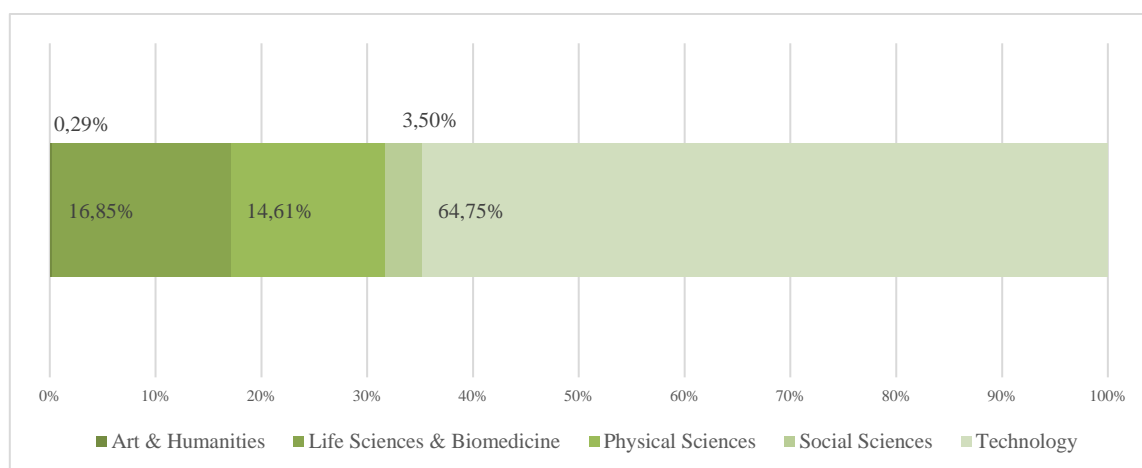


Figure 2. Category of journal that published the scientific production between 2000 and 2018.

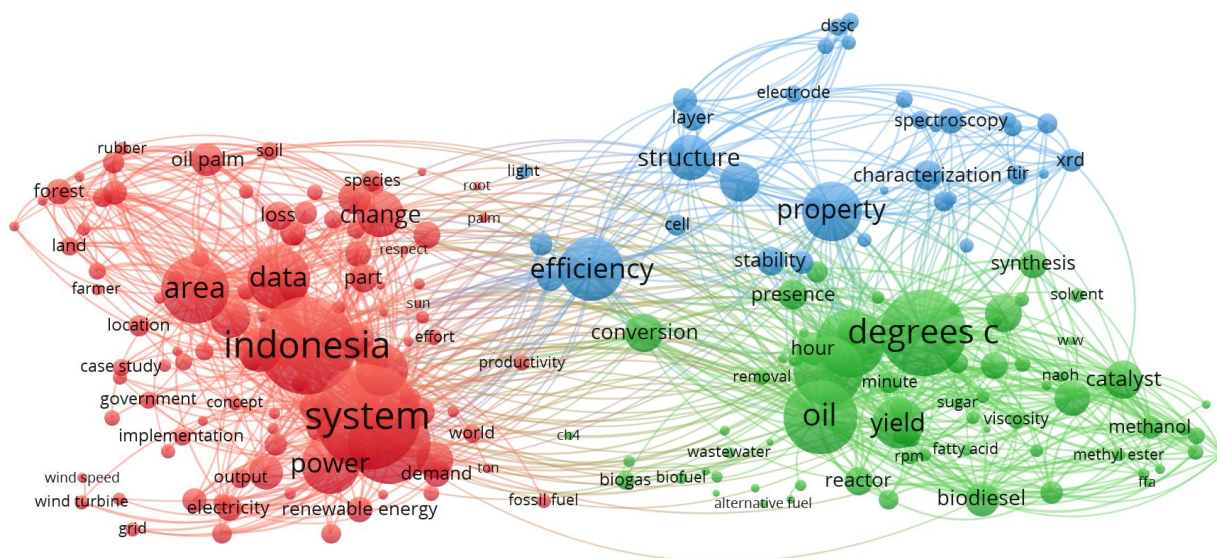


Figure 3. The network visualization for scientific knowledge productions on renewable energies between 2000 and 2018.

between one to two years (Constantini et al., 2017; Lindman & Söderholm, 2016).

We observe that most of Indonesia's scientific literatures belonged to the category of applied science (physical sciences and technology) journals, representing 79.36% of the total publications (Fig. 2). The rest are categorized as basic science (art & humanities, life sciences & biomedicine, and social sciences). This implies that the scientific knowledge production in Indonesia most often involves discussions of the mastery and implementation of RETs. However, the linkage between basic and applied knowledge is extremely meaningful to the innovative capability (Lundvall, 2016). The mismatch between basic and applied research is identified a systemic problem contributing to the poor innovative performance (OECD, 1997). This study suggests that Indonesia embarked on the energy transition by benefiting the innovation capability in applied knowledge. However, there is no scientific literature about Indonesia's RE innovation capability as of August 2019 that displays the contemporary innovation measurement such as R&D expenditure, or the number of patents applied for or granted.

Using network visualization, we observe that there are three clusters within the scientific publications (Fig. 3). We identify that the first cluster is related to biofuel and biomass, with the most often-occurring terms as degree C, oil, yield, and catalyst. The second cluster is recognized as the research themes on solar energy, with the most often-occurring terms being efficiency, property, structure, and characterization. All terms on both clusters are specific technologically related terms, even though we recognize that there may be overlap between the terms in one cluster or another. The remaining terms were clustered with most research themes in the power system and data processing to support the electricity generation from RES. The most often-occurring terms for this clusters are system, power, data, and area.

3.2. Biofuels and biomass dominated the scientific knowledge productions

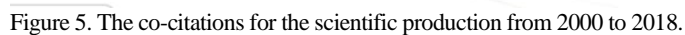
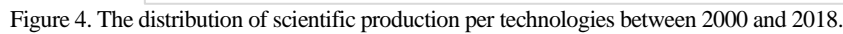
Within 5,709 scientific papers published from 2000 to 2018, half of the research themes are biofuels and biomass (52.90%), followed by solar (16.85%), hydro (13.27%), and geothermal (9.51%) (Fig. 4). Our observation suggests that the research themes on biofuel and biomass are influenced by its relatively abundance resources (i.e. palm oil, paddy, sugar cane, corn, cassava, and wood waste) with estimation to produce the energy of 470 GJ per year (Dani & Wibawa, 2018). The research themes on bio energy are more often related to applied knowledge (73.41%) than basic knowledge (26.59%). However, the portion of basic research on solar and hydro energy is indeed smaller than that on bio energy, respectively 10.53% and 13.64%. This suggested that the capability for basic knowledge production on bio

energy is higher than that on solar and hydro. Again, the abundance resources of biofuel and biomass in Indonesia provide greater access for researchers than on solar and hydro, for which there are more significant up-front costs for the physical infrastructure development (materials, laboratories, and testing equipment). Biofuel and biomass have been long regarded as substantial pre-industrial energy sources, given that nature freely offers woody plants and rivers (Zweifel, Praktiknjo, & Erdmann, 2017).

Co-citation is used to probe the scientific knowledge transfer across disciplines (Trujillo & Long, 2018). We are interested in assessing whether the research insights from different disciplines are being used by one another. Disciplinary siloes may present and lead to partial or full failures to draw conclusions of the research question (Stuckler, 2015). Our study identifies that most of Indonesia's scientific knowledge productions are from Bioresource Technology, with 2,808 co-citations (Fig. 5). This category is followed by Renewable Sustainable Energy Review (2,018 co-citations) and Fuel (1,374 co-citations). We recognize that there are 5 visible clusters of the co-citations in bio-energy, sustainable energy, energy physics, energy for fuel, and energy chemistry. Our study did not find any weak co-citation links for any cluster. Even the scientific production on the area of policy and economics were co-cited by different clusters.

3.3. Limited focus on the area of policy and economics and hybrid systems

The presence of the research on public policy and business economics is important, given that there are firms seeking profits that construct and operate the RES power stations. The business climate must be tuned to support a large-scale deployment of RET. Tailor-made policy instruments should be identified, especially regarding specific technology, as Negro et al. (2012) argued regarding the necessity of specific policy measures on specific technological systems to accelerate the diffusion of knowledge on renewable energies. We identify a lack of research themes on policy and economics for renewable energies. 73 scientific publications are found from 2000 to 2018 with a significant raise on 2018 (Fig. 6). Most policy and economics studies in this regard examine national level issues and problems on RE development using descriptive method (50.68%). The attractiveness of biomass and biogas to replace fossil fuels in Indonesia's energy system is widely acknowledged but requires a more mission-oriented strategies at the national level (Bunyamin & Purnomo, 2017; Mulyana, Fitriani, Saad & Yuliah, 2017; Sukirman, 2018; Sommeng & Anditya, 2018; Rosyidi, Bole-Rentel, Lesmana & Ikhsan, 2013; Wahyudi, Kurnani, & Clancy, 2015). Other studies use empirical method to draw conclusion at macro- and micro-economics level (45.21%) and the descriptive me-



While hybrid systems are important for energy transitions, our study observes only 19 scientific publications on hybrid systems (Fig. 6). Hybrid systems have been regarded as one of the technological solutions in the narration of energy transition in Indonesia. Although there is no modular definition of hy-

brid systems, it is inevitable that diesel–solar PV systems may provide lower Cost of Energy (COE) when the GoI dismantles diesel subsidies (Arisaktiwardhana & Akbar, 2018). Such hybrid systems, combining fossil fuel and renewable sources, are deemed important to decrease the COE (Ismail, Moghavvemi, Mahlia, Muttaqi & Moghavvemi, 2015) and reduce the carbon emission in the current

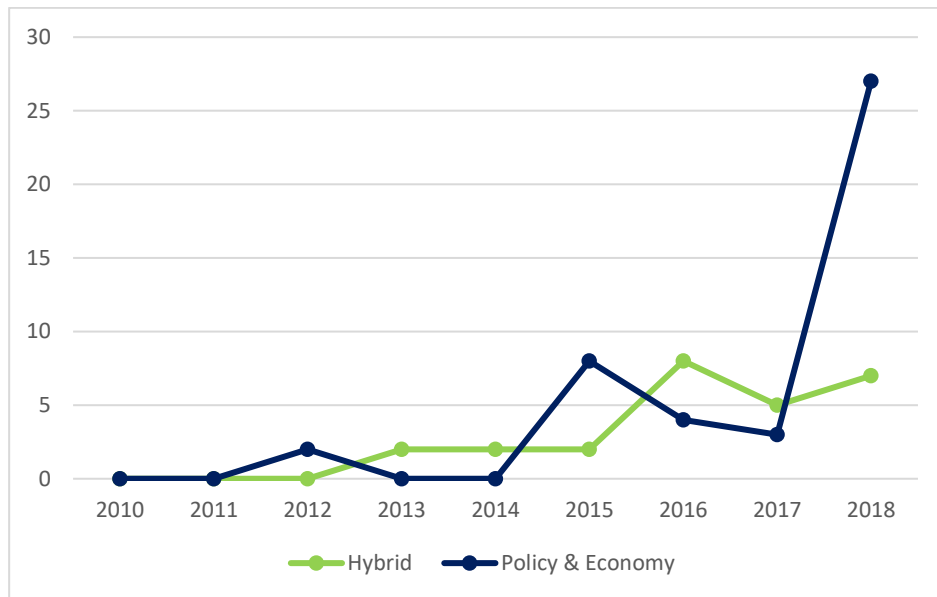


Figure 6. The scientific production for policy & economics and hybrid systems from 2000 to 2018.

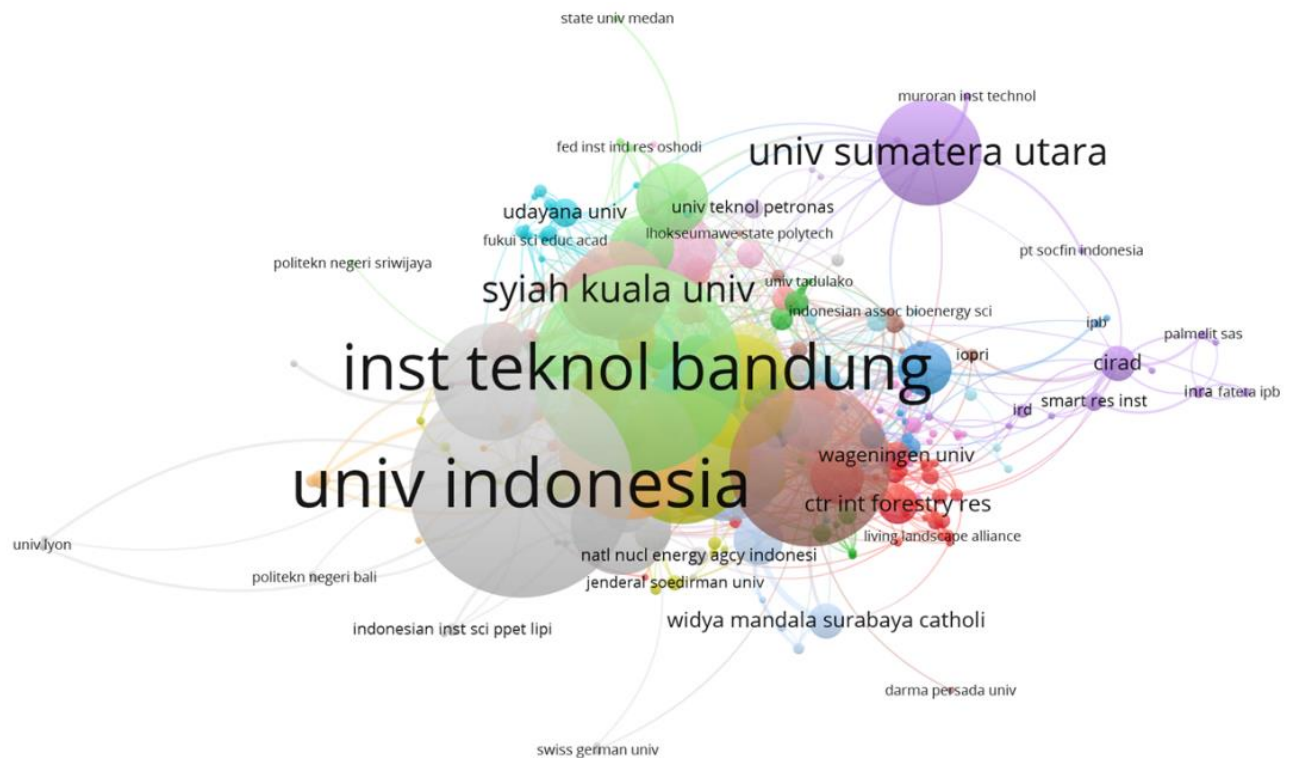


Figure 7. The network visualization for the institutions producing scientific production on renewable energies from 2000 to 2018.

energy system (Faanzir, Soedibyo & Ashari, 2017). We identify that most studies are related to the implementation of the hybrid systems for the isolated off-grid areas (42.31%). For example, the hybrid system in Labuan Bajo (Nizam & Wicaksono, 2018), in Miangas Island (Rumbayan & Nagasaka, 2018), Papua (Ardin, Rahardjo, & Hudaya, 2017), Sebira Island (Wicaksana, Muslim, Hutapea, Purwadi, & Haroen, 2016), or East Sumba (Mehang, Tanoto, & Santoso, 2016). Most hybrid systems are the combination of diesel-solar PV. Other scientific studies

were related to the on-grid systems (30.77%) and the off-grid systems in the commercial and industries areas (23.08%).

3.4. Actors behind the scientific knowledge productions on renewable energies

A total of more than 300 different universities and research institutions contributed to the scientific knowledge productions on renewable energies in Indonesia. The five (5) top Indonesian universities and research institutions were Institut Teknologi Ban-

dung (11.53%), Universitas Gadjah Mada (8.89%), Universitas Indonesia (8.60%), Institut Pertanian Bogor (5.83%), and Institut Teknologi Sepuluh Nopember (3.91%) (Fig. 7). The network visualization map recognizes several clusters regarding the universities and research institutions behind the scientific knowledge productions on renewable energies. We identify several cluster leaders with high publication productions: Institut Teknologi Bandung with solar, hydro, and geothermal energy; Institut Pertanian Bogor with biofuel and biomass; and Institut Teknologi Sepuluh Nopember with wind energy. Universitas Indonesia leads the cluster, with even distribution of the scientific knowledge productions on all renewable energies. It is worth noting that Universitas Sumatera Utara (3.55%) is among the most active Indonesian universities in the knowledge productions on biofuel and biomass.

We recognize that a number of collaborations takes place within the international society (universities and research institutions). Malaysia, Germany and Australia are among the top foreign countries with high interest in collaborating with Indonesian scientists. The geographical and historical proximity between Indonesia and these countries push forward the international collaboration. The top seven (7) foreign universities or research institutes were Universitas Malaysia (2.49%), Universitas Sains Malaysia (2.25%), Universitas Putra Malaysia (1.97%), Universitas Kebangsaan Malaysia (1.96%), Universitas Teknologi Malaysia (1.76%), University of Queensland Australia (1.68 %), and Universitaet Gottingen Germany (1.61%).

4 Conclusions & policy implications

Using the data from WoS, this study observed a total of 5,709 Indonesia's scientific literatures on sustainable energy between 2000 and 2018. Nuclear is excluded due the regulatory and contemporary view on renewable energies. The study reveals a significant growth on the scientific production since 2012. The increased growth is a result of different R&D policy sets and compensation structure for senior academic members (Rochmyaningsih, 2018). The analysis reveals that most scientific production in Indonesia are in the area of bio energy, in which there are abundance resources of biofuel and biomass throughout the country. This suggests a positive influence of the availability of the specific energy resources for scientific production in Indonesia – not like what have been identified by Manzano-Aguliaro et al. (2014). We argue that the up-front infrastructure costs for investigating bio energy is lower than that of any other sustainable energies in Indonesia.

Most scientific production on RE is related to applied knowledge. This suggests that, from the innovation perspective, the patterns of research in Indonesia represents the innovation mode of technology

modifiers and technology adapters. Our study reveals no weak co-citation links for policy and economics, despite their low scientific production, to other RETs. There is clear evidence of knowledge transfer on renewable energy from science and technology to the policy and economics. Hybrid systems to solve the problem of low rates of RET development is not yet the focus of the research in Indonesia. Our study reveals that most scientific publications on hybrid systems discussed the implementation for off-grid and isolated areas. These findings support our argument that hybrid systems are essential for energy transition where the lack of energy access is identified. Prioritizing renewable energy in the main national policy sets can align the sense of urgency with R&D, thus promoting the implementation of SDG7 and SDG9 in Indonesia.

Our study identifies that Indonesian universities have remarkably led and collaborated in the research on RET. However, policies to establishing a research cluster for a specific technology in conjunction with the priority of RET can successfully deliver the national R&D strategic goals and boost the existing national and international collaborations. The research cluster can increase the national competitiveness and act as a single point of contact to disseminate the existing applied scientific knowledge to the industries. Thus, both academia and industries can promote sustainable energies in Indonesia for the long run.

We acknowledge that our study is mainly carried out using the searching queries that may induce confirmation bias and limit the searching results. Further research on the interaction between Indonesia RE R&D spending, innovation output (patenting activities), knowledge spills-over, and collaboration may shed light on the dynamics of the national innovation system in accelerating the sustainable energy transition. It can also reflect the progress of SDGs related to affordable energy and innovation. Linking the analysis to the institutional setup (i.e. policy strategies, policy instruments) may increase the interdisciplinary understanding on this intradisciplinary topic.

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Agrobiodiversity in the Logic of Environmental Sustainability and Protection of Human Rights in the Context of International and European Union law

Agrobioróżnorodność w logice ekorozwoju i ochronie praw człowieka w kontekście prawa międzynarodowego i Unii Europejskiej

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Abstract

The origins of agriculture can be attributed, among others, to biodiversity. The emergence of new, more productive varieties and breeds resulted from combining the adaptation capacities of organisms with human intellect. Today, this component of cultural heritage requires special legal protection and sustainable use for the benefit of present and future generations.

Key words: agricultural biodiversity, protection of biological resources, environmental sustainability, human rights

Streszczenie

Początki rolnictwa uwarunkowane były m.in. bioróżnorodnością. Pojawienie się nowych, bardziej produktywnych odmian i ras wynikało z połączenia zdolności adaptacyjnych organizmów z ludzkim intelektem. Obecnie ten element dziedzictwa kulturowego wymaga szczególnej ochrony prawnej i zrównoważonego użytkowania z korzyścią dla obecnych i przyszłych pokoleń.

Słowa kluczowe: agrobioróżnorodność, ochrona zasobów biologicznych, ekorozwój, prawa człowieka

Introduction

Man began his adaptation activities, based on adjusting his environment to the growing needs of a social group, by adopting a sedentary lifestyle, cultivating plants and breeding animals. Therefore, the development of agriculture was based on the use of living organisms to produce food and to satisfy growing vital needs. As the introduction already suggests, the aim of the article is to present biodiversity and the problem of the progressive erosion of resources. To provide an extended view on the situation, the issue is analysed in the context of international and EU law.

For persons analysing the present situation, the former communities of farmers and agricultural ecosystems that they created provide the best example of sustainable development and the so-called *bioculture*. The first steps of man towards adjustment of the environment to his own needs included activities known today as domestication. Initially, it consisted in a selective choice of specimens that satisfied his expectations in subsequent generations. Later, man tried to preserve primitive features *forced* by nature, combining them with the new ones, which emerged during cultivation and breeding and which were attractive from his perspective. The consistency of such a procedure led to consolidation and enhance-

ment of those features. Nevertheless, it was not possible (simply because people did not know how) to obtain a population of entirely uniform specimens, as it is currently done. Although uniform cultivars are characterized by generally good yields, it can be achieved only in specific, favourable environmental conditions. However, a lack of genetic diversity effectively prevents other attempts to *prove* their capacities to adapt to constantly changing environmental conditions. Therefore, those *varieties* were preferred that unfailingly produced, perhaps not the highest, but a guaranteed yield every year, regardless of the conditions. Of course, we cannot talk about pure breeding lines in this context, but about certain genetic mix, *self-improving* through adaptive mechanisms (with an obvious role of anthropogenic factors, e.g. through the application of proper techniques for cultivation, regulation of air-water conditions or fertilization). Therefore, plants emerged which were adapted to local conditions, very often limited territorially, specific or even unique, e.g. in severe mountain climates, microclimates of valleys, plains, barren or wet lands, resistant to high or low temperatures or resistant to pathogens occurring in a given area. In an economy oriented towards self-sufficiency, selection was obviously carried out, primarily from the perspective of production efficiency. Nature itself *cared* about taking into account the requirements of places where selected plants and animals had to live and survive, with no external support. Consequently, they adapted, using the potential hidden in genetic variation. Thus, numerous, yet primitive (in contemporary terms used for evaluation of such methods of creation), local breeds and varieties were formed, which nevertheless were irreplaceable in specific environmental conditions.

Results of analysis and discussion

1. Importance of agrobiodiversity for the economy and for man

Food production thus became everywhere dependent on useful and natural varieties of plants and animals, with their encoded adapting capacities, together with methods and forms of farming passed down from generation to generation of farmers (Skubala, 2010). Those processes were most intense in places with a specific centre of origin (Art. 2 C). These were the areas where crossing specific breeds and species with other related species ensured huge diversity in future generations, since interspecies barriers in the first generations of cross-breeds are insignificant. Therefore, they could combine relatively well with initial specimens, thus additionally increasing the variety of this site. For organisms with new genetic combinations, they had to, of course, satisfy minimal existential needs and be conducive to the generation of further variability. Otherwise, the *inappropriate* adaptation features would disappear with the speci-

mens that developed them. It was, among others, for these reasons that man used a huge variety of specimens and form variations, exactly in the places of origin of the species, intuitively selecting the ones that were most promising and demonstrated the best adaptation to the climate and places man was going to move to. It is not a coincidence that basic cereals spread in the Mediterranean Basin, maize in Central America and rice in Asia. This unusual concentration of varieties of individual species, despite inconceivable losses in biodiversity, can be observed even today. It is a characteristic feature of extensive farming sites mainly oriented towards self-sufficiency.

The high-volume agriculture of industrialized states is completely different. In the second half of the 20th century, along with the growth of industrialization and economic development, man developed another way of thinking, leaving behind the logic of planning and taking up activities oriented only towards survival. Various factors contributed to the development and strengthening of the feeling of security, and the previous uncertainty of success in seasonal farming was replaced with the logic of profit and efficiency of long-term operations. Those, in turn, led to the conviction that if the only important objective from the point of view of economics was the production and sale of food products in the largest amounts possible, then there was no need for expensive and complex adaptation of plants and animals to all of those environments where the production took place, since this would involve dispersion of means and measures, the more so that science would be able to provide them with any features required by the market. The problem of maintaining and *forcing* a non-adapted variety to yield in any conditions and place was solved through the use of artificial fertilizers, pesticides, drainage and intensified agricultural procedures (Cebulak, 2010).

Therefore, the approach taken was towards the production of scarce (as compared to the initial potential), genetically uniform varieties and breeds. Properly *aided*, they obviously proved very effective, except that their productivity was not possible without increasing general expenses and external support of the chemical or pharmaceutical industry. The price for quantity effects was a loss of a capacity to adapt to soil conditions, climate, risk of diseases or non-acceptance by diversified cultures and rural communities where they were used. Financial inefficiency of small farmers proved the only barrier in dispersing *globalised* cultivars, dissociating those farmers from the potential offered by high-volume farming. Once again, it turned out that sacrificing diversity for the sake of productivity did not bring the expected results.

The errors of this approach became visible by the beginning of the previous century, yet remarkable changes in this regard were made in the period of the so-called green revolution in the second half of the 20th century. The answer to the problem of world

hunger was intensification of farming innovation which was already present in industrialized states. Restoration and research activities were undertaken in response to a decrease in the biodiversity of plants and farm animals observed at the same time. The assumptions were that the preserved diversity was to be used for improvement and creation of cross-breeds of high-volume plants, successively introduced also in developing countries. Thus, the introduction of new methods (yet foreign, for a given farming culture cultivation) based on chemistry and mechanisation, were forced along with the reproductive material.

Initially, green revolution investments in farming and breeding gave positive results in the short term. However, production costs began to increase over time. The reason was the need to supplement the soil impoverished with intensive production with larger doses of artificial fertilizers, the application of protective measures and energy demand. An immediate cause was therefore not a decrease in the diversity of agricultural crops and animals, but a progressive degradation of soil and pollution of water with excessive amounts of biogenic compounds reaching the fields and, consequently, also water bodies (Szwejkowska, Zębek, 2006). Significant changes took place in fauna and flora of the top layers of soil, significantly responsible for fertility and air-water conditions of soils in which the main root mass develops. Destruction or a serious quantitative reduction of microorganisms changes the soil structure. In consequence, precipitation waters, instead of accumulating, easily wash away substances determining soil fertility. A decrease in fertility and bioavailability of topsoil must be therefore supplemented with increased doses of artificial fertilizers, which involves unfavourable changes, particularly for farmers in the poorest states, in the cost and profit balance. Many of them are not financially able to cope with such a situation, so they quit agriculture and move to the poorest city districts. Therefore, rural local communities irreversibly disintegrate and, along with them, the achievements of their ancestors, the culture of previous generations and accompanying diversity of organisms, which *nolens volens* provided a basis and a guarantee of their existence. The reason for such a situation is that those who created and made use of those achievements, being unable to withstand the competition, are forced to depart from previous sustainable farming methods, and even more frequently, to leave their land.

A significant decrease in agrobiodiversity was initiated much earlier, but its serious acceleration was recorded only in 1950s, in populations of both plants and animals. Without appropriate means for the creation of new, and the development of existing, germplasm banks or gathering still available (but not classified yet) genetic material, free provision of improved seeds by commercial companies to poorer countries may prove impossible. Economic crises

and the social effects of a policy of forceful industrialization of agriculture cannot possibly be compensated for by a collector's motives to restore varieties of plants which still preserve their adaptation potential. Even assuming a nostalgic willingness, or – which is equally probable and may be caused by various reasons – a need to restore the previous state, it would certainly be difficult to restructure the currently prevailing model of agriculture in view of the absence of quantitative and qualitative diversity of the reproductive material, which would be necessary for this purpose and which, unfortunately, has been largely lost. This proves that prosperity achieved at the expense of diminishing biological resources, jeopardizes, in the longer term, economic development and causes impoverishment of the human environment (Pink, 2016).

An example of the alarming changes in agriculture, breeding and natural environment caused by irreversible damage to the genetic potential should be used as an argument for rejecting the apparently erroneous concept of the relationship between man and the environment. First of all, we must not accept that degradation of the environment and of its components should be treated only as a problem of an ethical nature. Such a view has not much to do with the reality of everyday life, with the economy or our chances of existence. Therefore, activities aimed at maintaining (and if it possible, also reconstructing) diversity cannot be received only as noble initiatives for the benefit of other creatures and the environment. Those aims, with their ambitions, should not be depreciated, since nature (particularly living organisms) offers value in its own right, which cannot be overestimated. But the issue is not only of a purely sentimental significance, since its economic and business importance cannot be disregarded. Contrary to appearances, discussions concerning this subject serve both to raise the ecological awareness of society and promote models of sustainable development. Perhaps this latter aspect is more significant, as it is unavoidable.

Elements of the natural environment of man, just like nature itself, present an important, although not always measurable, economic value (Marino, Piotto, 2010). The need for a real and comprehensive look at the problem requires accounting for the potential, future value, apart from a direct value. For living organisms which, unlike industrial products, are characterized by the ability to *self-reproduce*, one can talk about their comprehensive economic value only after taking this factor into account (and even then not so obviously). From the economic point of view, it is actually easier to evaluate those goods (the volume of the resources of those goods) that have already entered the market and have their price, e.g. water or food produced on the basis of natural diversity of organisms (e.g. game). It is much more difficult to be achieved with natural and agricultural biodiversity, understood as a phenomenon, a key ele-

ment of a continuous process, which is not a product, but has a direct effect on the product. It cannot be predicted how, and to what extent, this biodiversity will influence at least the food safety in the nearest and farther future. Perhaps this value can be estimated only in case of its shortage. Then, in face of a deficiency caused by a decrease in productivity or a reduced access to primary resources, it will also be possible to evaluate the losses. Production costs will grow due to additional expenditures on artificial fertilizers, agricultural chemistry and energy. Therefore, decisions on ensuring food safety to the contemporary generation at any cost – at the expense of significant reduction of agricultural biodiversity to subsequent generations – may prove disastrous, in spite of being financially attractive. It also seems ethically doubtful to clearly place short-term economic profits above the logic of aware and prudent distribution of benefits derived from entering the path of sustainable development.

2. Agrobiodiversity in the logic of sustainable development

Agricultural biodiversity is the total of all components of biological diversity of importance for agriculture and farming ecosystems, which include crops and farm animals as well as some useful insects (e.g. bees, silkworms) and microorganisms (e.g. actinomycetes, yeast, bacteria, fungi). Having a large group of plants is important for fodder crops and provides a basis for animal production. Apart from them, a range of other cultivated and wild plants is used, providing fibres, medicinal substances, dyes, construction materials and fuel. About 40 species of mammals and birds have been domesticated which, by way of selection, gave rise to over 5,000 various breeds – being a source of e.g. meat, milk, skin, manure and draft force. Fish also make up an integral component of some farming ecosystems, e.g. in traditional rice cultivation system, where they provide about 70% of protein. Microbiological diversity supports plants in using chemical compounds, reducing pathogens and, above all, in creating irreplaceable humus. Additionally, the continuous interaction between harmful microorganisms and higher plants led to the development, through evolution, of resistant species, which were used for developing many cultivars.

In agroecosystems, the richness of the primary agricultural biodiversity ensures:

- sustainable production of food and other agricultural products, as well as the development of genetic resources used in the creation of new cultivars;
- biological enhancement of production through increasing soil fertility (nitrogen, diazotrophic bacteria), pollinating, competition and pest control;

- supplementing activities and improvement of farming ecosystems, i.e. protection and improvement of physical and chemical properties of soil, beauty of the landscape, purity and quality of air as well as surface and deep water.

An increase in the production and productivity of farming ecosystems in the last decades of the 20th century was achieved through the use of genetically improved plants and animals. This resulted in a loss of a huge majority of local breeds and varieties. Since the beginning of the 20th century, 75% of the genetic diversity of plants and animals used in agriculture have been irreversibly lost. In China, about 10,000 wheat varieties were cultivated before 1949, while in 1970 there were only about 1,000. Out of all maize cultivars known in Mexico before 1930, only 20% have been preserved. In the Philippines, local farmers cultivated thousands of rice varieties, while in 1980, only two varieties were cultivated in 98% of the fields. New rice cultivars, introduced more than fifty years ago, during the so-called green revolution, today occupy more than a half of the acreage of this cereal.

Globally, there are between 7,000 and 10,000 species of edible plants, of which only one hundred account for the food safety of most countries of the world and only four – maize, rice, wheat and potatoes – provide 60% of the food energy. The situation in animal husbandry is not much better. The departure from low efficiency breeds gives rise to concern. This partially results from a growing demand for meat, eggs, milk and other products of animal origin. An increased demand for protein in developing countries is accompanied by a dramatic decrease in the population of diversified local breeds and replacement with foreign, but economically viable, breeds. This biological homogenisation carried out all over the world poses many problems for breeders, even in relation to the impossibility of efficiently opposing dissemination of previously unknown or not present parasites, diseases and results of climatic changes. Without intensive support of pharmacology and veterinary medicine, animal production at the expected level would not be possible. Thinking oriented exclusively towards a quick increase in production quantity has inevitably led to irreversible damage. In the last century, about one thousand (i.e. about 15%) of all breeds of cattle and sheep irreversibly disappeared, of which 300 vanished within the last fifteen years. This phenomenon is now occurring at an intensified rate, mainly in developed states, where the process of industrialization is rapid. Only in Europe, more than a half of the local agricultural breeds were irreversibly lost in the last century, and more than 40% are now endangered (E).

Protection of genetic diversity provides a basis for food safety. Each one of its elements, each genetic combination, is required to construct this entirety, which may be used for supplementing and restoring

the *used up* production potential. Thus, even the richest states, in order to create new cultivars resistant to pests and diseases, have an incessant need to reach for genetic resources *dispersed across the land*. With this aim in view, the latest technologies of genetic engineering use the genes of cultivated, bred and wild organisms occurring on the local level (ZĘBEK, SZWEJKOWSKA, 2007). Taking into consideration the limited possibilities of maintaining a low – in the relation to the needs – number of specimens and the actual efficiency of conserving plasma in existing gene banks, maintaining a variety of plant and animal species *in situ* is recommended as the best method for their duration in time, and additionally, as the best method for their protection against destruction, degeneration or even sabotage. It is highly important, for example, due to the fact that genetic diversity is not of a high value for modern and industrialized farming, which uses a much reduced gene pool, efficiently supported by agricultural chemistry. Therefore, it is not so much interested in its protection. Such thinking in short-term categories of economic profits is obviously erroneous, although prevailing. Maintaining *by force* uniform and genetically stable monocultures may bring results, but it is against nature and must lead to failure.

The researchers analysing the problem of risk propose various initiatives, with emerging movements attempting to stop this alarming phenomenon. In India, for instance, the Navdanya organisation counteracts the loss of biodiversity caused – as they claim – by the activity of multinational concerns introducing seeds protected under patents. The protesters are, in principle, concerned with maintaining local cultivars, cataloguing them and assigning them the status of shared property. At the same time, seed deposits and banks, owned by local population, are being established. Apart from these initiatives, the so-called *freedom zones* are created, i.e. villages in which farmers reduce or reject artificial fertilizers, crop protection chemicals and, in this way, handle the issue of genetically modified seeds protected by property rights. All of these activities result from the fact that people have become convinced that the diversity of varieties and species to a lower extent make the yield dependent on cost-consuming protection measures and, at the same time, contributes to an increase in crop resistance to unfavourable weather conditions, protects them against massive pest infestation and diseases and, in short, improves the level of food safety and self-reliance of local communities. Apart from this, farmers, targeting their production towards the local market needs (not for export), somehow automatically diversify the group of their customers, which in turn (based on feedback), stimulates them to increase species and quality diversity

of products of plant and animal origin offered by them. Thus, forced by market demand, crop diversity enhances the self-sufficiency of local communities and stabilizes the market, not to mention the numerous biological and environmental advantages.

Unquestionably, agriculture has made huge progress. Nevertheless, at least some successes of genetic engineering in the field of production should be considered ambiguous, as they are related, e.g. to the feeling of continuous threat – or at least a risk – related to biotic and human factors (Sengur, Atabeyoglu, Erdogan, Erdem, 2015). Large farms and industrialized agricultural enterprises, which have begun using genetic monocultures, have actually already caused a loss. Large farms of breeding animals, unlike small and diversified family farms, regardless of the level of advanced technical means they use, are much more exposed to losses caused by an outbreak of epidemics or diseases. A lack of genetic diversity significantly reduces the chances for survival of at least a part of the herd, particularly selected breeds of low populations. Therefore, they are much more susceptible to devastating natural or man-induced factors, including criminal and/or terrorist acts, e.g. in order to weaken the competition or to destabilize the market. Some infectious diseases, either as *spontaneous* natural pathogenic factors or a biological weapon, can decimate populations of animals concentrated in small areas. Balanced cultures, based on maximum diversification, demonstrate much higher stability in similar situations.

3. Legal logic of biodiversity protection

Destruction of species diversity and ecosystems (agricultural and natural) in some cases leads to serious economic losses that can be predicted and determined to some extent. Their consequences will be suffered, first of all, by the societies in developed states that have reached their status, e.g. by exploiting the natural resources of Third World Countries in a way that certainly would not be referred to today as sustainable. For various reasons, not many people realize that changes are taking place, and only few of them want, or are interested in, changing the situation¹. Worse still, even institutions competent in this regard do not demonstrate a determined will to effectively implement measures established by international agreements (mainly the Convention on Biological Diversity). The difficulties observed result from the fact that it is virtually impossible to start improvement of ecological conditions (therefore, also protection of biodiversity) without taking into account (quite often much excessive, Cirtina, Gamaneci, 2015) the living standard expectation of man, economic conditions and, above all, the involvement of significant means. The concept of the

¹ Grass-roots initiatives of farmers and non-governmental organizations oriented towards protection of agrobiodiversity and promotion of *alternative* agriculture are

worth noting in this regard (Priwieziencew, Sieniarska, 2013).

future of the world, perceived through the prism of so-called international environmental treaties, is based on principles which apparently clearly contrast with those determined by the current rules of world trade (the WTO in general). More-or-less direct references to the principle of the *common good* (and the need to protect both the achievements of past generations and provide for generations to come) are generally covered by international environmental treaties. Therefore, because this good [biodiversity] is for all humanity, it becomes indispensable, so its use requires rules to guarantee, at the international and local level, the fair division of profits resulting from its use. At the same time, this division (unlike for other goods) not only has to be fair, but it also has to fit quite narrow limits of sustainable management. In turn, this sustainability, which is not completely specified by itself, quite clearly indicates its objectives. The most important of them is to ensure the genetic diversity of plants and animals important for nutrition, health and satisfaction of various other needs of people living in equally diversified social and civilization conditions. Consequently, it should not be surprising that the list of tasks assigned to contracting parties to the Convention, which through international treaties expect to obtain certain advantages, is quite long, especially with the awareness of an increasing value (also economical one) of the remaining resources of the living world. Unfortunately, many states, particularly those of poorer economic status and not well-established international position, are not able to maintain control over the resources in the territory under their jurisdiction. Apart from that, not being able to exert any impact on the global economy, they are forced to submit to the concentration of scientific potential by international capital which usurps unlimited rights, both to the biological research material and human knowledge and experience gathered by generations of indigenous populations and local communities.

Most activities of those states are therefore reduced to obtaining at least short-term benefits, with simultaneous marginalization of risks concerning the future occurrence of unpredictable, uncontrolled changes in nature. To cover current expenses, pay debts and improve living standards of inhabitants, some of them dispose of their natural resources or resign from exercising control over them. This happens against the assumptions of the Convention on Protection of Biological Diversity, as profits generated by external entities from the use of local resources do not go to the communities that are their actual owners, and sometimes also creators (as in the case of agricultural biodiversity) (Salerno, 1996). Consequently, there is no discussion about executing any sanctions for unauthorized appropriation of resources, impoverishment of ecosystems or exploiting the accumulated experience of generations. Such behaviour is also against any suggested legal forms of protection and maintaining the *in loco* achieve-

ments of the inhabitants of the given region, including traditions, customs, cuisine, food, etc. fully in line with local production capacities (Marfoli, 2012). A certain symbol of pressure exerted by the economically, technologically and scientifically developed North on the South which is lagging behind, but still having resources at its disposal, are changes in the scope of patent law, derived from purely technical solutions and extended into biological processes, living organisms and their parts. The boundary between living and dead matter, between physiology and mechanics, is becoming blurred – from the legal perspective, differences in their nature have almost disappeared. Intellectual property rights, covering both the final result of the idea, as well as the process used for its production, cover all materials from which the product was obtained, including any other (products) emerging as a result of the application of a given method. Of course, the patent also covers the method itself, which was used, e.g. for isolating the gene or substance. This means that any use of the product or the method by a third party must be always preceded by appropriate payments to the discoverer of the gene, molecule or method. Since most patents are in hands of biotechnological concerns requesting significant amounts for the transfer of rights, individual persons, or even less affluent institutions, have practically no chance to start research into the possibilities of using diversity offered by nature. Thus, limited access to the initial material for further experiments makes it impossible to genetically improve plants or animals (by selection led by farmers, classical cultivation of plants or using modern biotechnology) or find new methods to adjust crops to unpredictable environmental changes to meet future human needs. The limitations go even further, since they eliminate not only the poorest states, but also affect those of medium potential – jeopardizing their scientific and technological potential to improve food production through adaptation of organisms to the local requirements of the environment. An increasing dependence on external producers is one of the economic effects of this process (Marino, Piotto, 2010).

The current international legal situation therefore encourages so-called *biopiracy*, i.e. unauthorized appropriation of biological material and the rights to agricultural and wild biodiversity. In consequence, this leads to another alarming phenomenon – *bio-prospecting*. It consists in financing biological research in sites of outstanding diversity of utility and other species by interested corporations. A later consequence of the thus obtained material is the patenting of an element which is important, e.g. for pharmacology, agriculture or the processing industry. In the next stage, this leads to obtaining rights to the entire plant and components included in this plant (Lucchi, 2014). For useful organisms, this typically occurs without any knowledge or awareness of inhabitants, farmers or healers preserving the accumu-

ated experience for generations, being their actual discoverers and, at the same time, custodians. Generally, they are also passed over in the distribution of profits obtained in this way.

A specific response to such abuse is the International Treaty on Plant Genetic Resources for Food and Agriculture, which clearly specifies that the contracting parties establish (apart from the primary objective, which is protection of agricultural biodiversity) measures protecting and promoting farmer's rights. It also indicates the need to sustain traditional knowledge important for the protection of plant resources and food production (Art. 9.2 (a) C), the right to equitably participate in sharing benefits arising from the utilization of plant genetic resources for food and agriculture (Recitals 8 and 14 of the Preamble, Art. 1.1; 9.2 (b), 10.2, 11.1, 13 Point 2 (d) (ii) C) and the right to participate in making decisions, at the national level, on matters related to the conservation and sustainable use of plant genetic resources for food and agriculture (Recital 8 of the Preamble, Art. 9.2 (c) C).

The treaty, although it repeatedly emphasizes the ecological and civilization importance of biological resources for local communities and humanity (Art. 5.1 (c), 9.1 C) (including future generations (Recitals 4, 13 B)), actually only supports the objectives significant for the contemporary economy. Just like the Convention on Biological Diversity which, in spite of demonstrating noble objectives,² protects the interests of biotechnological corporations, without protecting existing resources against their improper or unfair use or enforcing sanctions for breaching the regulations. It therefore comes as no surprise that none of the parties fully meets its obligations, and the system of treaty protections has hardly changed anything in the legally and morally questionable procedure for patenting biotechnological solutions. The failures are equally experienced by local communities and states that still have high diversity at their disposal which, in the light of the effective law, are deprived not only of the basis for their existence, as well as of a multi-generational experience that allows them to stay in harmony with the surrounding environment (Miceli, 2008).

As results from the foregoing, the apparently mono-thematic issue of agrobiodiversity becomes a global problem, and actually covers practically all sectors of individual and collective life, concerns vital issues of culture (Sadowski, 2019) and economy, and in various ways violates the human rights of each of the three generations. Therefore, it requires and demands relevant changes to legislation, education and funding. A significant role in implementation of numerous measures aimed at dissemination of

knowledge and awareness of the need to perform the necessary tasks must be provided by mass media (Mikłaszewski, 2010).

Conclusions

Today, we already realize that we are the only species able to change and destroy ecosystems all over the Earth. This results more from intellectual and technical rather than biological abilities. Therefore, it has not much to do with the strategy applied by any other living creatures, which owe their adaptive capacities to the diversity of emerging genotypes. This method – obviously in relation to the ambitions and expectations of man – could be assessed as quite *primitive* and certainly slow. But ever since life emerged on our planet, it was entirely sufficient – efficiently ensuring the reproductive process, emergence of new species and their expansion in time and space. Moreover, this model performed and functioned well for several billions of years, and all disasters in the past resulted in even larger diversity of forms.

This was the situation before man started to lead a sedentary life and took up farming. By breeding animals and cultivating plants, man initiated changes in the environment, in a more-or-less aware way. Gradual intensification and then industrialization of production through innovation and the introduction of new technologies strengthened the belief that the environment – just like the production of tools, construction of equipment or technological lines – can also be first designed, then constructed and finally controlled. This led to implementation of the idea of creating the world to suit the needs of contemporary man, a world which can be predicted and, more importantly, controlled. The idea itself was tempting, since such a world would not need the diversity of living organisms. Their *stable* nature would make management easier. However, the reality is slightly different, as nature is an open system, dynamically changing, in which events with unpredictable effects, intensity, place and time continuously occur. This forces living creatures to incessantly search for methods of surviving as a species through geno- and phenotypic varieties of individual specimens. Meanwhile, contemporary man, treating the environment as a source of goods that belong only to him, encounters significant limitations in the quantity of natural resources and the access to those resources. In most cases, he is the very cause of the problem. What might cause some optimism is the fact that the destruction of wild and agricultural diversity does not take place at the same rate everywhere. To some extent, a growing ecological awareness in societies and

² Principal aims of the Convention of Biological Diversity are specified in Art. 1. They include: *conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by*

appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and technologies and by appropriate funding.

legislation channelling organized activities of states provides a hindering factor. Unfortunately, those measures do not always prove effective enough, particularly against market principles. The need to satisfy (real and imaginary) requirements has led to a growing divide, schematically-speaking, between the rich North and the poor South. Tensions caused by the economic gap have caused wasteful exploitation of natural resources, sometimes only minimally improving the living conditions of the inhabitants of exploited areas³, but have resulted in the destruction of the most susceptible ecosystems and caused rapidly progressing erosion of species. Although it directly and indirectly affects the quality of the living environment and existence conditions (clearly violating the rights of the so-called third generation), for certain reasons the fact that the very existence of man becomes jeopardized is neglected. Perhaps for this reason, we should also apply an extended interpretation to the human rights of the so-called first generation.

Today, the wealth of the state is still not measured by the amount of indispensable natural resources, purity of water and air, soil fertility, natural and agricultural diversity, or the ability to use those resources without infringing a fragile equilibrium. The significance of this equilibrium consists in the fact that as long as it exists, the system can be substantially predictable. It is this predictability that is precisely at stake here – this is what man has been always attempted to achieve. Predictability means the possibility to control, and, in consequence, to manage and exploit in a planned manner. Sustainable use of natural resources is, therefore, important not only for purely philosophical and ecological reasons, but also for economic ones. This is the truth that nobody can afford to ignore today.

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³ It happens despite numerous regulations of the international law indicating the need to protect the environment and biodiversity, with respect for real rights of creators and depositaries of this particular heritage located all over the world, in particular in the poorest regions and with an extensive farming model. It was specifically emphasized in the Convention on Biological Diversity (Dz.

U. of 6.11.2002), in the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity or in the Cartagena Protocol on Biosafety to the Convention on Biological Diversity (Dz. U. of 2004, No 216, item 2201).

Integrating Behavior Into Regional Resilience Concept for Sustainable Growth: An Example of Agricultural Sector

Integracja behawioru z koncepcją resilencji regionalnej na rzecz zrównoważonego wzrostu: przykład sektora rolnego

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Abstract

Regional economic resilience, which is a necessary and indispensable component for ensuring both regional and overall sustainability, is understood principally in relation to the system's structure and overall functioning ignoring human agency and its bounded rationality. This leads to missing important and potentially crucial elements fostering or hindering resilience, and consequently to designing resilience enhancing programs with low effectiveness. This paper argues that the focus of the resilience concept should shift from the system structure to the behavior of agents, since any outcome at the macro level is a product of the myriad of interacting behaviors. The structure of the system and all the context matters as the options for the behavior and which options are chosen depends on the internal factors of the decision maker. A framework, depicting the mechanism how the above mentioned factors interact and determine behavior thus consequently influencing resilience is proposed. An exemplary analysis of how to use the framework is also presented.

Key words: behavior, regional resilience, model, sustainability, risk management, agriculture

Streszczenie

Regionalna resilencja ekonomiczna rozważana jest przede wszystkim w odniesieniu do struktury systemu i ogólnego funkcjonowania, ignorując ludzkie działania i związaną z nimi racjonalność. Jest niezbędnym elementem zapewniającym regionalną i ogólną zrównoważoność, w szczególności w jej wymiarze ekonomicznym. Jednak wąskie podejście do niej w konsekwencji prowadzi do utraty ważnych, potencjalnie kluczowych elementów wspierających lub utrudniających resilencję, a zatem opracowywane tak programy mające zwiększać resilencję charakteryzuje niska skuteczność. W tym artykule sugeruje się, że celem koncepcji resilencji powinno być przesunięcie ze struktury systemu na behawior, ponieważ każdy wynik na poziomie makro jest wynikiem niezliczonych zachowań. Struktura systemu i cały kontekst ma znaczenie, ponieważ opcje zachowania i dokonany wybór zależą od wewnętrznych czynników decydenta. Zaproponowano ramy obrazujące mechanizm interakcji wyżej wymienionych czynników i determinujące zachowanie, a tym samym wpływające na resilencję. Przedstawiono także przykładową analizę korzystania z frameworka.

Słowa kluczowe: behawior, resilencja regionalna, modelowanie, zrównoważoność, zarządzanie ryzykiem, rolnictwo

Introduction

In the last decade the popularity of resilience has surged both within the various disciplines as well as

among them. Politicians and various public bodies are actively adopting this concept too. This is no surprise, since resilience holds a large potential of securing viability of the relevant system in the

face of increasing pace of changes and uncertainty of the future, thus providing long-term sustainability. At the same time the practical application of the resilience concept is still in its infancy. The spread of usage is inhibited by several reasons. First of all, there is no consensus on what exactly resilience means, how it can be measured and even less in what determines resilience and how it can be increased. Without strong theoretical background it is hard to define practical guidelines. Second, the majority of resilience literature has focused on the structural aspects of the analyzed system without taking into account the bounded rationality of human agency which can significantly and unpredictably affect the resilience of the whole system. Implementation of any resilience-enhancing strategy inevitably involves changes of behavior of at least several agents (corporate or individual) therefore failing to consider potential behavioral aspects makes the effectiveness of those programs very low.

In this paper we focus on the latter notion – the necessity of integrating human agency into the resilience research with a special focus on the mechanisms of how resilience is influenced by behavior and how the latter is in turn determined by psychosocial factors.

First we give a short overview of resilience concept development in the regional economic literature. Then we provide basis for integrating human agency into regional economic resilience research followed by a model of behavior-resilience relationship. Finally we present a framework for practical implementation of a particular behavior-based resilience-increasing strategy together with an exemplary case study.

Ensuring sustainability through regional economic resilience

Resilience is broadly defined as the characteristic of a complex system to withstand external shocks, meanwhile sustainability (or sustainable development), although much harder to define, is usually described as *development that meets the needs of the present without compromising the ability of future generations to meet their own needs* (Brundtland Report, 1987). Sustainability starts with a functioning system, and then looks at how long that system can operate without wearing down. It also takes into consideration how a system's component functions can be improved so that the system can run continuously on its own. Resilience starts with a disaster, and then looks at how to clean up afterward. It then considers how to prevent or minimize a future disaster, or at least minimize the negative effects of the disaster. The end result may or may not be sustainable, although a sustainable outcome is ideal.

Speaking about resilience and sustainability means speaking about two highly abstract and multifarious concepts, each of which has a great variety of

interpretations and definitions (Derissen et al, 2011). According to Derrissen et al. (2011) four relationships between resilience and sustainable development are distinguished: resilience of the system in a given regime is both necessary and sufficient for sustainable development, b) resilience of the system in a given regime is sufficient, but not necessary, c) resilience of the system in a given regime is necessary, but not sufficient, and d) resilience of the system in a given regime is neither necessary nor sufficient for sustainable development. Meanwhile, Lebel et al. (2006), Perrings (2006) strengthen, that resilience is seen as a necessary precondition for sustainability and sustainable development, economic activities and development strategy are sustainable only if the life-support ecosystems upon which they depend are resilient. All these provide an understanding, that resilience as a capacity to overcome unexpected problems, adapt to change, prepare for and survive catastrophes in its continuity becomes a basis for sustainability.

Within the literature on regional economic resilience three different uses of the term can be distinguished (Boschma, 2015). The first one comes from the physical sciences and is called engineering resilience. It focuses on the resilience as the ability of the system to quickly recover or bounce back from the shock to a pre-shock state or development path (Hill, Wial and Wolman, 2008). The second definition comes from the ecology field and defines resilience as system's ability to absorb shocks. It emphasizes stability of system structure, function and identity in the face of shocks (Martin and Sunley, 2015). The third concept is based on the adaptive capacity of the system, highlighting the need for adaptability and transformability in order to be resilient. First found in psychological sciences it was extended to organizational theory and theory of complex adaptive systems (CAS). This definition is preferred by evolutionary economic geographers since it parallels with the main ideas of the field, namely path dependency, non-equilibrium dynamics and constant change (Bristow and Healy, 2014). Finally, some authors integrate all three notions under one umbrella, suggesting that regional economic resilience is multidimensional, embracing resistance to shocks, and recovery from them as well as transformation leading to new growth paths (World Economic Forum, 2013).

Although quite different all these conceptualizations of resilience have common grounds. First, all of them define resilience in terms of the functioning of the regional economy as a system. Second, they all measure overall economic performance as a means to evaluate resilience. And finally, and most importantly, all of them focus on system structure features as the determinants of resilience (Bristow and Healy, 2014). For example, some researchers argue that inherited regional production structures determine how regions react to recessionary shocks and to what scope and how fast recover after

them (Hill et al., 2011). There is a lot of research dedicated to finding out if and what industrial structure leads to resilience (Desrochers and Leppala, 2011, Evans and Karecha, 2013, Doran and Fingleton, 2013).

Other researchers emphasize a plethora of inherent as well as nurtured factors influencing coping ability of a region. For example, Briguglio et al. (2006) hypothesize that resilience stems from macroeconomic stability, microeconomic market efficiency, good governance and social development. Wink et. al (2018) emphasize economic structure, community networks, skilled workforce and government policies. Still other focus on how system structures go through adaptive cycles of change and resilience depends on the phase of cycle the system is in (Simmie and Martin, 2010).

Consequently regional economic resilience, despite different perspectives, is understood principally in relation to the system's structure, performance and overall functioning (Bristow and Healy, 2014). Such structural point of view led to ignoring a potentially crucial component of resilience – namely human agency and its power and willingness to create and change or on the contrary – to keep the status quo locked in. Even when CAS perspective looking at regional economies as collections of myriad of interacting agents (workers, businesses, government, etc.) is being adopted, the incentive, motivation and proactive power of human agency is left somewhere behind.

Despite acknowledging the role of the behavior in resilience conceptual models, when planning for resilience, whatever the scientific approach, the behavior change of relevant actors is at least one of the targets. The behavior is then most often treated as some universal actions made by a more or less homogeneous set of actors (de Bruijn et al., 2018, Mehmood, 2016, Resilience Alliance, 2010). Quite on the contrary to marketing professionals who perceive potential customers as a very varied set of individuals and perform an extensive research on their motivations, preferences, lifestyle and habits before suggesting them company's products or services. If a company doesn't know its customer, good sales are more of accidental nature than that of a planned one. However many governmental bodies and various public institutions still develop programs for others based on their own understanding of others' problems (World Bank, 2015). Consequently many of those programs fail or do not produce the expected results (ibid).

Integrating agency into regional economic resilience

Despite the focus on the structural components of the system many authors admit (Martin and Sunley, 2015, Briguglio et al., 2006, Hill et al., 2011) that resilience is nurtured and depends mainly on the actions of the myriad of economic agents. However these actions (or as we call it here – behavior) apart from being mentioned are not rendered with any further attention. Nevertheless we argue that exactly the behavior is at the core of the resilience.

The underpinning logic is straightforward. **First of all, all the developments at the macro level depend on the activities at the micro level.** Let it be industry structure, export concentration or supply chains – all and each of them depend on the choices and actions made by lots of entrepreneurs, company leaders and government. **Second, any outcome at the micro level depends on the human action** (or inaction, since inaction is also an action). Low interest rates or good equity market conditions just by themselves do not mean anything until human choice is made and an action towards exploiting or not exploiting these conditions is being done. Of course, it is not to be said that financial arrangements or other context do not matter – on the contrary, they do matter. But not by their mere existence – they matter as options of possible choices from which a human chooses the ones to exploit. Accordingly business structure, financial arrangements, labor market conditions in different countries or regions may present more or substantially less options to choose from, however the choice of one or the other option and the effectiveness of its implementation is contingent on the behavior of a human agent. A wide array of research (Obschonka et. al, 2016, Steel, Rinne & Fairweather, 2012) show that regions subject to the same macroeconomic forces and having similar economic structure perform very differently. It is because that with the same set of structural elements there is a huge set of possible choices. Which ones would be selected depend first of all on the human agency. **Third**, as it is widely acknowledged in psychology and behavioral economics, humans are not always rational. Moreover, they are more often irrational than rational (World Bank, 2015). Humans have a limited cognitive capacity and therefore use mental shortcuts and automatic models for filtering and interpreting information (ibid). This means that a human will never be able or even willing to identify, explore and evaluate all the available options. Instead he looks only at the most salient¹ options. The implications are that **it is not the real options that**

¹ Saliency – aspect of a stimulus that, for any of many reasons, stands out from the rest. Saliency may be the result of emotional, motivational or cognitive factors and is not

necessarily associated with physical factors such as intensity, clarity or size (Wikipedia, 2020).

matter, it is the options that human agency conceives as possible that matter. An entrepreneur acting in the same context and with the same resources after a shock to the market can conceive several opportunities as available on the contrary to the conventional businessman who sees none. Or, if a small business owner holds a negative attitude towards borrowing and prefers better to work with an outdated machinery instead of investing in a new one and thus expanding business through taking a loan, even very good loan conditions and additional state support provided to subsidize loan interests may have no impact. In other words, although taking a loan is one of the options for the businessman to develop his business, it is not considered as a possible one.

Human behavior depends on a wide array of internal factors, including attitudes, beliefs, social norms, values, fears, trust, etc. Through modifying behavior they have a huge impact on economic performance. Rose et al. (2009) found that fear costed more than 85 billion US dollars for the US economy, due to a decline in airline travel and related tourism (even after adjusting for the downturn in both of these activities due to the pre-9/11 recession) (Rose, 2009). Human motivation and willingness to act and to adapt to changes was estimated to be a major prerequisite for business continuity with all its consequences for resilience (ibid). And Bristow and Healy (2017) make a conclusion that innovation (which is widely accepted as one of the main drivers of regional resilience) is a mindset and a capacity as much as an outcome. All these examples lead to a conclusion that internal human factors can't be ignored in researching resilience.

Summing it up, the regional or sectoral resilience is determined by the reciprocally interacting behaviors of the myriad of agents (workers, business, government, etc.) which are in turn determined by two blocks of factors: external (or the context), representing all the possibly available options, and internal, framing the *window* or lens through which these options are seen, evaluated, chosen and implemented (Figure 1). In the next section we discuss these factors and the whole model in detail.

Behavior based resilience model

The above model is based on ones of the most widely used theories for explaining human behavior and designing interventions for changing it, namely the Socio-ecological Model (Bronfenbrenner, 1989) emphasizing the different layers of influence (individual, community, organizational and political) on human behavior, Social Cognitive Theory (Bandura, 1986), explaining the reciprocity of relationships between personal factors, behavior and environment, and Theory of Planned Behavior (Ajzen, 1991), explaining how personal factors influence intention

and behavior. Since each theory analyzes human behavior from a different view-point, we integrate them to see the whole picture. According to these theories human behavior is influenced by internal (arising from within the human) and external (arising from outside the human) factors. Both sets of factors are discussed in detail below.

Internal factors. Standard economic theories most often assume that people are rational beings, who consider all possible options, evaluate their costs and benefits from a selfish perspective and according to the results make a decision. However people are nothing like that although many think of themselves as such. Rather, people are malleable and emotional actors whose decision making is influenced by contextual cues, local social networks and social norms, as well as shared mental models, which all play a role in determining what individuals perceive as desirable, possible, or even *thinkable* for their lives, what they pay attention to and how they evaluate possible options (World Bank, 2015). Many resilience researchers (Boschma, 2015) do mention institutions (formal and informal) as playing some role in shaping regions' or sectors' resilience; some (Martin and Sunley, 2015) go a bit deeper alluding to the role of attitudes and expectations. However, in most cases these factors are only mentioned, without going into any detail of how they really work and what is their effect. Thus important elements, hindering or fostering resilience are missed.

According to the Theory of Planned Behavior psychosocial factors comprise attitude towards a particular behavior (subjective value or evaluation of each outcome), social norms (perceived social pressure) and perceived behavioral control (the extent to which people believe that they can perform a given behavior) (Ajzen, 1991). In the extended models of TPB more factors are singled out as influencing behavior directly and indirectly (through the impact on the beliefs) – namely habit and trust (Giampietri et al., 2018, Leung and Chen, 2017, Hagger et al. 2002). Trust is one of the psychological constructs rendered significant attention in the resilience literature and widely acknowledged as an important factor leading to enhanced economic performance and greater resilience (Algan and Cahuc, 2010, Boschma, 2015). In economic literature trust is most often operated as a shared asset residing as social capital in various networks (Boschma, 2015, Aldrich, 2017). However each individual holds certain general and particular beliefs about if and whom to trust, therefore it is an individual factor as well.

Habit in contrast has received undeservedly very little attention. But research shows that habitual behavior is a very significant factor leading to behavior lock-ins and misses of occurring opportunities (Maréchal, 2010, Murray and Haeubl, 2007, Barnes et al., 2004). Therefore, it may be a strong inhibitor for resilience enhancing behaviors.

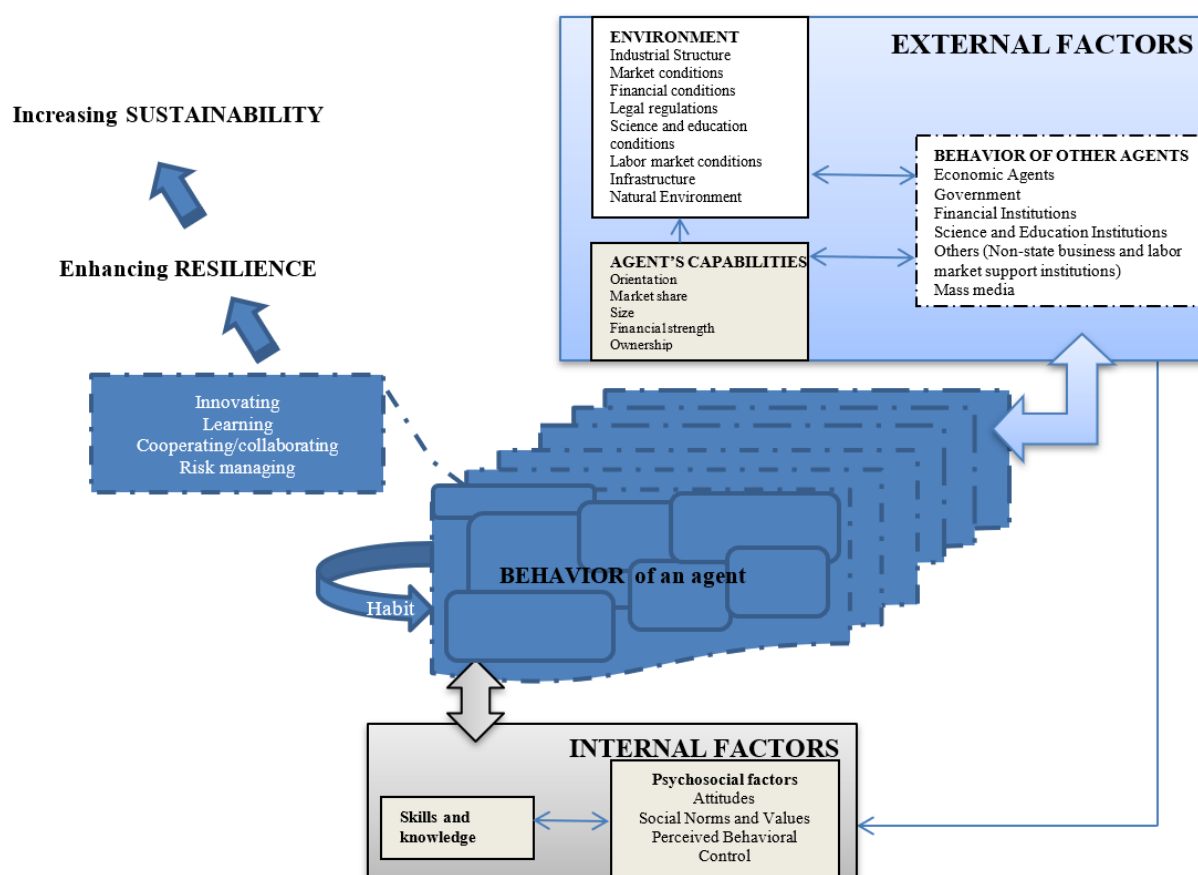


Figure 1. Behavior-based resilience model, source: compiled by authors, 2019

The other relevant group of internal factors is skills and knowledge. The importance of them as drivers of resilience is widely acknowledged. Human education and/or skills are integrated into the majority of resilience models (Hill et al., 2011, Martin and Sunley, 2015, Boschma, 2015), therefore the argumentation why it is important, will not be expanded here. Instead we argue that its influence on the resilience is not direct, but acts indirectly through influencing behavior. Its influence on the behavior is twofold: direct and indirect, through influencing psychosocial factors (attitudes, social norms and perceived behavioral control), which in turn influence skills and knowledge through feedback mechanisms (World Bank, 2015). In the model skills and knowledge are combined with psychosocial factors under internal factors block alluding to the idea that they are influencing human from within. These factors together form *a window* from which one perceives and evaluates the world (ibid) and makes a decision if, when and how to act.

The relationship between internal factors and behavior is reciprocal: not only internal factors influence behavior but they are influenced by the behavior as well (Bandura, 1986). When people for one or the other reason engage in a certain behavior their

attitudes may change depending on the outcomes, making the behavior more or less probable in the future.

External factors represent the context or in other words, all the possibly available options for the agent. These options are defined by three main groups of external factors: environment, agent's capabilities, and the behavior of other agents.

Environment represents all the available options at some point in time. For example, the existence of supply of credits for start-ups provides a possibility (i.e. an option) for a company to apply for a credit. The company may or may not apply for it, however its existence makes one of the available options to act upon. The more the options, the more flexible the company's or individual's answer to the change may be. As flexibility (due to the diversity) is ubiquitously indicated as one of the main elements of adaptability, and adaptability – as one of the main capacities for resilience (Martin and Sunley, 2015, Resilience Alliance 2010, Carpenter et al, 2001), the breadth of choice is an important factor in increasing resilience.

Which elements of the environment are relevant for the issue at hand depends on the actor. For a private service company it may be legal regulations, interest

rates, labor market and natural resources, for a governmental body – international regulatory arrangements, tax revenues, external debt and budget deficit; and for a science institution – infrastructure, e.g. if there is no educational infrastructure to prepare high quality rocket engineers and it is costly to acquire, science and education institutions will most probably not offer a program for preparing rocket engineers.

Environment reflects the static state of the context, whereas the behavior of other agents represents its dynamics. The others' behavior may either directly limit/expand the available options for an agent or change the environment and thus indirectly change the availability of options. If one company breaches trust, the relationships between this company and its partner would either break off completely or have a long term negative effects (directly limited options of cooperation). If there is a research institute in an area and government starts an incentive to encourage business-science communication, a company may start a very productive relationship with that institute, which can boost company's performance and resilience in hard times (indirectly expanded options for cooperation). These relationships reflect the feedback mechanism between the behavior of other agents and the environment. The interaction is reciprocal, i.e. both sides directly influence each other. When government issues new waste management regulations (behavior), these regulations change the legal conditions and at the same time alter market conditions by imposing waste management taxes, which in turn directly influence how much tax revenue the government will get and will be able to act on.

Agent's capabilities may include its size, ownership, financial strength, network relationships, employees' skills, market share (for the private companies), etc. These capabilities are included in the external factors' block since they limit the amount and quality of possibly available options (or to be more exact the relevant environmental conditions) to act upon. A financially sound firm holds a much greater chance to get a credit (if applied), to get a larger one and with lower interest rate when a crisis hits than a company with a bad credit history.

What needs to be mentioned however is that the breadth of choice just by itself does not increase resilience. As it was argued before, an agent must consider these options as possible ones in order for them to have any impact. In other words, the internal factors limit the really available options for the entity to the options subjectively perceived as available.

External factors not only directly influence behavior through the availability of options, but they also have an indirect effect by impact on the internal factors. External factors may influence skills and knowledge as well as psychosocial factors, such as attitudes or perceived social norms (Bandura, 1986). For exam-

ple, the rise of the shared economy has an impact on the attitudes towards sharing things (apartments, cars, etc.) and even if the initial attitudes were negative, the existence of the practice together with the observation of others doing it may alter the attitudes or directly encourage trying it out. Or if the government issues a new regulation for waste management identifying fines for not complying with it, economic agents' knowledge, beliefs and probably perceived social norms would change, influencing the change of behavior. What exactly the changes of the behavior would be (e.g. starting good practices or continuing with the bad ones, just hiding them) depends on the change of above mentioned personal factors.

The relationship between the behavior and external factors is reciprocal. As external factors mostly represent the options for behavior, they are also the outcomes of it. Inflation, industry structure, state of the environment – all of them are the results of the human actions.

Application of the model

The behavior based resilience model is best suited for resilience planning since it proposes a holistic view of the problem at hand and suggests its possible solutions. Integrating three levels – human internal factors, behavior and the context – it allows to identify the real causes of the problem, which otherwise could have been missed. Most of the governmental programs up to date focus mainly on external drivers of behavior and therefore the effectiveness of those programs is very low (World Bank, 2015). Many European countries offer significant subsidies to farmers for taking up crop or animal insurance. The risk of various perturbations in agriculture is increasing however the uptake of insurance is very low. One of the main reasons is supposed to be farmers' beliefs that in case of a climatic event their national government will grant some kind of *relief* payments anyway (OECD, 2011). There are also several other possible reasons identified, like the lack of trust, the lack of knowledge how to acquire insurance and risk perception (OECD, 2011, European Commission, 2017). All of those possible problems identified by various researchers represent the internal factors of the human agent. Failing to account for these factors makes the problem hard to solve.

Since this model accounts not only for internal but also for external factors, i.e. the context of the agent, it allows to identify causes of the problem related to external factors as well. For example, the cooperation of farmers in Lithuania is very limited (only 4% of farmers have joined cooperatives), although economic motives seem to be very clear: greater bargaining power leading to lesser input costs and better output prices, mutual help, knowledge sharing, etc. National support for cooperation although significant did not render effective.

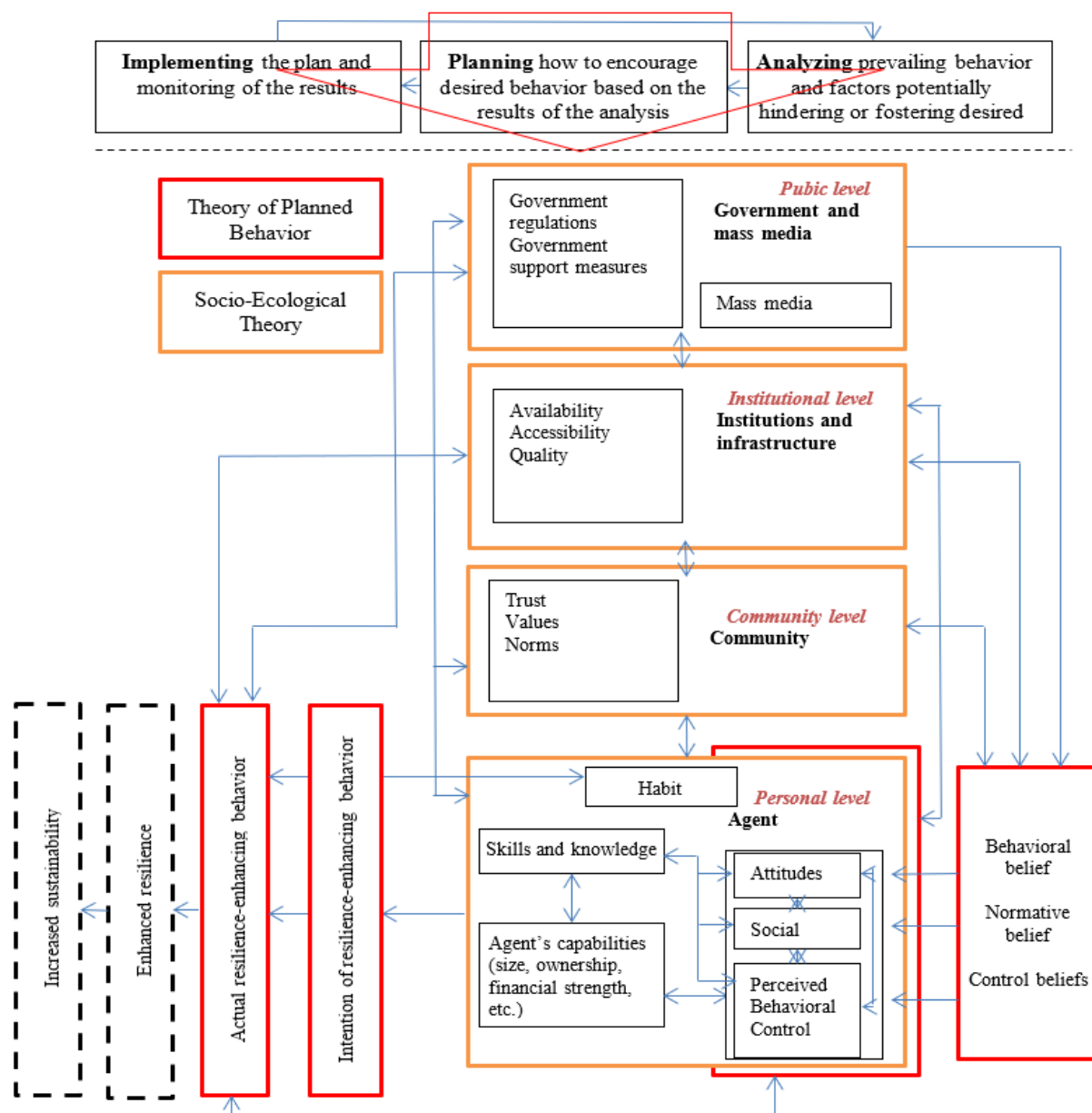


Figure 2. Analytical framework, source: compiled by authors, 2019

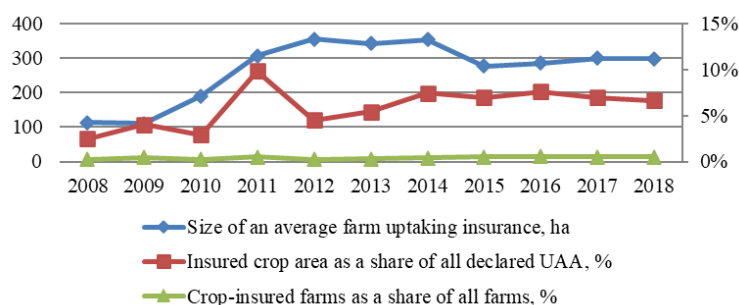


Figure 3. A share of insured crop area, a share of farms holding crop insurance and the size of an average farm insuring crops in the period 2008-2017 in Lithuania, source: compiled by authors, based on data obtained from the Ministry of Agriculture of the Republic of Lithuania

results. Kuliesis and Pareigienė (2010) found that co-operation is hindered by several reasons, one of the most important being the lack of cooperatives in the area.

The feedback mechanism allows taking into consideration cross-scale effects and evaluating how the changes in one factor could impact others.

To make this conceptual model more user-friendly for resilience planners we propose an analytical framework (figure 2) and an example of its application (table 1).

Example case of behavior model application

Increasing resilience is at the focus of lots of researchers. There is no consensus on what are the main drivers of resilience, and researchers lately tend to agree that resilience is context specific (Martin et al., 2016) so consequently there is no recipe for resilience that could fit all. Different agents with different belief/value/norm systems acting in different contexts create unique systems with unique interrelationships, therefore a resilient agent or system in one context will not necessarily be resilient in the other context. However, most of researchers coming from various fields tend to mention several behavior patterns that lead to resilience in multiple contexts, namely: creating and absorbing innovations (Wink et al., 2018, Bristow and Healy, 2017, Martin and Sunley, 2015), increasing qualifications (education) and improving skills (Obschonka et al., 2016, Martin and Sunley, 2015), collaborating and cooperating (Wink et al., 2018, Boschma, 2015) and managing risks (Linkov et al., 2014, Mitchell and Harris, 2012). Although recently there has been a shift from the traditional, vulnerability-driven risk management approach to resilience (Simonovic, 2016) risk management is still a very important part of ensuring resilience of a system. Lately, as Aven (2016) notices in his review of recent advances in risk management, integrative thinking, incorporating traditional risk analysis, resilience and antifragility, leading to broader risk management frameworks, is starting to emerge.

A case study of risk management in Lithuania's agricultural sector is presented below, providing an example of why the behavior analysis is necessary and how to use the above presented model in order to increase risk management at the farm level thus seeking to enhance resilience of the whole agricultural sector.

One of the main risk management tools for crop producers is crop insurance. It allows producers to stabilize income in the face of increasing frequency and severity of harsh weather events. The conditions for taking up insurance in Lithuania are very favorable: state has been subsidizing up to 65% of insurance premiums (which by themselves are reasonable charged) for a number of years. However, the uptake of insurance, although gradually increasing, is low (figure 3). And the absolute majority of farms insuring crops are large or very large (>150 ha). The rest of the farms (accounting to more than 95%) do not insure their risks despite very favorable insurance conditions and constant state propagation of insurance schemes.

Here comes the necessity for behavior analysis: why different farmers act in different ways; what stops them from acting in a resilience enhancing way and what would motivate them to act differently? Deeper analysis may reveal quite shocking results. For example, one of the main issues that may be stopping farmers from taking up insurance is high share of direct payments and other subsidies in their net incomes (figure 4). Other studies (Finger and Lehmann, 2012) support the hypothesis that smaller farms rely more on subsidies than on their agricultural business therefore the incentive to insure crops is quite low. The other possible explanation is that existence of *ad hoc* payments (which are paid after in the case of a disastrous event) do not motivate farmers to uptake insurance since they expect the state to take care in the case of severe event. If these hypotheses are true they hold very important implications for politicians, who aiming to make agriculture more resilient actually are encouraging quite the opposite.

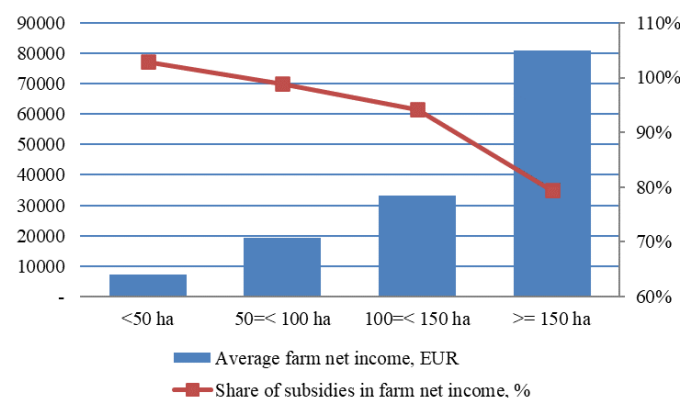


Figure 4. Average annual farm net income and share of subsidies in it according to farm size in the period 2010-2017 in Lithuania, source: compiled by authors, based on FADN and Statistics Lithuania data

Although these hypotheses are quite convincing there may be other important factors hindering insurance behavior. What's also important is that different groups of farmers are driven by different motives; they are by no means a homogenous group, therefore efforts to change their behavior in a more resilient way have to be based on the motives relevant for each particular group. Since insurance is a part of the risk management behavior the holistic approach is necessary. In the table below (table 1) we present an example of how risk management behavior could be analyzed according to the behavior model.

Managing risks starts at the farm level, where farmers have a large variety of options to choose from in order to reduce their exposure to risks, mitigate the potential effects of the risk or cope with the actual perturbations. That involves 1) knowing how to (i.e. learning/getting information about potential risks, available risk management tools and their application), 2) actively engaging in risk management (pre-

Table 1. Example of application of behavior based analytical framework to farmers' risk management behavior analysis, source: compiled by authors, 2019

Level	Dimension	Factors potentially fostering behavior	Factors potentially hindering behavior
Personal	Skills and knowledge	<p>Sufficiency of knowledge and/or skills on:</p> <ol style="list-style-type: none"> 1. Potential risks (economic and price-related risks, climatic, environmental, pests and diseases, etc.). 2. Management of those risks: <ul style="list-style-type: none"> • Possible tools: e.g. diversification (that can occur in many forms and over different scales; crop/animal/income insurance; use of improved crop or animal varieties; early warning systems, etc. • How to apply them (<i>ex-ante</i> and <i>ex-post</i>). • Where to start when the adverse event happens? 3. Farming (improved livestock management practices, soil and water conservation, crop rotations, hygiene standards, etc.) and farm management (finance, marketing (e.g. how to create more value added products), etc.). 4. Available support measures for: <ul style="list-style-type: none"> • Farm modernization. • Risk management. • Increase of the competitiveness of the agricultural sector. • Diversification of rural businesses. • Innovations. <p>The up-to-datedness of the above knowledge.</p> <p>Skills of coping with stress.</p>	<p>Lack of knowledge and/or skills on:</p> <ol style="list-style-type: none"> 1. Potential risks. 2. Management of those risks. 3. Farming and farm management. <p>Obsolescence of knowledge</p> <p>Use of obsolete methods</p> <p>Misunderstanding of information</p> <p>Erroneous use of information/methods</p>
	Attitude toward the behavior	<p>Positive farmers' attitude towards necessity and effectiveness of risk management.</p> <p>Attitude towards risk taking (willing to take risks or risk averse).</p> <p>Positive attitude (expectations) towards farming in general.</p>	<p>Satisfaction with status quo.</p> <p>Perception of farm risk management as a shared responsibility as opposed to farmer's own responsibility.</p> <p>Exaggerated farmers' reliance on state support means in case of the perturbation.</p>
	<i>Behavioral beliefs</i>	<p>Farmers' beliefs on benefits of preparations for risks <i>ex-ante</i>.</p> <p>Farmers' beliefs on potential gains of learning/getting information about possible risk management tools and their application.</p> <p>Farmers' beliefs on the necessity and efficiency of available risk management tools (separately for each one).</p> <p>Farmers' beliefs on the availability/accessibility of various tools.</p> <p>Farmers' beliefs on the severity of various risks.</p>	<p>Farmers' beliefs on costs related to risk management (financial, time, technological, etc.).</p> <p>Distrust in <i>new</i> risk management tools.</p> <p>Absence of perception of benefits of <i>ex-ante</i> preparations/learning.</p> <p>Negative farmers' beliefs towards the effectiveness of available tools.</p> <p>Farmers beliefs that state support is the main and sufficient means for farm risk management.</p>
	Subjective norm	Perception of important others (close relatives, neighbors, friends) as highly encouraging for risk management.	Perception of important others as highly discouraging of risk management
	<i>Normative beliefs</i>	<p>Beliefs on important others' approval of various risk management tools</p> <p>Beliefs on important others' approval of learning, changes and innovations.</p>	<p>Beliefs on important others' disapproval of various risk management tools.</p> <p>Beliefs on important others' disapproval of learning, changes and innovations.</p>
	Perceived behavioral control	<p>Farmers' perception that farm risk management depends only on them.</p> <p>Farmers' perception that they can control various risks (by preparing or managing them on spot).</p>	<p>Farmers' perception that farm risk management is theirs as well as others responsibility.</p> <p>Farmers' perception on how difficult it is to manage risk.</p>

	<i>Control beliefs</i>	Farmers' beliefs on the sufficiency of the available resources (knowledge and skills, financial, technological, etc.) to manage risk (in general and separately for each risk management tool).	<p>Farmers' disbelief of the effectiveness of risk management on the whole (Fatal thinking <i>Whatever I do, it won't change anything</i>).</p> <p>Farmers' belief of insufficiency of the available resources (knowledge and skills, financial, technological, etc.) to manage risk.</p> <p>Farmers' beliefs on the necessity of governmental support in case of:</p> <ul style="list-style-type: none"> • catastrophic events (large negative impact, very rare) • mild to medium perturbations (price decrease, crop damage due to wild animals, pest damage, frequent rains).
	Farm capabilities	<p>Sufficiency of farm resources for risk management:</p> <ul style="list-style-type: none"> • financial capital, • land characteristics, • seed/animal species, • machinery, • access to internet, • other relevant resources. 	Full or partial insufficiency of farm resources.
Community	Cultural values	<p>Activities, perceived as valuable:</p> <ul style="list-style-type: none"> • individual incentive; • learning/knowledge acquisition; • knowledge sharing. 	<p>General envy for success of others.</p> <p>Perception of individual incentive as a break out.</p> <p>Denial of the importance of learning/permanent knowledge updating.</p> <p>Perception of those who learn as showing off.</p>
	Norms	<p>Existence of a tradition of consultations, knowledge and best practice sharing.</p> <p>Existence of a tradition of mutual help.</p> <p>Generally accepted norms of individual responsibility for one's own farm (business).</p>	<p>Norms of waiting for someone's help, denying one's own responsibility.</p> <p>Alcohol or substance abuse, leading to neglecting, poor efficiency and fatal thinking.</p>
	Trust	Trust in other farmers in general.	General distrust.
Organizational	Availability, accessibility and quality of products, services, institutions	<p>Availability, accessibility, reputation and quality of:</p> <ul style="list-style-type: none"> • Consultation services. • Financial services (general attitudes towards lending to farmers, interest rates, loan terms and conditions, fees and charges, collateral requirements, repayment flexibility, alternative sources of finance, guarantee funds, forward contracts, etc.). • Insurance services. • Supply of new, better quality, risk-resistant plant and animal varieties, technological solutions, etc. <p>Availability, accessibility and good quality of non-governmental farmer and rural people support institutions.</p>	<p>Lack of availability, accessibility or efficiency (quality) of relevant products, services and/or institutions.</p> <p>Negative farmers' attitude towards borrowing in general.</p> <p>Distrust in relevant service providers.</p>
	Availability, accessibility and quality of infrastructure	<p>Early warning systems.</p> <p>Irrigation and/or drainage systems.</p> <p>Internet.</p>	Lack of availability, accessibility or quality of infrastructure.
	Governmental regulations	Sufficiency and efficiency of local and national legal regulations and requirements in the relevant fields (e.g. the time needed for new seed variety certification in a country, environmental requirements for	Insufficiency and/or inefficiency of local and national legal regulations.

		farm management, legal regulation for insurance service providers, regulations for credit providers, etc.).	Redundancy of requirements posing limits on relevant actions.
			Redundancy of inspections, large fines for minor misdemeanors.
	Government agricultural and rural policies and support measures	Availability of national and local support measures (for: farm modernization, risk management and <i>ad hoc</i> disaster aid, increase of the competitiveness of the agricultural sector, diversification of rural businesses, innovations, cooperation, learning, etc.; direct payments; special treatment on taxation, credit subsidies etc.) Is support easily accessible and timely? Co-financing costs? Does support come with necessary consultations to ensure beneficiaries know how to use acquired machinery, technologies, etc.?	Redundancy of state risk and farm support measures (crowding out personal risk management)
	Mass media coverage	The sufficiency and positivity on how risk management in general and different risk management tools are presented on mass media.	The negativity of mass media coverage towards risk management in general and different risk management tools.
Level	Dimension	Factors potentially fostering behavior	Factors potentially hindering behavior

paring for those risks, coping with the effects of actual perturbations using various tools) and 3) learning from the experience and using these lessons to increase farm resilience in the future. But first and foremost farmers have to accept and internalize the idea that they themselves are responsible and best equipped for managing risks on their own farm. In each and every step mentioned above the beliefs, attitudes and other tacit factors play a very important role, determining if and how well the risks would be managed.

The analysis of relevant behavior is done similarly to customer research in the field of marketing. The relevant *customers* (agents whose behavior is sought to be changed) are grouped into segments and the picked out agents from those segments are studied. The intervention measures/programs based on the results are being prepared. The implementation of these measures should be done according to the adaptive management principles, i.e. implement – monitor – learn – change the measure if needed (Carpenter et al., 2001).

The advantages and limitations of behavior based resilience model

Since resilience is context specific and dynamic (Pendall et. al, 2010, Martin et al., 2016) and the future is very uncertain, nobody knows what systems will be resilient in the future. However, most of researchers tend to agree that in order to be resilient a system (individual, corporation, sector or region) must be able either to adapt to and take opportunity of the changes whatever are brought by or to transform in order to stay viable and preferably better off (Martin and Sunley, 2015, Boshma, 2015, Martin-Breen and Anderies, 2011). In any case at least some kind of activity must be done in order to adapt or

transform. Therefore behavior should be at the core of the resilience research.

The main advantage of our behavior based resilience model is its holistic view at the problem in hand, depicting all the relevant structural elements as well as the causal relationships between them. It allows to identify drivers fostering resilience increasing behaviors, but also the ones hindering such behaviors. Therefore strategies based on these results could be much more effective.

This resilience model is highly flexible and can be applied to a range of systems across various scales, ranging from individuals to communities and regions, since it takes into consideration the unique context where it is applied at. The model itself does not provide any universal *cures* but allows identifying the most effective ones for the particular issue at hand.

It also allows understanding and monitoring processes and dynamics within people, between them and their environment, which is necessary in order to understand resilience.

As with any theoretical model, the strengths of this resilience concept come with some limitations. First of all, this model is best suited to analyze and foster or inhibit some particular behaviors that are known beforehand. For example, most of the researchers agree that innovation creation and absorption activity is one of the most important determinants of resilience. So this model is particularly useful in planning how to increase innovation behavior. However it lacks analytical power to determine which exactly behavioral patterns lead to resilience.

Using this model it is hard to compare the resilience among regions, however it allows being very context specific and efficiently improving resilience by working on region specific weaknesses and strengths.

Conclusions

Resilience has been increasingly considered as a necessary precondition for sustainability and sustainable development. Ensuring the continuity of the system it becomes a basis for sustainability. The concept of regional economic resilience itself, due to the adopted perspective, varies from the ability of the system to absorb shocks to the ability to quickly recover from them and to the ability to transform itself and start new development paths. Despite different viewpoints resilience is understood principally in relation to the system's structure and overall functioning, ignoring the human agency and its bounded rationality. However people are malleable and emotional actors whose decision making is often influenced by lots of factors others than rational calculations, such as their attitudes, contextual cues and social norms, which all play a role in determining what is perceived as desirable or possible, what the attention is paid to and how the possible options are evaluated. Thus not including human agency into resilience research leads to missing important elements, hindering or fostering resilience. Consequently the effectiveness of resilience enhancing strategies is quite poor.

In this paper, it is argued that human behavior should be at the core of the resilience concept, since whatever the shock, its potential impact will mostly depend on the (ex-ante and ex-post) behavior (of a myriad of reciprocally interacting agents). The behavior is in turn determined by two blocks of factors: external (or the context), representing all the possibly available options for an action, and internal framing the *window* or lens through which these options are seen, evaluated, chosen and implemented. External factors encompass environment, agent's capabilities and the behavior of other agents, while internal factors comprise psychosocial factors (beliefs, attitudes, social norms, self-efficacy) and skills and knowledge.

The framework, grounded on psychological theories, reveals the mechanism how the above mentioned factors interact and determine behavior thus consequently influencing resilience. Integrating three levels – human internal factors, behavior and the context – it offers its users a holistic view of a certain resilience enhancing strategy. An exemplary analysis of enhancing risk management behavior at the farm level is provided as a sample of how to use this framework.

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On Religious and Cultural Principles of Environmental Protection

W sprawie religijno-kulturowych zasad ochrony przyrody

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Abstract

The influence of religion on the human attitude to nature has been a thoroughly studied issue over the last sixty years. The present paper addresses a particular aspect of this issue, namely, it provides a comparison of religious and cultural principles characterizing animistic religions and Christianity. It also concentrates on the ecological consequences of supplanting animism with Christianity. The results of the conducted research indicate that the role of religious and cultural principles standing guard over nature is usually either overestimated or depreciated. Religion may only become an important ally making a real contribution to nature conservation at both local and global levels, providing that those principles are attributed their proper significance.

Key words: animism, Christianity, primal religions, environment, religion and ecology

Streszczenie

Wpływ religii na stosunek do przyrody jest zagadnieniem gruntownie badanym od ponad sześćdziesięciu lat. Opracowanie to podejmuje szczególny przypadek tego zagadnienia. Porównuje bowiem religijno-kulturowe zasady obecne w religiach animistycznych i chrześcijaństwie. Prezentuje ponadto ekologiczne konsekwencje wyparcia animizmu przez chrześcijaństwo. Wyniki przeprowadzonych badań wskazują, że rola zasad religijno-kulturowych stojących na straży przyrody jest zazwyczaj albo bardzo przeceniana albo niedoceniana. Tylko przyznanie tym zasadom właściwego im znaczenia może uczynić z religii ważnego sprzymierzeńca, który realnie przyczyni się do ochrony przyrody zarówno na poziomie lokalnym, jak i globalnym.

Słowa kluczowe: animizm, chrześcijaństwo, religie pierwotne, środowisko, religia i ekologia

Introduction

The mutual interaction between the world of nature and the world of culture has long been the subject of human reflection. The ancients were already aware of the fact that nature constitutes an important factor shaping the environment of human life, which is clearly illustrated in such writings as Thucydides' *The History of the Peloponnesian War*, Hippocrates' *On Airs, Waters and Places*, or Aristotle's *Politics*. The above works provide evidence of the ancient Greeks' conviction that the type of climate affects the temperament of a group of people inhabiting a

specific area, and even the structure of their countries. In the ancient approach to the relationship between nature and culture, considerable emphasis was laid on the influence of nature on culture, since human culture was considered as weaker and more susceptible to environmental influences. For centuries, people failed to realize that their activity may affect nature and spur a process of significant changes taking place in the environment. Even at the dawn of modernity, Francis Bacon, Descartes and Galileo Galilei still naively shared the opinion about the immunity and immutability of nature (Sadowski 2015, 17-20).

It was not before people experienced the acute effects of the ecological crisis caused by the industrial revolution, that they were able to discover the extent to which the activities of civilized humanity influenced the natural world. The experience of discovering that humanity influences the natural world forced people to examine the assumption of the immunity and immutability of nature by exposing its variability and fragility. Humanity began to realize nature's susceptibility to changes as well as the risks. The rising awareness of the general influence of culture on nature was not accompanied by any interest in the influence of religion on the environment and, consequently that issue remained neglected for a long time. Broader studies referring to the influence of religion on the environment were first initiated among Christian thinkers in the 1950s with such major works as, for example, *Religious Approach to Nature* (1950) by W. H. Dew, *Nature and Man in Biblical Thought* (1953) by E. C. Rust, *A Theology for Earth* (1954) by Joseph Sittler, or *The Work of Creation* (1958) by Karl Barth. The Faith-Man-Nature Group also played an important role in the research on the relation of Christianity to the environment. The period of the most intensive research conducted by the scientists belonging to this association fell on period between the mid-1960s and the mid-1970s.

Reflection on the role of Christianity in the so-called ecological issue entered a new phase with Lynn White's publication entitled *Historical Roots of Our Ecologic Crisis* (1967). This seminal article became a catalyst for the ongoing discussion on the relationship between Christianity and nature having a major impact on the creation of the assumption about the anti-ecological character of Christianity. However, numerous, interdisciplinary studies on this issue point to the unusual complexity of this subject and allows to conclude that the blame attributed to Christianity for causing the environmental crisis is strongly exaggerated. The conclusion that Christianity for causing the environmental crisis is strongly exaggerated is confirmed by the research conducted within a project called the Forum on Religion and Ecology, which brings together scientists from around the world representing all the most important religious traditions. In their research on the relationship of religion to the environment, the scientists do not confine themselves strictly to the role of Christianity in the emergence of the ecological crisis, but they broaden the scope of their interest exploring a variety of religious worldviews on human attitude to nature (Tucker 2003).

Based on the research findings from the Forum on Religion and Ecology, it can be concluded that the influence of Christianity on nature is fairly ambivalent. Although the Christian tradition provides arguments justifying human interference in the natural world, it also offers arguments for the protection of the created world. The aim of this study is to present religious and cultural principles related to nature. On

the one hand, it shows how Christianity eliminates the animistic principles guarding nature and, on the other, how Christianity introduces its own principles protecting nature.

1. The role of Christianity in removing religious and cultural principles protecting nature

Studies on the influence of Christianity on the human relationship to nature deploy various arguments to support the idea that it leads to nature's destruction. Proponents of that view point out that the anti-ecological character of Christianity is manifested in the fact that, firstly, it removes religious and cultural principles that stand guard over nature and, secondly, it introduces other principles justifying humanity's unlimited interference in nature.

One of the fundamental objections raised against Christianity in the context of eliminating the principles protecting nature is that it supplanted animistic religions, since wherever Christianity became the dominant religion, animism, which, as some scientists contend, had a much more pro-environmental character than Christianity, gradually disappeared. As animistic religions proclaimed a belief in the presence protective spirits in nature, its followers were inevitably forced to use natural resources in a limited way. They could benefit from nature's wealth providing it was necessary to support the life and functioning of their community. The fear of the guardian spirit's anger provided protection against any reckless abuse of nature. This anger could bring disaster or even death to the culprit. Any trespassing could expose the entire community to the anger of deities. Religious and cultural principles shaped in this way were respected by all community members and constituted protection against any inconsiderate abuse of nature (Sutton and Anderson 2004, 156).

The above or similar arguments are often deployed in the discussion on the role of Christianity in the ecological crisis. It seems that they were widely propagated by Lynn White in the article *Historical Roots of Our Ecologic Crisis*. White claims that the victory of Christianity over ancient paganism constituted the greatest psychological revolution in the history of our culture, because it radically changed the way of thinking about man and the surrounding nature. *In Antiquity every tree, every spring, every stream, every hill had its own genius loci, its guardian spirit. These spirits were accessible to men, but were very unlike men; centaurs, fauns, and mermaids show their ambivalence. Before one cut a tree, mined a mountain, or dammed a brook, it was important to placate the spirit in charge of that particular situation, and to keep it placated. By destroying pagan animism, Christianity made it possible to exploit nature in a mood of indifference to the feelings of natural objects* (White 1967, 1205).

White also points to the argument put forward by some scientists, namely, that the animistic worship

of local gods of nature was replaced by the Christian cult of saints. However, this change in no respect contributed to preserving the religious principles protecting nature. For, while the animistic deities belonged to the local nature, Christian saints belonged to heaven, a reality radically different from the reality of the Earth. In addition, as White argues, the Christian religion granted man a monopoly on spirituality, which in the pagan world was enjoyed by all nature. This approach still further widened the gap between the world of culture and the world of nature, at the same time sealing the breach with pagan principles protecting nature (White 1967, 1205).

Consequently, Lynn White states that Christianity bears a huge burden of guilt for the contemporary environmental crisis. An antidote to the existing crisis that White offers is abandoning Christianity for the sake of Eastern religions that unlike Christianity put more emphasis on the relationship of man with the natural world. Another solution could also include a thorough transformation of Christianity which, as White proposes, should draw on the ideas of Saint Francis of Assisi, who emphasized the people's relationships with nature, rejected their ruling, dominant position and developed a new concept of human attitude to nature understood in terms of democracy of all God's creatures (White 1967, 1206). Other scientists also support similar opinions on the destructive influence of Christianity on nature due to its eliminating religious and cultural principles protecting nature. One of them is Arnold Toynbee, an outstanding historian and theoretician of civilization conducting research on, among others, human attitude towards the environment as the cause of the civilization collapse (Toynbee 1934). Toynbee attributes the blame for the contemporary environmental crisis to monotheistic religions, especially to Christianity, which supplanted the polytheistic religions of ancient Greece and Rome. Toynbee holds an opinion that religions of ancient Europe proclaimed a much more friendly attitude of man to nature than monotheistic religions.

Toynbee goes as far as to state that *for pre-monotheistic man, nature was not just a treasure-trove of 'natural resources.' Nature was, for him, a goddess, 'Mother Earth,' and the vegetation that sprang from the Earth, the animals that roamed, like man himself, over the Earth's surface, and the minerals hiding in the Earth's bowels, all partook of nature's divinity. For primitive man, the whole of his environment was divine, and his sense of nature's divinity outlasted his technological feats of cultivating plants and domesticating animals* (Toynbee 1974, 142-143).

According to Toynbee, even the emergence of philosophy did not eradicate the divine dimension of nature from the Greek culture, since in this culture, the gods were closely related to natural phenomena which were widely interpreted in a religious key (Hughes 1975, 48-49). Similarly, the anger and the bounty of ancient gods were expressed respectively

in the failure of crop or in plentiful harvest (Homer 1999, book XXI, verse 130-211, book XVI, verse 215-219, Homer 1995, song XIX, verse 60-64). By contrast, the Judeo-Christian concept of the relationship between man and nature removed the previous religious and cultural constraints on human greed, which had been hampered so far by the feelings of admiration and worship that the followers of ancient polytheism cherished for nature. *Man's greedy impulse to exploit nature used to be held in check by his pious worship of nature. This primitive inhibition has been removed by the rise and spread of monotheism* (Toynbee 1974, 145).

In the similar vein, Ian McHarg blames the Judeo-Christian tradition for supplanting animism and worship of nature which safeguarded human limited use of natural resources by propagating the attitude of respect, deference and submission (McHarg 2006, 2). McHarg's opinion is supported by Max Nicholson, who justifies the friendly relationship between the followers of primal religions and nature by a strong sense of the existing bond between their communities and the environment. Nicholson perceives this bond as a factor conditioning the formation of harmonious relationships between man and nature as well as human adaptation to the rhythm of nature's life (Nicholson 1989, 18 and 12).

Donald Worster, an American environmental historian, is another scholar blaming Christianity for eradicating religious and cultural principles that protected nature in the ancient world. However, Worster's argument is of a different character. In his opinion, the Western culture being dominated by Christianity, rejected the ancient myth of the Arcadian shepherd and replaced it with the concept of the Good Shepherd presented in John 10 (Worster 1994, 26; Sadowski 2016, 239-240). According to Worster, this change epitomizes the supplanting of the Arcadian vision of the harmonious coexistence between man and nature prevalent in Hellenic culture by the Christian vision of the destructive presence of man in the world contained in Christian culture, which he defines as *imperial* (Worster 1994, 29).

Worster justifies his idea in the following way: *The Good Shepherd of the New Testament was more ascetic and otherworldly than his arcadian counterparts. Probably he was also meant to be more humanitarian, at least toward those fragile human creatures in his sheepfold. In the Christian version of the pastoral dream, the shepherd does not mere with nature through his flock nor is his occupation a protest against urban alienation from the natural world, both of which are key themes in the arcadian version. On the contrary, he is the defender of the flock against the hostile forces of nature – wolves, lions, bears – and his profession is to lead his lambs out of this sorry world to greener pastures* (Worster 1994, 26).

What is more, Worster argues that Christianity is a catalyst for hostile references to nature, because it

perceives it as a source of spiritual threats, carnal temptations and animal instincts that Christians should radically oppose. In his opinion *Christianity has maintained a calculated indifference, if not antagonism, toward nature. The good shepherd, the heroic benefactor of man, has almost never been concerned with leading his flock to a broad reverence for life. His pastoral duties have been limited to ensuring the welfare of his human charges, often in the face of a nature that has been seen as corrupt and predatory* (Worster 1994, 27).

Referring to the above-presented opinions on the question of Christianity's role in removing religious and cultural principles protecting nature, it should be stated that these allegations are largely justified, since animistic or polytheistic concepts of nature are unacceptable from the Christian point of view. A good example here is a description of the martyrdom of Saint Adalbert, the main patron of Poland, who was murdered by a pagan priest for not respecting the holy grove of pagan Prussians (Kanapariusz 2009).

However, contemporary research on the attitude to nature among the followers of animism and primal religions shows, that despite their adopting religious and spiritual principles protecting nature, they were often guilty of its excessive exploitation. A good illustration here are studies on the use of natural resources in ancient Greece, Rome, the civilizations of the Near and Far East, or in the pre-Columbian America (Hughes 1975, 68-86; Thomas 1983, 23-25). Examples of nature's abuse by the followers of primal religions are also provided by studies on the myth of the noble savage and the Pristine Myth (Sadowski 2016). Both those examples refer to adherents of primal religions who had no contact with Christianity. Despite the presence of religious principles guarding nature, communities of American Indians significantly interfered in local ecosystems and the consequences of their activity are noticeable even after several hundred years (Denevan 1992, 376-377).

The question of the ecological consequences following the process of supplanting the primal religions by Christianity has recently become a subject of growing interest. A good example here is research related to the medieval processes of Christianizing the pagan tribal groups of the Eastern Baltic and their ecological consequences (Pluskowski 2019). It seems, that it is only through thorough and interdisciplinary research on this subject, that we can gain the knowledge allowing us to conduct reliable evaluation of the ecological balance of introducing or removing religious and cultural principles developed in particular religious traditions.

2. The role of Christianity in introducing religious and cultural principles protecting nature

Although, admittedly, Christianity eradicated religious and cultural principles protecting nature prevalent in the animistic tradition, it at the same time replaced them by other that, although for different reasons, lead to the same goal, i.e. concern for nature. Two sources may basically be indicated as regards Christian principles protecting nature, namely, the Holy Scriptures and the Church tradition. As they are interlinked and inseparable, it is sometimes difficult to clearly differentiate between those two sources. On the one hand, the Holy Scripture was written in the Church and for the Church, and on the other hand, the history of the Church is inspired by the message of the Holy Scriptures.

2.1. Biblical inspirations of Christian care for nature

The Bible leaves no doubt that people have the right to use natural resources. However, the claim that the Bible provides people with an unlimited right to its exploitation is unjustified. Although, the Judeo-Christian tradition clearly rejects the sacralization and deification of nature as well as any approaches potentially leading to pantheism, it nevertheless underlines the Creator's presence in the world and His concern for all creation.

Although, along with eliminating animistic principles that stand guard over nature, Christianity undermines its protection, it at the same time introduces new religious principles that, as it seems, to the same extent support nature's conservation. The biblical concept of nature clearly highlights human obligations to the creation as well as the reasons why people should use natural resources in a moderate and responsible manner.

It seems that one of the most important reasons for the human concern for nature issues from the awareness that God is the absolute ruler and owner of the world that He created, and that man is only His tenant, regent (Gen. 1-2; Ps. 24: 1; Chr. 29: 11-14)¹. Therefore, man can use natural resources only under the powers given him by the Creator (Gen. 2: 16-17). A good illustration of the constraints on the use of natural resources is the establishment of the Sabbath year (Lev. 25: 1-12) and the division of animals into clean and unclean (Deut. 14: 4nn).

Another source of Christians' respect for nature are biblical passages evidencing God's concern for non-human nature. In this way, the Creator shows that nature in all its richness and diversity is valuable and important. This thesis finds its confirmation in the covenant concluded by God with Noah. The Bible emphasizes that apart from people, all living beings are also partakers of this covenant (Gen. 9: 9-11). In

¹ All biblical texts are quoted from an online edition of the Bible available on the website: <www.catholic.org/bible/>.

addition, the Holy Scriptures show God's concern for wild nature. In no way can this concern be justified by its utility for man (Ps. 104: 10-11, Job 38: 25-27).

Christian concern for the creation also issues from biblical passages indicating that the creation is the space in which God's existence and many of His attributes are revealed – *ever since the creation of the world, the invisible existence of God and his everlasting power have been clearly seen by the mind's understanding of created things* (Rom. 1:20; Wisdom 13:1; Isa. 49:26).

Another biblical inspiration for Christian concern for the creation is the awareness that it itself praises the Creator (Ps. 148; Ps. 66: 1b-4). Destruction of nature would then mean depriving God of praise and belittling His glory (Rev. 5:13). In addition, the beauty of the creation provides an inspiration and encouragement for man to worship his Creator (Ecless. 43:11; Dan 3: 41-90).

One more biblical inspiration for the responsible care for nature is the Creator's command, according to which man was given the right to subdue it and be its master (Gen 1:28), but at the same time he was obliged to cultivate and take care of nature (Gen. 2:15). The Creator's command is unambiguous. Man cannot usurp the role of a dictator and tyrant toward creatures, but he should rather be their caring guardian and prudent manager who remembers to *govern the world in holiness and saving justice and in honesty of soul to dispense fair judgement* (Wisdom 9:3).

In addition, the Bible, especially in messianic prophecies, proclaims universal salvation of all creation. According to the Creator's intention, the original harmony that prevailed in the Garden of Eden will be restored at the end of time. Then, there will be perfect unity between man and God and between man and all other creatures (Isa. 11:6-9; Hos. 2:20). Christian encouragement to provide the creation with protection ends with a biblical warning that the destruction of nature will be met with a severe retribution of the Creator (Rev. 11:18).

An analysis of biblical arguments supporting prudent and responsible care for nature allows to state that the Christian tradition, to no lesser extent than animism or other primal religions, protects nature through its religious and cultural principles.

2.2. Historical inspirations of Christian concern for nature

Other inspirations for pro-environmental attitudes of Christians can also be found in the rich tradition of the Church. The patristic thought seems particularly abundant in this respect. A conviction that the beauty of the creation reflects the Creator's beauty, and that the creation reveals His many qualities, found its expression in the metaphor of *two books*. The Church Fathers were convinced that God addressed His message to man in the book of the Holy Scriptures and

in the book of the creation (nature). While the first of those books is written in words, the other is inscribed in creatures (Glacken 1976, 203). It seems that this metaphor draws its inspiration from biblical passages capturing the world as a book: *The heavens will be rolled up like a scroll* (Isa. 34:4) and *the sky disappeared like a scrolling up* (Rev. 6:14).

As Socrates Scholasticus claims, there are many indications that this metaphor was first used by Anthony the Great. When asked by a philosopher how he can withstand the desert without access to books, Anthony was to answer *my book, oh philosopher, is the nature of things that are made, and it is present whenever I wish to read the words of God* (Socrates Scholasticus 1891, book IV, ch. 23). Gregory of Nyssa, Augustine of Hippo, John Cassian, John Chrysostom, Ephrem the Syrian and Maximus the Confessor were among those who also used the metaphor of two books in reference to nature as a space in which the Creator reveals His existence, attributes and plans. In Christian antiquity there were also writers who, although they did not directly use the expression *book of nature*, proclaimed the idea that God speaks to man through nature (Tanzella-Nitti 2005, 237).

A good example of such a concept of nature is provided in the words of Basil the Great: *through the beauties of created things we can read God's wisdom and providence as if these beauties were letters and words* (Basili Magni 1885, col. 222c-223a). Also, Saint Augustine referred to the metaphor of the book of nature in the context of discovering the Creator in the creation. Giuseppe Tanzella-Nitti quotes in this context a passage from one of his sermons *Some people, in order to discover God, read a book. But there is a great book: the very appearance of created things. Look above and below, note, read. God whom you want to discover, did not make the letters with ink; he put in front of your eyes the very things that he made. Can you ask for a louder voice than that?* (Tanzella-Nitti 2005, 237).

In addition, Saint Augustine points out that while the book of the Bible is available only to those who have mastered the ability of reading, the book of the universe is available to all people. *It is the divine page that you must listen to; it is the book of the universe that you must observe. The pages of Scripture can only be read by those who know how to read and write, while everyone, even the illiterate, can read the book of the universe* (Augustinus 1845a, col. 518).

Many early Christian writings contain inspirations for religious and cultural principles protecting nature. Saint Augustine writes about *vestigia Dei* – signs-tropes, which the Creator inscribed in nature to be discovered by man (Augustinus 1845b, col. 302). Other Christian thinkers liken the creation to a mirror in which the Creator Himself is reflected. By observing nature, man can learn a lot about his Creator (Pedersen 1992, 22-23; Palmer et al. 2010, 82). Ori-

gen, on the other hand, states that nature and the Holy Scriptures reflect one another to such an extent that, it seems, a person seeking answers to questions in nature and a person seeking answers to the same questions in the Scriptures will come to the same conclusions (Origenis 1862, col. 1079-1082).

The idea of defining nature as a place of God's revelation, developed in Christian antiquity as well as the metaphor of two books and mirrors prevalent in Christian literature provide yet another source of religious and cultural principles aimed at protecting nature. Consequently, the destruction of nature would be, for Christians, an offense against the Creator, as it would belittle His glory, hinder His recognition and waste the heritage entrusted to human beings.

Conclusions

It seems that many contemporary studies tend to overestimate the influence of religious and cultural principles on human decisions regarding the environment. It turns out that those principles often fail to fulfil their role, as regards both protecting nature in accordance with religious and cultural principles present in animism and primal religions as well as in Christianity. Although, it cannot be argued, that those principles have no impact on human decisions, their effectiveness is rather limited. This fact very often remains unnoticed by scholars who ascribe them a decisive role in the decision-making process. Consequently, religious traditions are burdened with responsibility for specific attitudes towards the environment. Such an approach to the problem prompted some scientist to come up with simple answers to difficult and complex issues, which in all probability contributed to the emergence of the assumption about the anti-ecological character of Christianity. This assumption is based on a simplified concept of the human decision-making process and of the significance of religious beliefs for human attitude to nature.

Another reason behind this assumption may be traced back to the very comparison made between the followers of primal religions and Christian communities as well as the ecological consequences of their functioning. James Nash draws attention to the difficulties arising from such comparisons. It must be considered that Christian communities constitute very complex and numerous social structures, whereas animist communities are mostly poorly structured and limited in number. Any comparison of communities so different in terms of numbers, complexity, pluralism, anonymity and the degree of technological sophistication is an extremely difficult process, if at all possible (Nash 1991, 90).

Conscientious evaluation of the significance of Christian principles protecting nature demands considering the fact that depriving nature of the spiritual

dimension present in animistic religions and introducing the concept of transcendent God present in Christianity cannot be the only or even the essential reason for the transition from pro to anti-ecological attitudes. This view seems to be supported by Karen Gloy, who contends that irresponsible exploitation of nature rather than being a consequence of the prevalent presence of the God-Creator in the Euro-Atlantic culture, is due to the lack of that presence. In Gloy's opinion, a Westerner who eliminates God from his life, takes His place becoming an *alter deus* with all its consequences. He aspires to be an uninhibited owner of the world, and hence, to dispose of its resources in an arbitrary manner (Gloy 1995, 164-165).

There are many indications that religious beliefs are a factor having much more limited impact on human decisions than it is generally assumed. The decision-making process is governed by manifold conditionings and it is extremely complex. Although religious beliefs do influence human decisions, they are only one of the many factors determining man. His decisions are also influenced by other aspects such as economy, politics, aesthetics, ethics, psychology, etc. In specific cases, the complex combination of all those factors results in human decisions whose consequences may be either favourable or harmful for the environment.

Being aware of the limited role of religious and cultural principles protecting nature in securing the future of life on the Earth, one should nevertheless consider their impact on human choices. The ecological potential of religion is usually either overestimated or depreciated and poorly utilized. Religious and cultural principles should be assigned their proper role in the environmental protection in order to make religion an important ally effectively supporting initiatives undertaken to protect the Earth's ecosystem both that at the global and the local level.

The present study can be encapsulated in the following conclusions:

- ✓ The charge against Christianity for supplanting animistic religious principles protecting nature is justified.
- ✓ Christianity's contribution to formulating religious and cultural principles protecting the creation is underestimated.
- ✓ Convictions about the effectiveness of religious and cultural principles protecting nature seem to be exaggerated. It is necessary to provide research aimed at evaluating the real impact of those principles on human decisions as regards the environment. This will allow for the optimal use of religion's ecological potential.
- ✓ The effectiveness of religious and cultural protection of nature as regards animistic religions and Christianity seems at least similar.

- ✓ Attributing a more destructive influence on the environment to Christians than to animists and followers of primal religions is unjustified. Such comparisons often fail to consider the difference in the size of those communities or their disparate historical background due to which they are radically divergent as regards the level of civilization development and technological possibilities.

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Who Will Speak for the Water and the Wildlife Conservation? Solving the Problems of Sustainable Development through Cause-related Marketing

Kto przemówi w obronie ochrony wody i dzikiej przyrody? Rozwiązywanie problemów zrównoważonego rozwoju poprzez marketing

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Abstract

CRM is adopted by organizations as a viable business strategy to implement sustainability initiatives. The existing literature suggests the variations in the execution style of the CRM campaigns by various organizations. This study proposes Cause-related Marketing (CRM) as one of the novel approaches to combat various issues related to sustainable development. The present study is focused to understand the role of CRM in aiding private sector organizations to address the problems of sustainable development and thus support the 'United Nations Sustainable Development Goals (SDGs)' in an Emerging Economy India. The study attempts to integrate the various areas of focus of the CRM campaigns, the sustainability dimensions focused and the various SDGs supported. Further implications, limitations and future research directions have been discussed.

Key words: Sustainable Development Goals (SDGs), sustainability dimensions, triple bottom line, cause-related Marketing, qualitative study, India

Streszczenie

Marketing CRM jest przyjmowany przez organizacje jako realna strategia biznesowa do wdrażania zrównoważonego rozwoju. Istnieją jednak różnice w stylu realizacji kampanii CRM przez różne organizacje. W niniejszym artykule uznano marketing CRM za jedno z nowatorskich podejść do zrównoważonego rozwoju. Niniejsze badanie koncentruje się na zrozumieniu roli marketingu CRM w pomaganiu organizacjom sektora prywatnego rozwijającej się gospodarki Indii w rozwiązywaniu problemów związanych ze zrównoważonym rozwojem, a tym samym wspieraniu Celów zrównoważonego rozwoju Organizacji Narodów Zjednoczonych (SDG). W badaniu podjęto próbę integracji różnych obszarów zainteresowania kampanii CRM, wymiarów zrównoważonego rozwoju i powiązanych z nimi Celów zrównoważonego rozwoju. Omówiono dalsze implikacje, ograniczenia i przyszłe kierunki badań.

Słowa kluczowe: Cele zrównoważonego rozwoju, wymiary zrównoważonego rozwoju, trojakić podejście marketing CRM, badania jakościowe, Indie

*If we are to be responsible, we must accept the fact
that we owe a massive debt to our environment. It
won't be settled in a matter of months, and it won't
be forgiven us*

Russell E. Train (1970)

Introduction

The Rio Declaration on the Environment and Development (1992) stated, *human beings are at the center of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.* As these concerns grew among the consumers, the organizations expectations that this concern would certainly influence consumers' behaviour also enhanced (Peattie & Peattie, 2009). The endemic of Globalization brought with itself the issues such as environmental degradation and climate changes (Pawłowski, 2013; Herrmann, 2004). The evident damage to the environment has encouraged various social institutions, Governments and the consumers to reconsider their ways of production and consumption to achieve sustainable development (Jaca et al., 2018). Organizations have always been considered as one of the major stakeholders responsible for decay in the environment conditions. Therefore, in order to be accepted by the society, organizations need to be more sustainable and responsible (Rosati and Faria, 2019).

The implementation of the arduous 2030 agenda of Sustainable Development has provided a global vision for sustainable future. Jones et al. (2018) suggests that achieving this sustainable future requires the commitments from all the stakeholders of the society, including the Governments and the corporate sector. Moreover, the United Nations has called for the urgent need of the contributions from the private sector organizations towards achieving the Sustainable Development Goals (SDGs hereafter) (UNCTAD, 2017). Organizations are called to play a positive role to a more sustainable development (Kolk and Tulder, 2010). The UNCTAD report (2017) suggested that organizations ought to adopt various innovative business approaches focused more closely towards the social and the environmental aspects for achieving these goals. According to Sharma (2002), *another area of research that has been given less attention by extant organizational and natural environment research relates to lesser developed countries and development issues. These include the unique processes of organizational change and problems of firms in lesser developed countries, as well as understanding and resolving the complexity of multilevel global interconnectedness of organizational and environmental issues with multiple governance issues* (p. 6).

Birkin et al. (2009) pointed towards the need for the development of new and innovative business models for sustainable development. Similarly, Asharfi et al. (2018) opine that organizations should contribute in

sustainable development by developing such business models that cover economic, social and environment perspectives. According to Sharma and Hart (2014), *the world faces major sustainability challenges that need the collective brainpower of business research and pedagogy for solutions that generate corporate performance on the bottom line* (p. 6). Similar to the other activities of the organizations, marketing plays a potential role towards solving environmental problems and achieve sustainable development (Polonsky et al, 1997). In this regard, the present study attempts to propose cause-related marketing (CRM) as an innovative business approach towards achieving the SDGs in an emerging economy. CRM is considered to be one of the novel ways of communicating corporate social responsibility (CSR). The studies related to sustainable development and CSR have been slowly now recognized as a relevant field of study in various prominent management journals (Kolk and Tulder, 2010). Various authors draw our attention towards the scant literature on marketing with a social dimension in emerging markets and call for more research in this direction to advance the field (Nkamnebe, 2011). In addition, Kolandai-Matchett (2009) argue, *further research that focus on effective framing of related messages would be instrumental in aiding progress towards sustainability.* Moreover, researchers such as Burgees and Steenkamp (2006) point out that marketing theory have limited applicability in embedded emerging market context and have stressed the need for further research in the emerging market context. In view of the above discussion and call for research in this direction, the authors of the present study have considered the cases of three private sector organizations operating in an emerging economy India. Discussing the CRM initiative adopted by the select organizations, the authors attempt to establish the role of CRM in aiding organizations to contribute towards the achievement of SDGs in India. The paper is outlined as: firstly, the paper outlines the literature review related to sustainable development, sustainability and cause-related marketing establishing the theoretical background of the present study. The next section details the methodology adopted followed by the findings and discussion. Further, after considering the conclusions, limitation and future research directions of the study are provided.

Literature review

This section describes the theoretical background of the study, discussing the Sustainable Development Goals, the sustainability dimensions, the role of private sector organizations and the concept of cause-related marketing.

The Sustainable Development Goals (SDGs)

The arduous Sustainable Development Goals (SDGs) were adopted by all the nations at the 2012

Rio+20 summit. Since then, the Open Working Group (OWG), which was formed to look after the activities to achieve the SDGs comprised of certain business organizations as well, has undergone a lot of groundwork. As an outcome, the Sustainable Development Solutions Network (SDSN) has been set up to mobilize activities from the various sections in solving the problems of sustainable development at local, national, and global context (Gaffney, 2014). The SDGs are the global goals intended with the philosophy that no-one/no-country should be left behind in the path of progress. All the nations are equally responsible for contributing towards the attainment of the global vision. Though these goals are alike for different nations but while implementing them, different degree of attention is targeted to different countries, based on where the specific country stands in relation to the resources and the responsibilities. The threats related to the water scarcity, global warming, river pollution, deforestation etc. have demanded the urgent implementation of the SDGs (Sachs, 2012). In addition, these factors have encouraged the policy makers to adapt sustainable development approach (Pawłowski, 2008). These are also known as Post-2015 or 2030 Development Agenda that suggests the need to work towards the societal and environmental paradigms along with economic development. The 17 Sustainable Development Goals comprise of 169 targets that relate to poverty eradication, addressing issues of gender equality, improving health and education, enhancing communities and tackling urgent challenges such as climate change (United Nations, 2015). Achievement of these potential targets of the SDGs require the committed efforts of all sections of the society including Government, Non-Government Organizations (NGOs), private sector organizations and individuals (Bebbington and Unerman, 2018; Ali et al., 2018).

The present study closely looks towards the role of one of the section of the society viz. private sector organizations towards SDGs. The next section discusses the role of business organizations and various sustainability approaches adopted by them towards SDGs.

Private Sector Organizations and the Sustainable Development

The United Nations Sustainable Development Goals provide a myriad of opportunities for the private sector organizations to strategically engage and contribute towards the society. According to a report published by Price Waterhouse Coopers (2015), SDGs act as a catalyst to drive growth in an organization. Due to such opportunities for businesses, research on SDGs has recently gained momentum in various related disciplines such as business and management (Bebbington and Unerman, 2018). Organizations adopt strategies that are congruent with the country specific social needs along with the ambitions of the

Government. Various authors have stressed on the necessity of research in the field of sustainability and sustainable development. However, there exist limited empirical evidence on organization's involvement with the SDGs, with only single study conducted by Price Waterhouse Coopers (2015) that has analyzed the role of business organizations in supporting the SDGs (Bebbington and Unerman, 2018). The present study attempts to extend the existing literature and contribute by emphasizing the role of Organizations' cause-related marketing efforts in order to aid them to achieve sustainable development and sustainability, while supporting the SDGs. The concept of cause-related marketing is discussed further.

Cause-related Marketing

The existing challenges of organizations growth and survival, necessitates the emergence of the concept of sustainability. The concept provides many advantages to the organizations including advancement in performance, risk minimization and enhanced market opportunities (Peloza et al., 2012). Researchers consider CSR as a necessary communication tool for organizations to implement sustainability initiatives and establish their presence in the society (Vanhamme et al., 2012). One of the novel forms of conducting CSR is cause-related marketing (CRM) (Sheikh and Beise-Zee, 2013). It is defined as *the process of formulating and implementing marketing activities that are characterized by an offer from the firm to contribute a specified amount to a designated cause when customers engage in revenue-providing exchanges that satisfy organizational and individual objectives* (Varadarajan and Menon. 1988, p. 61). Authors such as Bloom et al. (2006) argue that an effectively framed CRM campaign has the potential to generate positive consumer judgement, influences their attitude and purchase intention (Koschate-Fischer et al., 2012) as well affect their choice (Barone et al., 2000). With CRM, organizations form alliances with non-profit causes or NGOs to generate funds to support the social causes along with accomplishing the goals of the organizations.

The concept of CRM can be related with the three sustainability dimensions (Economic, Social and Environmental). Through CRM, organizations contribute towards the society a part of their revenue generated by associating with a cause. Thus supporting the social dimension of the sustainability. Secondly, organizations employ CRM campaigns to maximize profits along with helping a social cause. This covers the economic dimension of sustainability. Lastly, in forming alliances, organizations may collaborate with a non-profit organization working towards the environmental cause or organizations may directly support an environmental cause. Thus sufficing the environmental dimension of sustainability. Therefore, CRM activities of an organization can be associated with the sustainability dimensions (Christofi et al., 2015).

Objective of the study

The above discussion suggests the relationship based on the existence of the sustainability dimension in the concept of CRM. This further the explanation that as like CSR, CRM has the potential to contribute towards the sustainable development. Therefore, the present study attempts to address the following research objective: How are private sector Organizations supporting the SDGs? Moreover, what role does CRM play in enabling organizations to contribute towards the SDGs?

Research methodology

The methodology adopted for understanding the concept of CRM in relation to its potential to aid organizations in contributing towards the SDGs is further discussed below.

Research Approach Adopted

The present study adopts the qualitative case study approach to research. Qualitative study allows the researcher to draw rich and profound data from different mediums for analysis (Hewitt-Taylor, 2001). Yin (1989), defined case study as *an empirical enquiry that investigate a contemporary phenomenon within its real-life context; when the boundaries between phenomena and context are not clearly evident, and in which multiple sources of evidence are used* (p. 23). Case study is the most widely used method in qualitative study (Yin, 1989; Barnes, 2001).

Case Selection and Sampling Approach Adopted

According to Seawright and Gerring (2008), the main objective behind selecting a case is that the selected case should provide useful variations in terms of theoretical interest. Therefore, the present study concerns itself with the cause-related marketing campaign of three of the famous *fast moving consumer goods (fmcg) companies* operating in India. A group of students studying in a reputed institute in India was approached and was asked to mention five FMCG/Consumer Goods Companies they are aware of and whose products they have previously purchased. After taking the responses from the respondents, the authors ranked the companies name in order of their preferences by the respondents. Further, the authors identified the cause-related marketing campaigns conducted by the companies mentioned by them. Later, the authors also consulted two of the faculty members who are experts working in the field of marketing. The opinion of the experts motivated the authors to select three companies and their cause campaigns for the present study. Moreover, the selection was also keeping in view the objective of the study. The authors were inclined to analyze the efforts of the organizations towards the green/environmental causes only. Therefore, purposive sampling technique was best suited for the present study.

Patton (2002) argues that purposeful sampling allows researchers to select information-rich cases to be studied in detail.

Case Summary

The selected CRM campaign cases are discussed below. The details related to the name of the organization, name of campaign and NGOs (if any) has been depicted in Table 1. In addition, the description about the aim of the campaign is given below.

Table 1. Details of the Selected Cases

S. No.	Name of Organization	Name of Campaign	Associated NGOs (if any)
1.	Himalaya Animal Health Care Ltd.	Build a Bond	CUPA (Compassion Unlimited Plus Action)
2.	Hindustan Unilever Ltd.	Start a Little Good (The Shower)	Hindustan Unilever Foundation (HUF)
3.	Colgate-Palmolive India Ltd.	Make Every Drop Count	Water For People – India Trust

1) Build a Bond Campaign

Himalaya Animal Health collaborated with CUPA (Compassion Unlimited Plus Action) to launch its *Build a Bond* Campaign showing its commitment towards wildlife protection. With this campaign, Himalaya aims to generate sensitivity among individuals towards the animals. It created an app on its Facebook page and urged people to take a *pledge* for animals. Every pledge taken accounts for contribution of one rupee to CUPA Adoption Centre located in Bangalore (India). This initiative provides opportunity to the consumers to show their commitment and involve themselves directly with the cause. Moreover, Himalaya itself adopted dogs sheltered at CUPA and takes care of their needs.

2) Start a Little Good (The Shower)

Start A Little Good is an advertisement campaign of HULs commitment towards certain social causes prevailing in India. In the advertisement, a shower booth is set up in the village. A curious villager steps in and turns it on. Seeing the water coming out of it, he starts drinking it to quench his thirst. Soon, many villagers queued to drink water from the shower and fill their baskets. The advertisement highlights the value of water for those deprived of it and the need to conserve it. Speaking about the campaign, a company spokesperson for HUL told, *The aim is to raise awareness and prompt action on pressing environmental issues the country (India) is currently facing.*

3) Make Every Drop Count

Colgate-Palmolive (India) collaborated with the METRO Cash & Carry wholesaler (India) to start the second season of their water conservation programme on March 22, 2019 to mark the *World Water Day 2019*. The organizations conducted a month

long *Save Water* awareness programme (through April 2019) in 27 Metro Cash & Carry stores across the country. In addition, through this campaign, Colgate pledged a donation of Rs. 10 for every purchase of the select Colgate toothpaste from the 27 stores of Metro Cash & Carry. The proceeds thus generated were donated to the partnered NGO *Water for People* for enabling the access of water to communities deprived of it.

Analysis of Data

The qualitative approach to research was adopted for the analysis of the study. The study aimed at capturing the focus of the campaign concerning (1) the type of cause supported, (2) message appeals and (3) organizations' objective of implementation. The main objective of the authors was to find out whether the campaign has environment sustainability dimension in its implementation. Therefore, the authors adopted the qualitative content analysis method for case study research (Kohlbacher, 2006). The various sources of evidence related to the campaign were collected and analyzed. The iterative coding process of the grounded theory (Strauss and Corbin, 1997) was applied in the present study.

Coding Procedure

The selected cases were analyzed in depth. Two coders independently coded the data. The codes were formulated and categories were derived after iteratively coding the data. The themes were then related with the existing theory (to attain theoretical sensitivity of the data) as suggested by Glaser and Holton (2004) to generate final coding categories. Firstly, all the 17 SDGs and their targets were analyzed to identify the main SDGs, which are targeted towards the environmental sustainability dimension (*categorization done based on Elkington's (1998) three dimensions of sustainability*). Secondly, the selected campaigns were analyzed for the type of cause/issue they supported (*based on Lafferty and Edmondson, 2014*). Table 2 describes the deductive coding scheme adopted for the study. The authors further grouped the causes supported by them and the appeals made in the campaign into the major focus of the campaign promotion. These final cause promoted were related with the sustainability dimension along with the SDG that these organizations attempted to support.

Results

The key findings generated from the analysis are highlighted in this section. Firstly, the authors analysed all the 17 SDGs and their targets and identified the main goals that are intended to combat the environment related problems in the world (including conservation of natural resources, wildlife protection, climate change etc.). Secondly, the authors dis-

Table 2. Coding Scheme Adopted for the Present Study

S. No.	Coding Dimensions	Coding Categories	Reference
1.	Sustainability Dimensions Focused	-Social Dimension -Economic Dimension -Environment Dimension	Elkington (1998)
2.	Cause Type/ Cause Focused	-Health-related Causes -Animal-related Causes -Human-related Causes -Environment-related Causes	Lafferty and Edmondson (2014)

cussed the various cause supported and message promoted by the CRM campaigns. Lastly, the authors integrated the CRM campaign's focus with the respective SDGs and their targets and formulated an integrated model of CRM supporting the SDGs in an emerging economy. The results are shown up in three tables viz. Table 3, 4 and 5.

1) SDGs for the Environment

After analyzing all the 17 SDGs and their respective targets thoroughly, motivated the authors to conclude that all the 17 SDGs are focused towards the three dimensions of sustainability also known as the Triple Bottom Line or 3Ps (Elkington, 1998). The sustainability dimensions include Social Sustainability (People), Economic Sustainability (Profit) and Environmental Sustainability (Planet). As the major focus of the study was towards environment sustainability therefore, in Table 3 the authors present the SDGs and their targets that are directed towards addressing the environment sustainability issues of the world.

2) Focus of the CRM Campaigns

The select CRM campaign cases were analyzed and coded based on the dimensions and framing components of the campaign suggested in existing CRM literature. The various cause categories used in the framing of the CRM campaign as suggested by Lafferty and Edmondson (2014) were considered to identify the focus area of the selected CRM campaigns. In Table 4, the authors provided the analysis of the three CRM campaigns based on the focus area of the campaign and in which cause category it belonged.

3) Integrating CRM, Sustainability and the SDGs

In the last phase of the analysis, the researchers attempted to integrate the focus area of the CRM campaigns, sustainability dimension addressed by the CRM campaigns and the SDGs supported by the CRM campaigns. The objective of the researchers was to understand how environment related causes

Table 3. SDGs focusing towards Water and the Wildlife Conservation

S. No.	SDGs Focusing towards the Environmental Sustainability Dimensions	Targets
1.	Goal 7: Affordable and Clean Energy	7.1: Affordable energy services 7.5: Upgrade technology
2.	Goal 12: Responsible Consumption and Production	12.2: Management and Efficient use of Natural Resources. 12.8: Disseminating relevant information and make people aware of sustainable lifestyle in harmony with nature
3.	Goal 13: Climate Action	13.2: Integration of measures related climate change into strategies and policies. 13.3: Enhance education and raise awareness on climate change mitigation and early warnings.
4.	Goal 14: Life under Water	14.1: Prevention of all kinds of marine pollution. 14.3: Minimizing ocean acidification and addressing its impact.
5.	Goal 15: Life on Land	15.5: Protection and prevention of endangered species. 15.7: End poaching and trafficking of protected species.

Table 4. Describing the cause focused by the campaigns

S. No.	Campaign	Cause Focused	Cause Type
1.	HULs <i>Start a Little Good</i> The Shower Campaign	Water Wastage	Environment Cause
2.	Himalaya <i>Build a Bond</i> Campaign	Cruelty Against Animals	Environment Cause
3.	Colgate-Palmolive <i>Make Every Drop Count</i> Campaign	Water Wastage	Environment Cause

Table 5. Integrating the CRM Campaigns with the Sustainability Dimensions and Ultimately the SDG Supported

S. No.	Campaign Name	Cause Promoted	Sustainability Dimension Focused	SDGs Supported
1.	HULs <i>Start a Little Good</i> The Shower Campaign	Water Conservation	Environmental	Goal 12
2.	Himalaya <i>Build a Bond</i> Campaign	Animal Protection	Environmental	Goal 15
3.	Colgate-Palmolive <i>Make Every Drop Count</i> Campaign	Water Conservation	Environmental	Goal 12

are being addressed by these business organizations. Therefore, the only dimension considered in the study is environmental dimension. The environmental dimension deals with sustainable business practices by encouraging recycle and reuse, encouraging reduction in energy and water wastage, turning towards green and ecofriendly products, conserving wildlife and habitat. In table 5, the authors depict the integration of all the three concepts (CRM, sustainability and SDGs).

Discussion

The examination of the marketing strategies and practices with a sustainable development dimension is an area of research that is evolving. Therefore, the researchers and the practitioners require developing a rich understanding of the various ways in which marketing could enable sustainable development. The lack of success experienced by organizations in implementing sustainability initiatives is due to their failure in able to integrate them with their core business strategy (Amini and Bienstock, 2014). The present study has suggested CRM as one such marketing strategy that provides solutions to the problems of sustainable development. Although various authors have suggested that CRM campaigns act as a useful tool in promoting and communicating about a

social/environmental cause. However, what remains to be explored is the role that CRM plays in aiding organizations to support the SDGs. In order to address this research question, the present study attempts to integrate the CRM model with the 'United Nations Sustainable Development Goals (SDGs)'. The present study is one of the earlier studies in this direction. Moreover, the issue considered by the authors i.e. water conservation and preservation of the wildlife is of high concern. Marketing seeks to accomplish the needs and wants of the society which have not been previously met in the society (Nkamnebe, 2011). For an increasingly consuming world, if such needs are being met without considering its impact on the environment and sustainability may deprive future generations of certain valuable resources (Nkamnebe, 2011). This situation tasks the marketers to rethink their approaches that be in tune with the Sustainable Development definition which states, *development that meets the needs of the present without comprising the ability of future generations to meet their own needs* (WCED, 1987, p. 43). Resources should be utilized more efficiently with the aim of fulfilling present needs without compromising future generations (Singh, 2018). The vision for 2030 brought the leaders of the world together to declare, *We envisage a world in which every country enjoys sustained, inclusive and sustainable econo-*

mic growth and decent work for all. One in which humanity lives in harmony with nature and in which wildlife and other living species are protected (World Animal Protection, 2015). In this aspect, the present study throws some light on the efforts of the organizations in India towards achieving the Sustainable Development Goals.

The present study addresses issues raised by Hawkins (2015) that how different pressures of engaging and reporting the CSR in different countries/cultures affects the structure of the CRM campaigns. The results of the present study support the notion of counter-topography approach (Hawkins, 2015), which details the differences in the pressures on for-profit organizations for engaging and reporting their CSR differently in different geographical context. As in India, The Company's Act (2013) mandates the organizations to engage in CSR. Following this, many private sector organizations supported the cause of national importance. Expressing his views on the India's water crisis, Amitabh Kant (CEO, NITI Aayog, Government of India) has stated that all stakeholders must come together and business organizations must take water conservation efforts as their top most priority (The Hindustan Times, 2019). Various organizations have implemented similar initiatives in the developed markets as well, related to the cause of conservation, for example, Unilever through its sustainable living plan acts towards biodiversity conservation and Colgate Palmolive contributed over \$400,000 to support The Nature Conservancy in US. The structure of the CRM campaign differs between both developed and developing markets. The differences are not just based on execution and implementation but also on the novelty of the concept. CRM is a more novel concept in developing markets and its novelty helps the organizations to gain the maximum from such efforts (La Ferle et al., 2013).

Moreover, partnerships are important in achieving the SDGs as *Governments, NGOs, intergovernmental organizations (IGOs), and the private sector each bring different strengths to development while facing different challenges. Partnerships recognize the range of activities that affect sustainable development and provide opportunities for the various sectors to pool their assets and thus mitigate individual weaknesses* (Hale & Mauzerall, 2004, p. 223). The researchers opined that partnerships and collaborations are effective for immediate implementation of developmental projects. CRM could be used as a vehicle for developing a partnership between various stakeholders including the NGOs and consumers along with business organizations. Hence, it acts as a win-win to achieve SDGs.

Finally, the present study highlights the role of business organizations in sustainable development. It also shows how through marketing strategy, an organization can tap its latent potential to support the SDGs and solve the problems of the planet. The study also highlights the role of organizations in

communicating about the prevailing social causes in the society. They have the potential to be the voices for creating awareness about the conservation of the important natural resources and the habitat.

Implications, limitations and future scope

The findings of the study has the following implications. Firstly, the study suggests that CRM can be used as an economic-oriented marketing strategy (Varadarajan and Menon, 1988) that enables organizations to be socially oriented at the same time. Secondly, adopting a CRM approach to tackle the problems of the planet would have implications for developing a positive attitude of the individuals towards the organizations. Lastly, enhancing consumer experiences at shopping and engaging them with the campaign motives directly would enable organizations to attract huge socially conscious consumer segment (Grewal et al., 2009). The success of the initiatives undertaken for protecting the environment depend upon the support of all the stakeholders including the people. Therefore, communications of such efforts of the organizations is critical as it influences the choice of the people (Kolandai-Matchett, 2009). The main contribution of the study lies in its effort to provide a practical support on the recommendations provided by Stafford-Smith et al. (2017) for implementing SDGs through multi-stakeholder partnerships.

All studies suffer from certain limitations. Following are the points that may be raised towards the limitations of the present study. Firstly, the authors analysed only three campaigns of three different organizations. Questions may be raised regarding the generalizability of the results in broader context. Secondly, the study has focused only on the FMCG sector as this sector gains more consumer attention. This could be taken as a future research opportunity to analyze the efforts towards sustainability being done by various organizations belonging to different sectors. Thirdly, the limitations of qualitative study applies to the present study as well. Future research is needed to explore consumer responses to various forms of CRM campaigns and their perception regarding the role of organizations in sustainable development. Lastly, the quantitative approaches could be adopted to analyze the dynamics of how do the organizations effort towards sustainability impacts the consumers.

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The Idea of Sustainable Development in Reflection on the Meaning of Knowledge and Cognition

Idea zrównoważonego rozwoju w namyśle nad znaczeniem wiedzy i poznania

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Abstract

In the case of philosophical justifications of sustainable development it is important to work out epistemological standpoints, adequate to the problems considered in the areas of particular development concepts based on speculative, theoretical knowledge as well as on practical one related to activity and serving its purposes. Epistemology must correlate with the problems that are their material object as well as with goals and cognitive and practical tasks that they (concepts) have to deal with.

The present article makes an attempt at presenting reflection on knowledge and cognition by indicating the epistemological basis of the concept of sustainable development. It will endeavor to draw attention to the need of shaping the attitude of the knowing subject, to facilitate adequate understanding of what we commonly address as sustainability and implementing the proposals of sustainable development and verification of the related sources of cognition.

Key words: sustainable development, knowledge, cognition, sustainable development epistemology

Streszczenie

Dla filozoficznych uzasadnień zrównoważonego rozwoju znaczące jest wypracowywanie stanowisk epistemologicznych, adekwatnych do problemów rozpatrywanych na obszarach poszczególnych koncepcji rozwoju opartych na wiedzy teoretycznej – o charakterze spekulatywnym – i praktycznej, związanej z działaniem i jemu służącej. Epistemologia, będąc częścią każdej z koncepcji rozwoju, powinna korelować z problemami będącymi ich przedmiotem materialnym oraz ze stawianymi przed nimi (koncepcjami) celami i zadaniami poznawczymi i praktycznymi.

Artykuł stanowi próbę ukazania rozważań nad wiedzą i poznaniem poprzez wskazanie epistemologicznych podstaw koncepcji zrównoważonego rozwoju. Celem jest natomiast zwrócenie uwagi na potrzebę ukształtowania właściwego nastawienia podmiotu poznającego, pozwalającego możliwie adekwatnie uchwycić to, co zwykliśmy nazywać zrównoważonym rozwojem, i jednocześnie wdrażającego postulaty zrównoważonego rozwoju, a ponadto weryfikacja związanych z tym źródeł poznania.

Słowa kluczowe: zrównoważony rozwój, wiedza, poznanie, epistemologia zrównoważonego rozwoju

1. Introduction

The idea of sustainable development is approached by a number of scientific disciplines, such as, e.g. economics, political science, law, or environmental protection. Its in-depth theoretical analyses resulted

in the formulation of various concepts of sustainable development. In the framework of those concepts, scientists present sustainable development proposals that can be implemented in the future. In addition,

they highlight interrelations and interactions of manifold factors underlying practical implementation of those proposals.

The humanities, including philosophy, make an unquestionable contribution to shaping the theoretical foundations of sustainability. Philosophy provided grounds for elaborating and explaining a number of important issues, both from the methodological and substantive points of view. Among others, it helped to provide semantic solutions which are of crucial significance for researchers dealing with sustainable development as well as to carry out an analysis of categories which are commonly considered contradictory and disparate, such as *development* versus *sustainable*. Finally, the issue of sustainable development was discussed with the use of scientific and research instruments from the field of ethics and axiology, or even specialist ecophilosophy.

In the case of philosophical justifications of sustainable development it is important to work out epistemological standpoints, adequate to the problems considered in the areas of particular development concepts based on speculative, theoretical knowledge as well as on practical one related to activity and serving its purposes. Epistemology, as part of each development concept, must correlate with the problems that are their material object as well as with goals and cognitive and practical tasks that they (concepts) have to deal with.

Theoretical knowledge, which provides grounds for theoretical solutions of sustainable development issues, plays a crucial role in providing answers to such questions as, for example, the existence of necessities within the reality, the value of the existing things, the nature of the truth, or other questions related to the limits and possibilities of human cognition, the sources of knowledge, or even to the position of man among other beings. In the context of the above questions, the issue that comes to the fore is a desire to recognize and understand the ultimate causes, i.e. the reasons for the functioning of the world, including the heterogeneous dimensions of human existence, and an analysis of what is and what it is like. Providing answers to the above-outlined questions as well as their constant discovery, or elaboration of new standpoints emerging from the already known views, from our heightened awareness of the assumptions and consequences of specific positions, and finally better understanding of the nature of human endeavors, is supposed to be facilitated by the ongoing progress.

Practical knowledge, which also lies at the basis of the sustainable development concept, supports its *neglected* aspect of *praxis*. It is due to the fact that philosophy includes both theory and practice. It has at its disposal tools that can be deemed significant and, moreover, necessary for the development and implementation of sustainable development programs and strategy, and finally, for the management of such a development.

The present article makes an attempt at presenting reflection on knowledge and cognition by indicating the epistemological basis of the concept of sustainable development. At the same time, it is not aimed at making any binding decisions related to selecting cognitive methods in individual concepts. Instead, it will endeavor to draw attention to the need of shaping the attitude of the knowing subject, to facilitate adequate understanding of what we commonly address as sustainability and implementing the proposals of sustainable development and verification of the related sources of cognition.

2. Towards the epistemology of sustainable development

Epistemology deals with the question of truth and validity of man's cognition as an informer in order to discover the ultimate causes for qualifying the value of this cognition. This, in turn, serves the purpose of formulating, in the next stage, the criteria for assessing its actual results and consequences in a critical and non-dogmatic way (Stepień, 2001, p. 64-65). Epistemology is also defined as a philosophical inquiry explaining the nature and value of cognition, in other words, it implies analyzing and assessing reliability of information about the reality, reflected in acts of cognition (Krapiec, 2002, p. 193).

Epistemology, which constitutes a philosophical reflection on cognition, is today more and more often taken into account in scientific solutions provided by researchers from a number of scientific disciplines such as, for example, psychology (Campbell 1989), cultural anthropology (Kapusta, 2007), cognitive science (Żegleń, 2013), or biological science (Creath and Maienschein, 2000). What is more, epistemology can be discussed from different perspectives and contexts, including, for example, information epistemology (Hetmański, 2013), management epistemology (Sulkowski, 2012), or naturalized epistemology (Miłkowski, 2011). Due to the place and position of epistemology in modern science, or, ultimately, the noticeable transformations that epistemology is undergoing, one can point to the interdisciplinary character of its research on cognition. Following the scientific conception of M. Hetmański, epistemology can thus be described as remaining *among* or *between* other cognitive studies that surpass theoretical considerations (Hetmański, 2007, p. 8-9). In this way, a strictly philosophical reflection is opening up to the study of the socio-cultural phenomenon relying in the practical issue of cognizing and evaluation of knowledge.

The idea of sustainable development is an idea of restructuring the world in which *boundaries have been surpassed* leading to the emergence of *non-separate crises*, e.g. the environmental crisis, the development crisis, the energy crisis, but of one overall crisis. The crisis, which originates in a failure to adjust human actions to the environment's capacity, resulting in

adverse changes in the terrestrial systems, including a direct threat to life. According to the World Commission on Environment and Development, this is the status quo of the new reality and there is no escape from it. It is, in turn, necessary to try to understand it and deal with it (WCED, p. 11-13).

The multidimensional character of sustainable development requires conducting a complex epistemological analysis of the idea's assumptions, and thus it requires going far beyond the traditional understanding of epistemology essentially understood as a metatheory of cognition.

The idea of sustainable development needs ordering, clarifying its concepts, defining its cognitive proposals, methods, directions of research and interpretation in the field of social and natural environmental protection, as well as other scientific disciplines whose representatives are involved in the discourse on sustainable development. In this sense, within the sustainable development epistemology, while taking into account the links between natural sciences and humanities together with technical and social sciences, one should reflect on the nature of knowledge that underlies sustainable development, i.e. answer the questions about the source of knowledge, which for the knowing subject consists in information, about the context in which it is communicated, which has a significant impact on its reception. It seems plausible, moreover, to ask about the recipient's experience or to reflect on the cognitive paradigm and the directions of scientific and common thinking, which are being constituted together with the progression of the sustainable development idea. In addition, it is necessary to examine what type of knowledge is addressed by advocates of sustainable development, i.e. whether it has a descriptive, explanatory or justifying character. At the same time, it is worth considering the character of knowledge, so that it could be effectively communicated to the recipient.¹

Sustainable development epistemology can also be viewed from the perspective of management. Management that should be linked with the idea of sustainable development concerns, on the one hand, managing the process itself, i.e. implementing the theoretical assumptions of sustainable development into social practice. On the other hand, it means managing the organization, administration and strategy in relation to the operation of institutions and bodies responsible for creating and implementing sustainable development programs. Epistemological reflection covering management issues can thus help define cognitive directions of development and solve a dilemma in a situation where *a particular way of thinking, related to a specific discipline, ensures an illusion of permanence as regards cognitive issues*

(Sułkowski, 2015, p. 194). It is worth emphasizing that those kinds of cognitive issues often emerge when common research areas are being established within the framework of *balancing* the levels of sustainable development.

It is difficult to provide unequivocal solutions on strictly epistemological issues within analyses of the idea of sustainable development. However, epistemological issues concerning, among others, the sources of cognition, the impact of experience on the development of knowledge in the area of sustainable development, the role of reason in the process of creating knowledge or the issue of its ambiguity or variability, should not be neglected.

3. Philosophical reflection on knowledge and cognition in the context of sustainable development

The idea of sustainable development assumes adopting a holistic approach to the complex problem of socio-economic growth. A systemic approach to the category of *sustainable development* should reflect consistent implementation of economic and social goals. Consequently, scientists emphasize, among other things, the importance of applying conjunction in goals and the principle of interrelationships, which points to *interconnectedness of all civilizational activities and their products with nature as their carrier, conditioning and ensuring the future of modern society* (Jaromi, 2004, p. 158-159). Modern society being a knowledge society constitutes one of the assumed effects of implementing sustainable development proposals. It is supposed to be a society that skillfully uses knowledge in the form of information. It will bring about an increasing quality of the *human capital*, which will have an impact on the pace of socio-economic development (Polska 2025, p. 13). According to this approach, man is the subject of sustainable development, he is the implementer and recipient of all the effects of cognitive and practical activities following the implementation of individual sustainable development strategies. Finally, he is part of a complicated system and the only entity who can discover in it the previously unseen paradigms and strive to balance its elements.

The anthropocentric character of sustainable development results above all from the place and role of man in creating the civilization of sustainable development, whose existence does not stand in contradiction to the needs of nature (Ab Razak and Sanusi, 2010, p. 23). The privileged position of man in the environment cannot and should not mean unrestricted transformation of the world. Man as a primary being, free and rational, and constituting an end in itself, should remain subjected to the laws that he

¹ The author is aware that the posed questions go beyond philosophy, bordering on the sociology of knowledge or the psychology of cognitive processes. The multidimensional character of sustainable development, however,

sometimes makes it impediment to adopt a broader approach to the addressed issues, in this case in the field of knowledge and cognition.

himself creates, but without acting in a manner independent of natural causation. Reason, which directs human activities, or is subjected to it (Krapiec, 1991, p. 55) manifests itself in conscious decision-making acts. Free action in the external world, i.e. the feature of free agency (Rousseau, 1956, p. 154), is the second argument substantiating human uniqueness among other beings. *In the natural world, we do not meet with freedom, but with determinism, while man, having made a free decision, can 'play' on determined natural (social) forces, while pursuing his goals* (Krapiec, 2012, p. 310). Implementation of the guidelines for sustainable development should in the first place be an expression of rational and non-accidental human activity, based on knowledge gained in the course of analysis.

Reflection on knowledge and cognition conducted in the context of sustainable development requires differentiating the concepts of *cognizing* and *cognition*. The first means activity (activities), while the second the product (products) of these activities, i.e. knowledge, since cognizing does not always end with cognition. Another difficulty lies in assessing the quality of knowledge gained in the cognitive process and in indicating whether it is knowledge in the sense of *episteme* or *doxa*. In connection with this, as J. Woleński points out such qualifications as: *cognitive failure, partial knowledge, superficial knowledge* are accepted. The author adopted from A. R. White another important distinction which refers to the following approaches to cognition: cognition as action (activity), as a success, as a performative state, as a disposition, or cognition as an ability (Woleński, 2005, p. 355-360). Due to the heuristic nature of the idea of sustainable development, epistemological reflection on knowledge in the process of cognizing related to, for example, the sources of the ecological crisis, ways to stop the degradation of the natural environment, hunger and poverty, seems to be highly significant. Attainment of goals implies one more important issue, namely, it is important that the *theoria* knowledge of sustainable development be translated into the sphere of *praxis*, since the type of cognition determines the effect of human action. Referring to White's suggestion, it might be pointed out that man as the subject of cognition can:

- act using his cognitive powers, e.g. the reason;
- achieve a certain mental state, consisting in his being convinced with regard to a given question or having begun to believe in something;
- develop a tendency or ability to gain and possess knowledge.

This differentiation implies the necessity of providing further epistemological solutions, because in the case of information on sustainable development, cognitive success should not consist solely in acquiring specific knowledge by humans, but it is also necessary to carry out qualification of the gained

knowledge into *episteme* and *doxa*, and take into account the question of discrepancies in cognitive results and succumbing to illusions.

Implementation of sustainable development proposals requires communicating specific knowledge. However, it is worth noticing that, today, the social and natural environment is so variable that information about the surrounding reality is quickly becoming obsolete. At the same time, it is widely emphasized that knowledge is a prerequisite of individual and collective success, and the *intellectual climate of development*, evidently emphasized in current development strategies, is propagated (Kiwak, 2007, p. 12). In this context, the question of providing knowledge about the *know-how* processes gains on importance. Knowledge about facts, such as *know-what*, i.e. passing on news about events, seems to be insufficient at present. Knowledge about processes enables adaptation of the knowing subject to current conditions, shaping his heuristic thinking skills. This opens up for man a chance to acquire the ability not only to identify problem situations, but also to respond to them in an active way, even to those that generate a sense of cognitive and practical uncertainty.

Sustainable development epistemology should approach man as the subject of cognition, analyze the issues of his cognitive functions, their significance in our lives as well as the role of reason or experience. Thus, it is possible to investigate how the ways of gaining knowledge about the world can be described by means of precise and objective rules, and finally, how lasting they are, by what methods they are achieved and what role they play in human activity and in human experience of the world (Kapusta, 2007, p. 161).

4. From *theoria* to *praxis* of sustainable development. Skill-related dimension of epistemology

Due to the practical context of knowledge, epistemology in its skill-related dimension may focus its reflection on the relationship between theory and practice, and additionally, on the problem of the agency of the idea of sustainable development. In this case, the practicality of theoretical knowledge is evaluated. It seems that the idea of sustainable development clearly implies the proposal of developing theory by solving specific practical problems. Thus, a close relationship between theory and practice is assumed. However, it should be realized that there is no smooth transition from *theoria* to *praxis* of sustainable development. Therefore, their mutual interaction requires defining and subsequently acknowledging epistemological differences between them. It is also important to realize the existence of two forms of knowledge – theoretical and practical. Re-

alization of the fact will allow to take them into account in the cognitive process and using each of them in appropriate situations.

Epistemological reflection may also have an impact on implementing sustainable development programs. Practice requires knowledge, which in the case of sustainable development is provided by theoreticians' scientific output, by researchers dealing with this area of study in the framework of various disciplines. Knowledge about the world, however, includes both common and scientific knowledge. People as thinking and acting beings select and interpret the data about reality. Those data incorporate, for example, scientific facts, but also events that emerge as a result of individual observation or experience. The idea of sustainable development is a concept which sets a strictly defined course of action and shows the objectives of their implementation. It is a multifaceted idea, whose basic assumption is to combine, among others, social, economic and environmental issues. Each of the scientific disciplines addresses in its own specific way the problem of getting to know and describing the reality. What is more, each of them contains their own specific constructs, i.e. sets of abstractions, generalizations, formalizations, or idealizations specific for particular levels of the thinking structure (Schütz, 2006, p. 868). Constructs constituting knowledge, which provides the basis of the theoretical and practical assumptions of sustainable development, must be considered in a context that is coherent with respect to this idea. In this case, the goal of sustainable development epistemology would be to provide tools for the verification of the knowledge inscribed in the context characteristic of a specific scientific discipline.

According to A. Schütz, human condition is biographically determined, which means that people have their own history embracing all the previous experience constituting their knowledge. This situation implies some possibilities for future theoretical or practical actions (Schütz, 2006, p. 871). This individual knowledge has an impact on the system of these actions' significance. Consequently, it seems that the priority task as regards the idea of sustainable development should consist in socializing knowledge. However, this should be a type of knowledge that would not be exposed to the risk of, for example, misinterpretation of facts about the real world, which could be the result of the knowing subject's everyday experience. Interpretation of reality complements the knowledge about global problems of the world, which are the basis for the sustainable development strategy. While the idea itself can be considered as heuristic, since its primary goal is to inspire man to action, programs and strategies of sustainable development should be interpreted as defined algorithms containing proposals for specific tasks. Implementation of individual plans means a transition to the level of *episteme* in a practical sense.

Practical knowledge will be understood here as the foundation of action resulting from the adopted theoretical project. Action will in turn result in an act materializing the whole process and indicating practical implementation of the assumed plan.

Practice implies also decision-making and choosing from among given possibilities (Gadamer, 2008, p. 41). Our life undergoes constant changes, both quantitative and qualitative, resulting in the emergence of new patterns of thinking, deciding and acting. Without reliable knowledge about, for example, the effects of human action in the environment, or of the living conditions of, for example, inhabitants of the South, people will not understand the validity of remedial and auxiliary actions planned in accordance with the assumptions of sustainable development. Whether a given action is evaluated as a priority, depends on the motives by which the planning individual is inspired. The feature of priority or fundamentality in individual evaluation determines when and in what phases a given action should be implemented in order to achieve the intended goal. The feature of importance, validity indicates the reasons why such an action should be taken. Planning constitutes the first step in a decision making process leading to implementation of a given action. The decision, in turn, is connected with reflection on the righteousness of a given action. This stage may involve some difficulties, especially when such an action does not have an every-day quality. The scale of consequences following undertaking or neglecting a given action for future life is an essential factor influencing human choice. An additional obstacle here are multifaceted dependencies appearing at the point of convergence between the project of action and the decision to take action. That is why, when developing a sustainable development strategy, it is necessary to consider the issue of validity as regards the assessment of planned activities from the perspective of their urgency and importance, including adherence to the principle of rationality at the moment of selecting alternative actions. It is also worth pointing out the potential consequences of not only implementing a planned program, but also of a failure to implement it. This will enable an individual evaluating a given situation to predict the consequences of their future actions. It is particularly important in view of the fact that in the course of developing a plan or strategy, implementation of goals is technically, almost automatically assumed. In addition to communicating knowledge in the form of scientific facts, there is a need for justifications that will motivate people to take action. *There is and there always be a difference whether argumentation appeals to our feelings and our ability to be interested in concrete practical goals or cultural forms and content, or to our conscience, when the problem refers to the validity of ethical norms, or finally – to our skills and needs* (Weber, 2004, p. 141). Actions undertaken in the course of implementing the postulates of sustainable development,

can be defined as effective when the goals based on them motivate an individual to undertake or repeat those actions. Reiteration of certain defined activities leads to their routinization in effect of which people begin to evaluate their own activities as important (rationality of values) and urgent (rationality of the goal) (Adamczyk, 2003, p. 20) and implement them in line with the assumptions of the strategy. However, the conviction of the righteousness, and sometimes even the necessity to apply the proposed solutions requires communicating reliable knowledge based on truth, a knowledge which is often hard to be propagated in the conditions of socially established *doxa*.

5. Conclusion

Sustainable development can find its practical expression, as long as the person involved in its implementation consciously and willingly decides to adopt a knowledge-based vision of the world, which requires certain sacrifices, changes in attitudes and ways of behavior and is associated with respecting a specific catalog of values. Striving for this vision requires providing theoretical knowledge along with information about its practical consequences. Nowadays, knowledge has become a socio-cultural phenomenon, *the goal of practical and cognitive procedures and evaluations* (Hetman, 2007, p. 9) of man. For this reason, and because of the multi-contextuality of knowledge, epistemological reflections that underlie sustainable development should be considered important from the point of view of the human being as a cognitive and then acting subject. The direction of these reflections should include the issue of ordering concepts, analysis of definitions and assumptions of sustainable development, bearing in mind the possibility of emerging discrepancies in cognitive results. It would also involve developing the idea itself by formulating cognitive proposals, enriching concepts and sources of knowledge, and also considering the practical dimension of learning and valuing knowledge in the field of sustainable development. Due to the heuristic and interdisciplinary character of the idea, this reflection should concentrate on its cognitive foundations, conducted not only from the perspective of philosophy, but also from the standpoint of other scientific disciplines.

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The Relationship Between Health Outcomes and Health Expenditure in Europe by Using Compositional Data Analysis

Związek między stanem zdrowia a wydatkami na zdrowie w krajach Europy, w oparciu o analizę danych złożonych

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Abstract

The type of health system in each country and the resources devoted to it determine its outcomes. Relationships between ratios of expenditure to Gross Domestic Product (GDP) classified by provider and indicators reflecting health outcomes in 2015 are examined for 30 countries by means of a compositional data analysis and a regression analysis. The countries in the sample are the European Union (EU-28) countries plus Iceland and Norway. The outcome indicators used are life expectancy at birth (LE); healthy life years in absolute value at birth for females (HLYf) and for males (HLYm); and death rate due to chronic diseases (DR) (response variables). The results indicate that the higher the ratio of expenditure on retailers and other providers of medical goods in relation to other types of expenditure in the composition, the higher the DR indicator and the lower the LE indicator. The ratio of expenditure on residential long-term care facilities in the composition seems to have had a positive effect on both HLY indicators. The effect of expenditure ratios on providers of healthcare system administration and financing is not straightforward.

Key words: healthcare expenditure, life expectancy, healthy life years, death rate due to chronic diseases, sustainability, efficiency, compositional data analysis

Streszczenie

Rodzaj systemu opieki zdrowotnej w każdym kraju i środki na niego przeznaczone determinują jego skuteczność. W tej pracy zbadano zależności między stosunkami wydatków do produktu krajowego brutto (PKB), a wskaźnikami odzwierciedlającymi wyniki zdrowotne w 2015 r. w 30 krajach za pomocą analizy danych złożonych (CoDA) i analizy regresji. To kraje Unii Europejskiej (UE-28) oraz Islandia i Norwegia. Stosowanymi wskaźnikami wyników są: oczekiwana długość życia w chwili urodzenia (LE); lata zdrowego życia w wartości bezwzględnej przy urodzeniu dla kobiet (HLYf) i dla mężczyzn (HLYm); oraz wskaźnik zgonów z powodu chorób przewlekłych (DR). Wyniki wskazują, że im wyższy stosunek wydatków na zdrowie w stosunku do innych rodzajów wydatków, tym wyższy wskaźnik DR i niższy wskaźnik LE. Stosunek wydatków na placówki długoterminowej opieki zdrowotnej miał pozytywny wpływ na oba wskaźniki HLY. Natomiast wpływ wskaźników wydatków na zarządców systemu opieki zdrowotnej i jego finansowania nie jest jednoznaczny.

Słowa kluczowe: wydatki na zdrowie, długość życia, czas życia w zdrowiu, śmiertelność w wyniku chorób przewlekłych, zrównoważoność, wydajność, analiza danych złożonych

1. Introduction

The rationale behind this work lies in a consideration of the concept of sustainable development (SD) and its adoption as a basic philosophy. Since its essential definition was accepted (WCED, 1987), many further definitions, methods of measurement, and parameters have been developed. According to this definition (WCED, 1987), SD is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The three-pillar approach to SD is based on that view of SD which refers simultaneously to economic, social and environmental systems, all of which must be sustainable at the same time. This is because each of these pillars is independently crucial and the pillars are interlinked. Moreover, the fourth, institutional dimension is emphasized as the fourth pillar of SD because of its necessity in supporting progress in the previous three pillars and in SD generally (United Nations et al., 2003). All these aspects are considered in Drastichová and Filzmoser (2019) (see more also in Drastichová (2018a) or Sucháček et al. (2018) in relation to spatial dimension of SD). The concept of SD can then be interpreted as a balance between its pillars, i.e. the economic, social and environmental pillar. In this paper, the focus is on the issues of health and wellbeing, because health can be understood as a crucial aspect of people's wellbeing. These aspects of health and wellbeing reflect Sustainable Development Goal 3 (SDG 3) in the EU SDG indicator set. The SDGs are a central part of the United Nations 2030 Agenda, which was adopted by the United Nations (UN) in September 2015. SDG 3 aims to ensure health and wellbeing for all. These issues will be analysed in this context and they encompass the different dimensions (economic, social, environmental, as well as institutional). Not only must social aspects be considered (although they are the most significant for this issue), but also economic, environmental and institutional aspects.

The 2030 Agenda for SD and its 17 SDGs, which represent a recent policy framework worldwide, have provided an impetus to global efforts for pursuing SD. The EU, in coordination with its Member States, is committed to supporting the implementation of the 2030 Agenda. This agenda, its SDGs and their importance are described in more detail in (Bergman et al., 2018). The EU's response to this Agenda is included in the 2016 European Commission's Communication (European Commission, 2016). Since the EU adopted the topics of SDGs, replacing its SD strategy with them, the indicators included in the EU SDG indicator set represent the basis for the measurement of various aspects of SD. Two which are included in the topic of *good health and wellbeing* (SDG 3) were chosen for analysis in

this paper. Health represents the basic constituent of wellbeing, while continuous increases in wellbeing should be the main aim of SD policies (see more in Drastichová (2018a), subsection 2.2.4, where the aspects related to the human development approach in term of SD are explained in detail).

Both the type of health system and the resources devoted to it affect the health of the population. The performance of the health system of different countries can be evaluated according to the relationship between resources and outcomes.¹ A higher performance of a health system means that a country generates better health outcomes for the same level of resources or the same outcomes but with a lower level of resources. Health systems are financed either through taxes, in the case of healthcare services owned by the state, i.e. national health services, or through income-related social contributions, i.e. social security systems (Elola et al., 1995). In reality, different combinations exist, and other sources are used as well. A measurement of performance requires an explicit framework defining the goals of a health system against which outcomes can be judged and performance quantified (Smith, 1990). Healthcare evaluation can be understood as a critical assessment, through rigorous processes, of an aspect of healthcare to assess whether it meets its objectives. Several aspects of healthcare can be assessed, including effectiveness (the benefits of healthcare measured by improvements in health), efficiency (compares the cost of healthcare with the outputs or benefits obtained), acceptability (the social, psychological and ethical acceptability regarding the way people are treated in relation to healthcare) or equity (the fair distribution of healthcare amongst individuals/groups) (Blackwood, 2009). Efficiency metrics are of great importance for governing, managing and reforming any health system, and improving the management of its institutions (Cylus et al., 2016).

It is important to note that economists refer to two concepts of efficiency, which are allocative efficiency (AE) and technical efficiency (TE). AE can be focused on the choice of outputs or the choice of inputs. On the output side, it examines whether limited resources are used to produce the correct mix of healthcare outputs, given the preferences of funders, acting on behalf of society in general. With regard to input, AE examines whether an optimal mix of inputs is used to produce the chosen outputs, given the prices of those inputs. TE indicates the extent to which the system minimizes the use of inputs in producing its chosen outputs, regardless of the value placed on those outputs. It can be also said that it is maximizing its outputs given its chosen level of inputs. In either case, any variation in performance from the greatest feasible level of production indicates technical inefficiency, or waste (Cylus et al.,

¹ Many methods for the evaluation exist which are beyond the scope of this article.

2016). Although different aspects are analysed in this paper, the above-mentioned concepts are considered in the analysis carried out in this paper. An even more important aspect than efficiency covered in this paper is the sustainability of health care systems. The main philosophy of sustainable development (SD) in compliance with its most quoted definition is considered.

The aim of the paper is to discover in the sample of 30 countries the effects of the components of healthcare expenditure by the provider on the indicators representing the effects of healthcare at the macroeconomic level. Regarding statistical methods, compositional data analysis and regression analysis are applied. We posed two main research hypotheses. Firstly, not only the overall amount of resources but also their composition can play a role in achieving desired health outcomes. Secondly, the structure of the expenditure patterns in the analysis can be similar in a particular group of countries within the overall sample investigated.

2. Materials and Methods

This section describes the scientific works which formed the basis for this paper, the methodology and the data used.

2.1. Literature Review

A number of works include health outcome indicators (or other indicators reflecting aspects of health) as part of the analysis of SD as a whole, health being an important constituent of wellbeing and SD. Others focus on effectiveness, efficiency, or sustainability of healthcare, or analyse specific aspects related to healthcare and the relationships between variables (including both macro- and micro-level analysis). The studies of Megyesiöva and Lieskovska (2019) and Drastichová and Filzmoser (2019) need to be mentioned as the representatives of the first group. Both analysed SD indicators and applied the methods of cluster analysis and principal component analysis (PCA). The first study (among others) analysed relationships between healthcare expenditure and health outcomes (life expectancy (at birth and at the age 65), standardized death rates of noncommunicable diseases) in the OECD countries. They emphasised the importance of the analysis of indicators included in the SDG set in order to achieve SD. Drastichová and Filzmoser (2019) applied hierarchical cluster analysis (HCA) and PCA to the data of 12 indicators included in the EU SDG set in the 28 EU countries and Norway in the period 2012-2016. The

indicators were selected to represent all the dimensions and crucial aspects of SD, while life expectancy at birth was chosen to represent SDG 3. This topic was taken as crucial for SD.

In the second group of works, the resources of health systems can be measured by several indicators such as healthcare expenditure², number of physicians, number of hospital beds, etc. (Or, 2000; Ramesh and Mirmirani, 2007, Baltagi and Moscone, 2010; Jaba et al. (2014). Nixon and Ulmann (2006) reviewed key studies which consider the relationship between health expenditure, among other explanatory variables, and health outcomes, using macro-level data. This work reviewed key findings and methodological approaches in this field³. The authors also analysed the relationship between total healthcare expenditure and health outcomes in the former 15 EU countries over the period 1980–1995, by means of a fixed-effects model conducted on panel data, using life expectancy (females and males) and infant mortality as the dependent variables. These two dependent variables were examined as the output of the healthcare system, and various life-style, environmental and occupational factors as inputs. Increases in healthcare expenditure over the period under analysis were significantly associated with major improvements in infant mortality, but made only a marginal contribution to the improvements in life expectancy in the EU countries. Infant mortality has been more than halved by the significant contribution of health expenditure and medical care (number of physicians), the predominant determinants of both male and female life expectancy are those contained in the constant term, namely the unaccountable salient variables and country-specific characteristics. According to these authors, relatively few studies have managed to find a link between healthcare expenditure and health outcomes, because there can be other principal factors affecting health outcomes, and particularly life expectancy (such as diet, life-style or environment).

A number of studies have assessed the impact of healthcare spending on health outcomes, usually reporting multiple estimates of the elasticity of health outcomes, most often measured by a mortality rate or life expectancy, with respect to healthcare spending. However, the extent to which study attributes influenced these elasticity estimates is not clear (Gallet et al., 2017). Gallet et al. (2017) utilized a meta-data set, consisting of 65 studies completed over the period 1969-2014, to examine the elasticity estimates using meta-regression analysis (MRA). The result is that healthcare spending has the greatest impact on the mortality rate, greater than on life expectancy.

² Different units can be used, such as total expenditure per capita, as % of GDP, or as % of public expenditure in total health expenditure.

³ In terms of dependent variables, the vast majority of studies utilise mortality rates (age-specific or infant mortality in particular) and/or life expectancy (mainly at birth, but

also at specific ages). Ten of the 15 studies use income as an explanatory variable in addition to health expenditure, but there is a need to acknowledge, as several studies do, that the correlation between these two variables is high. These are also important findings for the analysis carried out in this work.

MRA results showed that the spending elasticity for the mortality rate was particularly sensitive to data aggregation, the specification of the health production function, and the nature of healthcare spending. The spending elasticity for life expectancy was particularly sensitive to the age at which it was measured, and the decision to control for the endogeneity of spending in the health production function.

Jaba et al. (2014) analyzed the relationship between the dynamics of the inputs (healthcare expenditures per capita (current US\$)) and the outputs of healthcare systems (life expectancy at birth (years)). They applied a panel data analysis to data of 175 world countries, grouped according to the geographic position and income level in the period 1995-2010. They estimated life expectancy by a function of health expenditures. A significant relationship between health expenditures and life expectancy was identified. Country effects were significant and important differences between the countries exist.

Linden et al. (2017) analysed relationships between life expectancy at birth, public and private health expenditure with econometric panel time series methods for 34 OECD countries in the period 1970-2012. The countries were grouped in three clusters depending on size of public health expenditure as a share of GDP. The relationships between life expectancy and health expenditures were not uniform between the three groups of countries with different levels of public health expenditure as a share of GDP. When the share of public expenditure on health in GDP in a country is large, positive correlation between life expectancy and health expenditure was discovered. On the contrary, when this share is low, life expectancy and private health expenditure do not always support each other, but a significant positive link between public expenditure and life expectancy was still identified. Private and public health expenditure had similar positive effects on life expectancy in the cluster with the highest public share. These effects disappeared in clusters with a lower share and private effects turned negative in the cluster with the lowest share. The exogeneity of expenditure was ruled out as life expectancy has significant effects on both health expenditure in clusters with high and low shares. However, only in countries with high public shares do increases in life expectancy drive both public and private health expenditure upward. The authors also showed that larger public health expenditure led to higher private health expenditures, except in the USA.

Lv and Xu (2016) summarized the works which indicate a strong and positive relationship between national income and healthcare expenditure. As income is one of the main determinants of healthcare expenditure, the question arises of what the optimal amount of health spending for a society is. Recognizing this relationship should help policymakers to make judgments, plan health reforms, or achieve efficient allocation of resources. Accordingly, economic theory should determine what the optimal percentage share of GDP should be. The authors also pointed out that most of the literature on the determinants of health expenditure deals with the relationship between healthcare expenditure and income. An HCA for the evaluation of selected indicators representing healthcare inputs (current health care expenditure (percentage of GDP) and outcomes (life expectancy at birth and death rate due to chronic diseases) was applied in Drastichová (2018b).

Nixon and Ulmann (2006) confirmed that establishing causal relationships between health expenditure and health outcomes is complex and difficult because healthcare expenditure is only one of many quantitative and qualitative factors that contribute to health outcomes, and measurement of health status is an imperfect process. The innovation of our study lies in the application of an approach based on a regression analysis and compositional data analysis to the data on healthcare inputs and outcomes, while the data on inputs are classified according to their percentage shares in the whole (see the beginning of this subsection). The results of the previous studies concerning the relationships between healthcare inputs and health outcomes are considered, while this work concerns the relationships between the components of healthcare expenditure (their proportion or percentage) and health outcomes.

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2.2. Data and Methodology

2.2.1. Data

All data for the indicators used are available on Eurostat (2019a). The indicator at the macroeconomic level applied in this paper for measuring healthcare inputs (resources) is the current health expenditure (CHE) (percentage of GDP). Healthcare expenditure is recorded in relation to the international classification for health accounts (ICHA), defining: healthcare expenditure by financing schemes (ICHA-HF), healthcare expenditure by function (ICHA-HC) and healthcare expenditure by provider (ICHA-HP). The last classification is applied in the analysis of this paper as an explanatory composition. It classifies units contributing to the provision of healthcare goods and services – such as hospitals, residential facilities, ambulatory health care services, ancillary services or retailers of medical goods. Healthcare providers are the organizations and actors that deliver healthcare goods and services as their primary activity, as well as those for which healthcare provision is only one among a number of activities (Eurostat, 2019b). The main items are defined in Table 1. The first seven categories of expenditure (percentage of GDP) are used in the analysis (the remaining two are minor, and data for them are often unavailable).

Table 1. Categories of current healthcare expenditure by provider (ICHA-HP), source: Eurostat (2019b)

Hospitals: the licensed establishments that are primarily engaged in providing medical, diagnostic and treatment services that include physician, nursing and other health services to inpatients and the specialised accommodation services required by inpatients and which may also provide day care, outpatient and home healthcare services (HOS);
Residential long-term care facilities: establishments that are primarily engaged in providing residential long-term care that combines nursing, supervisory or other types of care as required by the residents, where a significant part of the production process and the care provided is a mix of health and social services with the health services being largely at the level of nursing care in combination with personal care services (RES);
Providers of ambulatory healthcare: establishments that are primarily engaged in providing healthcare services directly to outpatients who do not require inpatient services, including both offices of general medical practitioners and medical specialists and establishments specialising in the treatment of day-cases and in the delivery of home care services (AMB);
Providers of ancillary services: establishments that provide specific ancillary type of services directly to outpatients under the supervision of health professionals and not covered within the episode of treatment by hospitals, nursing care facilities, ambulatory care providers or other providers (ANC);
Retailers and other providers of medical goods: establishments whose primary activity is the retail sale of medical goods to the general public for individual or household consumption or utilisation, including fitting and repair done in combination with sale (RET);
Providers of preventive care: organisations that primarily provide collective preventive programmes and campaigns/public health programmes for specific groups of individuals or the population-at-large, such as health promotion and protection agencies or public health institutes as well as specialised establishments providing primary preventive care as their principal activity (PRE);
Providers of healthcare system administration and financing: establishments that are primarily engaged in the regulation of the activities of agencies that provide healthcare and in the overall administration of the healthcare sector, including the administration of health financing (HSAF);
Rest of the economy; Rest of the world providers

As response variables, three indicators are used to reflect health outcomes at the macroeconomic level. The first indicator, healthy life years in absolute value at birth (HLY), is separately applied for men and women. Then, overall four indicators are used in the analysis. The indicator of HLY measures the number of remaining years that a person of specific age is expected to live without any severe or moderate health problems. The second one, life expectancy at birth (LE), is defined as the mean number of years that a new-born child can expect to live if subjected throughout his life to the current mortality conditions. It is one of the most frequently used health status indicators. The last one, death rate due to chronic diseases (DR), measures the standardised death rate of chronic diseases. The data are presented as standardised death rates, meaning they are adjusted to a standard age distribution in order to measure death rates independently of different age structures of populations. The LE and DR indicators are included in the SDG 3 topic of the EU SDG indicator set. While LE and DR indicators clearly refer to quantitative aspects of life, HLY also indicates qualitative aspects. LE is not able to show whether extra years of life gained through increased longevity are spent in good or bad health. Therefore, indicators of health expectancies, such as healthy life years have been developed. HLY focuses on the quality of life spent in a healthy state, rather than the quantity of life, as measured by LE (Eurostat, 2019a). It was considered desirable to include both types of indicators in the analysis. HLY was included in order to more clearly reflect the aspects in SDG 3. Data for all indicators are used for the 30 countries (the sample), and Switzerland, which was intended to be included in the

analysis, but data for several expenditure components were missing.

The standard of living, measured by GDP per capita (in current prices, purchasing power standard (PPS) per capita, at market prices) (further only GDP per capita in PPS) is the last variable used in the analysis. Data from 2015 were used for the analysis, and data from 2016 were used, in addition, for calculation of the correlation coefficients.

2.2.2. Methodology

Regression analysis is the main methodology applied in this paper. Its goal is to explain the response variable Y using known explanatory variables x_1, \dots, x_D . A linear regression model can be written in terms of a conditional expected value as

$$E(Y|x) = \beta_0 + \beta_1 x_1 + \dots + \beta_D x_D, \quad (1)$$

with unknown parameters β_0, \dots, β_D to be estimated, e.g. using the standard least squares (LS) method. However, this approach is fully reasonable when both the response Y and the covariates $x = (x_1, \dots, x_D)'$ carry absolute information (represented often by variables corresponding to physical units). However, the explanatory variables can describe relative contributions of the components on the whole. In such a case, the sum of the variables (parts) is not important and the only relevant information is contained in the ratios between these parts. Often, such data, named compositional data or compositions (Aitchison, 1986) are represented in proportions or percentages and are characterized by a constant sum constraint (1 or 100, respectively) (Hron et al., 2012). Accordingly, compositional data analysis, which involves the analysis of compositional data (i.e. data that measure parts of a whole, such as percentages, pro-

portions), is applied in this paper. Compositional explanatory variables should not be directly used in a linear regression model because any inference statistic can become misleading. While various approaches for this problem were proposed, here an approach based on isometric logratio (ilr) coordinates is used. This means that the composition is expressed in the usual Euclidean geometry using orthonormal coordinates. For D compositional parts, $D-1$ coordinates need to be constructed. For reasons of interpretability, so-called pivot coordinates are used, being defined as

$$z_i = \sqrt{\frac{D-i}{D-i+1}} \ln \frac{x_i}{\sqrt{\prod_{j=i+1}^D x_j}}, i = 1, \dots, D-1, \quad (2)$$

(Fiserova and Hron, 2011). The first coordinate z_1 covers all relative information about part x_1 , and x_1 does not appear in any of the other coordinates. Therefore, z_1 can be interpreted in terms of x_1 , which will be important here for the statistical inference in regression analysis. For this purpose, the idea is to construct pivot coordinates for each single explanatory variable, estimate the regression parameters and derive the statistical inference, and then report just the coefficient and the inference information of the first pivot coordinate. This creates an inference table with the information of all first coordinates of the respective pivot coordinate systems. The corresponding regression coefficient refers to a logratio of the respective part on an average behaviour of the remaining parts in the composition. Consequently, the interpretation can be done in an analogous way as it is done in standard regression. If the coefficient is positive, this variable is dominant in the composition within the model, while if it is negative, the opposite is true (Hron et al., 2012).

This procedure is implemented in the function `lmCoDaX` (Classical and robust regression of non-compositional (real) response on compositional predictors) of the R package `robCompositions` (Hron et al., 2012). It must be noted that the classical least-squares regression is very sensitive to data outliers, and therefore robust regression is used. Most importantly, also the inference statistic is robust. Function `lmCoDaX` by default takes robust regression (Maronna, Martin and Yohai, 2006). Note that the multiple R-square is the same for every pivot coordinate system (Hron et al., 2012). For further details we refer to Filzmoser et al. (2018).

3. Results

Section 3.1 presents the results of the regression analysis and the compositional data analysis and section 3.2 contains a detailed analysis of the results and discussion.

3.1. Relationships between healthcare expenditure and healthcare outcomes

Table 2 shows the results of four regression analyses. In each of them the same composition of CHE (per-

centage of GDP) classified by provider is used along with a different response variable. From the seven component variables, representing expenditure ratios on particular healthcare providers, overall, only five were statistically significant. Depending on the response variable, one, two or three components of expenditure were statistically significant.

Table 3 displays R-squared and p-values for each of the four models. All models are statistically significant and the highest value of adjusted R-squared is achieved for the response variable LE. It is clear that other factors affect the health outcome indicators as well. The standard of living, measured by GDP per capita in PPS was included in all models as a non-compositional explanatory variable but it was proved as statistically insignificant in each model. Therefore, only the model containing compositional data was used.

Three response variables are applied in the model, while the first of them, HLY, is separately used for men (HLYm) and women (HLYf). As regards HLYf, the statistically significant variables in the structure of expenditure are those on residential long-term care facilities (RES), where the dominance of the variable was confirmed and on the providers of ambulatory healthcare (AMB), where the opposite is true. So, when in the composition of expenditure, the variable RES as a ratio to GDP is increasing and thus getting more dominant in the composition, it is connected with higher values of HLYf. When the variable AMB is decreasing and thus getting less dominant in the composition, it leads to higher levels of HLYf in the sample. For HLYm, the same applies to the expenditure on residential long-term care facilities (RES), but another statistically significant variable is that representing expenditure on providers of healthcare system administration and financing (HSAF). However, this variable is not dominant. Accordingly, when the variable RES as a ratio to GDP is getting more dominant in the composition, it is connected with higher values of HLYm in the sample. When HSAF is decreasing relative to an average of the remaining parts in the composition, it leads to higher values of HLYm in the examined sample. For the LE indicator, three components of expenditure are statistically significant. Those on providers of ancillary services (ANC) and on retailers and other providers of medical goods (RET) are not dominant. The dominance of expenditure on providers of healthcare system administration and financing (HSAF) was confirmed. So, for this response variable, its higher value is connected with more dominance of the last kind of expenditure. Lower levels of previous two kinds of expenditure are connected with higher LE values. For the DR indicator, only the expenditure on retailers and other providers of medical goods (RET) is statistically significant and the dominance of this variable is confirmed. So, the more dominant (in the composition) this expenditure gets, the higher the values for this response (DR) is.

Table 2. Results of regression analysis for four different response variables, source: author's calculations

HLYm	Estimate	Std. Er.	t val.	Pr(> t)	HLYf	Estimate	Std. Er.	t val.	Pr(> t)
Int.	70.3809	9.1896	7.659	<0.0005***	Int.	59.937	11.145	5.378	<0.0005***
HOS	-10.2768	6.4772	-1.587	0.1283	HOS	10.309	8.749	1.178	0.2507
RES	3.0962	1.2898	2.400	0.0262 *	RES	3.590	1.730	2.074	0.0494 *
AMB	6.0906	4.2586	1.430	0.1681	AMB	-16.933	6.359	-2.663	0.0139 *
ANC	2.7124	2.2610	1.200	0.2443	ANC	-2.021	1.825	-1.107	0.2796
RET	2.1759	3.198	0.680	0.5041	RET	5.051	4.803	1.052	0.3039
PRE	0.8626	1.1453	0.753	0.4601	PRE	1.943	1.845	1.053	0.3033
HSAF	-4.6611	1.7509	-2.662	0.0150 *	HSAF	-1.939	2.675	-0.725	0.4760
LE	Estimate	Std. Er.	t val.	Pr(> t)	DR	Estimate	Std. Er.	t val.	Pr(> t)
Int.	81.39357	3.18593	25.548	<0.0005***	Int.	176.258	52.825	3.337	0.00275 **
HOS	3.17027	2.49787	1.269	0.21970	HOS	-60.087	41.805	-1.437	0.16354
RES	-0.09279	0.53332	-0.174	0.86371	RES	-4.576	8.244	-0.555	0.58398
AMB	-1.78646	1.83250	-0.975	0.34187	AMB	-14.991	26.423	-0.567	0.57596
ANC	-1.18831	0.55724	-2.132	0.04623 *	ANC	5.139	8.744	0.588	0.56217
RET	-3.84207	1.37628	-2.792	0.01163 *	RET	87.587	20.782	4.214	<0.0005***
PRE	-0.15604	0.62471	-0.250	0.80544	PRE	2.547	8.818	0.289	0.77522
HSAF	3.89540	1.30347	2.988	0.00755 **	HSAF	-5.484	12.604	-0.435	0.66735

Note: Signif. codes: 0 '***'; 0.001 '**'; 0.01 '*'; 0.05 '.'; 0.1 ' ' 1.

Table 3. Other features of the models for four (different) response variables, source: author's calculations

HLYm	Multiple R²	Adjusted R²	p-value	HLYf	Multiple R²	Adjusted R²	p-value
	0.506	0.357	0.01742		0.4603	0.319	0.01789
LE	Multiple R²	Adjusted R²	p-value	DR	Multiple R²	Adjusted R²	p-value
	0.7592	0.683	<0.0005		0.6584	0.573	<0.0005

Note: R² – R-squared.

Although the positive relationship between the healthcare expenditure and health outcomes was confirmed by a number of authors, there is no unambiguous result which kind of expenditure should have a dominant share in GDP when different health outcomes are applied. For both HLY indicators, it seems to be desirable to increase the ratio of expenditure on residential long-term care facilities in the composition. Nevertheless, the lower ratio of expenditure on ambulatory healthcare in the case of HLYf and on providers of healthcare system administration and financing in the case of HLYm are connected with their higher levels. The last-mentioned expenditure as a component in the structure of expenditure is also associated with higher LE values, which is in conflict with negative effects on HLYm in the structure. However, for both response variables, this occurs by simultaneous changes of ratios of other statistically significant expenditure. Moreover, for both LE and DR, an unfavorable relationship between the variable and the ratio of expenditure on retailers and other providers of medical goods is confirmed. This makes sense between LE and DR negative correlation exists. Accordingly, the effect of this kind of expenditure seems to be less ambiguous and more straightforward, as it is related to both the length of life and death rates. However, no relationship was found between its ratio and indicators reflecting quality of life (HLY).

Although in absolute values each component of expenditure is crucial for increasing health outcomes, it is confirmed that in relative values the results can be quite different. Moreover, countries face different conditions and challenges and generally, many other factors can affect relationships between healthcare inputs and outcomes.

In Figure 1, which reflects the predictions of the four models (described in Table 1 and 2), some outliers are visible. The concrete values of variables are analyzed in subsection 3.2 in more detail. The Netherlands is a significant outlier for both HLY indicators (see Figure 1 (a), (b)). It showed poor results in both HLY indicators although the performance in other two response variable is relatively good. Similarly, Luxemburg (an outlier for DR – Figure 1 (d)) showed one of the best results for LE and DR and the performance in both HLY indicators is lower. It showed the third lowest CHE ratio in the sample, while the Netherlands had the fifth highest (when also Switzerland is included). Denmark and Finland are outliers, in particular for both HLY indicators, and, in the case of Denmark, also for the LE indicator (Figure 1 (a), (b), (c)). Although these countries showed high CHE ratios, the performance in HLY indicators and that of Denmark also in other two response variables are lower (see subsection 3.2.). Moreover, Denmark showed the highest ratio of expenditure on hospitals in the sample (see Table 4 in

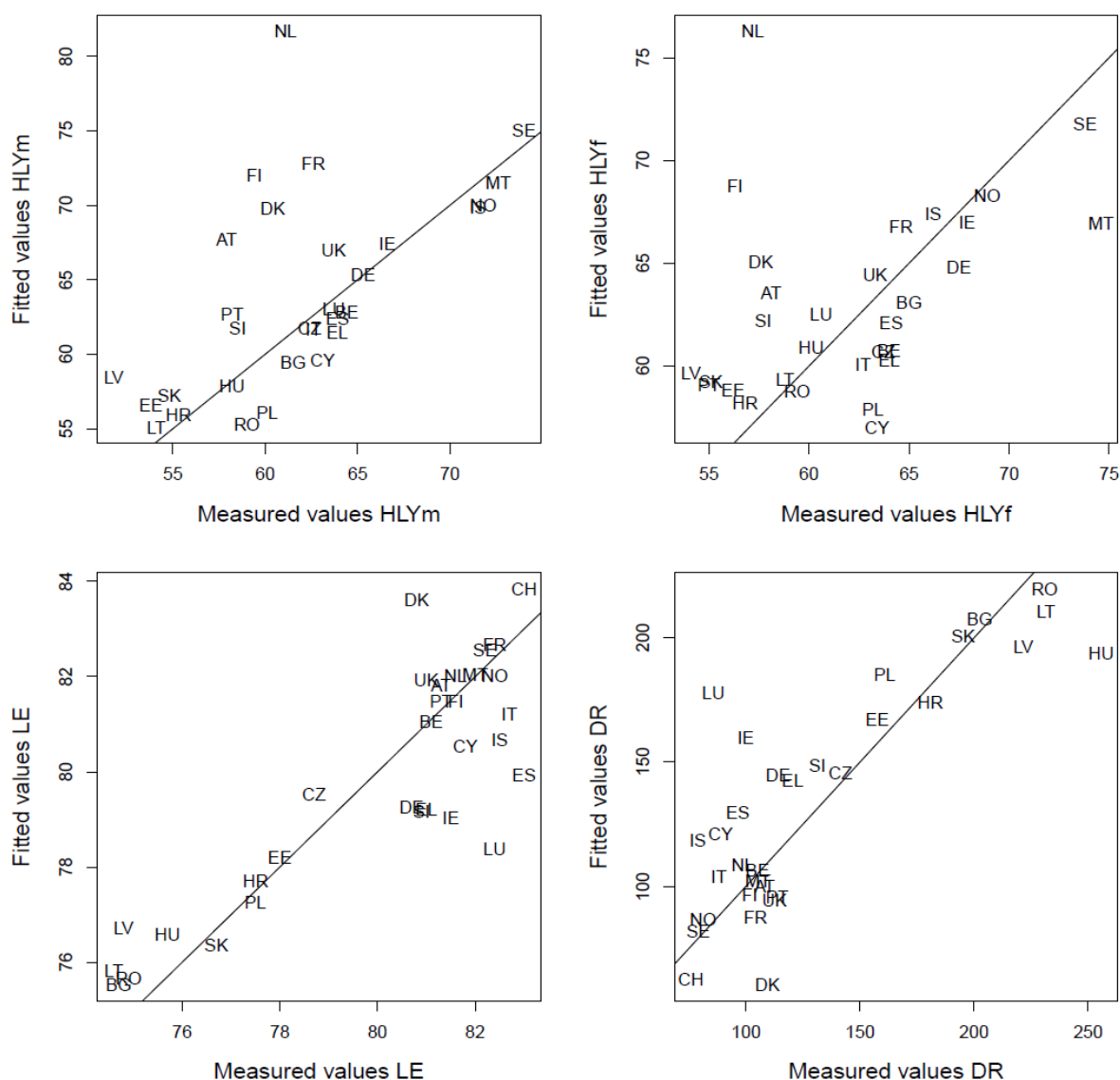


Figure 1. Measured values and fitted values: (a) HLYm; (b) HLYf; (c) LE; (d) DR, source: author's calculations

subsection 3.2), which is similar to other countries with the highest ratios of overall CHE. These are France, Sweden, Switzerland and Norway, which often showed the high performance in the response variables.

3.2. Detailed analysis of results and discussion

As regards the relationships between the indicators applied, the negative correlation between the LE and DR indicator is obvious (the correlation is below -0.96 in both 2015 and 2016). There is a clear positive correlation between two HLY indicators (0.904 and 0.898 in 2015 and 2016 respectively). However, a higher positive correlation can only be found between LE and HLYm (0.674 and 0.626 in 2015 and 2016 respectively). It was low between LE and HLYf (0.415 and 0.358 in 2015 and 2016 respectively). For both years the correlation between the overall CHE and GDP per capita in PPS this coeffi-

cient was very low and positive (0.321 and 0.297 in 2015 and 2016 respectively). Medium value is achieved when Luxembourg is left out of the analysis ($r=0.666$ in 2015). This country represents an outlier because it showed the highest GDP per capita and the third lowest ratio of overall CHE. Moreover, GDP per capita and the overall CHE ratio showed a medium level of correlation with the DR and LE indicators (the coefficients were around 0.6 for both DR and LE in absolute values in both 2015 and 2016, while there is a negative correlation between GDP per capita/CHE ratio and DR and a positive correlation between GDP per capita/CHE ratio and LE). Between GDP per capita/CHE ratio and HLY indicators the coefficient was very low (and positive). Accordingly, GDP per capita was insignificant when used as a non-compositional explanatory variable in the regression analyses presented in Table 1. Figure 2 displays overall expenditure ratios for 2015 and

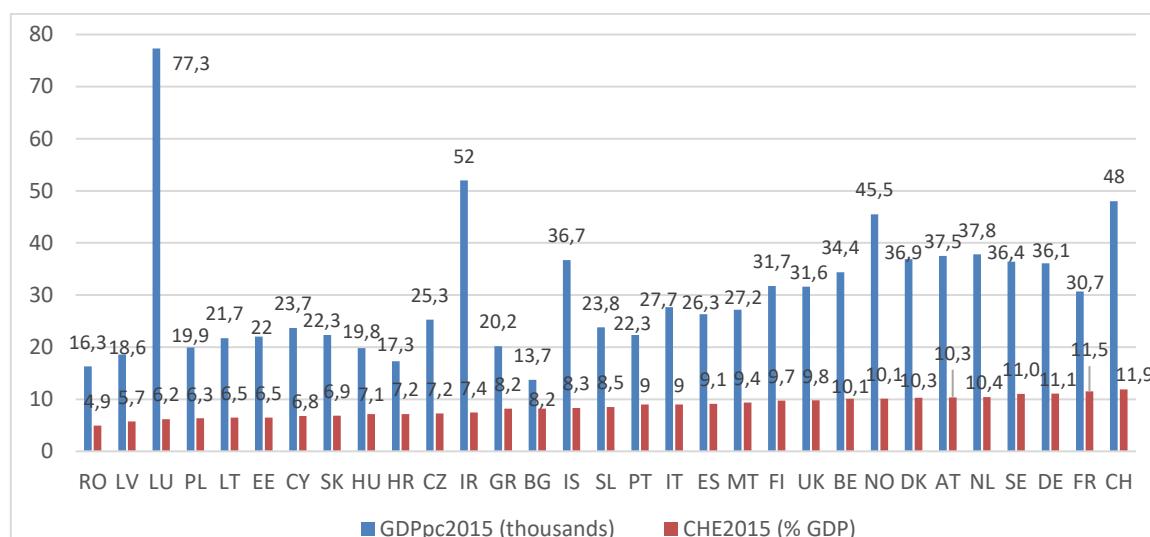


Figure 2. CHE (percentage of GDP) and GDP per capita in PPS in the EU countries, Iceland, Norway and Switzerland, source: Eurostat (2019a)

Table 4. Countries with the five highest and five lowest values for the indicators, 2015, source: author's calculations

V	H	L	V	H	L
HOS	DK, FR, SE, CH, NO, UK	LV, RO, LU, LT, PL	HSAF	FR, DE, CH, NL, BE	NO, FI, IC, BG, CY
RES	NL, SE, CH, NO, FI, IE	SK, BG, HR, RO, GR	HLYf	MT, SE, NO, IR, DE	LV, PT, SK, EE, FI
AMB	BE, CH, DE, FI, DK, NO	RO, SK, BG, LV, LT	HLYm	SE, MT, NO, IC, IR	LV, EE, LT, SK, HR
ANC	SK, CY, PT, LV, GR	SE, SL, NO, IR, EE	LE	CH, ES, IT, IS, NO, LU	LT, BG, LV, RO, HU
RET	BG, GR, SK, HU, DE	LU, IR, DK, NO, CH	DR	HU, LT, RO, LV, BG	CH, IC, SE, NO, LU
PRE	NO, IT, NL, UK, SE	PL, PT, FI, LV, RO	GDP	LU, IR, CH, NO, NL, AT	BG, RO, HR, LV, HU

Note 1: H – highest; L – lowest; V - variable; GDP – GDP per capita.

Note 2: The highest values are ordered from the highest and the lowest values from the lowest. When Switzerland shows the indicated value, six countries are displayed.

GDP per capita for the countries in the sample and Switzerland. This Figure shows that the relationship between the displayed variables is not clear but it would be stronger after omitting some outliers. Apart from Malta, Slovenia and Bulgaria, the new member countries had relatively low CHE ratios, the Southern countries showed medium values and the more developed countries predominantly showed relatively high values (except for Ireland and Iceland). Table 4 displays countries with the highest and lowest values of all indicators used in the analysis, including GDP – per capita. Switzerland is included as well (if its value is displayed, then six values are shown). This can help manifest the relationships between the explanatory variables (seven types of healthcare expenditure) and the response variables. Table 4 shows that countries with the highest (or relatively high) CHE ratios (see Figure 2) also have the highest (or relatively high) ratios of expenditure on hospitals, residential long-term care facilities, providers of ambulatory healthcare, providers of preventive care and providers of healthcare system ad-

ministration and financing. They often exhibited low values of expenditure ratios on providers of ancillary services and retailers and other providers of medical goods and a relatively high performance in the response variables. However, there are several exceptions. Ireland and Iceland had among the highest expenditure ratios on residential long-term care facilities, but the overall CHE is relatively low in Ireland and medium in Iceland. For providers of ambulatory healthcare, the expenditure ratio of the Netherlands is relatively low although its overall ratio is one of the highest and the same applies to Germany in the case of providers of preventive care. As regards providers of healthcare system administration and financing, the UK exhibited a ratio slightly lower than the average. However, Finland, whose expenditure ratio is also among the highest, exhibited the second lowest ratio for this component. Switzerland, which showed the highest CHE ratio, had medium values for providers of ancillary services and Belgium, Austria and France exhibited relatively high values. As regards retailers and other providers of medical goods, Germany along with France showed rela-

tively high ratios and those of Austria were medium. All five Northern countries showed relatively low ratios for these two types of expenditure along with a high performance in the response variables (outcomes), except for Finland and more so Denmark, which showed poorer results.

Regarding HLY indicators, Ireland and Iceland showed one of the highest HLY indicators, Bulgaria showed a relatively high value of HLYf. The Netherlands and Austria exhibited relatively low values of HLYf. Austria also had a low HLY value, while those of the Netherlands and France were medium. Denmark and Germany exhibited only medium values of LE while those of Spain, Italy and Iceland are among the highest. This is also similar for DR where Cyprus had one of the lowest values and those of Denmark and Germany were higher.

Countries with lower overall expenditure ratios exhibited low expenditure ratios on hospitals and providers of ambulatory healthcare. They predominantly showed higher ratios on providers of ancillary services and retailers and other providers of medical goods and often lower ratios for the remaining categories. These countries often showed a relatively low performance in the response variables. However, there are exceptions again.

Notably, France had the highest CHE ratio in the EU, and had relatively high ratios in all other analyzed components; although its GDP per capita was only medium. It achieved very good results in the response variables, except for a slightly lower value of HLYm. Switzerland, having the lowest DR and the highest LE, along with the highest CHE ratio, showed typical features of the developed countries, i.e. low ratios for providers of ancillary services and retailers and other providers of medical goods, while the other ratios are among the highest in the sample. This is also a country with one of the highest standards of living in the sample. Norway and Sweden, exhibiting among the best results in all response variables and among the highest standards of living and overall CHE ratios, are in most aspects related to expenditure ratios similar to Switzerland. Expenditure ratios on hospitals, residential long-term care facilities, providers of ambulatory healthcare and providers of preventive care were similarly high, but on providers of healthcare system administration and financing they differed significantly. Norway had the lowest ratio in the sample, Sweden had a relatively low value as well, while that of Switzerland was one of the highest in the sample. Ratios for providers of ancillary services were among the lowest in Sweden and Norway, i.e. much lower than those in Switzerland.

Iceland, which showed very good results in all response variables and has one of the highest standards of living, differs slightly from the majority of the developed countries which performed well in the response variables. It had relatively low ratios of expenditure on providers of preventive care and pro-

viders of healthcare system administration and financing. Another small country, Luxembourg, which exhibited among the best results in DR and LE indicators and had one of the highest standards of living, had lower ratios of expenditure on hospitals, providers of ambulatory healthcare and providers of preventive care. However, its relatively low expenditure ratio on providers of ancillary services and the lowest ratio on retailers and other providers of medical goods are in line with the majority of the developed countries. Smaller countries often face distinctive conditions, so these two countries can nevertheless be regarded as among the most developed countries, although their overall expenditure ratios are lower.

Lithuania, Bulgaria, Latvia, Romania and Hungary display the poorest performances in both DR and LE. As regards HLY indicators, there are also other countries with a poorer performance. In particular, Slovakia and Croatia performed among the worst, as well as having poor results in both LE and DR. Moreover, Bulgaria showed better results in HLY indicators, especially in HLYf. Common features of these seven countries are low ratios of expenditure on hospitals, long-term residential care facilities, providers of ambulatory healthcare, providers of preventive care and providers of healthcare system administration and financing. On the other hand, they exhibit high ratios for providers of ancillary services (except for Lithuania and Hungary) and retailers and other providers of medical goods. Only Slovakia and Croatia exhibited higher ratios for providers of preventive care and providers of healthcare system administration and financing. All of these countries also showed the lowest standards of living measured by GDP per capita (see Figure 2; only that of Slovakia is slightly higher).

Overall, it is obvious that the relationships between standards of living/expenditure ratios and their components and the response variables are not that straightforward, especially for the two qualitative variables. However, some patterns were detected.

4. Discussion

According to Cylus et al. (2016) AE can also be considered at a broad sectoral level to examine whether the correct mix of health services is funded, so that at a given aggregate level of expenditure, health outcomes are maximized, which means, for example, that an efficient allocative health system would allocate funds between sectors such as prevention, primary care, hospital care, and long-term care so as to deliver the maximum level of health-related outcomes in line with societal preferences. This was also investigated in the paper and it is desirable to deal with the composition of expenditure from different points of view (see subsection 2.2.1) in order to increase the efficiency of health systems. Thus, it is important not only to determine what the optimal

percentage share of GDP for overall CHE should be, but also its allocation into particular components. As Goldacre (1996) claims, the evidence for a causal link between health care expenditure and health outcomes remains elusive as problems emerge from the difficulty of isolating the contribution of the health service *input* as a determinant of health status *output*. This frustrates attempts to measure the overall effectiveness and efficiency of healthcare. Moreover, it can be difficult to find a significant relationship between standards of living and CHE ratios (% of GDP), and between standards of living and health outcomes measured by the four response variables used in the group of developed countries, which show no significant differences in values for these variables.

The composition of expenditure clearly revealed certain patterns dividing the countries into at least two groups. Accordingly, the analysis of the composition of expenditure can provide some guidance. From the practical point of view, it is required that policymakers set out clearly what they mean by efficiency and give local decision-makers the leadership capacity and autonomy necessary to pursue improved efficiency. They should also ensure that there are information systems which measure progress accurately and in a timely fashion. Based on this, efficiency metrics can play a more prominent role in policy-making and relevant decisions. Moreover, all these decisions should be incorporated into the framework of pursuing the path of SD, i.e. into strategies of SD.

5. Conclusions

The aim of the paper was to discover in the sample of 30 countries the effects of the components of healthcare expenditure by the provider on the indicators representing the effects of healthcare at the macroeconomic level. The indicators reflecting health outcomes were chosen carefully, taking into consideration the EU's priorities in SD and the indicators included in the EU SDG indicator set, and also taking into account that health is a crucial constituent of wellbeing and the main outcome of the strategies aimed at SD. The EU countries, and Norway and Iceland were investigated. Switzerland, for which data for both HLY indicators were missing, was included in comparisons of all other indicators. The data of Eurostat (2019) in 2015 were used. Compositional data analysis, regression analysis and cluster analysis were applied as the main methods. In the sample of countries, many similar features were discovered, although several outliers were also present.

The results in the sample indicate that the higher the ratio of expenditure on retailers and other providers of medical goods in relation to other types of expenditure in the composition, the higher the DR indicator and the lower the LE indicator. The ratio of expenditure on residential long-term care facilities in the composition seems to have had a positive effect

on both HLY indicators. The effect of expenditure ratios on providers of healthcare system administration and financing is not straightforward. This ratio had an effect on the composition of two variables: a negative impact on HLYm was identified, and there was a positive impact on LE indicators. Another two components of expenditure had negative effects on the response variables in the composition, namely: expenditure ratios on providers of ambulatory healthcare in the case of HLYf, and on providers of ancillary services in the case of the LE indicator. Therefore, the first research hypothesis is confirmed. The standard of living, as measured by GDP per capita in PPS, did not significantly correlate with overall CHE ratios or the response variables. The relationships would be stronger if outliers were omitted. Since all countries in the sample were developed countries and the values of all variables exhibited no significant differences, the structures of expenditure analyzed in this paper had similar patterns, and two groups of countries were identified.

Countries with the highest (or relatively high) overall expenditure ratios also have the highest (or relatively high) ratios of expenditure on hospitals, residential long-term care facilities, providers of ambulatory healthcare, providers of preventive care and providers of healthcare system administration and financing. They often exhibited low values of expenditure ratios on providers of ancillary services and retailers and other providers of medical goods and a relatively high performance in the response variables. Overall, Norway, Sweden, Iceland and Switzerland (used only for comparisons) achieved the best results in outcomes along with highest values of GDP per capita and CHE ratios (both except for Iceland, which is a small country that could have extraordinary conditions).

Countries with lower values of overall expenditure ratios exhibited low expenditure ratios on hospitals and providers of ambulatory healthcare. They had predominantly higher ratios on providers of ancillary services and retailers and other providers of medical goods and often lower ratios for the remaining categories. Countries with the poorest results are Hungary, Lithuania, Romania, Latvia and Bulgaria. These are the countries with low standards of living, relatively low CHE ratios (except for Bulgaria), the lowest LE and highest DR values. Slovakia and Croatia, exhibiting slightly higher performance in DR and LE, can be added to this group, as they had very low HLY values as well, while those of Bulgaria are higher. Slovakia and Croatia differ from the other five countries (and general features of countries with poor results) in their higher ratios for providers of preventive care and providers of healthcare system administration and financing. Accordingly, the second hypothesis is confirmed. Since the aspects of the relationship between health and wellbeing are crucial for SD, these results should be considered in strategies for SD in the EU as a whole, in member

states, and at lower levels. Furthermore, they should be incorporated into decisions taken regarding healthcare and other policies which affect wellbeing and overall SD. The countries which performed poorly should be inspired by the composition of the expenditure of those which performed better. It is a comprehensive task to evaluate the relationships between the resources devoted to the health system and its outcomes, since healthcare expenditure is only one of many quantitative and qualitative factors that contribute to health outcomes. It is not only the overall amount of resources but also their composition that can play a role in achieving desired health outcomes. Several patterns were discovered in this analysis. In order to increase effectiveness, efficiency as well as sustainability of health systems it is necessary to investigate all relevant aspects at different levels and their interconnections. The methodology applied is a challenging task, as is the role of policymakers in improving efficiency based on the efficiency metrics applied. A focus on these aspects should be a crucial part of the measurement of sustainability and the path towards SD, while compositional data analysis could be a part of the appropriate methodology for this measurement.

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The Principles of Sustainable Development and the Possibilities of Limiting the Global Effects of Smog by Medium-sized Cities Located in the European Union on the Example of Mikołów (Poland) and Žylina (Slovakia)

Zasady zrównoważonego rozwoju a możliwości ograniczenia globalnych skutków smogu przez miasta średniej wielkości zlokalizowane w Unii Europejskiej na przykładzie Mikołowa (Polska) i Žyliny (Słowacja)

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Abstract

The urban smog has negative global effects. They are expressed in the increased mortality of people, an increase scale of respiratory diseases as well as climate changes causing negative effects in the field of agricultural crops, which results in an increase in food prices. The occurrence of these phenomena mobilizes the global community to conduct activities aimed at limiting their occurrence. Medium-sized cities can play a significant role in this respect.

The element conditioning the life of city dwellers is the appropriate condition of the natural environment. In Polish and Slovak conditions, smog is becoming a problem, which negatively affects the health of citizens of these countries. Therefore, actions are taken to limit the occurrence of this phenomenon. They are described in the current ecological policy of both countries.

This article tries to show on the example of the Polish commune of Mikołów and the Slovak commune of Žylina the actions taken in them to reduce air pollution and thereby reduce the phenomenon of smog. In both analysed cities, measures taken to reduce the phenomenon of smog are implemented in a planned manner and may be an inspiration for other medium-sized cities in the world having air quality problems.

Key words: global effects of smog, medium-sized cities, environmental policy, urban smog, smog prevention, health

Streszczenie

Występowanie smogu przynosi ujemne globalne skutki. Wyrażają się one zwiększoną śmiertelnością osób, zwiększaniem się zapadalności na choroby dróg oddechowych a także zmianami klimatycznymi wywołującymi negatywne skutki w dziedzinie plonów rolnych co skutkuje wzrostem cen żywności. Skala tych zjawisk mobilizuje społeczność światową do prowadzenia działań mających ograniczyć ich występowanie. Znaczną rolę w tym zakresie mogą odgrywać miasta średniej wielkości.

Elementem warunkującym życie mieszkańców miast jest odpowiedni stan środowiska naturalnego. W warunkach polskich i słowackich problemem staje się zjawisko smogu, które w ujemny sposób wpływa na zdrowie obywateli tych państw. Podejmowane są w związku z tym działania mające na celu ograniczyć występowanie tego zjawiska. Wpisane są one w obecną politykę ekologiczną obu państw.

Niniejszy artykuł próbuje pokazać na przykładzie polskiej gminy Mikołów i słowackiej gminy Žyľina podejmowane w nich działania mające na celu ograniczyć zanieczyszczenie powietrza i tym samym zmniejszyć zjawisko smogu. W przypadku obu analizowanych miast podejmowane działania zmniejszające zjawisko smogu są realizowane w sposób planowy i mogą stanowić inspirację dla innych miast średniej wielkości na świecie, mających problemy z jakością powietrza.

Słowa kluczowe: globalne skutki smogu, miasta średniej wielkości, polityka ekologiczna, smog miejski, zapobieganie smogowi, zdrowie

Introduction

Urban agglomerations have problems related to air quality. Its pollution has a negative effect on human health, and also contributes to negative climatic phenomena. Polluted air also reduces agricultural yields (Shindell et al., 2012).

For a long time, London was a city that had good and unpolluted air. This was until the spring in 1952, when for four consecutive days smog persisted in it, which was called the *great smog*. It caused the death of about 4.000 adults. A similar phenomenon occurred in Los Angeles in the 1940s. The appearance of urban smog has caused the change in the legal regulations of England and the United States, and then in other countries around the world. They aimed at the planned control of the quality of air (Melamed, Zhu, Jalkanen, 2013).

The problem of urban smog and polluted air is manifested by the negative impact on the health of people living in large urban centres. The OECD (Organisation for Economic Co-operation and Development) report indicates that by 2050 contaminated air will be the largest external factor contributing to human mortality on an equal footing with contaminated water or lack of sanitary sewage (OECD 2012). It can be concluded that human health depends on air quality and the absence of urban smog.

The problem of urban smog is not only found in large cities. Increasingly, it affects small and medium-sized towns. It is a growing challenge for European cities, including Polish and Slovak. Due to the increasing intensity and its global effects, it has become part of the environmental policy of the European Union Member States.

Global effects of urban smog

84% of the world's population breathes polluted air. Annually, 3 million people die of smog, compared to 1.3 million who die in traffic accidents. Air pollution is classified by the WHO as one of the most important health risk factors in the world. It is ranked 4th among the 10 most important global risk factors related to behaviour, environment, work and metabolism. The greater health risks are only a poor diet based on highly processed products, smoking and high blood pressure (Deloitte-Sustainability Insights, 2017).

Smog is ranked 5th among the most harmful factors contributing to death in the world (Special Report On

Global Exposure To Air Pollution & Its Disease Burden IHME, 2019). Prolonged exposure to polluted air impairs the defences of the respiratory tract, paving the way for infections, and also hinders exchange in the lungs, which causes a greater burden on the heart. Breathing polluted air contributes to the development of many dangerous diseases related to the respiratory system (asthma, respiratory failure, bronchitis, lung diseases), the circulatory system (heart attack, embolism, stroke, chest pain), and cancer.

The particles that make up smog constitute the so-called climatic factors. They affect the amount of solar energy (including heat) that the Earth retains, and the amount of energy that is sent back into space. Climatic factors include the most important air pollutants such as ozone, methane, particulate matter and nitrous oxide. Particulate matter is a complex pollutant. Depending on its composition, it can have a cooling or warming effect on local and global climate. Other types of PM containing sulphur or nitrogen compounds have the opposite effect. As a rule, they act as small mirrors reflecting solar energy, which in turn leads to a cooling of the climate. Simply put, it all depends on the colour of the particle. *White* particles usually reflect sunlight, while *black* or *brown* particles absorb them. A similar phenomena can be observed on land. Some particles settle together with rains or snow, or simply settle on the surface of the ground. For example, *black carbon*, which is one of the components of fine particulate matter (PM) and is formed as a product of incomplete combustion of fuels, absorbs solar and infrared radiation in the atmosphere, affecting global warming. Other types of PM containing sulphur or nitrogen compounds have the opposite effect. As a rule, they act as small mirrors reflecting solar energy, which in turn leads to a cooling of the climate.

The *colour* of particles suspended in the air or settling on the ground is not the only property that can affect the climate. The air consists partly of water vapour – fine water molecules suspended in the air. Clouds are a more condensed form of water vapour. These particles play an important role in the cloud formation process; they affect their durability and the ability to reflect solar radiation; they determine the type of precipitation generated by a given cloud, the place of occurrence of such precipitation, etc. It is obvious that clouds are crucial to our climate; the concentration and composition of particulate matter may affect the date and distribution of traditional precipitation systems.

Changes in the abundance and frequency of precipitation are associated with real economic and social costs, as they usually have an impact on global food production and, consequently, on its price ((Zmiana klimatu a powietrze, 2016).

The principles of sustainable development and the problem of smog

In the process of sustainable development, not only material development, but also intellectual and spiritual development of man is important. Therefore, it is about re-evaluating the current lifestyle and introducing a person who is *aware* to a path of development, leading towards quality rather than quantity (Skowroński, 2006, p. 51).

The essence of sustainable development is to reconcile ecological, economic and social reasons. The assumptions of this concept come down to three basic goals:

- 1) ecological – consisting in stopping the degradation of the environment and eliminating its threats,
- 2) economic – seeking to meet the basic material needs of humanity using the techniques and technologies that do not damage the environment, and
- 3) social and humanitarian – which focuses on securing the social minimum (ending hunger, misery and poverty), health protection, development of the human spiritual sphere (culture), security and education (Machowski, 2003, p. 100-101).

The problem of urban smog is associated with the first goal of the analysed concept. It leads to degradation of the natural environment. It also has references to the second of the mentioned goals of the sustainable development. Urban smog is partly the result of the communication needs of city dwellers, business activities and living needs related to heating homes and flats in the winter period. Modern heating technologies and the increasing use of electric buses in public transport come to the rescue against smog. The occurrence of urban smog is also related to the third of the above-mentioned goals of sustainable development. This phenomenon causes negative social effects which are particularly damaging to the health of residents of smoky cities and thus to health care. In 2015, the United Nations General Assembly adopted 17 goals that set out the direction of efforts for a better life and a cleaner environment. They are the content of the 2030 Agenda – a global plan for sustainable development.

The current lifestyle using the Earth's natural resources intensively had led to more production and consumption than ever before. A larger number of toxic chemicals and particulates present in the air became the by-products of production and consumption processes. In turn, increased greenhouse gas

emissions to the Earth's atmosphere from manufacturing activities caused dangerous climate change. Climate change and air pollution are interrelated. By limiting air pollution, negative climate change can be countered.

Actions aimed at reducing air pollution and thus the phenomenon of urban smog are an important part of the 2030 Agenda indicated above. They constitute the specification of 17 goals set out in it. The problem of air pollution and smog is determined by specific tasks related to the implementation of Objective number 12 (Responsible consumption and production) and 13 (Climate action). Taking action to reduce air pollution, on the other hand, implements the assumption of Objective 3 (Good health and quality of life), and also inclines to actions postulated in Objectives: 7 (clean and available energy), 9 (Innovation, industry, infrastructure) and 11 (Sustainable cities and communities). Building a circular economy to lead to the effective management of Earth's resources, supports the protection of biodiversity and measures necessary to preserve the natural environment in water and on land, which also has an impact on air quality (Objectives 14 and 15) (UN, 2015).

The problem of urban smog and directions of scientific research related to it

The World Health Organization recognizes each substance that has a harmful effect on health or is dangerous for other reasons, regardless of the physical form of the substance, as air pollution (Krzyżanowski, 2008, p. 47-50). The phenomenon of urban smog accumulates these pollutants, in the long run leading to negative health effects or even death. So one can talk about the catastrophic effects of urban smog, which are greater the longer it lasts in a given territory.

Taking into account the Polish perspective as the main source of air pollution, anthropogenic emissions resulting from coal combustion in central heating furnaces by homeowners and from industrial activities, as well as those resulting from emissions from public transport are indicated. One of the features of air pollution is the possibility of their movement. The fuel and energy, as well as metallurgy industries are largely responsible for dust pollutions that contributes to the formation of smog in Poland (Malec, Borkowski, 2016, p. 161-170)

In relations to smog, there are a lot of studies on the problems that are raised by this phenomenon in large urban agglomerations. A good example illustrating this direction of research are works devoted to the occurrence of smog in various provinces and areas of China in a social context (Zhou, Dai, 2017).

Another research direction related to the issue of smog is focused on designing and developing the functionality of air pollution monitoring systems in cities and notifying their residents about the level of pollution (Rhode, Muller, 2015).

Research in the field of urban smog also takes into account the activity of citizens and non-governmental organizations in the field of environmental education regarding the harmfulness of polluted air and the possibilities of preventing this phenomenon (Gallet 2018, Hernandez, 2015).

Current ecological policy of Poland and Slovakia and the problem of urban smog

On February 14, 2017, the Council of Ministers adopted a new medium-term national development strategy – Strategy for Responsible Development until 2020 (with a perspective until 2030) – SRD. The strategic goals, activities and projects indicated therein were to be reflected in all Poland's strategic documents and thus also the environmental strategy. As a result of the work of the Ministry of Environment, a new document was created, which was named the 2039 Ecological State Policy 2030 (ESP). It takes into account the problem of air pollution in Poland and its causes.

The priority of the new ecological policy of Poland is to be the construction of an innovative economy while maintaining the principles of sustainable development, which are a requirement of modern state policy. It is man who is the supreme value in the 2030 Ecological State Policy by drawing attention to such issues as the quality of life, health and well-being of Poles. The key to achieving the goals of the new ecological policy is the proper use of the environment at the local government level, especially through rational spatial planning, which helps to protect the population against air and noise pollution and nature against excessive pressure of human activity.

Striving to improve the quality of life creates a constant need for development, which can only be achieved through the sustainable use of natural resources. None of the forms of human activity can cause permanent deterioration of natural resources. That is why the development process will be monitored by means of appropriate indicators enabling the assessment of such aspects as: the improvement of water and air quality, reduction of impact on climate change and preservation of the full species composition of native fauna and flora.

As part of the National Environmental Policy, actions are to be implemented until 2030 to improve the air quality by reducing low emissions. At the governmental level, they mean the preparation of relevant provisions and instruments for financial support for investments and coordination of their implementation in the regions.

In Poland, air, water and soil pollution have decreased since 1990 as a result of structural changes in the economy, the implementation of the state's environmental policy and its implementing programs with pro-environmental investments, and tightening the legal regulations. Effective management of in-

dustrial emissions, especially from the energy sector, significantly reduced their share in exceeding air quality standards in Poland and allowed for a significant reduction in greenhouse gas emissions. However, effective climate protection requires further emission reduction, using constantly improved technical and natural methods.

The most important challenges in this area include the elimination of the so-called low emission, which is the result of the use of solid fuels (including low-quality coal) and waste is the domestic and municipal sector, primarily for individual heating of buildings, exploitation and technological maladjustment of furnaces and small local boiler rooms, as well as the low energy standard of buildings. In urban areas and along commuting routes, a significant share of air emissions from transport has a significant impact on air quality. Currently, regulations on emission standards for cars are adopted at the EU level, and activities in the field of electric means of transport are promoted at the national level (Uchwała Rady Ministrów z dnia 16 lipca 2019 r. w sprawie przyjęcia *Polityki ekologicznej państwa 2030 – strategia rozwoju w obszarze środowiska i gospodarki wodnej*, 2019).

In February 2019, Slovakia adopted a new Environmental Policy with a perspective until 2030. Its main element in the field of improving air quality are activities aimed at significantly reducing pollutant emissions over the period under analysis. The instruments that are currently used (emission limits, technical requirements and operating conditions) are insufficient. In the case of Slovakia, the national emission reduction program is to be key to achieving the commitment made. It refers to the main areas with the highest emission reduction potential, such as transport, household heating, agriculture, industry and energy. An effective measure contributing to the reduction of the smog phenomenon in Slovakia may also be the emission trading scheme, which is to help reduce emissions of a given pollutant taking into account the benefits of this title for the environment, society and the economy. This system would replace the current charging system and would be introduced for the pollutants that are the most problematic for Slovakia in terms of achieving the emission targets set.

Another element of the Slovak new environmental policy in the field of air protection is to be the dissemination of the latest combustion technologies. This is particularly relevant to industrial installations. The emerging new plants, especially medium-sized ones, will have to have documentation confirming that such installations are environmentally friendly and are based on the latest technological achievements limiting their negative impact on air quality.

As part of the adopted ecological policy, measures will be promoted in Slovakia aimed at switching households from the use of old heating appliances to

solid fuel, which significantly contribute to air pollution, to more efficient heating installations. Emission standards and energy efficiency of combustion equipment, including used fuel, will also be monitored for small combustion installations. Illegal waste burning in domestic furnaces will be controlled by independent authorities and punished to avoid air pollution and damage to public health. At the same time, legislative and support mechanisms will be introduced to replace older, less energy-efficient heating devices that do not meet the latest emission standards. Market regulation will be introduced with heating devices up to 0.3 MW. Only devices that meet the new emission criteria will be available on the market. The population will be encouraged to use municipal heating plants whenever possible.

Another element of the currently implemented environmental policy of Slovakia are activities aimed at limiting the use of coal to generate heat and electricity.

As part of the ongoing environmental policy in Slovakia, low-emission transport based on electromobility and alternative fuels with a minimal impact on air quality will be promoted. Transport and in particular passenger cars have an increasing share in the total greenhouse gas emissions and other pollutants, in particular nitrogen oxides. It is responsible for almost half of all nitrogen oxide emissions. Low-emission public passenger transport and city bike rides will be preferred in urban areas of Slovakia. Long-distance public transport will promote low-emission public passenger transport, in particular railways, trams and electric buses. Municipalities will be able to charge owners of passenger cars for congestion and create conditions to limit car traffic, creating free zones. In addition, the cities will have different emission zones with access for vehicles that meet certain emission criteria. The tax system of Slovakia is already in favour to low-emission transport. In addition, vehicles negatively affecting the environment will be taxed higher (Greener Slovakia. Strategy of the Environmental Policy of the Slovak Republic until 2030).

Research objectives and methods

The cognitive goal of this article is to show measures to reduce the phenomenon of smog in medium-sized cities on the example of Mikołów and Żylica, taking into account the currently implemented ecological policy in Poland and Slovakia.

The theoretical goal is to indicate to what extent the activities related to smog in Mikołów and Żylica coincide with the main directions of research in this field conducted by scientists.

For the purposes of this study, the case study method was used. To prepare it, the so-called secondary research of documents, articles, analyses and press articles available on the Internet were used. The materials collected in this way allowed to com-

prehensively describe the tasks and initiatives aimed at reducing the phenomenon of smog in the analysed cities.

Actions to reduce the phenomenon of urban smog in Mikołów

Mikołów is a town with 40,000 inhabitants located in the Silesian voivodeship in Poland. It is a town that aspires to develop with the principles of ecology and sustainable development. To realize this intention, various activities and projects allowing to achieve this goal have been implemented and promoted in the analysed city for many years (Czuba, 2018, p. 347-357).

In the autumn-winter period, the so-called problem of low emissions appears in Mikołów. Exhaust fumes from cars, dusts and gases emanating from domestic heating furnaces and coal boiler rooms are its source. The town wants to change this situation. In the municipal office, you can get a subsidy to replace the outdated source of heating the house with a more ecological one from the funds of the government's CLEAN AIR program.

However, human awareness plays the most important role in the fight against low emissions. More and more residents of Mikołów are aware of the need to burn the right quality coal.

In November 2016, the City Guard of Mikołów together with firefighters from the Volunteer Fire Brigade started a series of demonstrations of ecological coal burning. About 150 people took part in the first shows. Similar events were also carried out in nearby towns neighbouring Mikołów. During the shows, two identical furnaces were presented, with the same fuel, wood and coal of the same quality.

Traditional bottom combustion was used in the furnace producing smoke, while in the one with less smoke – upper combustion. The second method is more difficult to master because the furnace should be loaded with coal straight away, and only then the kindling is placed on it and the entire insert should burn out to the end.

This type of combustion produces much less smoke and the additional benefit comes in the form of more heat energy. The above mentioned furnace demonstrations are complemented by instructional companies regarding these issues. They can be viewed on the city guard website (city guard website from Mikołów, 2018)

In 2015, City Guards from Mikołów received over 100 reports due to excessive smoke. 84 burning controls were carried out and reports were drafted. At that time, it turned out that the reason for the smoke was inefficient coal burning, and only in a few cases it involved burning of unauthorized waste (Demska, 2016).

The new and aesthetic facades of the buildings are visible in several Mikołów housing estates. After renovation, heating the same buildings is cheaper

and uses less fuel for this purpose, and therefore air pollution is also reduced. In 2018, dozens of buildings were thermo-modernized in Mikołów. Thanks to the revitalization of the city centre, tenement houses located in the town square and on the streets adjacent to it, which are currently heated with coal, will be connected to the municipal heating network and will stop producing smoke.

In mid-2018, the municipality of Mikołów also began installing solar installations. The mayor of this town raised over PLN 3.2 million from the European Union for this purpose. These funds will allow for the installation of ecological installations in 173 households in Mikołów. (Urząd Miasta Mikołów, 2018).

In 2018, the largest infrastructure investment began in Mikołów, i.e. the construction of a transfer centre. As a result, the vicinity of the station and the organization of traffic in this area will change. A large parking lot for cars and buses will be created to service the transfer centre. The changes are to serve better and more convenient travel by public transport. In addition, the Upper Silesian-Zagłębie Metropolis, of which Mikołów is a member, plans to purchase about 300 electric buses. They will drive residents of this town without the exhaust emissions that aggravate the smog phenomenon (Urząd Miasta Mikołów, 2018).

In addition to the aforementioned measures to reduce the phenomenon of smog, Zakład Inżynierii Miejskiej spółka z o.o. (ZIM), which is owned by Mikołów, in 2007-2013 carried out investments regarding the modernization of boiler rooms and heating installations.

As part of the project, heating mains along with technical infrastructure were rebuilt and built, and the existing heat exchanger stations were modernized. One of the two municipal boiler houses has also been modernized, as well as its dedusting and flue gas installation, and a new three-pipe chimney has been built in the modernized 60 m high heating plant (ZIM website).

The presented actions aimed at limiting the phenomenon of smog in Mikołów were planned and medium-term. In Mikołów, the public space has been striving to be ecological and aesthetic for many years. It is worth doing it because it is a common good. Therefore, it should be neat, aesthetic and have a positive impact on the environment which is inhabited by residents of this town.

The problem of urban smog in the city of Žylina in Slovakia

Žylina is the fourth largest city in Slovakia with 80,000 inhabitants. It is an important administrative, business and industrial centre and the capital of the Žylina Region – a region bordering the Silesian and Lesser Poland voivodeships. It is located in a valley in which dirt is accumulated, including those flowing

in from outside. The main transit car thoroughfares of a quasi-urban highway run through the centre of Žylina. What distinguishes Žylina from Polish cities is that legally none of its residents burns coal. The municipal heating network and gas heating are the foundations of heating, just like in other Slovak cities. Single-family houses on the outskirts of the city are heated with gas (it is cheaper than in Poland) or wood. Burning garbage in domestic boilers is a marginal phenomenon. However, the surrounding cities and villages are the problem. The nearby Kysuce region is one of the few in Slovakia, where heating of houses with coal is common (Orava is the second such region). It causes that during the heating period, the valley of Kysuce River is covered with smog from individual sources of emissions. The pollution generated in this way flows down to Žylina. In addition, there is quite a large inflow of pollution from abroad – mainly from the nearby Czech Silesia, including mainly from the metallurgic plants in Trinec. Pollution from the Czech Republic, Poland and Hungary also flows into Žylina. In order to learn the scale of this phenomenon in Slovakia, pollution measuring stations from border areas are to be installed in the border areas. One of the biggest sources of pollution is the local industry, including paper factories located near the centre of Žylina, commonly known as *Celulozka*. Despite the continuous improvement of technology, the plants are still polluting and are considered a larger ecological problem than local low emissions.

As part of the fight against smog in Žylina, actions are taken to organize and reduce car traffic. Žylina gives the impression of a city that is subordinate to cars. Transit car thoroughfares of a quasi-highway nature cross its centre. There is a huge noise everywhere, there is dust on the sidewalks, and a walk around the city is not very pleasant. The infrastructure for pedestrians and public transport passengers is also not conducive to giving up the car. The pavements in the centre are crooked, dirty and made of very unsightly paving. This is a sensation, because in other cities of Slovakia pavements are built of asphalt. The city, fighting pollution, follows the 2013 Air Quality Improvement Program. Its implementation includes: reducing the activity of the industry excessively polluting the air, development of bicycle transport, modernization of the trolleybus network, renewal of street greenery, revitalization and expansion of the existing parks, reconstruction of inter-block greenery and increasing the area of green areas in the city. These activities are already visible in the city in question. Bike paths that are created in the blocks of flats and on the outskirts of the city look good. New pavements are currently being built exclusively from asphalt, which also promotes walking. Scooters are very popular in the city (in blocks of flats), especially as access to school, skateboards as well to a lesser extent. Both methods of transport require a smooth surface, mainly asphalt. According

to the Slovak law, people on scooters and skateboards can move both on bike paths and on pavements. Outside the centre of Žylina, the conditions for cycling and scooters are good, but the closer it gets to the Old Town and the train station, the worse it gets.

In the case of Žylina or Slovak smog in general, the topic of low heating emissions does not appear at all. Not because it does not exist – limiting wood burning on the outskirts of the city would also significantly improve air quality, and the liquidation of smoking furnaces in the nearby villages of the Kysuce Nowe Miasto and Czadca would improve it even more. However, there is a lack of awareness that such a problem exists, monitoring stations, smog information campaigns, and scientific research. Smog itself is not negated, although it is several times smaller than in Poland. Activities in this field in the analysed city in the coming years will focus on transport. The motorway bypasses of Žylina will be completed in a few years. It can be expected that then the car traffic in the centre will be limited, which is even supported by the die-hard car supporters taking into account European trends in this area. Also the Slovak Air Act goes in this direction – one of its most important provisions is the establishment of low-emission zones in city centres, where cars that do not meet exhaust gas quality standards will not be allowed. Therefore, it can be expected that such a zone will be established soon in Žylina. (Loginow, 2017).

Discussion

Moving to the discussion on the case studies presented above, it can be stated that the actions taken in Mikołów to reduce the phenomenon of smog fit into the previously presented directions of scientific research in this field. However, the second perspective, concerning the research and development of pollution monitoring systems, is becoming particularly important. Mikołów has sensors located in its individual parts and the information derived from them is presented graphically on the Airly website. So far, however, no system of text notifications for residents has been created, providing information on the threat of smog.

In the case of the analysed Slovak city of Žylina, taking into account the outlined research perspectives on the phenomenon of smog, one can basically find a reference only to the issue of installing pollution sensors originating mainly from the countries bordering Slovakia. These actions are taken to determine the scale of imports of this type of pollution. In the case of Slovakia, there is basically no involvement of NGOs and citizens themselves in environmental issues. This element is different from the Polish specificity.

Despite the low environmental awareness, which is confirmed by research conducted in Poland, it begins to gradually increase (Płatkowska-Prokopczyk,

2017). Such changes can also be seen in the attitudes of the inhabitants of Mikołów, which are becoming more and more environmentally friendly. They are manifested in reporting suspected burning of illegal items in central heating furnaces or burning of poor quality coal. Their interest in the so-called top burning is growing, which is more ecological and causes much less exhaust gas. These attitudes correspond to the third research perspective presented in this study, related to the importance of social awareness and non-governmental organizations as important entities for reducing the phenomenon of smog. Local ecological organizations run various types of training directed at pupils and teachers of schools in Mikołów to make their participants more sensitive to the problem of smog. (barrel alarm of Łaziska website).

It seems that in order to achieve successes in reducing urban smog, it is important to harmonize actions and initiatives undertaken by the government, local government of a given city and by its residents and non-governmental organizations operating on its territory. In the case of Mikołów, these relationships are visible. The Polish state, adapting to the EU requirements regarding the level of pollution, implements an environmental policy, which includes reducing low emissions in cities and thus the phenomenon of urban smog. This ecological policy is reflected by the government program CLEAN AIR, which includes social campaigns aimed at sensitizing urban residents to the problem of urban smog, and a subsidy program for the replacement of traditional coal furnaces with fifth generation coal or gas furnaces (Shakhil, 2018) carried out for two years. Mikołów, and especially its authorities, promote the possibility of using the above-mentioned subsidies. In this area, activities carried out by the Polish government meet with the activity of the municipal authorities of Mikołów.

For many years, Mikołów has been independently implementing investments that have an impact on reducing low emissions. These activities were presented in a case study and relate to the modernization of municipal boiler rooms, expansion of the heating network, conducting thermo-modernization of housing estates and taking actions to encourage residents to use public transport more often. The weakness of activities in this respect is the lack of activities encouraging owners of single-family homes to use the heating services of municipal boiler rooms despite a similar heating cost to the cost of gas heating.

Similar mechanisms exist in Slovakia and the analysed city of Žylina. The new ecological policy of Slovakia adopted in 2019 until 2030 takes into account the issue of air pollution and its components are activities related to conducting appropriate activities to reduce the phenomenon of urban smog. In case of Žylina, the assumptions adopted in the field of environmental policy of Slovakia are manifested in the promotion of low-emission transport in this

city and shaping conditions for its further development, as well as in the reconstruction of the road network to relieve the city centre from the negative effects of excessive car traffic.

Summary

This article addresses the possibilities of counteracting urban smog and its global negative effects in medium-sized cities. The conducted considerations in this area were referred to Polish and Slovak experiences. In the case of both analysed cities, i.e. Mikołów and Żylna, it can be seen that the measures implemented in this area related to the current ecological policy of the given country on which territory they are located.

In the case of Poland, the main factor in creating urban smog is the so-called low emissions mainly from individual furnaces of home and apartment owners, as well as city boilers. Therefore, Poland is carrying out activities aimed at limiting the scale of this phenomenon. Their expression is the currently implemented government program STOP SMOG, which includes subsidies for replacing old coal furnaces with gas furnaces. The municipal authorities of Mikołów promote the possibility of using this type of subsidies among the residents. An additional investment-related activities related to the modernization of municipal boiler rooms or expansion of the heating network, as well as thermo-modernization of blocks. Also the social perspective related to the change in the behaviour of residents regarding the methods of using coal furnaces, as well as their transition to gas heating is important in this respect. The social perspective also includes the activity of local government organizations or municipal guard initiatives to educate residents of Mikołów about the risks of smog and change their attitudes regarding burning plastic waste in furnaces and teach them the so-called top burning.

In turn, taking into account the specificity of Slovakia, its main problem related to the occurrence of smog is primarily public transport and road traffic. The presented phenomena can be seen in the case of Żylna. However, actions are being taken in this city to promote electro-mobility, increasing the amount of green areas absorbing pollution, and road investments to relieve the city centre from air pollution resulting from excessive vehicle traffic.

It should be assumed that Poland, being successful in reducing low emissions, which is the main source of smog in this country, will benefit from Slovak experience focusing on issues of electro-mobility development and reducing excessive road traffic.

Despite comprehensive measures implemented in Poland to reduce the phenomenon of smog and their visible positive effects, an important limitation of their effectiveness is the economic barrier to the transition to more ecological forms of heating for many households. This situation results from the price of

coal in Poland, which means that it is currently the cheapest carrier of heat energy. The cost of gas heating in Poland is 20-30% more expensive compared to heating with coal. Following the example of Slovak solutions, it may be necessary to introduce special, reduced tariffs for owners of electric furnaces for heating in Poland, and promote the connection of property owners to municipal heating networks operating in many Polish cities.

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Indicators of Sustainable Use of Wildlife: Problems of Formation and Implementation in the Russian Federation

Wskaźniki zrównoważonego użytkowania dzikiej przyrody: problemy związane z ich formowaniem i wdrażaniem w Federacji Rosyjskiej

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Abstract

This article examines the legal category sustainable use of wildlife as a process of realization of rights and obligations by the subjects, based on the provisions of the Concept of Sustainable Development, International law and National legislation on wildlife. This process is aimed at ensuring biological diversity, achieving a balance of economic, environmental and social interests of the citizens, society and the state as a whole, the process, as well as to preserve the reproductive ability of the animal world.

Based on the analysis of certain provisions of the legislation on wildlife and law enforcement practice, the author makes a conclusion that Russia lacks a complex system of legal support measures for the sustainable use of wildlife. Legal, economic, ideological, organizational measures, proposed by the author of the article will make it possible to use wildlife in such a way, that will preserve and increase the number of wildlife populations, maintain an ecological balance, and ensure the needs in favorable environment for life and health for the present and future generations. The measures proposed by the author can create the legal basis for sustainable management of wildlife. The author suggests, that these measures can be useful in developing national programs for sustainable use of wildlife; providing incentives for the transition to sustainable use; strengthening the dialogue between the authorities and the population in order to involve them into the process of sustainable use of wildlife, so that to ensure a balance of economic, environmental and social interests.

Key words: wildlife, sustainable use of wildlife, legal support measures, conservation of biodiversity of wildlife, environmental balance, public and private interests

Streszczenie

Artykuł analizuje kategorię prawną zrównoważone użytkowanie dzikiej przyrody rozumianą jako proces realizacji praw i obowiązków przez podmioty, w oparciu o postanowienia koncepcji zrównoważonego rozwoju, prawa międzynarodowego i ustawodawstwa krajowego dotyczącego dzikiej przyrody. Proces ma na celu zapewnienie różnorodności biologicznej, osiągnięcie równowagi interesów ekonomicznych, środowiskowych i społecznych obywateli, społeczeństwa i państwa jako całości oraz zachowanie zdolności reprodukcyjnych świata zwierząt.

Na podstawie analizy niektórych przepisów dotyczących dzikiej fauny i flory i oceny realizowania tych zapisów w praktyce, autorka stwierdza, że w Rosji brakuje kompleksowego systemu prawnych środków wsparcia dla zrównoważonego użytkowania dzikiej przyrody. Zaproponowane przez autorkę artykułu rozwiązania prawne, ekonomiczne i organizacyjne umożliwią korzystanie z dzikiej przyrody w taki sposób, który zachowa i zwiększy liczbę populacji dzikich zwierząt, utrzyma równowagę ekologiczną i zapewni zaspokojenie potrzeb życia i zdrowia dla

obecnych i przyszłych pokoleń, w korzystnym środowisku. Środki zaproponowane przez autorkę mogą stworzyć podstawę prawną dla zrównoważonego zarządzania dziką przyrodą. Autorka sugeruje, że rozwiązania te mogą być przydatne w opracowywaniu krajowych programów zrównoważonego użytkowania dzikiej przyrody; zapewnienia zachęt do przejścia na zrównoważone użytkowanie; wzmocnienia dialogu między władzami a ludnością w celu włączenia ich w proces zrównoważonego wykorzystywania dzikiej fauny i flory, aby w ten sposób zapewnić równowagę interesów gospodarczych, środowiskowych i społecznych.

Słowa kluczowe: dzika przyroda, zrównoważone użytkowanie dzikiej przyrody, środki pomocy prawnej, ochrona bioróżnorodności dzikiej przyrody, równowaga ekologiczna, interesy publiczne i prywatne

Introduction

Wildlife is an integral part of different biological diversities and thus is one of the conditions for solving problems and achieving the environmentally oriented development. Environmental protection is not an absolute value and environmental requirements should be set at a level that does not impede the economic growth. In fact, it is a question of implementing the concept of sustainable development, stated in the international document *Our Common Future* and, therefore, implemented in the international treaties of the Russian Federation on environmental protection and the sustainable use of its components. Thus, ensuring sustainable use of wildlife is a strategic task, which is also aimed at realizing Russia's international obligations. The efficient economic development as well as the present and future generations welfare strongly depend on the proper implementation of this task. In order to complete the task, first of all, it is necessary to form an effective legal tool kit. With the help of a set of legal measures, it is possible to organize such use of the animal world that will save and increase the number of wild animal populations, maintain the ecological balance in nature, and ensure the satisfaction of the present and future generations needs. Ensuring the sustainable use of wildlife is one of the acute issues of the modern world, requiring urgent resolution at the international and national levels.

According to the report on the current environmental situation adopted in 2016, *one in eight bird species, one in four mammal species, every third amphibian species, and six out of seven species of sea turtles* (State report, 2016) are currently threatened with extinction. According to the WWF *Living Planet* report, the average annual decline in the number of mammals, birds, and fish populations is 2%. Currently, there are no signs of a slowdown in this process. If these trends continue, then by 2020 the number of populations will decrease by two-thirds (67%) (WWF's Living Planet Report, 2016). Over the past 30 years the flying insects population of the nature reserves and national parks in Germany, decreased by 75%. Wherein, the main threats to the animal world and its habitat are directly related to human activities. The environmental consequences of human activities are increasingly exceeding the biological assimilation potential of the Earth, which ultimately leads to the extinction of wildlife. All this,

according to experts, can lead to an irreplaceable loss of biodiversity on a large territory of the earth by the middle of the 21st century. Scientists from the University of Sydney and the Chinese Academy of Agricultural Sciences have analyzed 73 studies from different countries over the past 40 years on reducing insect populations and published a report (Sanchez-Bayoa, Wyckhuysbn, 2019). According to them, the total biomass of insects is reduced by 2.5 percent per year, which means that insects can disappear during this century.

The National Environment Commission claims that only a healthy economy can provide the resources needed to invest in environmental protection. For this reason, sustainable development aims at a decent standard of living for all, combined with maintaining the integrity of all ecological systems. Of particular importance in this situation is the doctrinal development of the concept of sustainable use, provided through legal, economic, ideological, organizational measures. These measures will achieve a balance of interests between society, business and the state.

In this regard, the opinions and decisions proposed in this article can be used by the representative and executive bodies of the state power in Russia and the CIS countries in the development of new plans and strategies in the field of sustainable use and conservation of wildlife. This article may also be of interest to environmental lawyers engaged in research on the sustainable development of sustainable use of wildlife and the conservation of wildlife, as well as ordinary citizens who are interested in the environmental consequences of human activities, which pose a threat to the animal world and its environment.

1. Sustainable Use of Wildlife: a Process or a State

Based on international law, all states have the sovereign right to dispose of their natural resources in accordance with their environmental policy. States are responsible for ensuring that any economic activity carried out on their territory or under their control does not cause any significant damage to the nature of other states outside the borders of national jurisdiction. States are also responsible for the sustainable and safe use of natural resources, including natural resources exclusively on their own territory, in order to promote the development of their peoples, paying particular attention to the rights of indigenous peoples, as well as the conservation and sustainable

use of natural resources. Thus, almost all countries of the world recognize the need for sustainable use of biological diversity. To ensure this use, states adopt strategic planning documents at the international level and carry out other actions aimed at resolving issues related to the conservation of natural resources. Wild animals living within the territorial borders of the state are under their sovereignty and are their property. Thus, it is very important for each state to provide legal support for the sustainable use of wildlife timely and efficiently, since *the condition of this component of the natural environment on the globe will mainly depend on this* (Kolbasov, 1982). At the present stage, the necessary task of states is to establish international cooperation to solve the complex problem of the sustainable use and conservation of certain species of the animal world, their habitat, as well as all biodiversity in natural ecological systems.

Russia plays a leading role in maintaining global biodiversity through conservation of natural ecological systems, combined with a significant part of the world's species diversity. In the modern world, under the influence of negative anthropogenic factors on natural objects, including the objects of animal world, full and comprehensive ensuring of the sustainable use of wildlife is possible only by applying a whole range of measures for this sustainable use, reproduction and conservation. There appears a need for a comprehensive study of different aspects in the protection and use of wildlife in order to develop interrelated measures aimed at ensuring the sustainable use of wildlife. The need for legal support for the sustainable use of wildlife is directly related to the satisfaction of the material and spiritual needs of all people on the planet. Thus, nowadays there is no doubt that the implementation of sustainable use of wild animals is of great importance for the whole mankind.

According to some authors, the sustainable use of wildlife should be regarded as an ongoing process, and not a state, which must be sought. This happens because the ecological knowledge of the species and populations used, on the one hand, and the socioeconomic knowledge of wildlife, on the other hand, remain uncertain. This is due to the fact that economic, environmental and social requirements for the use of the animal world change in time. In order for the use to be sustainable, public administration of the animal world should comply with new requirements, standards, and criteria in the field of its use. So, the question of whether a particular use is sustainable or not can be answered by analyzing the past (Webb, 2002). From this point of view, sustainability can be considered only as a process supported for a certain period time. Probably, sustainability requires not only the study of environmental information, but also the ability of the existing wildlife management system to meet and adapt to new changes.

This suggests that the given characteristic of the sustainable use of the animal world can be much more important than a detailed study of each object of the animal world and their interaction within the environmental system. Such treatment of sustainability as a process means that it is impossible to determine whether the use is sustainable or not at a specific (given) time section. The only thing that can be determined is whether the use has been sustainable until now, and what is the probability of the use to be more or less sustainable in future.

However, this position is definitely of great importance for the legislation and state environmental policy, for which it is necessary to have evidence that the use is sustainable before allowing it in future.

This view is widely supported by most of the key policy documents on sustainable use. So, according to the White Oak principles of SU, sustainable use is a dynamic process, not a state. This position is also supported in the Analytical Framework 2001 (Moncrieffe, Luttrell, 2005). The Africa Adaptation Program emphasizes the dynamism of this process: sustainable use is not a fixed state, but rather a consequence of balancing a wide range of factors that vary depending on the context of use. More than that, the sustainability of use cannot be regarded as definite, but it is rather probable, since it can change if the conditions under which the management is carried out change. The IUCN experts on sustainable use state that the enhancement of the wildlife sustainable use is a long time process of improved management of these resources. Although this value is not entirely clear, it is certainly interpreted in support of the concept of sustainable use of the animal world as a process, not a state. It is in the process of sustainable use that the requirements of the rule of law are transferred into practical life.

The study of the institutional meaning of the concept *sustainable use of wildlife* is of significant importance, which is due to the harmonization of all its components (economic, social and environmental), which allows to meet the needs of society and the state. This study becomes very important at the present stage of development of legal regulation of relations in the field of wildlife protection and use.

Global environmental problems associated with such negative processes as loss of biological diversity, climate change, desertification, deforestation, water pollution, the consequences of natural and technological disasters directly affect the state interests of the Russian Federation and the interests of its citizens. Therefore, the sustainable use of the animal world is to some extent connected with the needs and interests of the state and society.

Thus, sustainable use of the animal world should be defined as a process of exploitation and consumption of the animal world resources, i.e. the components of natural environment that can be removed by humans for their needs. This process is subject to legal regulation by the norms of various industry affiliations.

That is why sustainable use of the animal world is so diverse in character.

2. A Variety of Legal Support Measures: Problems of Their Implementation in Russia

According to M.N. Marchenko, the concept of *legal measures (means)* allows to summarize all those phenomena which are designed to achieve the goals set in the legislation (Marchenko, 2001). V. A. Sapun notes that the main purpose of legal measures is to show what social problems can be solved through these legal mechanisms, where and how they can be used in practical legal activities to achieve socially significant results (Sapun, 1992). Thus, the concept legal measures, which help to provide sustainable use of the wildlife includes the idea of sustainable use of the animal world as a model of subjects behavior, stated in the legislation on the animal world, aimed at achieving the optimal balance of interests between society and the state.

In order to ensure the sustainable use of the animal world, to preserve its habitat, to maintain the functioning of natural environmental systems, the norms of legislation on the animal world are designed to affect the subjects of legal relations. The result of such influence is a balance of interests between society and state. The main legal tool kit of legal regulation is legal documents. Legal documents are regarded as a place where the that primary legal norms and rules of conduct are stated, which represent the starting point for the means of action (technology), legal awareness, existence and realization of law. Legal documents help to achieve the sustainability of relations in the use of wildlife. Such legal documents comprise normative legal acts, *documents containing decisions of an individual nature, documents fixing facts – the will of the subjects of law* (General theory of state and law. Academic course in 3 volumes. Volume 2, 2002). Therefore, it is hardly possible to agree with the opinion of some scholars who argue that the legal framework includes only laws, decrees, resolutions of state authorities, orders, instructions and other regulatory documents of ministries, departments, organizations, local authorities (URL: Legal support, 2018).

However, to ensure the sustainable use of the animal world, it is necessary to have a set of measures in which legal regulation plays an important, but not the only role. The concept of *legal support for the sustainable use of the animal world* is a broader concept than *legal regulation*, since it includes not only a system of regulatory legal acts, but also a whole set of interrelated measures of an economic, organizational nature.

Another important means of ensuring the sustainable use of the animal world objects is the formation of an effective economic stimulation mechanism, which will ensure the implementation of environ-

mental, economic and social interests of business entities.

The system of economic incentives operation is provided by special legislation of the Russian Federation. This includes, first of all, tax, banking, budget legislation. According to the Art. 473 of the Tax Code of the Russian Federation, *only those categories of taxpayers whose activities are directly related to the use of the animal world are exempted from paying a fee for the right to use wildlife and biological resources* (Tax Code of the Russian Federation of August 5, 2000).

However, for legal entities and citizens whose activities are not directly related to the use of objects of the animal world, but have a negative impact on them, tax concessions are not provided by law. For example, the activities of industrial enterprises, agricultural organizations cause great harm to the animal world, their habitat, as well as natural environmental systems. In its internal essence, the producers of goods are not interested in environmental protection, because economically and technically they can produce more products at lower costs if they do not spend money on environmental protection. Therefore, the task of introducing benefits on *environmental taxes* is to stimulate the enterprises to change the technological process in favour of environmental friendliness of production. Improving the environmental friendliness of production can be achieved, firstly, through the acquisition of treatment facilities. For enterprises, both fees and treatment facilities purchase lead to increased costs. Tax incentives in this case offset the additional costs of financing activities to reduce emissions. Secondly, for the production process in which a harmful substance is a necessary by-product, tax incentives can stimulate the substitution of the production of a *non-environmentally friendly* product for another, a *more environmentally friendly one* (Kireenko, Baturina, Golovan, 2014).

Noting the importance of economic incentives for the protection of wildlife, I consider it necessary to develop a mechanism for providing tax benefits to legal entities and citizens whose activities are not related to the use of wildlife. As a way of influencing the interests of business entities, I propose the following economic incentive measures that are aimed at the conservation and sustainable use of wildlife. It is advisable, firstly, to fix taxes at a higher rate in relation to industrial enterprises and agricultural organizations whose activity is not directly related to the use of wildlife, but cause great harm to wild animals and their habitats. The introduction of increased taxes will be aimed at reducing the number of enterprises that have a negative impact on the environment. Secondly, it is proposed to develop tax incentives (lowering the income tax rate) for those legal entities and individual entrepreneurs whose activity is focused on the conservation of wildlife and their

habitats. Thirdly, an important economic incentive measure is to provide subsidies from the budget of the Russian Federation subject to those users of the animal world whose activity is aimed at restoring, preserving, increasing the number of individual species or their populations on the basis of data from state registration of wildlife objects.

The role of public administration in solving the problems of ensuring the sustainable use and protection of wildlife is great. The effective system of government regulation creation is one of the key activities of the state in the field of protection and use of wildlife. This fact has been repeatedly emphasized in regulatory acts which determine the main directions for the development of environmental legislation on the long term basis. Thus, in the Fundamentals of State Policy in the Field of Environmental Development of Russia for the Period until 2030, one of the first tasks to achieve the strategic goals of the state policy in the field of environmental development is the formation of an effective management system in the field of environmental protection and environmental safety, providing the interaction and coordination of government bodies activities.

The formation of a reliable and effective mechanism that can provide a balance of environmental, economic and social interests to meet the vital needs of the population is the main task of state administration in the field of protection and use of wildlife. Such a result is possible to be achieved only *due to the centralization and systematization of state environmental protection management* (Zhochkina, 2011). In order to streamline relations on the sustainable use of wildlife in the Russian Federation, a system of state bodies operates, the activities of which are aimed at fulfilling the requirements and conditions of the legislation on wildlife.

Sustainable use of the animal world is ensured through state registration of the number of objects of the animal world, as well as state monitoring and the state cadastre of objects of the animal world, planning, as well as federal state supervision in the field of protection, reproduction and use of wildlife objects and their environment and a number of other functions of management bodies provided by the legislation on the wildlife. Therefore, the content of legal support for the sustainable use of the animal world includes a system of organizational measures for such support.

A complex of organizational measures, without which the modern effective regulation of social relations in the field of sustainable use of the animal world seems impossible should be considered a part of legal support.

One of the efficient mechanisms of the biodiversity conservation is the development of the information and scientific support system, raising the educational level of government representatives and the public in the field of conservation and sustainable use of biological resources, ensuring public participation in re-

solving issues in this area. Therefore, the main tasks are: to increase the role and effectiveness of environmental education and upbringing to form the ecological culture of the population; to form a responsible active citizens position in the field of biodiversity conservation; to develop a humane attitude towards wildlife and to spread environmental ethics (Ikonnikova, Kirillov, Nazarenko, 2015).

To achieve the effectiveness of information support, it is necessary: 1) to organize and hold press conferences, other information campaigns on the conservation and sustainable use of biodiversity, to organize speeches and broadcasts on television; 2) to publish and distribute visual aids; Internet information on conservation and sustainable use of biological resources, to develop stimulating and educational environmental programs for children and adolescents, to develop green modelling, to create websites informing on the activities of environmental organizations, on the availability of tourist and environmental routes.

Measures of ideological nature should include measures aimed at scientific justification, forecasting the *social consequences of the operation of certain legal norms, theoretical development of the ways to overcome disagreements and the search for compromises* (Arzamaskin, 2016) in the process of implementing legal norms in the field of sustainable use of wildlife.

Sustainable use of the wildlife is impossible without scientific support. The main tasks of the scientific support for the sustainable use of the wildlife include the following directions: the development and support of scientific research on the problems of conservation of wildlife objects, the results of which can stop the process of reduction of wild animals and the destruction of natural environmental systems; the development of a unified system of sustainability criteria in the use of wildlife; scientific support of the programs for the protection, reproduction and use of the wildlife.

Thus, the totality of means ensuring sustainable use of the wildlife includes: 1) legal means; 2) economic means aimed at stimulating subjects to preserve wild animals; 3) organizational means: monitoring of the animal world, accounting, supervision of the implementation of legislation on the animal world; 4) other means of ideological, informational, educational, scientific nature.

The United States, among the first states, actively supported the idea of sustainable use of natural resources as *conservation through wise use* (Clepper, 1966). Moreover, the implementation of projects on sustainable use took place with the wide participation of both scientists and ordinary citizens who advocated for the protection of natural resources. Therefore, in the 80s of the XX century, some foreign countries, in addition to the basic laws on the wildlife, which determine the main provisions and criteria for the sustainable use of the wildlife, have

started to develop programs for the sustainable use of the animal world objects.

The proponents of sustainable use name a number of successful programs which implement the principles of sustainable use of the wildlife and balance the interests of citizens, business and the state. An example of such is the Program developed by Garth Owen-Smith and implemented in the Kaokoveld desert in Northwest Namibia (Bonner, 1993). In particular, the program allowed to increase the incomes of the local population due to the development of ecotourism. According to Owen-Smith, *The Purros program cost the villagers almost nothing, but generated a significant revenue for them* (Kriepe, 2019).

At the same time, the active and direct participation of people in the implementation of any sustainable use program is the most important principle of sustainable use. The local population support of sustainable use of the wildlife is important for achieving a successful result of any specific program. A project on the sustainable use and conservation of crocodiles was implemented in Australia. As a result, the annual income from the export of crocodile skins amounted to \$ 340,000. In addition, the project made it possible to provide jobs for the local population, which had 100 percent unemployment before the start of the project. The legal literature draws attention to the fact that sustainable use programs, which involve the local population in their planning and participation, lead to positive results, and in some cases, *lead to the failure of more traditional environmental programs* (Kriepe, 2019). Thus, the practice of implementing programs for the sustainable use of the wildlife is particularly successful when it provides specific economic and social benefits to the local population.

Positive results were also achieved as a result of the implementation of the Program for the Sustainable Use of Natural Resources in Central Asia. The new policy on recognizing the value of wild animals by the local population through the practice of community management has yielded tangible results in the restoration of wild animals in large areas. Thus, the practice of community management was successfully introduced in Tajikistan, where after five years of environmental protection, the number of certain species of wildlife was restored and as a result, the local community began to receive environmental and economic benefits from this. In Kyrgyzstan, two community organizations were created, equipped and trained in the principles of management, monitoring and conservation of the wildlife. In accordance with the Program for the Sustainable Use of Natural Resources, the users were delegated the rights to manage wild animals and hunting lands. In Kazakhstan, thanks to the support of the political dialogue on the sustainable use of wildlife, a discussion has begun on existing problems and opportunities on privatization in the hunting sector. Thus, the practice of implementing various projects on the sustainable use of the wildlife in different countries

makes it possible to balance the interests of the state and society.

At the same time, sustainable use of the wildlife provides a significant impetus to the economic and social development of remote underdeveloped rural areas. This conclusion was confirmed at the 2nd International IUCN Congress, held in Amman in 2000, where it was stated that the sustainable use of the wildlife is an example of the legitimate use of natural resources not only in Central Europe, but throughout the world. Therefore, the needs of local communities that live through the use and conservation of biological diversity, as well as their impact, should be reflected in the fair distribution of the benefits arising from the use of resources, along with the contribution to its conservation.

Alongside with the strategic documents on sustainable use of the wildlife, ecological tourism is an effective way to implement the principles of sustainable development. In foreign countries, the potential of ecotourism as an effective tool for sustainable use is so high that at present many states, especially developing countries, include it in long-term plans for economic development. Ecotourism helps in the development of municipalities by providing an alternative source of livelihood for the local community. The purpose of ecological tourism is the conservation of wildlife, the sustainable use of wildlife, the preservation of the environment and also economic and social benefits (Anisimov, Ryzhenkov, 2014). Therefore, tourism can be sustainable if the development meets the needs of tourists and local people, protecting the biological diversity of the wildlife. Otherwise, use may lead to a reduction or even destruction of certain species of wild animals or their habitat. This happened in the Himalayas, when the number of tourists coming increased by more than 25 times. Local residents began to actively cut down forests – for fuel for campsites and numerous hotels. The ridges, several years ago buried in the thickets of rhododendrons, turned into barren wastelands, the paths were littered, and the populations of many animals and birds declined. In general, there are not so many *absolutely positive* examples of ecotourism development in the world. Rather, we can talk about the successful implementation of certain specific principles of ecotourism (Bochkareva, 2019). By the moment, ecotourism has become the basis of a number of important official international declarations. As a result, the norms of international acts in the field of sustainable tourism development have become effective tools in the process of implementing the principles of ecotourism.

In many countries, especially the developing ones, the volume of organized hunting tourism has rapidly increased over the past 50 years. Hunting tourism has numerous advantages for the host country and its rural population: conservation of ecosystems; income generation and job creation in poor and disadvantaged areas; economical and rational use of hab-

it is unsuitable for agriculture or ordinary tourism; raising the awareness of the local population about the value of the animal world (otherwise hunting tourism is associated with harm, problems and expenses); less harmful impact on the environment than with other forms of tourism; a decrease in poaching, thanks to the joint efforts of all parties interested in generating revenue from hunting tourism (Baldus, Damm, Wollscheid, 2009). Thus, hunting tourism provides a significant positive impetus to the economic and social development of remote underdeveloped rural areas.

In general, we can conclude that Russian legislation contains a fairly wide range of effective legal measures to ensure the sustainable use of the wildlife, aimed at achieving a biological balance in nature, preserving ecological systems. Many of the examined foreign measures (the active involvement of interested citizens in the decision-making process related to the use of wildlife, and the involvement of local communities in wildlife management; the practice of implementing projects and programs for the sustainable use of certain species of wildlife) are of interest for the formation and improvement of the Russian legislation on the wildlife. Other provisions can be used in the comparative description for the formation of new ideas in the field of sustainable use of the wildlife.

3. Sustainable Use of Rare, Endangered Species: Arguments For and Against

Biodiversity is the main environment-forming resource on the planet, providing the possibility of its sustainable development, preserving the living environment for humans and biological resources in general. Unfortunately, for many years the living nature of our planet was treated as a given, fulfilling rather aesthetic and psychological functions. Nowadays, in the period of annual growth in world production, increase in the number of people on the planet, and at the same time, growing awareness of the acuteness and need for global environmental protection measures, the attitude towards biodiversity as an integral part of nature is changing. In recent years, the heads of most states have signed a number of protocols and conventions aimed at preserving biodiversity. Significant amounts of money are spent annually on various activities related to the conservation of wildlife, unique places on the planet and the maintenance of various ecosystem functions, as well as environmental education (Myaskov, 2009). Further reduction of biodiversity can lead to the destabilization of biota, loss of integrity of the entire biosphere and individual ecosystems, in particular, their ability to maintain the most important environmental qualities necessary for life. As a result of the irreversible transition of the biosphere to a new state, it may be unsuitable for human life. Preserving the bi-

odiversity of ecosystems on Earth is a necessary condition for human survival and the sustainable development of the civilization.

Rare and endangered species of animals, plants and mushrooms are the most fragile, but a very important part of biodiversity that needs priority in protection. The conservation priorities for such species are defined by the Convention on Biodiversity and Russian legislation, in particular the Strategy for the conservation of rare and endangered species of animals, plants and mushrooms. Rare and endangered species of animals, plants and mushrooms play an important role in various ecosystems and are the indicators of the natural ecosystems state (State Report, 2014). Due to the intense anthropogenic impact on the environment, the protection of rare and endangered species of animals remains particularly relevant.

The features characterizing various objects of the animal world are of great importance for the process of their sustainable use, and also for the mechanism of their legal regulation. Subjects enter into specific legal relations to satisfy different social interests and needs, realizing their subjective rights and obligations. Agitation should be mentioned among the main methods of protecting rare and endangered species of animals. The Analysis of domestic and foreign literature on the topic allows us to make a conclusion that the effectiveness of measures aimed at protecting nature is very high. Such measures should be focused on certain groups of population (taking into account age, professional, ethnic and other characteristics), most often in contact with endangered species and causing the greatest damage (Evstafiev, 2000). In our opinion, along with the public agitation, environmental education should be a powerful mechanism in the process of conservation of rare animal species.

It is necessary to form knowledge, experience and requirements for the conservation of rare animal species at all levels of education since early childhood. Legal informing of the population is also of great importance. It comprises reports on newly created natural reserves, on adding certain species into the Red Book, on filing special claims for the extraction of the species. The conservation of rare and endangered species of animals is the task of the whole mankind. Therefore, all people and all civil society institutions should participate in the conservation of rare species of wild animals. In our opinion, the most important condition for the conservation of rare species of animals is a responsible, competent attitude of people to these animals and to their natural habitats. The study of biological diversity and the protection of rare species require a high environmental and scientific culture, which implies the existence of a system of environmental and scientific education.

The proponents of sustainable use state that there is a need for some changes, especially since the CITES Convention does not work for many species, which

are at risk of extinction, although its developers intended to protect them. The question of the priority of some sustainable use programs over their analogues of nature conservation programs remains debatable. Since the benefits come from protecting species, such programs are usually less expensive than other conservation programs (Gerstenzang, 1994). Moreover, the costs of conservationists to combat poaching cannot be measured only in monetary terms. For example, anti-poaching associations of Zimbabwe National Parks have killed 167 poachers since 1984, while 4 police officers were killed and 8 more injured during the same period. In addition, at the same period of time, Zimbabwe lost 300 rhinos in 2 years, despite a strict conservation policy. In this way, sustainable use programs, providing a viable alternative to poaching, can help reduce human losses (Tyson, 1993). The last costs included in conservation programs are those incurred by communal and private landowners, many of whom are subsistence farmers. For example, these landowners are not protected from elephants, who can roam freely around their lands and trample their fields. While tourists enjoy the sight of elephants walking, one hundred miles away from this place, elephants can walk along the fields of farmers, destroying crops and threatening human lives. Residents of several countries criticize CITES and other protection programs for their inability to solve such social and economic issues as the damage caused by endangered species to people living in the neighbourhood. Sustainable use programs avoid this kind of criticism by providing reasonable benefits to residents of several countries who bear the burden of costly invasion of endangered species that they must protect.

Like many other treaties, CITES often gives rise to conflicts between richer nations, which usually hold a position in support of the nature conservation concept, and financially poor but rich in resources developing nations. Perhaps for these reasons, the Director of the Africa Environmental Program recognizes the right of developing nations for sustainable use a *vital for the long-term functioning* of CITES, as well as the principle of paramount importance of nature conservation throughout Africa (Cone, 1994). The opponents of sustainable use speak out against this policy for a number of reasons. Perhaps the most fundamental problem is the need to define the authorities, able to determine which use of which endangered species should be considered sustainable. Taking into consideration the difficulties in defining such fundamental concepts as *species* or *sample* within CITES, it seems unlikely that all parties will be able to agree on a common definition of sustainable use. However, such a definition was formulated as part of the CITES export permit requirements in Articles III and IV, which stipulate that sustainable use is an activity that *is not ... harmful to the survival of the species involved in it* (The United Nations Convention on International Trade in Endangered

Species of Wild Fauna and Flora, 1973). Thus, within CITES, the category of *sustainable use* can already be applied to Appendix II on species to a limited extent.

The opponents of this concept claim that because of the emphasis on the use of species for utilitarian purposes, sustainable use seeks to protect only those species that currently have economic value (Freese, Saavedra, 1991). Such detractors are worried that if wildlife has no value, then wild animals and their habitat will be destroyed in order to clear the place for other land users. This problem is especially acute for those species that do not have obvious use. Examples include species that are not commonly used for consumption, such as many species found in endangered rainforests that are threatened with extinction due to loss of habitat before their value can be discovered. This problem may concern more well-known species, especially those species which are in such a critical position that any consumer use is not sustainable. A similar problem applies to those species whose breeding rate is slow even under optimal conditions. However, sustainable use does not require any of the above species to be exposed to a greater risk than already exists. Non-consumer use, such as ecotourism, will not exacerbate existing problems. Moreover, sustainable use programs will not only help protect the habitat of endangered species, but also entire ecosystems, including those species which are less vulnerable to protection (Booth, 1993).

Perhaps, for some types of *problematic* species, not much will change if CITES allows the sustainable use of endangered species. These cases illustrate limitations in which the category of *sustainable use* may not have much effect on problems arising from CITES nature conservation programs. For example, it is likely that sustainable use of endangered species will have a limited effect on some of the current CITES problems, including cross-border poaching. A lack of funding for anti-poaching patrols, the high cost of animals, and the low risk of punishment provoke poachers to violate CITES regulations (Gerstenzang, 1994).

CITES is not an agreement supporting wildlife use and trade. The Convention provisions are aimed at regulating trade by introducing restrictions. It limits the principle of free circulation so that international trade does not lead to the extinction of species. CITES is often regarded as an international instrument for the biodiversity protection rather than an international trade agreement. The need to adopt this document was strongly connected with the fact that international trade in representatives of wild fauna and flora is one of the reasons for the decline in populations of many animals and plants. Since CITES entered into force, not one of the 30 thousand species of flora and fauna under its protection has disappeared (Kopylov, Merkulov, 2013).

Another important issue facing endangered species is habitat loss or degradation, as well as related issues, including the rapid growth of the human population and the introduction of exotic species. Regardless of the existence of sustainable use programs, CITES can do little to directly control the threats arising from these and other factors that are essentially outside its scope.

The proponents of sustainable use, however, claim that sustainable use programs provide and promote knowledge about endangered species, their value, and thus indirectly help alleviate issues not related to international trade. Since sustainable use has the potential to increase the caring attitude and concern of local people for endangered species, the existence of problems not related to sustainable use should not in itself prevent the introduction of sustainable use programs.

Conclusion

Interpretation of *sustainable use of wildlife* as a process of realization by the subjects of their rights and obligations allows us to study this concept in relation to a set of legal support measures, the implementation of which allows to achieve conservation of the biological diversity, formation of requirements for the sustainable existence and reproduction of wildlife, conservation of its genetic fund. Since the role and importance of legal support measures for the sustainable use of wildlife at the present stage is increasing in solving social, economic, and environmental problems, the study of legal support measures for the sustainable use allows, firstly, to determine the effectiveness of the legal impact on subjects; secondly, to identify the most effective means that should be applied to ensure a balance of private and public interests; thirdly, to examine carefully the problems of sustainable use. The measures of legal support for sustainable use of the wildlife presented by the author determine the conditions that should be met in order to confirm that the objects of the animal world are used sustainably.

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Environmental Management Systems in the Context of Sustainable Development – the Identification of Open Problems

Systemy zarządzania środowiskiem w kontekście zrównoważonego rozwoju - identyfikacja otwartych problemów

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Abstract

The cognitive objective of this paper was to establish the roles played by standardized environmental management systems in the process of the sustainable development of an organization. At present this process is analysed mainly in the context of the UN Sustainable Development Goals formulated within the scope of the 2030 Agenda for Global Action. The main research method used by the authors was a systematic literature review. The result of the conducted review was the identification of motives and conditions for the implementation of environmental management systems as well as advantages and disadvantages resulting from such implementation. The authors also indicated the major causes of failures in the introduction and improvement of systems consistent with the ISO 14001 standard and presented conditions determining their successful implementation. In the final part of the paper, they included recommendations for further research directions in the examined problem area.

Key words: ISO 14001, sustainability, environment, management

Streszczenie

Celem poznawczym artykułu jest określenie roli znormalizowanych systemów zarządzania środowiskiem w procesie zrównoważonego rozwoju organizacji, który obecnie analizowany jest głównie w kontekście konkretnych Celów Zrównoważonego Rozwoju ONZ, opracowanych w ramach globalnej Agendy 2030. Główną metodą badawczą wykorzystaną w pracy był systematyczny przegląd literatury. Zidentyfikowano motywy i uwarunkowania wdrażania systemów zarządzania środowiskowego oraz określono korzyści i niekorzyści wynikające z ich implementacji. Wskazano również najważniejsze przyczyny niepowodzeń wprowadzania i doskonalenia systemów zgodnych z normą ISO 14001 oraz określono warunki udanych implementacji. W końcowej części artykułu określono postulowane kierunki dalszych badań w rozpatrywanym obszarze problemowym.

Słowa kluczowe: ISO 14001, zrównoważoność, środowisko, zarządzanie

1. Introduction

Intensifying environmental problems, social pressure, regulatory frameworks, and considerable attention paid to social responsibility force business enterprises to face the challenges of sustainable development (Borys, 2011; Taherdangkoo et al., 2017).

The global and dramatic scales of the problem have been made manifest by two recent reports prepared by the United Nations Organization's Intergovernmental Panel on Climate Change (IPCC): *The Fifth Assessment Report* (AR5) published in 2014 (UNDP, 2015) and *Climate change and land* (Climate, 2019), a special report released in 2019. The

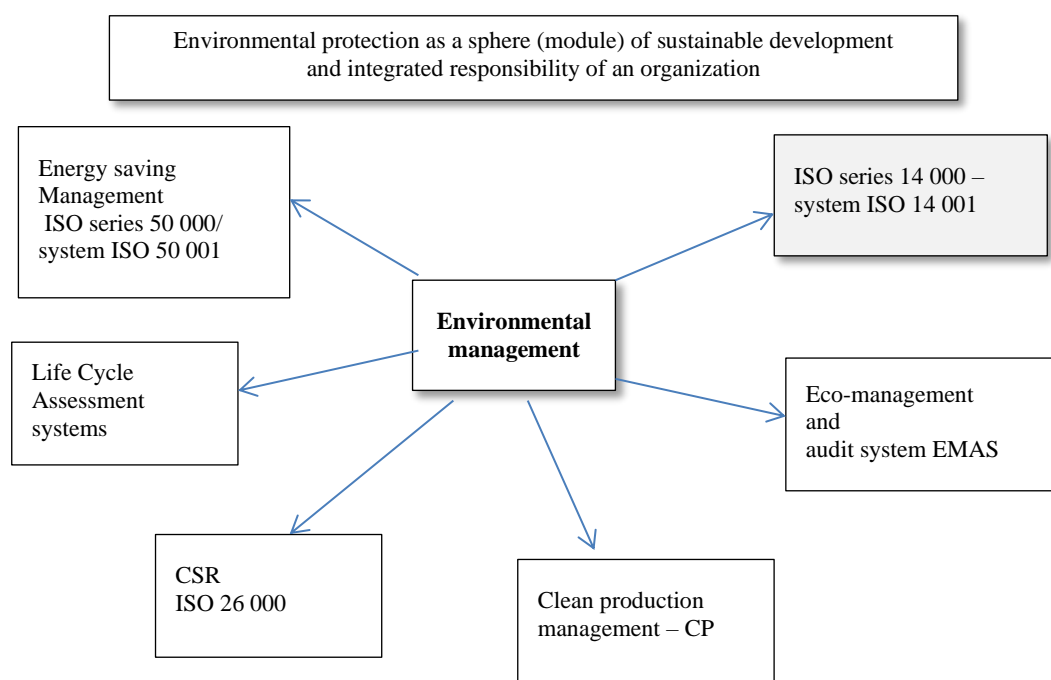


Figure 1. A basic systemic approach to environmental management, source: the authors' own work

conclusion common for both documents is that if the planet and its climate are to be saved, mankind has to replace its current lifestyle by a more pro-environmental one.

An even broader context for this demand is constituted by *Transforming Our World: The 2030 Agenda for Global Action – 2030* (Document, 2015), a document adopted by the UN in 2015. At present it is the leading global strategy, which replaced the Millennium Development Goals established in 2000. The Agenda is the most important point of reference for individual national strategies emphasizing the features of the new development paradigm (a sustainable development strategy) or its subjective sense (an intelligent and/or responsible character of development) (Document 2015).

A considerably positive role in such replacement processes can be played by pro-environmental behaviours at the microeconomic level of particular organizations (business enterprises, public administration units, etc.). Pro-environmental behaviours should complementarily combine the following three approaches:

- the educational approach based on inspiring people to change their awareness towards embracing pro-environmental behaviours;
- the economic approach assuming a complete internalization of external environmental effects (Ahmad, Shueb, 2015);
- the managerial approach introduced by using various techniques, methods and systems of managing the environment.

It is the third approach that constitutes the subject matter of the analyses conducted in this paper, with

special emphasis placed on the role of the trend towards standardization in the development of environmental management systems. In the past dozen or so years this trend has been spreading dynamically and exerting substantial influence on the majority of management systems. The prevalence of the standardization of human activities in the current civilization is described, among others, in the book entitled *Management Systems in the Standardized World* (Łańcucki, 2019).

It should be noted that systems or strategies making up environmental management constitute an increasingly large group of environmental protection instruments used at the microeconomic level. This is illustrated in Figure 1.

Obviously, the systems and strategies included in Figure 1 do not exhaust the whole set of operational tools or concepts introducing or supporting environmental management. This set also comprises such pro-environmental practices as green supply chain management, green human resources management, green public procurement, or the closed circuit concept. These managerial practices also convey well the gist of the principles of the green economy (Žak, 2015).

Among environmental management systems, four systems present a strategic approach to environmental issues: two systems standardized according to the ISO 14 000 standards, one energy management system based on the ISO 50 000 standards, and a non-standardized system defined in the EMAS Regulation. Experts are of the unanimous opinion that the leading role is played by the environmental management system built in accordance with the interna-

tional ISO 14001 standard (Habakuk et al., 2016; Puciato, Goranczewski, 2011; Sardana et al., 2018), which is a key element in the considerable set of standards marked as ISO 14 000 (cf. Matuszak-Flejszman, 2019). After the quality management system, it is currently the second most popular standardized management system, and the number of acquired ISO 14001 certificates is growing constantly (Neves et al., 2017; Suzana et al., 2017).

Although the popularity of systems based on the ISO 14001 standard is still lower than that of quality management systems, the question arises about the causes of so many entrepreneurs being persuaded to invest in the implementation, maintenance, and potential certification of an environmental management system based on the ISO 14001 standard. This paper is an attempt to answer the aforementioned question.

There is broad consensus that the essence of an environmental management system compliant with the requirements of the ISO 14001 standard is ensuring an organization's continuous development in the field of environmental management, and the objective of such a system is to minimize negative impact on the environment.

Following the phenomena described above, the recent years have witnessed a growing number of publications on environmental management systems. They discuss problems connected with the environmental, social, economic, and organizational aspects of the sustainable development of business enterprises (Adamczyk, 2001; Arena et al., 2012; Zhang et al., 2014). Nevertheless, few of them are critical works indicating, for example, the advantages and disadvantages of implementing such systems, the causes of failures in their implementation, or the potential areas of their improvement towards sustainability. The bridging of these research gaps is the main task of this paper, while its cognitive objective is to establish the roles played by standardized environmental management systems in the process of the sustainable development of an organization.

2. Research methodology

The main research method used by the authors was a systematic literature review. The literature on the subject was reviewed in the course of the following stages: (1) selecting key words: ISO 14001, sustainability, environment, management, (2) searching for works containing the identified key words in the following databases: Academic Search Ultimate, including Business Source Ultimate, Education Resources Information Center, AGRICOLA, Open Dissertations, Green FILE, Newspaper Source, and Google Scholar, (3) becoming familiar with the returned publications, (4) reviewing the publications, (5) preparing a map of the available literature, (6)

summarizing the selected publications, and (7) arranging the collected research material. The applied procedure is consistent with the general methodology of conducting research (Creswell, 2013; Easterby-Smith et al., 2015) and the methodology of research in management sciences (Easterby-Smith et al., 2015).

The main goals of the conducted literature review were to identify the following: (1) motives and conditions for the implementation of environmental management systems, (2) advantages and disadvantages resulting from the use of environmental management systems, (3) major causes of failures in their implementation, (4) improvements in environmental management systems towards sustainability, (5) conditions of the successful implementations of environmental management systems, (6) research gaps in the analysed area of knowledge, (7) directions of further research.

3. Environmental management systems and sustainable development of business enterprises

On the date of the preliminary survey the queried databases contained 21 articles in which the following two key words dominated: ISO 14001 and sustainability. The extension of the scope of search by the databases ERIC, Green FILE, Open Dissertations, and Newspaper Source resulted in further 23 publications, including 18 peer-reviewed academic papers.

An analysis of the content of the indicated literature showed the existence of relations between environmental management systems and sustainable development. Arena et al. (2012) showed that an environmental management system consistent with the ISO 14001 standard was important for sustainable development because it often constitutes the main instrument used to achieve sustainable development of an enterprise (Boroń, Kosiek, 2019; Zhang et al., 2014). Salim et al. (2018) proved on a documentary basis that the ISO 14001 standard contributed to the necessity of organizational commitment to sustainable manufacturing processes. In many business enterprises, persons responsible for the environmental management systems also take care of their sustainable development (Millward, 2009; Whitlock, 2016). Poltronieri et al. (2018) showed furthermore that the use of integrated management systems was of particular importance in the effective implementation of sustainable development principles. The process of creating such systems consists in integrating particular elements of formalized management systems, while integration itself means a combination of at least two systems – ISO 9001 and ISO 14001, or more and more often three systems – ISO

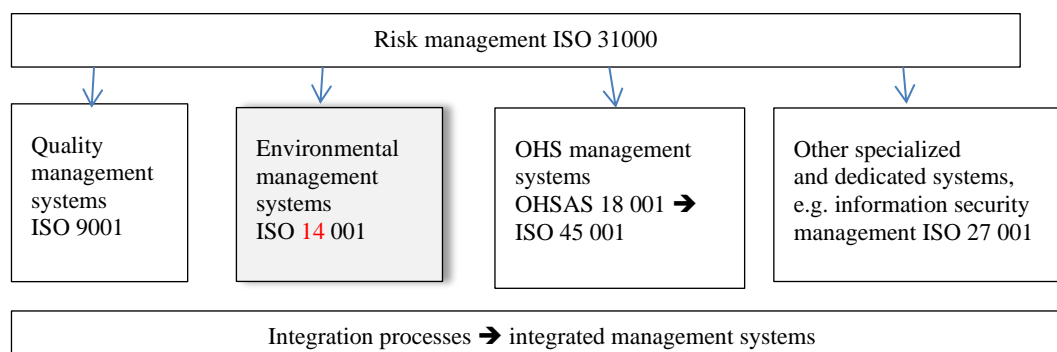


Figure 2. An environmental management system in the process of integrating specialist dedicated management systems, source: the authors' own work

9001, ISO 14001 and OHSAS 18001 (ISO 45001)¹ with an important role in the process of integration played by risk management (cf. Fig. 2) (Kafel, Sikora, 2011, p. 5).

The conducted literature review allowed the authors to identify a few key research areas, including the following:

- 1) motives and conditions for implementing environmental management systems (Arena et al., 2012; Habakuk et al., 2016; Kassolis, 2007; Simpson et al., 2014),
- 2) advantages and disadvantages of implementing environmental management systems (Graafland, 2018; Habakuk et al., 2016; Khor, et al., 2013; Li et al., 2016),
- 3) actions that organizations may take with a view to strengthening environmental management systems (Hojnik et al., 2018; Jabbour et al., 2015; Li et al., 2016),
- 4) attempts at combining an integrated system of managing quality, environment, occupational health and safety with the Responsible Care programme functioning in the chemical industry (Khair et al., 2018).

Continuing the literature review, the authors found that the selected databases returned an impressive number of over 28000 records indicating articles on various environmental aspects and the concept of sustainability in the practice of organizational management, with the decisive majority of them pertaining to natural resources (e.g. water) management or describing activities undertaken by public institutions rather than business enterprises.

The analysed publications included also three other issues important in the context of this paper's objective and tasks. The first of them concerns factors and motives influencing the implementation of environmental management systems, methods and tools in organizations (Huang et al., 2011; Ibrahim et al., 2019; Kothari et al., 2018; Neves et al., 2017; Rola

et al., 2013; Roxas et al., 2012; Sardana et al., 2018; Taherdangkoo et al., 2017). Described analyses comprised concrete internal (e.g. organizational) factors, external factors (e.g. institutional and political solutions), and conditions facilitating the implementation of the concept of sustainable development in value chains (Skowrońska, 2009). The second issue pertains to conditions determining pro-ecological organizational management methods (Craig et al., 2013; Opon et al. 2019; Schuler et al., 2017; Jain et al., 2018; Chen-Lung, Chwen, 2007; Dai et al., 2017; Ahmad, 2015; Sardana et al., 2018; Silvestre et al., 2017; Pinto et al., 2018). The third issue is related to the application of environmental management systems in enterprises representing various business sectors (Hoffrén et al., 2009; Kothari et al., 2018).

4. Motives and conditions for implementing environmental management systems

The literature review made it possible to distinguish key motives and conditions for the implementation of environmental management systems. It should be noted that such motives are in fact expected (potential) benefits from the introduction of such systems. Thus, the preliminary findings indicate that the main motives include the following:

- an image-related motive: an expected improvement and/or a more effective creation of an enterprise's positive public image (Arena et al., 2012; Graafland, Johan, 2018; Jovanovic, Janjic, 2018); publishing information on the effects of efforts aimed at reducing environmental impact helps to create a positive image of an enterprise for the public, thus improving its market position (Arena et al., 2012; Habakuk et al., 2016; Simpson, Sroufe, 2014);
- a motive resulting from the awareness of compliance with environmental protection regula-

¹ ISO 45001 is the first internationally recognized standard applicable to occupational health and safety systems. It is to replace the OHSAS 18001 standard, which will be withdrawn on 12 March 2021. It means that as of this date all

organizations holding currently valid OHSAS 18001 certificates, in order to maintain their continued validity, will be obliged to update their systems to meet the requirements of the ISO 45001 standard.

tions: more and more attention paid to good reputation and compliance with environmental protection regulations, including the necessity of reducing the emissions of carbon dioxide and the consumption of fossil fuels (Habakuk et al. 2016; Neves et al., 2017); this motive results from the necessity of ensuring the achievement of the required legal status with respect to environmental protection; one of the important recommendations of the ISO 14001 standards is to identify legal requirements binding for an organization; therefore, it is difficult to overestimate the motivational significance of legal and administrative regulations whose cognitive, regulatory and normative elements of an institutional environment are strongly connected with positive attitudes of managers towards environmental sustainability, which, in turn, exerts a positive influence on the environmental sustainability orientation (ESO): the knowledge of environmental issues, sustainable practices, and commitment to sustainable development (Roxas, Coetzer, 2012);

- a motive related to ecological awareness: this motive focuses on responsibility for the environment and increased ecological awareness is more and more emphasized in the literature on the subject (Arena et al., 2018; Tocan, 2016); it also appears in the contexts of both the importance of employees' ecological education and CSR;
- a motive concerning better adjustment to market requirements, including increasing awareness of the necessity of implementing a strategy of ecological marketing (Zaremba-Warnke, 2009), ensuring effective reactions to questions and pressure from customers, and improving an organization's ability to compete with businesses holding ISO14001 certificates (Arena et al., 2012; Simpson, Sroufe, 2014); the implementation of a system is regarded as a response to pressure from business partners connected (Ibrahim et al., 2019; Rola et al., 2013),
- an information (identification) motive from the knowledge management area: what is emphasized is a plan to introduce a system of knowledge, convictions, and interests of owners (Simpson, Sroufe, 2014; Habakuk et al., 2016),
- an economic motive: it results from the awareness of conducting economic calculations and a certain economic compulsion to curb increasing environmental fees, improved opportunities for obtaining funds from external sources, cost reduction (Arena et al., 2012; Huang et al., 2011; Jovanovic, Janjic, 2018; Tocan, 2014).

The most important conditions determining the successful implementation of environmental systems are the following:

- the type and size of an organization – research shows that larger, multinational, mainly indus-

trial enterprises active in export markets are to a larger extent obliged to follow environmental management practices (Urban et al., 2012),

- the level of revenues – businesses with high revenues are the most interested in acquiring environmental certificates (Hoffrén et al., 2009; Singh et al., 2014),
- the necessity to adjust to prevailing conditions, including institutional ones – business enterprises usually declare that ecology and sustainable development constitute no problems for them, but in practice few of them carry out activities aimed at improving ecological efficiency (Huang et al., 2011; Neves et al., Hoffrén, Apajalahti, 2009; Roxas et al., 2012; Taherdangkoo et al., 2017).

5. Advantages and disadvantages of using environmental management systems

The identified group of expected advantages generating motivation for the implementation of a system based on the ISO 14001 standard can be referred to as *ex ante* advantages (usually formulated before system implementation). This part of the paper focuses on identifying *ex post* advantages, that is ones that appear within the functioning processes of an ISO 14001 standardized system. The literature review revealed a few groups of advantages resulting from the implementation of an environmental management system for employees, suppliers, customers, and other stakeholder groups. They are as follows:

- managerial advantages: it is the largest group of the identified advantages. Thanks to the implementation of the requirements provided for in the ISO 14001 standards, it is also possible to pursue successfully strategic economic objectives of an organization, maintaining simultaneously compliance with the principles of environmental protection (Dai et al., 2017),
- environmental advantages (for the environment / its protection) and advantages in the area of environmental risk management; the literature on the subject stresses that organizations holding ISO 14001 certificates cope with environmental problems better than those that have not implemented and certified an environmental management system (Li, Hamblin, 2016),
- advantages related to efficiency: system implementation is followed by improvement in economic and environmental (sozoeconomic) efficiency consisting in lower environmental fees, reduced negative impact on the environment, etc. (Jovanovic, Janjic, 2018).

Among the identified disadvantages, the following should be indicated:

- the necessity of incurring additional costs and encumbering employees with additional tasks at

the stage of system implementation (Habakuk, Gurvits, 2016),

- the risk of failure to implement an environmental management system – despite implementing a system based on the ISO 14001 standard, some organizations fail to lower the volume of wastes, to reduce ecological costs (Dejkovski, 2016; Graafland, 2018; Khor, Udin, 2013; Rino et al., 2017; Sumiani et al., 2015).

6. The most important causes of system implementation failures

As a result of the conducted literature review, the authors distinguished a few groups of reasons for the unsuccessful implementation of environmental management systems. The most significant of them are as follows:

- limited ecological knowledge and awareness: some groups of managers are still interested more in satisfying the expectations of stakeholders rather than acquiring environmental benefits (Rino et al., 2017; Santos et al., 2016; Simpson, Sroufe, 2014; Zhang et al., 2014);
- financial costs: a system implementation process tends to be difficult because of not only high certification costs but also the necessity of incurring high and unplanned capital expenditures and modernization costs (Kothari et al., 2018; Rino et al., 2017; Santos et al., 2016);
- organizational problems: limited and gradually decreasing motivation as well as a process of changes in an organizational culture that is too slow or misdirected (Santos et al., 2016), difficulties with managing key processes connected with the environmental aspects of carried out tasks (Lee et al., 2017), failure to emphasize the necessity of preventing wastage (Sumiani et al., 2015), or difficulties with fulfilling the criteria of the ISO 14001 standard itself (Kothari et al., 2018),
- disturbances in the pursuit of environmental objectives: although difficult to achieve within a short time, an increase in the level of eco-efficiency resulting mainly from reduced consumption of natural resources is an important indication of the correct functioning of an implemented system (Hoffrén, Apajalahti, 2009).

7. Improvements in environmental management systems towards sustainability

Researchers propose various actions aimed at improving the effectiveness and efficiency of environmental management systems. The most important of them include the following:

- environmental training programmes organized to increase employees' awareness of environmental issues (Jabbour et al., 2015; Rino et al., 2017),

- accurate identification of environmental factors, encouragement to develop advanced technologies facilitating pollution monitoring (Zhang, et al., 2014),
- establishment of procedures concerning: environmental objectives and their operationalization, pollution reduction, periodic internal audits, commitment of all employees, assessment of environmental results, and managerial reviews (Fura, 2012).

The conducted research indicates that some organizations also undertake system improvement actions exceeding the requirements specified in the ISO 14001 standard. The most common of such actions are as follows:

- integrating all management systems functioning in a given organization, e.g. pollution prevention, life cycle assessment, environment management information system, green supply chain, environment performance evaluation and other management tools (Khor, Udin, 2013; Kumar et al., 2008);
- implementing eco-innovations with particular emphasis placed on process-related innovations (Hojnik et al., 2018; Li, Hamblin, 2016; Zhang, et al., 2014);
- carrying out pro-ecological investment projects – both *hard* ones aimed at infrastructure development and *soft* ones focused on human resources (Rino et al., 2017),
- improving an organizational culture towards environmental friendliness (Li, Hamblin, 2016).

8. Conditions for successful implementations of environmental management systems

The performed literature review shows a rather clear picture of conditions determining pro-ecological methods of managing organizations. Organizations need reliable data and high quality information to be able to decide which direction to choose, to be familiar with major environmental threats and opportunities resulting from the application of pro-environmental concepts and tools. The awareness of initiatives related to sustainable development goes hand in hand with the conviction that such development is important for an organization's success. Important internal sources include management, business meetings, and sustainable development reports. The popularizing function is fulfilled by professional and sectoral associations as well as partners in supply chains. What is necessary in this case is the integration of two global sustainable development perspectives, i.e. the pillars of sustainable development (environment, economy, society) and the objectives of sustainable development (Craig, Allen, 2013; Opon, Henry, 2019) (cf. Fig. 3).

It is not insignificant in the context of shaping the awareness of ecology, and the awareness itself may cause organizations not to act instrumentally, but to

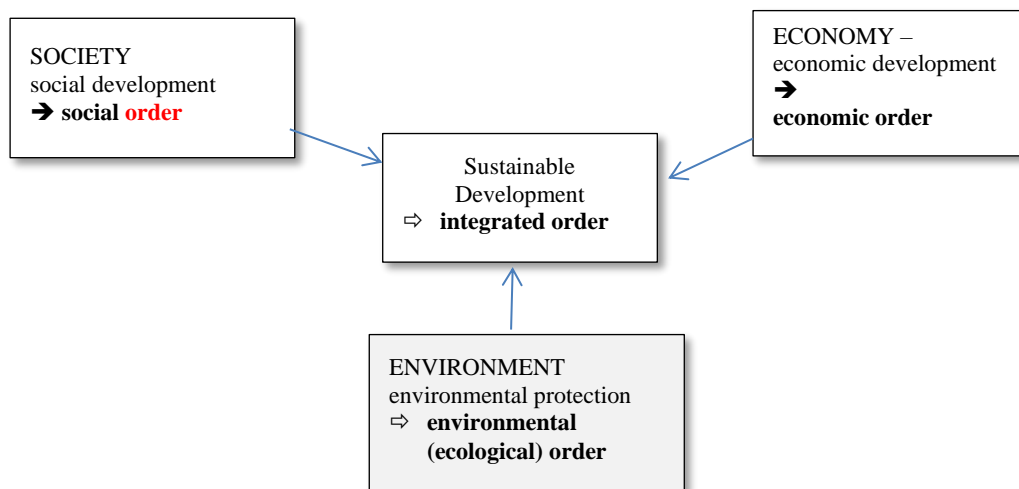


Figure 3. The pillars of sustainable development and the types of governance as target systems, source: the authors' own work based on (Borys, 2011)

pursue environmental management with a deep conviction about its rightness, effectiveness and efficiency, and also taking into consideration ethical principles (Schuler et al., 2017).

Describing actions undertaken by business enterprises, researchers should clearly distinguish between an instrumental understanding of sustainable development and an understanding recognizing the importance of sustainable behaviours, for example sustainable consumption of natural resources, the protection of the environment and its preservation for future generations, from the perspective based on the law and deep ecology, the latter appearing to be highly disputable. As Schuler et al. (2017) are correct to note, the current scientific discourse on sustainable development management, which is reflected in environmental management, in principle favours an instrumental approach towards sustainable development.

This is so because sustainable business practices are usually perceived as egocentric, i.e. based on a hard variety of anthropocentrism, and are conceptualized as a manner of achieving a competitive advantage. However, there is great demand for the ethical management of sustainable development of an organization, including for the appreciation of the autotelic value of nature (Rogall, 2010). Thus, people managing organizations have to be aware of benefits brought about by a closed circle economy (Jain et al., 2018) and well-functioning supply chains (Chen-Lung, Chwen, 2007; Dai et al., 2017).

If pro-environmental awareness is to increase, ordinary training events or allocation of responsibilities as recommended by the ISO 14001 standard no longer suffice. What should be followed is the principles of green human resources management (Ahmad, Shoeb, 2015; Sardana et al., 2018).

The public sector, including its institutions in both the subjective and objective meanings, also has an

instrumental role to play. Legal regulations need to be coherent, and entities responsible for their enforcement – effective (Liu et al., 2012; Silvestre et al., 2017). The concept of sustainable development requires holistic solutions comprising not only environmental practices, including an environmental management system, but also government policies, including a public procurement system. Various institutions often introduce their own regulations whose goal is to prevent events hazardous for the environment such as environmental breakdowns. They are to protect the environment, people and infrastructure. Enterprises use such recommended practices as a foundation for their management systems. However, various research and business practices show that these regulations lack uniformity. Another major problem is the ineffective enforcement of existing legal and normative requirements. For example, the subject matter of a certain analysis was environmental management practices followed by various organizations in Brazil, Russia, India, China and the RSA (BRICS) in the years 2011-2015. It turned out that China, India, the Republic of South Africa, and Brazil examine solutions in the area of CO₂ emission, while China, India and Brazil focus on water supply and water quality issues, regulatory standards for environmental management, and management practices related to green chain management (Pinto et al., 2018). An analysis of the results of the research conducted by the cited authors resulted in the following conclusion: the greater the importance of sustainable development in a given country, the greater the tendency towards presenting and publishing data on environmental management practices. This thesis explains why China, India, and Brazil tend to present papers on the subject of environmental management, while Russia and the Republic of South Africa are not able to follow this trend because of their weaker commitment to environmental protection.

9. Identified research gaps and recommended directions of further research

Looking into the motives and conditions for the implementation of environmental management systems, the authors noticed that two important aspects had not been addressed in previous research, namely relations with the environment and a dynamic approach to an organization. In fact, some research projects concerned relations between business enterprises and consumers in the context of examining their needs and expectations (e.g. Huang et al., 2011), but what was completely disregarded was the important topic of more and more businesses shaping their customers' consumption needs.

All published research results were of a cross-section character, thus they did not take into consideration change occurring in enterprises over time. Such a static approach to organizations is not sufficient in the context of examining the significance of environmental management systems for the implementation of sustainable development, which, by its nature, is a long lasting process. Furthermore, as Deming (1982) claimed, prospects for the continued existence of enterprises influence the ways in which employees are treated and the environment is protected. In general, businesses with short term perspectives are usually not interested in taking care of the environment or, with respect to management systems, exceeding the requirements of the 14001 standard, focusing exclusively on actions that are provided for in legal regulations.

The analysis of the conditions for the implementation of environmental management systems also showed that such systems were objects of interests of the following three types of entities: large industrial enterprises, small businesses with large revenues, and firms functioning as links within complex supply chains that are usually obliged to use such systems. At present, however, experts discuss to what extent formal management tools such as environmental reporting or ISO 14001 certification are appropriate for small and middle-sized enterprises. Some publications imply that such systems are not appropriate for this group of business entities, which seems to be a disputable argument. Research carried out by Graafland and Smid (2016) showed that only one in four small and middle-sized enterprises established goals oriented towards improving the condition of the environment.

Research on the advantages of implementing an environmental management system indicates mainly economic, particularly financial, and environmental advantages. Obviously, the introduction of process monitoring, environmental aspect identification, internal audits or environmental reviews favour the better protection of the environment. However, the dominant influence on the acquisition of advantages by an enterprise is its practice of establishing environmental objectives. Criterion 6.2.1 of the ISO

14001 standard points out the necessity of establishing such objectives. They are to be measurable, consistent with a strategy, communicated, and, if necessary, updated. In practice, however, there are many attempts to spread obvious environmental objectives over time. In fact, managers often do not want to achieve them, being exclusively interested in *satisfying auditors*.

Another problem requiring further attention and research is networking. Graafland (2018) wrote that previous research had disregarded possible mediators thanks to which environmental management systems based on the ISO 14001 standard could have a positive indirect influence on ecological results. ISO 14001 certification stimulates participation in external environmental networks, and such networks generate a positive impact on the ecological results of their participants.

The third noticeable issue in the area of advantages is that of an external context. Some previous research indicates the necessity of strategic environmental management (Taherdangkoo et al., 2017; Dai et al., 2017). The standard introduced in 2015 provides for the necessity of identifying the external context of an organization in the processes of system implementation and improvement. This requirement was not included in the previous standard adopted in 2008. Thus, the following questions arise: To what extent is an identification of an external context correct? Are the results of examining an external context taken into consideration in the formulation of environmental objectives?

Another important research gap seems to be related to the fact that the causes of failures in the implementation of environmental systems analysed so far are mainly of a secondary character. Proposals for new research directions within the context of the causes of failures in the implementation of environmental management systems are presented in Table 1.

In the authors' opinion, the knowledge of improvements made in environmental management systems should be supplemented with a few additional aspects. One of them is the role of an organizational culture in a system improvement process. Some research indicates a considerable importance of this role in the processes of not only the implementation but also maintenance and continuous improvement of environmental systems (Neves et al., 2017).

In the authors' opinion more attention should be placed on the effectiveness of integrated audits and environmental reviews, e.g. with respect to the criterion of employee participation. This is so because one of the current discussions aims to determine to what extent integrated (quality, environment, OHS) systems are more effective than non-integrated ones, but there is not enough knowledge of the effectiveness of audits themselves. The current state of knowledge allows the supposition that too many criteria taken into account in an audit hinder the process

Table 1. The primary and secondary causes of failures in the implementation of environmental management systems

Organizational systems	Primary causes	Comments
An organization's social system: the lack of ecological knowledge and awareness as well as motivation (Santos et al., 2016; Rino et al., 2017)	<ol style="list-style-type: none"> 1. Causes having their roots in improper people management processes (e.g. the lack of knowledge may entail wrong competence assessments, inadequate training methods, or the lack of any training activities). 2. Causes rooted in the quality of interactions (e.g. a sense of fear hinders knowledge sharing processes). 3. Structural causes (e.g. excessively complex functional structures hinder knowledge sharing processes). 4. Systemic causes (in particular the lack of solutions concerning the shaping of ecological awareness). 	<ol style="list-style-type: none"> 1. Various modifying training programmes tend to be ineffective. 2. The problem is the quality of knowledge rather than knowledge sharing. 3. Awareness is also a criterion in the ISO 14001 standard itself, item 7.3.
An organization's economic system: high costs of certification, costs related to possible modernization or investment projects (Kothari et al., 2018; Rino et al., 2017; Santos et al., 2016).	<ol style="list-style-type: none"> 1. Causes rooted in technology (e.g. impossibility of technology replacement; obsolete machinery). 2. Causes rooted in the external context (e.g. a market situation that makes it impossible to generate necessary profits; the lack of knowledge of technological development; the lack of forecasts concerning customer needs and expectations). 3. Causes rooted in value systems (e.g. a low level of business trust hindering investment processes). 	<p>The mentioned secondary causes are less significant because:</p> <ol style="list-style-type: none"> 1. Certification costs are falling because of the increasing number of entities offering certification. 2. A certificate confirms only that an enterprise has undertaken to improve its system continuously and complies with all legal requirements. The duration of the process is not limited.
An organizational system: the lack of a systemic approach, the failure to emphasize the prevention of wastage, problems with achieving eco-efficiency (Hoffrén et al., 2009; Kothari et al., 2018; Lee et al., 2017; Sumiani et al., 2015)	<ol style="list-style-type: none"> 1. Causes connected with the lack of knowledge leading to the incorrect identification of key processes as well as errors in operational control and the identification of environmental aspects. 2. Causes rooted in process measurement errors, ineffective monitoring, or failure to carry out necessary analyses and measurements. 	Secondary causes can be eliminated by aligning environmental management systems with lean management principles.
Technological systems: the lack of adequate computer support tools (Zhang et al., 2014)	<ol style="list-style-type: none"> 1. The lack of the integration of distributed databases. 2. The improper integration of existing management systems. 3. The wrong identification of key measuring points. 	The lack of the integration of distributed databases causes also the appearance of the aforementioned problems in the social system.

of looking for evidence. Another pertinent question is whether reviews characterized by a high level of employee participation are more effective than those of a closed nature in which only top managers participate.

The role of supervisory bodies in controlling improvement processes, for example an assessment of an objectives achievement level or environmental indexes by a supervisory board, is another open research problem. The research conducted by Roxas and Coetzer (2012) has shown that an institutional

environment influences managers' behaviours. Nevertheless, the exercise of corporate governance exerts a profound impact on the improvement of environmental management systems.

The last proposed research theme in this area is the competence level of external auditors and the influence of identified irregularities and provided recommendations on system improvement. In practice, there are different qualification criteria for auditors and different accreditation levels of certification bodies. Thus, relations between an auditor and an or-

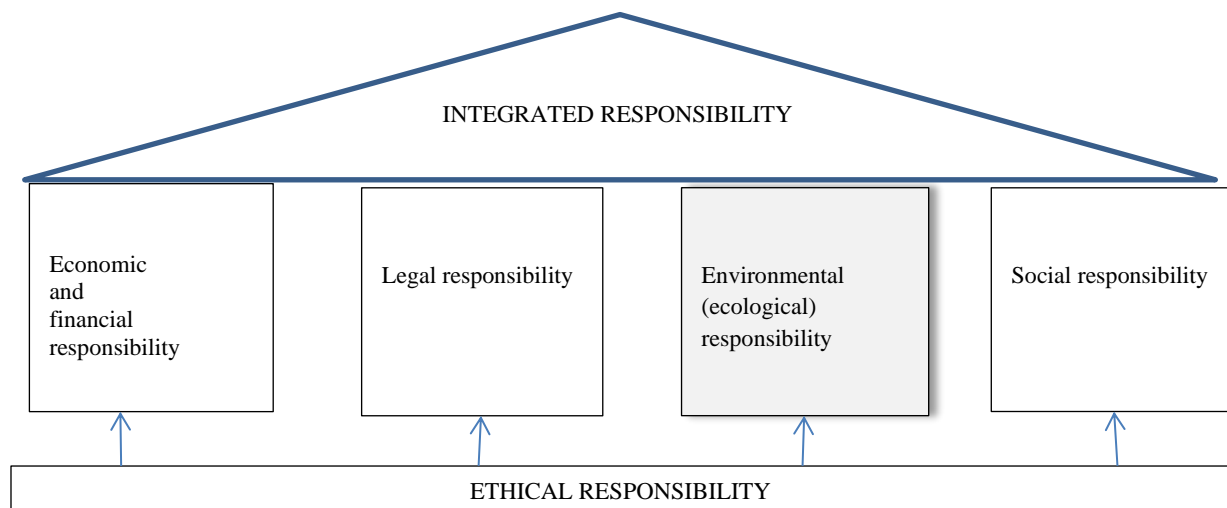


Figure 4. The place of environmental issues and ethics in the structure of integrated responsibility, source: the authors' own work based on (Borys, 2011)

ganization in the context of auditors' various interests and competencies also deserve in-depth empirical research.

With respect to conditions for a successful implementation of an environmental management system, attention should be paid to a few, often ignored, issues. One of them is a specific informational dilemma. On the one hand, the improvement of ecological awareness is facilitated environmental reporting (Craig, Allen, 2013), but on the other hand, it is usually accompanied by increasing concerns about possible leaks of precious knowledge, mainly that of a technological character. Analyses of environmental policies followed by business enterprises often indicate that the higher the level of technological advancement, the stronger the tendency to treat environmental objectives as classified.

Ethical environmental management should also be considered as an important research problem. This problem is closely connected with the scope of an organization's perceived responsibility and the function of ethical responsibility. One of the proposals concerning its integration with the other types of responsibility, including environmental responsibility, is *Integrated Corporate Responsibility* (Borys, 2011) (cf. Fig. 4).

The results of the authors' previous research (Bugdol et al., 2019) show that environmental behaviours are strongly influenced by appropriate leadership based on ethical values. Employees often follow and imitate their leaders, whose ethical attitudes sometimes have a greater influence on stakeholders than formal environmental management systems.

What also deserves special attention is the (intentional and non-intentional) causes of the growing interest in a closed circle economy. Observations conducted by the authors indicate that this interest results also from a sense of job insecurity or a threat of bad financial results. Looking for various ways of process optimization, insecure management boards

sometimes conclude that the only means of cost reduction is to introduce the principles of a closed circle economy.

Organizational games played among the participants of green supply chains may also constitute an interesting topic of potential future research. It is true that green supply chains are an increasingly popular research area (Ibrahim et al., 2019), but what tends to be disregarded in this process is inter-organizational relations connected, for example, with different interests and goals.

The last recommended research direction is the practices of green human resources management. The ISO 14001 standard contains relatively many criteria applicable to human management practices, e.g. responsibility, awareness, communication, or competencies. But there is a lack of research focusing on the influence of systems on the practice of green human resources.

10. Conclusions

Changes occurring in the natural environment are so serious and their dynamics is so great that what should be expected is the further intensification of actions aimed at building a sustainable society that harmonizes its behaviours in the economic, environmental, and social spheres. A considerable part of such actions has to be performed at the microeconomic level – in organizations responsible for the majority of the current environmental problems.

It seems that among all tools used currently in organizations to introduce the principles of sustainable development, environmental management systems are the most comprehensive and hence effective. Such systems can contribute to the shaping of pro-environmental behaviours in various groups of stakeholders such as employees, customers, or business partners.

Nevertheless, it should be remembered that besides many indisputable advantages resulting from the implementation of environmental management systems in organizations, there also occur some threats, including one of a failed implementation. This is first of all the result of limited ecological knowledge and awareness, unplanned and often high costs of system implementation and maintenance, various organizational problems, and disturbances in the pursuit of environmental objectives. Therefore, great importance should be attached to actions aimed at improving the effectiveness and efficiency of systems, both those provided for in the ISO 14001 standard and those exceeding its requirements.

It is also necessary to conduct further in-depth, particularly empirical, research of not only a cross-section (a static approach) but also continuous (a dynamic approach) character. It is problems resulting from limited ecological knowledge and awareness that seem to be the key barrier to both improving management systems and implementing the concept of sustainable development in contemporary organizations. In pursuing the goals of this concept, a vital, but still underestimated, role is to be played by environmental management systems.

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The Analysis of Government Expenditures in the European Union

Analiza wydatków rządowych w krajach Unii Europejskiej

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Abstract

This article analyses data on general government expenditure, at the level of the European Union (EU 28) according to the Classification of the Functions of Government – COFOG over the 2008-2017 period. Data shows that the expenditures increased at the beginning of the economic crisis in all EU countries, being followed by a slow-down in expenditures growth. All countries have adopted policies in order to reduce government expenditures towards the end of the period, aiming to increase their efficiency. Usually in high-income countries, compared with low-income countries, government expenditures are much larger as percent of gross domestic product (GDP), but the relations are not very strong though.

Key words: government expenditure, COFOG, Gross Domestic Product (GDP), EU 28

Streszczenie

W tym artykule przeanalizowano dane dotyczące wydatków instytucji rządowych i samorządowych na poziomie Unii Europejskiej (UE 28) zgodnie z klasyfikacją funkcji rządu – COFOG w latach 2008-2017. Dane pokazują, że wydatki wzrosły na początku kryzysu gospodarczego we wszystkich krajach UE, po czym nastąpiło spowolnienie ich wzrostu. Wszystkie kraje przyjęły polityki mające na celu zmniejszenie wydatków rządowych pod koniec tego okresu, mając na celu zwiększenie ich trafności. Zwykle w krajach o wysokich dochodach, w porównaniu z krajami o niskich dochodach, wydatki rządowe są znacznie większe niż procent produktu krajowego brutto (PKB), ale powiązanie to nie jest jednak bardzo silne.

Słowa kluczowe: wydatki rządowe, COFOG, Produkt Krajowy Brutto (PKB), EU 28

1. Introduction

Nowadays the Government's role in public society has increased, requiring the allocation of more public funds, in order to provide free and quality public services and goods to citizens. Government expenditures are very diverse, including sectors such as country's defence services, public order and national security, education and public health, environmental protection, social security, public administration and economic affairs. The issue of government expenditures has been studied in various papers – further on is presented a brief description of the subject discussed by authors worldwide.

The impact of government expenditures on education as GDP per capita of Tunisia and Morocco was analyzed in (IFA, GUETAT, 2018.), concluding that public expenditure on education serves to increase the GDP per capita of the two countries. Soft computing approach was applied in (Maksimović, Jović, Jovanović, Anićić, 2017) to predict the gross domestic product (GDP) according to several factors of health care expenditure.

Electoral impacts on the allocation of public expenditures was studied by (Vergne, 2009), the author concluded that for the election-year, public spending

shifts towards more visible current expenditures, in particular wages and subsidies, and away from capital expenditures.

In (Castro, Martins, 2018) the authors have investigated the political opportunism at aggregated and disaggregated levels of public expenditures and concluded that the expenditure components that have proved to be more related to that behaviour are public services, education, social protection and some sub-components of health expenditure, items that tend to generate outcomes that are more visible to voters. The influence of healthcare expenditure on the economic growth was analyzed in (Mladenovic et al., 2016) using adaptive neuro-fuzzy technique in order to detect the predominant factors affecting the forecasting of economic growth. In (Gamlath, Lahiri, 2018) the authors developed an overlapping generations model to examine how public and private education expenditures impacts on economy's long run outcomes. The level of public expenditure for education and healthcare in EU countries, as well as the relations between them, considered as input, and several social indicators, as output, were analyzed in (Mărginean, 2014). The comparison shows that the most developed countries allocate the largest resources for these areas and have the best performance, but the relations are not very strong though. In literature, several authors try to delimit public spending according to their effect, dividing them into productive and non-productive costs (Aschauer, 1989; Barro, 1990, 1991), saying that only the productive ones contribute to economic growth. Thus, (Kormendi, Meguire, 1985; Schultz, 1961) considers that defence and education expenditure is unproductive, while (Barro, 1991) falls into the category of productive arguing that public education is an investment in human capital with long-term effect. The theory of human capital is discussed by (Schultz, 1961; Becker, 1962), focusing on investing in education and training and (Lucas, 1988) develops the idea of investing in education, in its endogenous growth model.

The purpose of this article is to examine government expenditures in European Union countries in order to identify their tendency both in structure and dimension, knowing that all countries are constantly striving to build policies that will allow them to increase efficiency.

2. Government expenditures – structure and evolution

This study is based on statistical data regarding government expenditure (as % of GDP) obtained from Eurostat database (Annual government finance statistics). In the analysis were comprised 28 EU countries (Belgium – BE, Bulgaria – BG, Czech Republic – CZ, Denmark – DK, Germany – DE, Estonia – EE, Ireland – IE, Greece – EL, Spain – ES, France – FR, Croatia – HR, Italy – IT, Cyprus – CY, Latvia – LV,

Lithuania – LT, Luxembourg – LU, Hungary – HU, Malta – MT, Netherlands – NL, Austria – AT, Poland – PL, Portugal – PT, Romania – RO, Slovenia – SI, Slovakia – SK, Finland – FI, Sweden – SE, United Kingdom – UK). More specifically, this paper focuses and examines government expenditures by functional classification over 2008-2017 periods (2017 being the latest year with available data for most countries). According to this classification, expenditures are delimited taking into account the functions of the government. This classification can be found on the European Union website under the name of COFOG (The Classification of the Functions of Government). According to this classification, government expenditures are divided into ten major categories of expenditure: general public services, defence, public order and safety, economic affairs, environmental protection, housing and community affairs, health, recreation, culture and religion, education, social protection. These expenditures are further split into other categories that are presented further on.

The slowdown in economic growth that has occurred in all EU countries since 2008 has had an impact on real GDP. It also had a strong negative effect on the labour market and, implicitly, on public revenues, which, in each country, led to increasing pressures on the way public expenditure was allocated.

Figure 1 shows Government expenditures as % of GDP between 2008-2017 for EU countries.

The highest level of government expenditures has been recorded in countries like France, Belgium and the Nordic countries (Denmark, Finland). In these countries the government expenditures were above the EU average (Figure 1) with values between 50-60% of GDP. The lowest values of government expenditures were found in the last countries that joined the EU such as Romania and Bulgaria, as well as the Baltic countries Estonia, Latvia, Lithuania, where total government expenditures were below 40% of GDP. The highest fluctuations occurred in Ireland, country having the highest expenditures (65% of GDP in 2010) among all EU countries over the analyzed period. After 2010 in Ireland, government expenditures have been on a declining trend, in 2017 recording the lowest value in the EU, only 26.3%. High fluctuations also occurred in Greece (62.3% in 2013 and 47.3% in 2017) and Slovenia (59.5% in 2013 and 43.2% in 2017). In the other EU countries, government expenditures have fallen in the values of 40-50%.

Figure 2 presents government expenditures by type, knowing that each state authority tends to carry out public expenditure according to its specific functions. The classification of Government functions done by COFOG (useful international standard, established by O.N.U.), has allowed the analysis of resource allocation between sectors and the answer to the question: Where were public money spent? for each of the surveyed countries, in 2017.

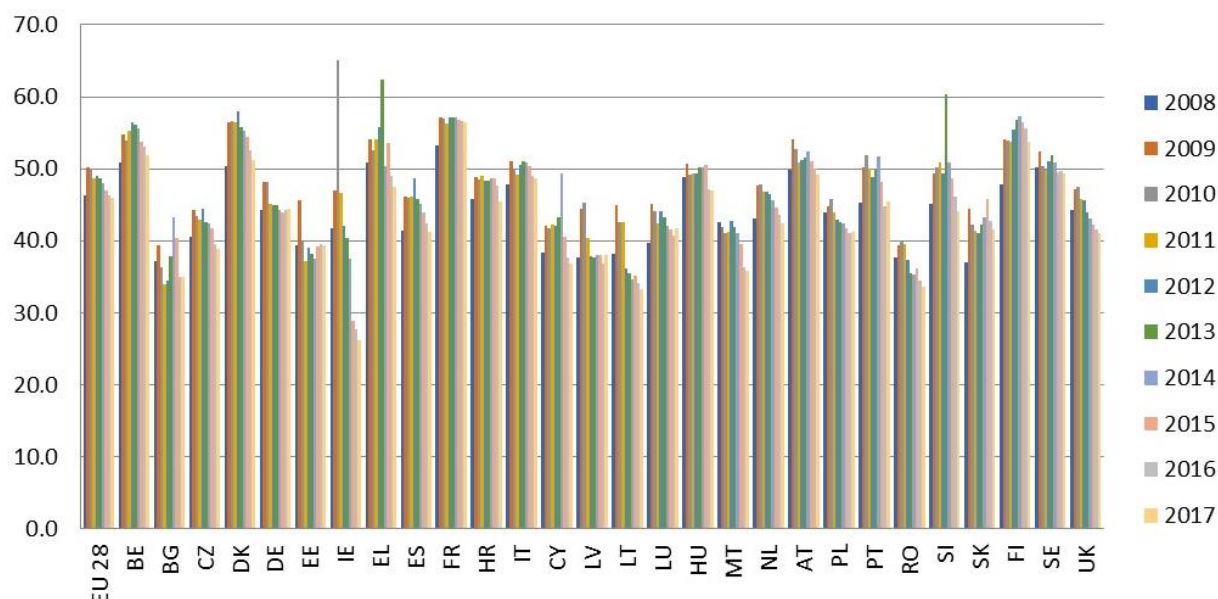


Figure 1. The evolution of government expenditure as % of GDP over 2008-2017 period, source: processed by authors based on data from Eurostat (gov_10a_exp)

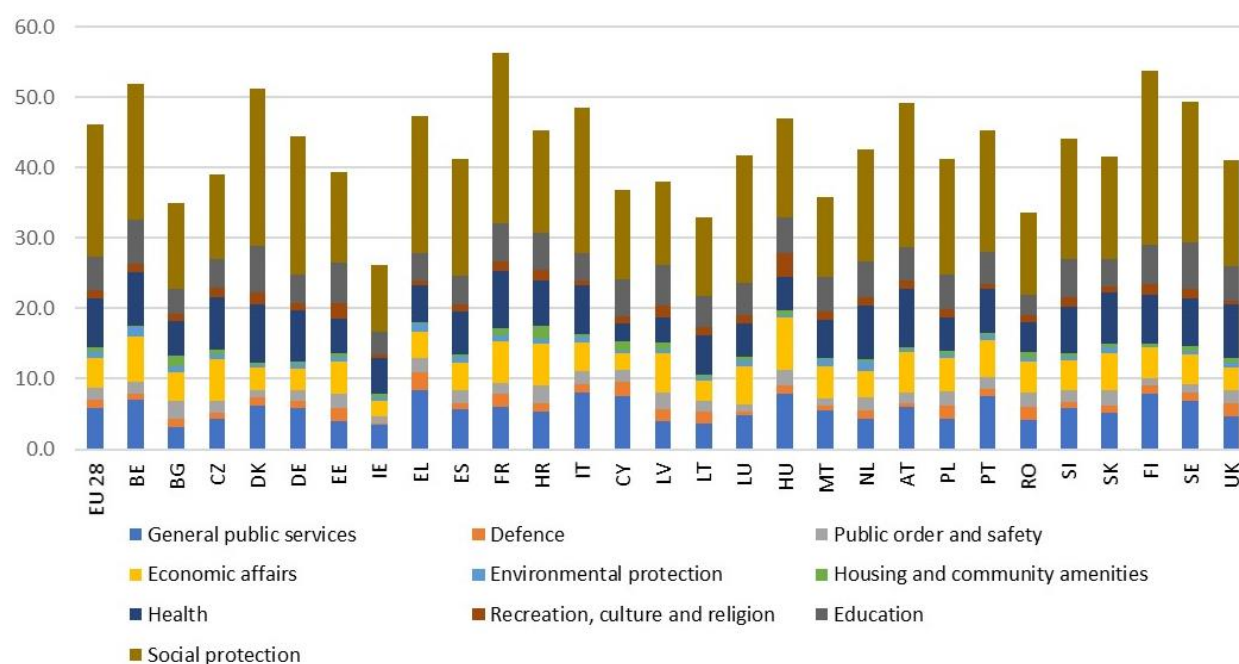


Figure 2. General Government expenditure by function in 2017, source: processed by authors based on data from Eurostat (gov_10a_exp)

Between 2008 and 2017 period the highest government expenditures were recorded for the indicator of social protection in all countries. The share of social protection expenditure in the total expenditures at EU 28 level increased from 38.2% to 41.1%. The highest values were recorded in Denmark (24.8 % of GDP in 2010) and the lowest values in Ireland (9.5% of GDP in 2017), low values were also registered in Romania, Bulgaria and the Baltic countries. In 2017, in the EU-28 countries more than half of the government expenditures were devoted to 'social protection'

(41.1% of total expenditure or 18.8% of GDP) followed by 'health' (15.3% of total expenditure or 7% of GDP), 'general public services' (12.8% of total expenditure or 5.8% of GDP), 'education' (10.2 % of total expenditure or 4.6% of GDP) and 'economic affairs' (8.9% of total expenditure or 4.0% of GDP), 'public order and safety' (1.7% of GDP), 'defence' (1.3% of GDP), 'recreation, culture and religion' (1.1% of GDP), 'environmental protection' (0.8% of GDP) and 'housing and community amenities' (0.6% of GDP).

2.1. General public services

According to COFOG, government expenditure on general public services at European Union level are divided in: executive and legislative organs; financial and fiscal affairs, external affairs; foreign economic aid; general services; basic research; research and development (R&D) on general public services; general public services not elsewhere classified (n.e.c.); public debt transactions; transfers of a general character between different levels of government.

At the level of the EU 28, expenditures on general public services recorded a lower level in 2017 (5.8% of GDP) compared to 2008 (6.5% of GDP). During this period, there was an ascending trend until 2013 (6.9% of GDP), followed by a decreasing one. Throughout the examined period, Greece recorded the highest spending on General public services, reaching a maximum of 12.9% of GDP in 2011; large expenditures were also recorded in Hungary 10.1% of GDP in 2013, Cyprus 9.5% of GDP in 2012, Italy 9.4% of GDP in 2012 and Portugal 9.3% of GDP in 2013.

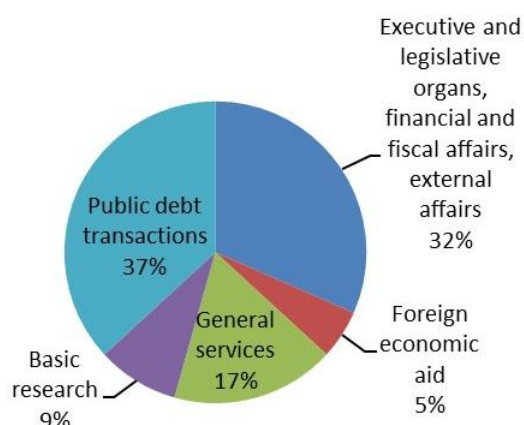


Figure 3. The structure of expenditures on general public services in 2017 at the EU level, source: processed by authors based on data from Eurostat (gov_10a_exp)

Figure 3 shows the structure of expenditures on general public services in 2017. It can be noticed that most important parts are allocated for public debt transactions (37%), being followed by the executive legislative organs, financial and fiscal affairs, external affairs (32%). The lowest expenditures were registered in Bulgaria, 2.8% of GDP, in 2016, respectively 3.2% of GDP in 2017, Estonia 3.2% of GDP in 2008 and Ireland 3.4% of GDP in 2017. Among these expenditures, according to figure 3, public debt transactions (interest, payable on general government debt instruments) represent the largest share of expenditure at EU level (37% of general public services in 2017), followed by executive and legislative organs, financial and fiscal affairs, external affairs (employees' wages) which amounted 32% of general public services in 2017 and other current transfers (e.g. grants in the context of foreign economic aid). Related to 2017 the highest level of expenditures on

executive and legislative organs were reported by Croatia (4.1% of GDP), while the lowest were reported by the United Kingdom (0.9% of GDP) and Ireland (1% of GDP).

2.2. Defence

At the level of EU countries, government expenditure on defence decreased over the 2008-2017 period from 1.5% in 2008 to 1.3% of GDP in 2017. The highest levels have been recorded in Greece during the whole analysed period (3% of GDP in 2008 and 2.5% of GDP in 2017), United Kingdom 2.4% of GDP in 2008 and 1.9% of GDP in 2017, France (1.9% of GDP both 2009 and 2010) and 1.8% of GDP in 2017, Poland 1.9% of GDP in 2008 and 1.7% of GDP in 2017 while the lowest level of expenditures on defence were reported in Ireland 0.4% of GDP between 2008 and 2014 and 0.3% of GDP between 2015-2017, Luxembourg in the range of 0.3%-0.5% of GDP, Malta 0.5%-0.9% of GDP, Austria 0.6%-0.9% of GDP.

Two high-income countries (Germany, France), a lower income country, Romania, and the data for EU 28 were chosen for a comparison exercise regarding government expenditures on defence. Figure 4 presents the evolution of government expenditures on defence in Germany, France and Romania, as well as for EU 28 countries. There is a significant increase in Romania in 2016 and 2017, while in Germany and France expenditures are almost constant. Also, we can see that the expenditures on defence in the high-income countries (Germany, France) are much larger compared with lower income countries like Romania.

As seen in Figure 4, the level of the EU-28, almost the whole part of defence expenditure is devoted to 'military defence' (1.4% of GDP in 2009 and 1.2 % of GDP in 2017) followed by 'civil defence' and 'foreign military aid'. Countries like Germany, Spain, France, Luxembourg, Portugal, Slovenia, Finland and Sweden spent about 0.1% of GDP for 'foreign military aid'. Regarding to the field of research and development (R&D) on defence the government expenditure was negligible in most countries except for United Kingdom (0.1% of GDP). According to Eurostat at the level of the EU-28, 46 % of total expenditure on defence in 2017 was devoted to employee's wages, as well as employers actual or imputed social contributions 31% was devoted to intermediate consumption and 20 % to capital investments (such as new equipment).

2.3. Public order and safety

Expenditure on 'public order and safety' is divided into the following categories: 'police services', 'fire protection services', 'law courts', 'prisons', 'R&D related to public order and safety' as well as expenditure not elsewhere classified. At the level of the EU-28, the expenditure on 'public order and safety' decreased in 2017 (1.7% of GDP) compared to 2008

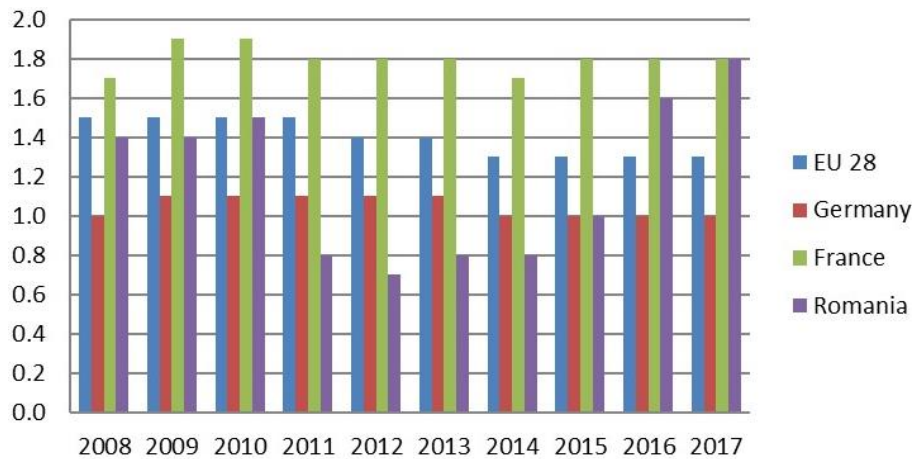


Figure 4. The evolution of government expenditures on defence in Germany, France and Romania, source: processed by authors based on data from Eurostat (gov_10a_exp)

(1.8% of GDP). The highest level of expenditure on 'public order and safety' in 2017 was identified in Bulgaria (2.5% of GDP), Hungary (2.4% of GDP), Latvia (2.3% of GDP), Croatia (2.2% of GDP) and lower in Denmark (0.9% of GDP) and Ireland (1% of GDP).

As it can be seen in Figure 5 in 2017 at the level of the EU 28 the major part of expenditures on public order and safety were devoted to police services (53% of total expenditure on public order and safety) followed by law courts 17%, fire protection services (including in fact all civil protection operations) and prisons both with 12%.

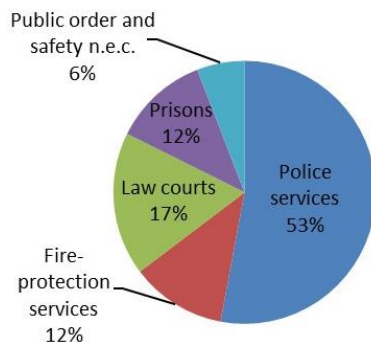


Figure 5. The structure of expenditures on public order and safety in 2017 at the UE level, source: processed by authors based on data from Eurostat (gov_10a_exp)

Countries like Greece and Hungary (both 1.4% of GDP) spent the highest amount on police services (including border and coast guards) followed by Croatia, Cyprus and Latvia (all 1.3% of GDP). The most part of expenditure on public order and safety represent salaries and social contributions for police, judges, firemen and prison guards.

The expenditure on fire protection services at the level of EU 28 remained constant (0.2% of GDP) for the examined period. Among the countries with the highest level of expenditure, 0.3% of GDP in 2017 are mentioned Romania, Greece, Bulgaria, France, Czech and Finland. At the opposite side, Denmark,

Ireland, Luxembourg, Malta, Portugal and United Kingdom registered expenditures on fire protection services less than 0.1% of GDP in 2017.

Expenditure on 'law courts', including courts operation and the justice system had the highest level in Bulgaria, ranging between 0.5% of GDP in 2010 and 0.7% of GDP in 2015 followed by Romania 0.5% of GDP in 2017.

Expenditure on prisons ranged between 0.1% and 0.2% of GDP in all countries except the Netherlands (0.4% of GDP most of the time and 0.3% of GDP in 2017).

2.4. Economic affairs

According to COFOG, government expenditures on economic affairs at the level of the European Union are divided in: general economic, commercial and labour affairs; agriculture, forestry, fishing and hunting; fuel and energy; mining, manufacturing and construction; transport; communication; other industries; R&D economic affairs; economic affairs n.e.c. In 2017 in the EU-28, total expenditure of general government on 'economic affairs' decreased at 4.0% of GDP, in comparison to 2008 (4.6% of GDP). This descending trend is encountered also at the level of the Member States. It can be observed considerable variations of expenditure on economic affairs, for example Ireland encounter the highest value of expenditure on economic affair (25% of GDP) in 2010 and the lowest (2.3% of GDP) in 2017. Important variation of expenditure was also encountered in Greece (16.4% of GDP) in 2013 compared with (3.6% of GDP) in 2017. These may be influenced by operations of an extraordinary nature, such as capital injections recorded as capital transfers and other categories of capital expenditures. The lowest values on economic affairs were identified in Denmark and ranged between 2.8% and 3.6% of GDP.

In what regards the divisions of economic affairs it was noticed that at the level of EU28 the expenditure on 'transport' amounted 49% of economic affairs ex-

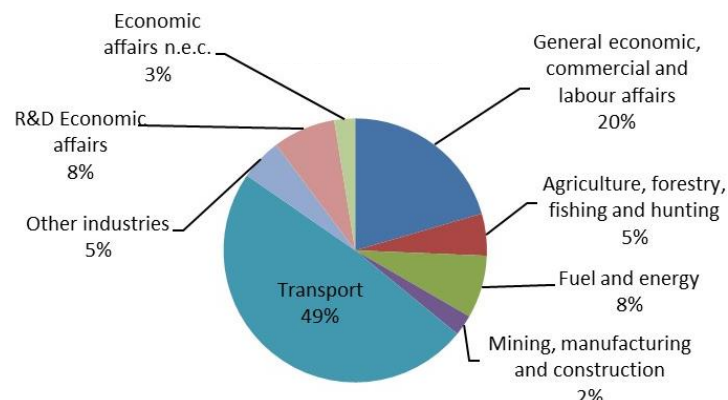


Figure 6. Structure of expenditures on economic affairs in 2017 at the EU level, source: processed by authors based on data from Eurostat (gov_10a_exp)

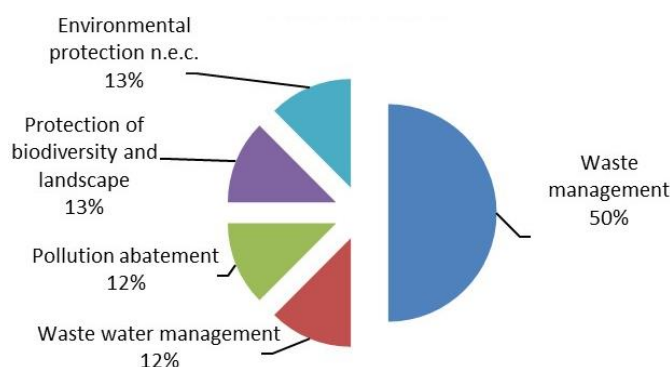


Figure 7. Structure of government expenditures on environmental protection in 2017, source: processed by authors based on data from Eurostat (gov_10a_exp)

penditure (figure 6) in 2017, followed by expenditure on 'general economic, commercial and labour affairs' with 20% of economic affair expenditure, research and development related to economic affairs (R&D economic affairs) and 'fuel and energy' both with 8%, 'agriculture, forestry and fishing' and 'other industries' both with 5%, 'mining, manufacturing and construction' and expenditure not elsewhere classified (n.e.c) summing 5%, while communication around 0%. The highest expenditure on general economic, commercial and labour affairs was encountered in Ireland (19.1% of GDP) in 2010, Greece (11.4% of GDP) in 2013, and Belgium (3.2% of GDP) in 2017.

Related to expenditure on transport, the highest were recorded in Slovakia (5.2% of GDP) in 2015 followed by Romania (4.9% of GDP) in 2012. In 2017, the highest expenditures to GDP ratios for 'transport' were recorded in Luxembourg and Hungary (both 3.8% of GDP), Czech Republic and Slovakia (both 3.2% of GDP). An important fact related to the expenditure on transport is that they depend on the value of subsidies given to public or private transportation companies, expenditure of transport companies and transport infrastructure.

2.5. Environmental protection

The expenditure for environmental protection, presented in Figure 7, are divided as follows: waste

management, waste water management (including sewage systems), pollution abatement, protection of biodiversity and landscape, R&D environmental protection, environmental protection n.e.c..

In 2017 in the EU-28, expenditure on 'environmental protection' recorded 0.8% of GDP. As it can be seen in Figure 7 half of expenditures are devoted to 'waste management' (0.4% of GDP), followed by waste water management, 'pollution abatement', 'protection of biodiversity and landscape' and expenditure not elsewhere classified relating to environmental protection (both 0.1% of GDP). At country level, Netherlands and Greece amounted the highest value of expenditure on 'environmental protection' (1.7 % of GDP) in 2009 and 2013, respectively.

In 2017 the Netherlands reported 1.4% of GDP to 'environmental protection' (of which, 0.5% of GDP on 'waste management', 0.4% of GDP on 'waste water management', 0.3% on 'pollution abatement', 0.1% on Protection of biodiversity and landscape), while Finland reported only 0.2% of GDP, followed by Cyprus and Sweden both with 0.3% of GDP. For 'Waste management', Member States allocated between 0 % of GDP (Ireland) and 0.6% of GDP (Greece and Bulgaria) in 2017. Regarding waste water management the highest ratios to GDP were recorded by Luxembourg (0.5% of GDP), while the highest value for 'pollution abatement' was reported by Greece (0.7% of GDP). For the 'protection of bio-

diversity and landscape', the countries allocated 0.2% of their GDP or less.

2.6. Housing and community amenities

The government expenditure on 'housing and community amenities' by COFOG contains: 'housing development', 'community development', 'water supply' (provision of water to households and businesses), 'street lighting', 'R&D housing and community amenities' and 'housing and community amenities not elsewhere classified'.

Over the 2008-2017 periods at the EU 28 level the expenditure on 'housing and community amenities' followed a descending trend from 0.9 % of GDP to 0.6 % of GDP. It can be seen in figure 8 that in 2017 the expenditures on 'housing and community amenities' were shared into 'housing development' and 'community development' (both 0.2% of GDP, 33% of expenditure on housing and community amenities, respectively) and 'water supply', 'street lighting' (both 0.1% of GDP).

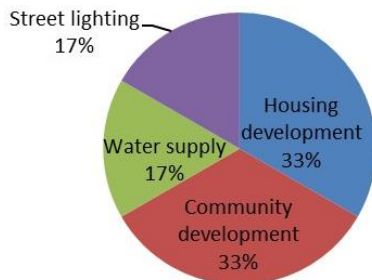


Figure 8. Structure of the government expenditure on Housing and community amenities, 2017, source: processed by authors based on data from Eurostat (gov_10a_exp)

It was observed that, over the analyzed time period, the following countries: Bulgaria, Cyprus, France and Romania reported the highest expenditure on housing and community amenities, ranged between 0.9% and 1.9% of their GDP. At the opposite side are situated Greece and Denmark (both 0.2% of GDP in 2017), Belgium and Netherlands (both 0.3% of GDP in 2017).

2.7. Health

Health expenditures are located on the second place in what regards the general government expenditure after social protection. In 2017 in the EU-28, expenditure on 'health' amounted 7% of GDP (1080 billion Euro), decreasing compared with 2009(7.3% of GDP).

Figure 9 shows the division of the health expenditure at the level of EU in 2017, in the following sectors: hospital services (46% of health expenditure), outpatient services (32% of health expenditure), medical products, appliances and equipment (15% of health expenditure), public health services, R&D health and health n.e.c. (all summing 7% of total expenditure on health).

Over the 2008-2017 period Denmark (8.9% of GDP in 2009), France (8.2% of GDP in 2014), Belgium (8.1% of GDP in 2014) recorded the highest expenditure on health, while Cyprus (2.6% of GDP), Latvia (3.5% of GDP) and Romania (3.6% of GDP in 2008 and 4.3% of GDP in 2017) reported the lowest.

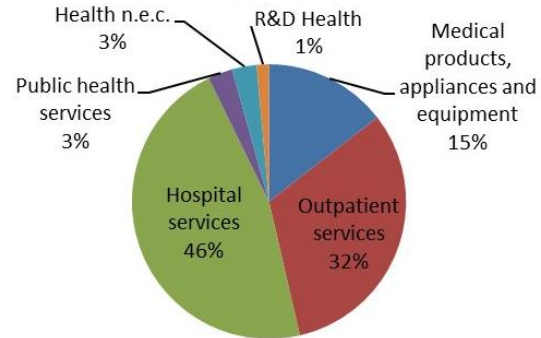


Figure 9. Structure of government expenditures on health in 2017 at the EU level, source: processed by authors based on data from Eurostat (gov_10a_exp)

At the level of the EU-28, the expenditure on 'health' increased in 2009 (7.3% of GDP) was followed by a decrease in 2011 (7.1% of GDP) and another increase in 2013 (7.2% of GDP), amounting to 15.3% in 2017.

2.8. Recreation, culture and religion

At the EU level, expenditure on 'recreation, culture and religion' amounted to 1.1% of GDP except for 2009 and 2010 when had recorded 1.2% of GDP. As it can be seen in Figure 10, in 2017 at the level of the EU 28 the main part of expenditure on 'recreation, culture and religion' was devoted to 'cultural services' (40% of total expenditure) followed by 'recreational and sporting services' (30% of total expenditure), 'broadcasting and publishing services' (20% of total expenditure), 'religious and other community services' (10% of total expenditure).

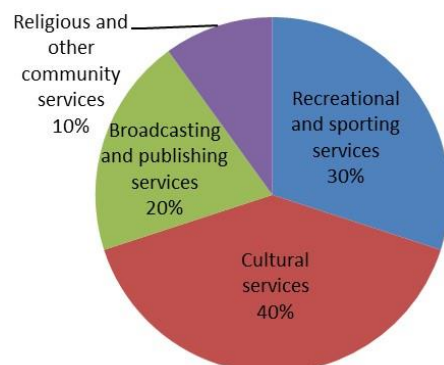


Figure 10. Structure of government expenditures on recreation, culture and religion in 2017, source: processed by authors based on data from Eurostat (gov_10a_exp)

In 2017, Ireland registered the lowest ratio (0.5% of GDP) devoted to 'recreation, culture and religion', followed by United Kingdom (0.6% of GDP) and

Greece (0.7% of GDP) while Hungary (3.5% of GDP), Estonia and Croatia (both 2.1% of GDP) registered the largest ratio.

2.9. Education

In the COFOG classification expenditure on 'education' is divided as follows: pre-primary and primary education, secondary education, post-secondary non-tertiary education, tertiary education, education not definable by level, subsidiary services to education (e.g. expenditure on providing school buses), R&D education, and education not elsewhere classified.

At the level of EU-28 expenditure on education increased in 2009 (5.2% of GDP), and decreased over the 2011-2017 period from 5.2 % of GDP in 2010, to 4.6% of GDP in 2017. Based on the data in Figure 11, the main part of total expenditure on education is devoted to secondary education (38% of total expenditure on education) followed by pre-primary and primary education (32% of total expenditure on education), tertiary education (15% of total expenditure on education) and subsidiary services to education (7% of total expenditure on education).

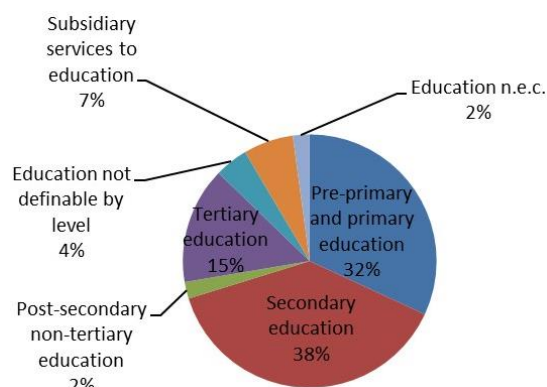


Figure 11. Structure of expenditures on education in 2017 at the EU level, source: processed by authors based on data from Eurostat (gov_10a_exp)

As percentage of GDP in 2017, the highest amounts were reported by Sweden (6.8% of GDP), Denmark (6.5% of GDP), followed by Belgium (6.3% of GDP), Estonia and Latvia (both with 5.8 % of GDP) while the lowest ratios of total expenditure were observed for Romania (2.8 % of GDP), Ireland (3.3% of GDP) and Bulgaria (3.6 % of GDP).

2.10. Social protection

Social protection has had the largest share in government expenditure throughout the 2008-2017 periods in all EU Member States. At the level of EU 28 expenditure on social protection recorded a significant increase in 2009 (19.4% of GDP) compared to 2008 (17.4%), followed by small fluctuations (± 0.1 -0.2% of GDP). In 2017 in EU28, expenditure on social protection amounted to 18.8% of GDP (41.1% of total government expenditure) and involved social benefits approximately 89%, wages and salaries of

staff administering social protection 5%, intermediate consumption 3% and 2% for other current transfers (e.g. to non-profit institutions serving households). The highest values for social protection expenditure, over the 2008-2017 period, were found in Finland (25.6% of GDP in 2016), Denmark (24.8% of GDP in 2010), France (24.5% of GDP in 2016), and the lowest values were recorded in Bulgaria (10.7% of GDP in 2008), Cyprus (10.2 of GDP in 2008) and Latvia (9.1 of GDP in 2008). In 2017 can be noticed a decrease of expenditure on social protection compared to 2016, thus the lowest level of expenditure could be seen in Ireland (9.5% of GDP), Lithuania (11.2 % of GDP), Malta (11.3 % of GDP), Romania (11.7 % of GDP) and the highest was reported by Finland (24.9% of GDP), France (24.3% of GDP), Denmark (22.4% of GDP), Italy (20.9 % of GDP).

In 2017 at the level of EU 28 (Figure 12) the most significant expenditure on social protection is represented by 'old age' (54% of total expenditure on social protection and 10.1% of GDP) followed by 'Sickness and disability' (14% of total expenditure and 2.7% of GDP), 'family and children' (9% of total expenditure and 1.7% of GDP), 'survivors' (7% of total expenditure or 1.3% of GDP), 'unemployment' (6% of total expenditure and 1.2% of GDP), 'social exclusion' (5% of total expenditure and 0.9% of GDP), 'housing' (3% of total expenditure and 0.5% of GDP) and 'social protection n.e.c.' (2% of total expenditure on social protection and 0.3% of GDP).

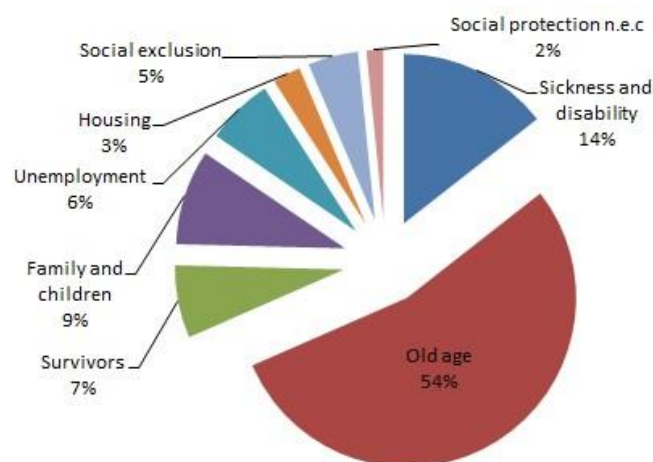


Figure 12. Structure of government expenditures on social protection in 2017 at the EU level, source: processed by authors based on data from Eurostat (gov_10a_exp)

The social protection expenditure on 'old age' relates mainly to pension payments and the highest expenditure was reported in Greece and Finland (13.8% of GDP), Italy and France (13.4% of GDP), and the lowest expenditure was in Ireland (3.4 % of GDP), Lithuania (5.7% of GDP) and Cyprus (6% of GDP). Expenditure on 'sickness and disability' relates mainly to social payment connected with the operation of social insurance schemes and the

highest values was recorded in Denmark (4.4% of GDP), Sweden and Netherlands (4.1 % of GDP), while Bulgaria (0.2% of GDP), Cyprus (0.5 % of GDP), Malta and Romania (1% of GDP) reported the lowest values. The expenditure on 'survivors', also relates to social benefits and the highest amount was recorded in Italy (2.6% of GDP), Spain (2.2 of GDP), Greece (2.1% of GDP), Germany (1.8% of GDP), while at the opposite side were located Romania and the United Kingdom (0.1% of GDP), Denmark and Luxemburg (0% of GDP). The expenditure on 'Housing' recorded 0.5% of GDP at the level of EU28 in 2017 and mainly relates to social protection payments to households to aid with the operation of social housing as well as the housing cost. The expenditure on 'family and children' accounted the highest values in Denmark (4.4 % GDP), Luxemburg (3.7 % of GDP), Finland (3.1% of GDP) and the lowest in Greece (0.6% of GDP), Malta (0.9% of GDP) and Czech Republic (1% of GDP). During the economic and financial crisis, the rate of unemployment in the EU 28 increased substantially and as an obvious result, the social protection expenditure on 'unemployment' increased from 1.3% of GDP in 2008, to 1.8% of GDP in 2009, followed by a descending trend up to 1.2% of GDP in 2017.

3. Conclusion

During the analyzed period government expenditure evolved differently across the EU countries. If at the end of the 19th century in the European countries' government expenditures were less than 10% of GDP, during the analyzed period (2008-2017), the expenditures exceed 50% of GDP in many European countries. An increase in expenditures can be noticed at the beginning of the economic crisis in all EU countries, so in 2009 all EU Member States recorded increases in government expenditure, except for Malta. In 2010 and 2011 there were increases in government expenditure in most EU Member States followed by a slowdown in expenditures growth. All countries have adopted policies in order to reduce government expenditures towards the end of the period, aiming to increase their efficiency.

In high-income countries compared with low-income countries, government expenditures are much larger (as % of GDP). More than half of government expenditures were devoted to the social protection, followed by health, general public services, education, economic affairs, public order and safety, while defence, recreation, culture and religion, environmental protection and housing and community amenities together, represented 5.5% of EU GDP in 2017. Government expenditure on social protection tends to be higher in rich countries than in poor countries. Taking into account that the world economy is permanently marked by changes at all levels: eco-

nomic, financial, political and social, certainly, the structure and amount of government expenditure will undergo changes in the future. Demographic changes, old ages, global heating, unemployment, migration phenomenon, government debt growth in some countries, international terrorism, all will affect the evolution and structure of the government expenditure in the EU and worldwide.

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Transformation of the Socio-economic System and the Implementation of Automation Processes in Terms of Shaping Order and Sustainability Processes

Transformacja technologiczna systemu społeczno-gospodarczego oraz wdrażanie automatyzacji w aspekcie kształtowania ładu i procesów zrównoważenia

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Abstract

This article addresses the topic of technological transformation, which is a challenge for progressing automation and robotization processes. The topic is extremely important in terms of changes in contemporary global reality. On the one hand, changes in production factors, automation and robotization processes, and changes in the labor market give rise to some fears, on the other hand, they can be a chance to build a new socio-economic order based on the pillars of sustainability. This system requires the application of the rules of universal behavior and the recognition of work as value in itself. These rules are an important recommendation and basis for shaping decisions in the sphere of choosing new order and ensuring sustainability, rather than only in consumption.

The article synthesizes existing research, which was the basis for further studies and the following hypothesis has been adopted: automation and robotization processes will result in turbulence on the labor market and in the social sphere.

The key purpose of this article is demonstrate that currently automation and robotization are not the subject of systemic research in the field of shaping the structural order in the economic and social sphere, to develop a scheme of technological transformation and to indicate the need to build a strategy for automation and robotization by states that will ensure strategic order and security.

Today, we need to think what should be done to ensure that automation and robotization, as well as the resulting income, do not push the crowds of society into the sphere of *lucky losers*. Will the distribution of benefits that automation and robotization give today affect the few or all of us? Will the economy and society based on these processes retain the value of work, and will the profits generated from automation and robotics contribute to prosperity, sustainability and development? Are decision makers ready today to prepare comprehensive solutions? The answer to these questions must be formulated today, because modernity will not pass us by.

Key words: technological transformation, automation and robotization, strategic management, sustainability, structural order

Streszczenie

W artykule podjęto temat transformacji technologicznej, która jest wyzwaniem dla postępujących procesów automatyzacji i robotyzacji. Temat jest niezwykle istotny z punktu widzenia zmian w czynnikach produkcji. Zachodzące procesy automatyzacji i robotyzacji, zmiany na rynku pracy z jednej strony budzą pewne obawy, z drugiej mogą być szansą na zbudowanie nowego ładu społeczno-gospodarczego opartego na filarach zrównoważenia i trwałości. Wymaga stosowania reguł powszechnego postępowania i uznania pracy za wartość samą w sobie. Reguły te stanowią istotne wskazania i bazę dla kształtowania decyzji w sferze wyboru nowego ładu i zapewnienia zrównoważenia, a nie tylko konsumpcji.

W artykule dokonano syntezy istniejących badań, które stanowiły bazę dla dalszych studiów i przyjęto hipotezę, że procesy automatyzacji oraz robotyzacji będą skutkowały turbulencjami na rynku pracy, a także w sferze społecznej.

Kluczowym celem niniejszego artykułu jest: wykazanie, że obecnie automatyzacja i robotyzacja nie stanowi przedmiotu badań od strony systemowej w zakresie kształtowania ładu strukturalnego w sferze gospodarczej i społecznej; opracowanie schematu transformacji technologicznej; wskazanie na potrzebę zbudowania strategii automatyzacji i robotyzacji przez państwa, która zapewni ład i bezpieczeństwo strategiczne.

Dzisiaj musimy zastanowić się, co należy uczynić, aby automatyzacja i robotyzacja oraz płynący z nich dochód gwarantowany nie zepchnął rzeszy społeczeństwa w sferę *szczęśliwi przegrani*. Czy dystrybucja korzyści, jakie dają już dziś automatyzacja i robotyzacja będzie dotyczyć nielicznych, czy też nas wszystkich? Czy gospodarka i społeczeństwo oparte na tych procesach zachowa wartość pracy, a zyski wypracowywane z procesów automatyzacji i robotyzacji przyczynią się do budowania dobrobytu, procesów zrównoważenia i rozwoju? Czy decydenci są dziś gotowi na przygotowanie kompleksowych rozwiązań? Odpowiedź na te pytania musimy sformułować już dziś, bo nowoczesność nas nie ominie.

Słowa kluczowe: transformacja technologiczna, automatyzacja i robotyzacja, zarządzanie strategiczne, zrównoważoność, porządek strukturalny

1. Automation and robotization in management literature and the state of the Polish economy compared to global trends

The relevant literature lacks theoretical solutions for creating system solutions for the automation and robotization of the economy. Automation and robotization issues mainly focus on technological issues and address processes pertaining to automation and robotization in companies. The discussion related to shaping corporate strategies based on automation has been a challenge for researchers for many years, in terms of competence (Meyer, N Dean, 1986) and exploring the automation and augmentation concepts in the management domain. Whereas automation implies that machines take over a human task, augmentation means that humans collaborate closely with machines to perform a task (Raisch S., Krakowski, 2020), and the automation of a business process as a key factor enables the improvement of business processes (Scheer et al., 2004). It is also important that, from the perspective of system approaches, the attempts in this context were already made by earlier authors. For example, R. W. Coombs considers the role played by technological innovation in the theoretical frameworks found in the literature on long waves. He highlights that some writers place emphasis on consumer good innovations, some on capital good innovations, some on new technologies which affect consumer and capital goods, while others take no view on the relative roles of consumer and capital goods innovations. It is suggested – in his opinion – that capital goods innovations embodying automation may have been important in the mechanism of the current long wave. Data on employment, rates of return, and value-added for the engineering industries lend support to the view that expectations and propensity to innovate may have been high in the capital goods sector before the upswing of the current long wave in economy (Coombs, 1981, pp. 360-370). In 1994, B. Carlsson and St. Jacobsson argued in their work that technological systems constitute a useful unit of analysis for not only innovation and diffusion studies but also work related to technology policy. In the case of Sweden's technological system for factory automation (e.g. robots), it is suggested that three features are central to explaining the ex-

tensive diffusion of new technology in the Swedish engineering industry, namely *bridging institutions*, user-supplier linkages, and critical mass coupled to advanced economic competence among a key set of users. As regards public policy, they argued that its role is to facilitate the formation of new technological systems and to enhance the functioning of existing systems rather than to rectify individual market failures. This can be done by creating or strengthening *bridging institutions* and centers of excellence, promoting speedy and wide diffusion of engineering competence, and strengthening compensating mechanisms (Carlsson, Jacobsson 1994).

R. Abbot and B. Bogenschneider point to the crucial problem of the taxation on automation and robotization. First of all, they emphasize that the problem of taxation on automation is ignored in the debate. Firstly, it is even more concerning that automation significantly reduces the government's tax revenue since most tax revenue comes from labor income. Secondly, they put attention to the fact that the current taxation system encourages automation by providing employers with preferential tax treatment for robot workers. Automation allows firms to avoid employee and employer wage taxes levied by Federal, state, and local taxing authorities. It also permits firms to claim accelerated tax depreciation on capital costs for automated workers, and it creates a variety of indirect incentives for machine workers. All of this is the unintended result of a tax system designed to tax labor rather than capital. Tax policies may thus result in automation in some cases in which a company would otherwise choose a human worker (Abbot, Bogenschneider 2017). The authors have suggested that *experts are widely predicting that automation is going to have a substantial impact on employment even in the near term. Bank of America Merrill Lynch argues that by 2025, AI may eliminate \$ 9 trillion in employment costs by automating knowledge work. A report by the World Economic Forum estimates that automation could result in the net loss of 5.1 million jobs by 2020. The consulting companies Deloitte claims that 35 percent of jobs in the United Kingdom are at high risk of redundancy due to automation in the next 10 to 20 years. The McKinsey Global Institute has stated that 51 percent of existing work activities could be automated using*

existing technologies. This is due to a combination of factors: improvements in automation technologies, decreased costs for such technologies, and increased labor costs. Whereas it was previously possible to automate a large number of work processes, it has now become practicable. As automation technologies continue to both improve and decrease in cost, it is difficult to think of work functions that will not eventually be susceptible to automation (Abbot, Bogenschneider 2017, pp. 8-9).

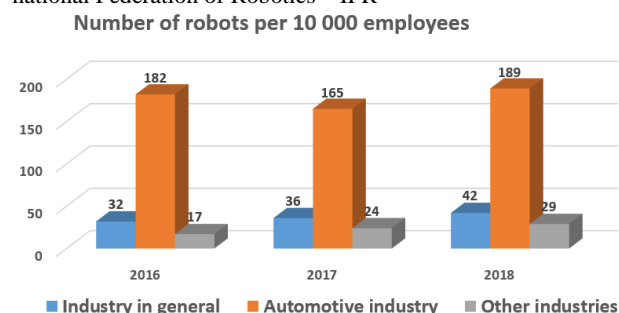
The International Federation of Robotics IFR indicates that the sale of robots in global markets maintains an upward trend and more and more companies are recognizing their benefits from the implementation of robotization and automation, especially in the face of crises, related either to the situation on the labor market or economic crises, or severe crises caused by the result of a pandemic. In 2018, compared to the previous year, the sales of industrial robots in the world increased by 6% and amounted to 422 thousand units, while in Europe it increased by as much as 14% to 75,560 units, setting a new record for the sixth year in a row. IFR analysts predict that global growth will continue; it is estimated that from 2020 to 2022, nearly 2 million new industrial robots will be located in companies around the world (World Robotic Report, 2019, pp. 13-16).

According to data from 2018, 5 countries are responsible for $\frac{3}{4}$ new installations, i.e. China, Japan, the USA as well as South Korea and Germany. China is the world leader in robotization, with over a third of the global market, despite a 1% decline in 2018. 154,000 units sold per year is more than the total number of robots sold in Europe and the Americas. Japan is second at the rate of robotization in the world with a result of 55,000 more machines in 2018 (an increase of 21%). The United States is in third place: 40.3 thousand units sold and 22% increase. South Korea occupies fourth place (38 thousand units) and Germany is in fifth place with 27,000 units, making it the largest European robotics market. In Poland, despite the 4.5% increase in GDP, increased minimum wage that everybody enjoys, the rising level of consumption, automation and robotization differ from global standards and indicators. According to the data from the *World Robotics 2018* IFR report, the average density of robots in the world is 99 units per 10,000 employees, in Europe 114 units, and in Poland we have only 42 (see Figure 1). Poland occupied the 16th place in the world ranking, with 13,632 devices installed.

The fundamental indicator which measures the degree of automation and robotization is the average density of robotization, which is measured by the number of industrial robots per 10,000 employees. Figure 1 shows the density of robotization in Poland in 2016-2018 in relation to the total industry, the automotive industry and other industries. The data show that only the automotive industry has a higher density of robotization, while in industry in general,

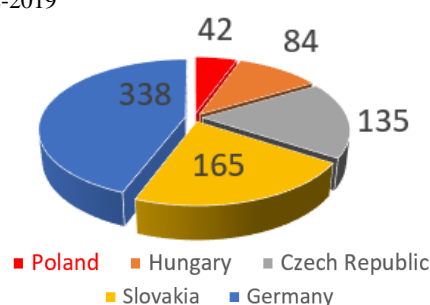
this indicator is more than 50% lower than the average density of robots in the world.

Figure 1. Density of robotization in Poland, source: <https://automatykaonline.pl/>, based on the International Federation of Robotics – IFR



Compared to our region of Europe, the level of automation of the Polish economy is also the lowest (see Figure 2). The domestic market has been growing more dynamically since 2014 (at least 1,000 industrial robots installed each year), but the number of installations is still insufficient to catch up with the Czech Republic or Slovakia.

Figure 2. Density of robotization – Poland compared to other countries in the region, average density in Europe is 144, source: <https://automatykaonline.pl> based on the International Robotics Federation – Raport-IFR-World-Robotics-2019



At the same time, the interest of Polish entrepreneurs in the introduction of robotization is still insufficient. The 2018 Work Service research entitled *The attitude of employers to work automation* shows that only a quarter of companies in Poland want to invest in work automation. Nevertheless, the plans of these companies are defined neither as to the dates nor the scale (see Figure 3).

Research results in individual industries are presented in Figure 4. Data show clearly that in the public sector in Poland only 10% of respondents are interested in automation and robotization. Such a low number certainly implies even lower implementation, so one can certainly conclude that the public sphere is not in the least prepared for real improvement in efficiency and effectiveness in the near future.

The research also shows that if the company is already planning to implement automation, they do it first of all to increase quality, competitiveness and

Figure 3. Attitude of companies to automation in Poland, source: ccnews.pl

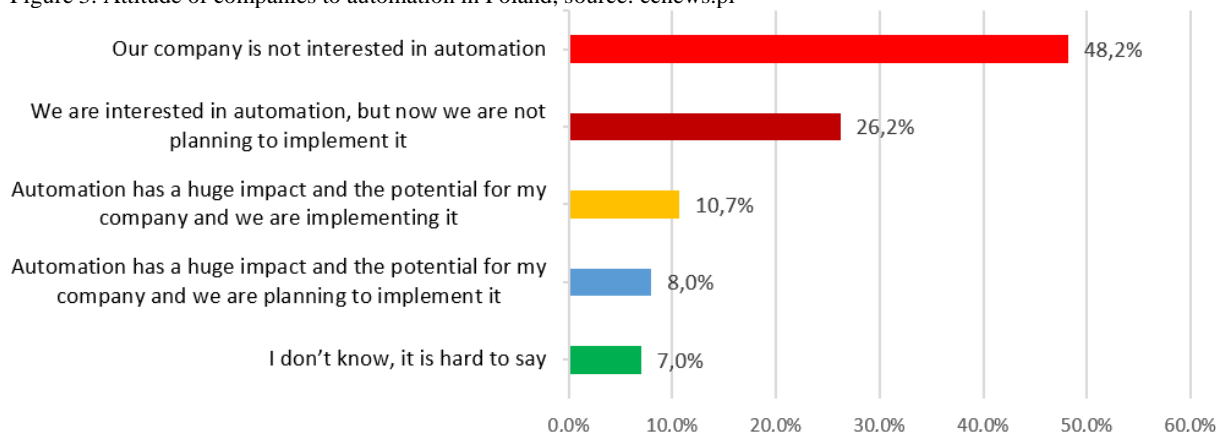
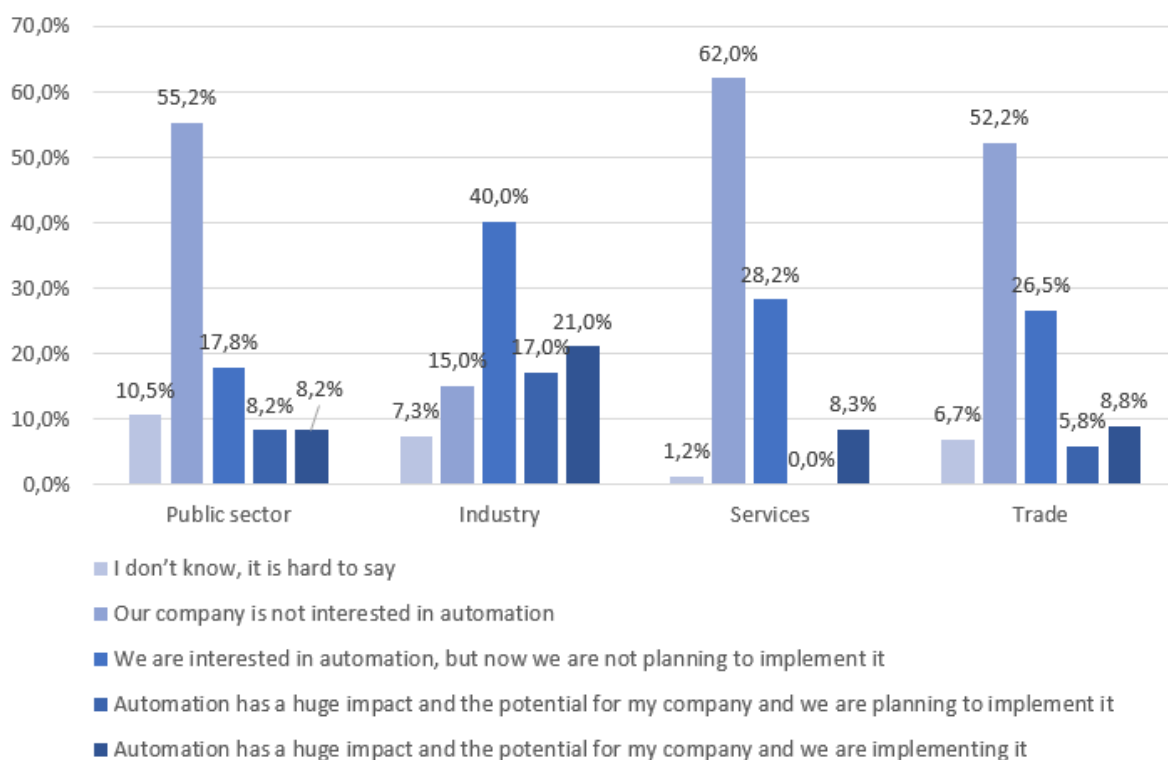


Figure 4. Attitude of companies in Poland to automation by industry, Source: Research conducted by Kantar Millward Brown, ccnews.pl



efficiency – 79.75% of companies, to increase employee safety and comfort (76.3%), to reduce costs (71.7%,) and only 57.2% to reduce staff shortages. In the decision-making process, Polish entrepreneurs most rarely take low unemployment and population decline into account. Meanwhile, the forecasts of the Central Statistical Office seem relentless. By 2050, the Polish population is expected to decrease from 38 million to 34 million people. This means a smaller population size by 1/9, in some regions this decrease may amount to even 30% (Raport, 2014). Fewer Poles simply mean fewer and fewer staff available on the labor market.

Raising the rates of robotization and automation can be the key to the development of many countries, to

get out of the middle income trap and to truly improve the quality of life.

Economies and societies are at a time when an attitude to automation and robotization must be addressed in a systemic way and requires a strategic approach. Today, robotization and automation processes create a need to build new socio-economic systems. Automation and robotization cannot be a goal in itself, but only a tool which enables the implementation of correctly defined priorities. They aim to contribute to increased efficiency and effectiveness while improving the quality of life and shaping the right relationship between *have* and *be*. Building a new socio-economic system based on the processes of automation and robotization requires

the application of the rules of universal procedures, understood as norms which determine and verify the procedures used, and the recognition of work as value in itself. Failure to take these actions will result in strengthening inequalities between the owners of technology (automation and robotization) and others in personal and institutional terms (i.e. states and societies).

2. Methodology

In order to effectively and objectively achieve research objectives, descriptive analysis and critical analysis methodology and a deductive method were adopted. The reason for using the deductive approach is that it allows for the determination of directions for shaping management policy and setting priorities. It becomes a verifier for the real sphere. P. Sulmicki (Sulmicki, 1973, p. 9) puts it in a synthetic way: *there is nothing better for practice than a good theory*. It allows you to answer the question of how it should be, and the process of collecting and analyzing data verified in relation to theory and only then is it subject to detailed and subjective modifications. Deduction-based methodology allows you to design the future and set priorities correctly. This is especially important for public management.

This methodology included primary and secondary sources for collecting relevant data and is the result of available research in this area. It included studies on automation and robotization, strategic management, sustainability, structural order, and strategic management in the public sphere.

3. Conducting theoretical research and practical solutions for strategic management

3.1. The category of the structural order and sustainability and the concept of development

There are a number of relationships between ensuring the structural order, sustainability and the concept of development. The core category is *the structural order*. It is a positive goal of developmental changes, an outcome which combines, in a consistent way, economic, social (including institutional and political) and environmental (including spatial) order. Therefore, the system of strategic environmental goals, and the goals of socio-economic development and spatial development creates a structural basis for shaping the integrated order (Borys, 2011). In other words, it is a state of order and harmony that permeates all areas of human activity as seen from economic, social, environmental and institutional perspectives, as well as in the broadly defined non-material dimension. The achievement of the structural order means the practical implementation and application of constituent axioms, natural law and superior values in the economic and social spheres of human activity. To put it simply, this means ob-

jective control and application of fundamental ethical principles in broadly defined management which are inherent in natural law. They determine the achievement of the economic order as well as international, moral, social and political order (Piontek, 2009). The structural order understood in this way is directly related to the category of sustainability. This category is related to the concept of development, which is sustainable development.

Sustainable development as a category does not have one definition. For example, in the article (B. Piontek, 2002), 44 definitions of this category were identified. This article adopts the definition of F. Piontek, which says that sustainable development is shaping the right proportions between the three types of capital (E: H: N) of present and future generations. The concept understood in this way can be considered in both subjective and objective terms. It is also important that sustainable development is not only an intellectual concept, but it can be implemented, for example, in public management at the central and local government levels, also in territorial systems (for example, by implementing the objectives contained in central policies and strategies at the regional level), which has its justification in art. 5 of the Constitution of the Republic of Poland. It should also be noted that the subjective approach does not and should not exclude the objective approach, including the one based on automation and robotization processes. This approach defines both formal and informal objects.

In the relevant literature, a homogeneous approach is usually applied to the concept of sustainable development, assuming that this is one concept. This approach is logically debatable, for example because of the multitude of definitions of the category itself. Practice also proves that in various conditions the assumptions of this concept can be implemented through a series of detailed concepts, equivalent to the fundamental assumptions of this concept, the integrating feature of which is sustainability. Therefore, it seems justified to treat two sets of concepts based on sustainability and unsustainability processes.

The core decision is to choose between a concept selected from a set of concepts based on sustainability processes and a concept selected from a set of concepts based on unsustainability processes.

Detailed attributes which diversify the sets of the concepts of development based on sustainability processes and unsustainability processes are discussed in the work (Piontek F., Piontek B., 2017):

In the set of sustainable concepts, a concept of *sustainable development* should be mentioned as a representative of this set. This is justified by the international commitment to work on this concept. Regardless of this, it should be pointed out that the set of concepts based on sustainability processes also includes other concepts, e.g. ordoliberalism, the social market economy and many options of their imple-

Table 1: Attributes that differentiate a set of concepts based on sustainability and unsustainability processes in relation to automation and robotization Source: Own study

No.	Differences that distinguish a set of concepts based on <i>sustainability processes</i> from a set of concepts based on <i>unsustainability processes</i>	Automation and robotization as a factor which shapes <i>sustainability processes</i>	Automation and robotization as a factor which shapes <i>unsustainability processes</i>
1.	Embedding the concept of development on norms, natural law and superior values, rather than on paradigms that are relative and criterion-based.	A criterion which verifies the processes of automation and robotization is norms, natural law and superior values	A criterion which verifies the processes of automation and robotization is paradigms
2.	An attitude to the types of capital: taking three fundamental types of capital (economic, human and natural) into account.	Shaping the proportion between three types of capital: E: H: N	Subordinating the processes of multiplying economic capital
3.	The growth process treated as a component of the development process, subordinated to development rather than an independent category, the result of which may be development, but also inequalities.	Growth process subordinated to the development process	Permanent growth
4.	Shaping the relationship between the types of capital – one cannot develop or grow at the expense of the other.	One cannot grow at the expense of the other	It is allowed that one develops at the expense of the other
5.	Strategic planning.	Obligatory strategic planning. Long-term dimension	Technological usability becomes a time period of planning
6.	The determination and development of strategic areas and industries.	Determined and related to automation and robotization. They are designed to ensure strategic security	None
7.	The correct understanding of the category of efficiency and its use in accordance with or contrary to the nature of the entities and phenomena assessed.	Processes that take economic, social and environmental efficiency into account.	Processes subordinated to economic efficiency
8.	The use of measures for measuring both the development and growth processes	Quantitative and qualitative measures	Quantitative measures
9.	The observance of appropriate relationships in processes between the speed of change in economic and non-economic figures while respecting quality parameters.	The pace of processes subordinated to sustainability and quality	The pace of processes focused on permanent growth
10.	Managing demand and supply as core areas for the implementation of selected concepts and adopted strategies.	Protection of domestic demand and supply which guarantees strategic security	Global demand and supply
11.	A choice between an external concept or a bottom-up concept.	A bottom-up concept which takes the internal potential into account.	Concepts adopted for the short-term use
12.	A choice between a diffusion-polarizing model and a sustainable model	Sustainable model	Diffusion-polarizing model
13.	Proportions between the sovereignty and integration of a country or region in the economic, social and institutional terms.	Proportions between the sovereignty and integration of a country or region in the economic, social and institutional terms.	Integration used to maximize flow and build value chains
14.	Equalling territorial opportunities.	Territorial development depends on the level of automation and robotization in a given area. The distribution of benefits related to the long-term plan and the functionality of strategic areas	Territorial development depends on the level of automation and robotization in a given area.
15.	Creating highly specialized jobs instead of cheap labor	Yes. A labor market which takes the structural order into account. Income guaranteed by a component of remuneration resulting from the adopted distribution model	Yes. A labor market shaped by the guaranteed income model

No.	Differences that distinguish a set of concepts based on <i>sustainability processes</i> from a set of concepts based on <i>unsustainability processes</i>	Automation and robotization as a factor which shapes <i>sustainability processes</i>	Automation and robotization as a factor which shapes <i>unsustainability processes</i>
16.	Criteria for environmental assessment	Coherence and correctly defined subordination to development. Created models which ensure the internalization of environmental costs	Subordinated to efficiency and growth. Pro-environmental models subordinated to efficiency, the implemented model of shifting environmental costs to the environment and in time
17.	Supporting industry education and building solutions aimed at developing the combination of education and practice.	Providing highly qualified staff to support automation and robotization processes. Science understood as <i>sofia</i> and <i>techne</i> .	Providing highly qualified staff for servicing automation and robotization processes. Science limited to <i>techne</i>
18.	Support for socially excluded areas.	Starting development processes in excluded areas.	The consolidation of the processes of technological stratification
19.	An attitude to the category of work	Work as a value. Ensuring access to work for everyone.	Work as an element of servicing automation and robotization processes. Work as a privilege, rather than a necessity. Access to work – limited
20.	Adoption of the model of benefit distribution resulting from automation and robotization processes.	The distribution of benefits resulting from automation and robotization in society.	The accumulation of benefits for the few
21.	The increased quality of life	The increased quality of life proportionally to the adopted model of benefit distribution. The new structural order ensuring access and quality of life of society.	Increased quality of life proportionally to the adopted model of benefit distribution.
22.	Consumption model	Change in the consumption model from a quantitative to a qualitative model. Consumption based on qualitative criteria	Ensuring the right to consume. Consumption based on quantitative criteria

mentation, which satisfy the sustainability criteria. However, there are also a number of solutions that, despite similar names, do not meet the sustainability criteria, are ostensible and sometimes contradictory. Unsustainability offers the possibility of creating more, also ostensible concepts. Automation and robotization processes will also significantly contribute to the preservation of specific sets.

The choice between concepts based on sustainability or unsustainability processes seems to be obvious and easy. It should be noted, however, that sustainability alone is not a sufficient condition to ensure the order. Ensuring the order lies in decisions, and their correctness should be shaped in accordance with the sense and purpose of human existence and action. For the purposes of this article, basic differences between the set of concepts based on *sustainability processes* and the set of concepts based on *unsustainability processes* should be discussed in a synthetic way, and these include:

- embedding the concept of development on norms, natural law and superior values rather than on paradigms, which are relative and criterion-based;

- an attitude to capital – taking three basic types capital, i.e. economic, human and natural into account, with the supremacy of human capital;
- the growth process treated as a component of the development process, subordinated to development rather than an independent category, the result of which may be development but also inequalities;
- the ways of managing individual types of capitals, shaping relationships between the types of capital - one cannot develop or grow at the expense of the other;
- taking quantitative and qualitative criteria into account;
- strategic planning or its appearances;
- the determination and development of strategic areas and industries;
- the correct understanding of the category of efficiency and its use in accordance with or contrary to the nature of the entities and phenomena being assessed;
- the use of measures for measuring both the development and growth processes;
- the observance of appropriate relationships between the pace of change in economic and non-

economic figures while respecting quality parameters;

- the management of demand and supply as the core areas for the implementation of selected concepts and adopted strategies;
- a choice between an external concept or a bottom-up concept;
- a choice between a diffusion-polarizing model and a sustainable model;
- a choice between the sovereignty and integration of the country or region in the economic, social and institutional terms;
- an attitude to the category of work;
- the adoption of a model of benefit distribution resulting from automation and robotization processes.

To put it simply, it can be assumed that the choice between concepts from the sets of:

- 1) concepts based on sustainability processes or
- 2) concepts based on unsustainability processes

is crucial for shaping the order and sustainability during the implementation of automation and robotization processes in the operational and conceptual dimensions.

3.1.1. Automation and robotization as a factor of shaping the structural order

Taking into account the attributes that distinguish the set of concepts based on sustainability and unsustainability processes in Table 1, the form that these attributes can take and the formula they can be used in when applying automation and robotization have been described. In this context, 21 attributes have been identified, but it should be noted that this is not a closed set and can be specified. It is important that the adoption of specific solutions in real terms depends on the state's efficiency in responding to challenges posed by contemporary reality in the area of strategic planning.

The analysis in Table 1 shows that automation and robotization can implement both sustainability and unsustainability processes in real terms. They are a production factor that will have a key impact on the condition of economies and countries. It depends on the institutions responsible for development which processes will be implemented based on automation and robotization.

3.2. Technological transformation of the economic and social system – challenges and recommendations

Technological transformation is a process of socio-economic changes shaped by a factor of change, that is the processes of automation and robotization, determined by the choice of the concept of development and the resulting attributes and subject to criterion assessment, which allows for the definition of the sense and purpose of existence and action, on the basis of which a new structural order and quality of life are shaped. The key element here is the factor of

change, which includes automation and robotization. It is important that this valuable factor is determined by the choice of the concept of development and can implement both sustainability and unsustainability processes in real terms. This choice is the autonomous choice of decision makers. It cannot be imposed, usually the public authority makes such a choice with a democratic mandate.

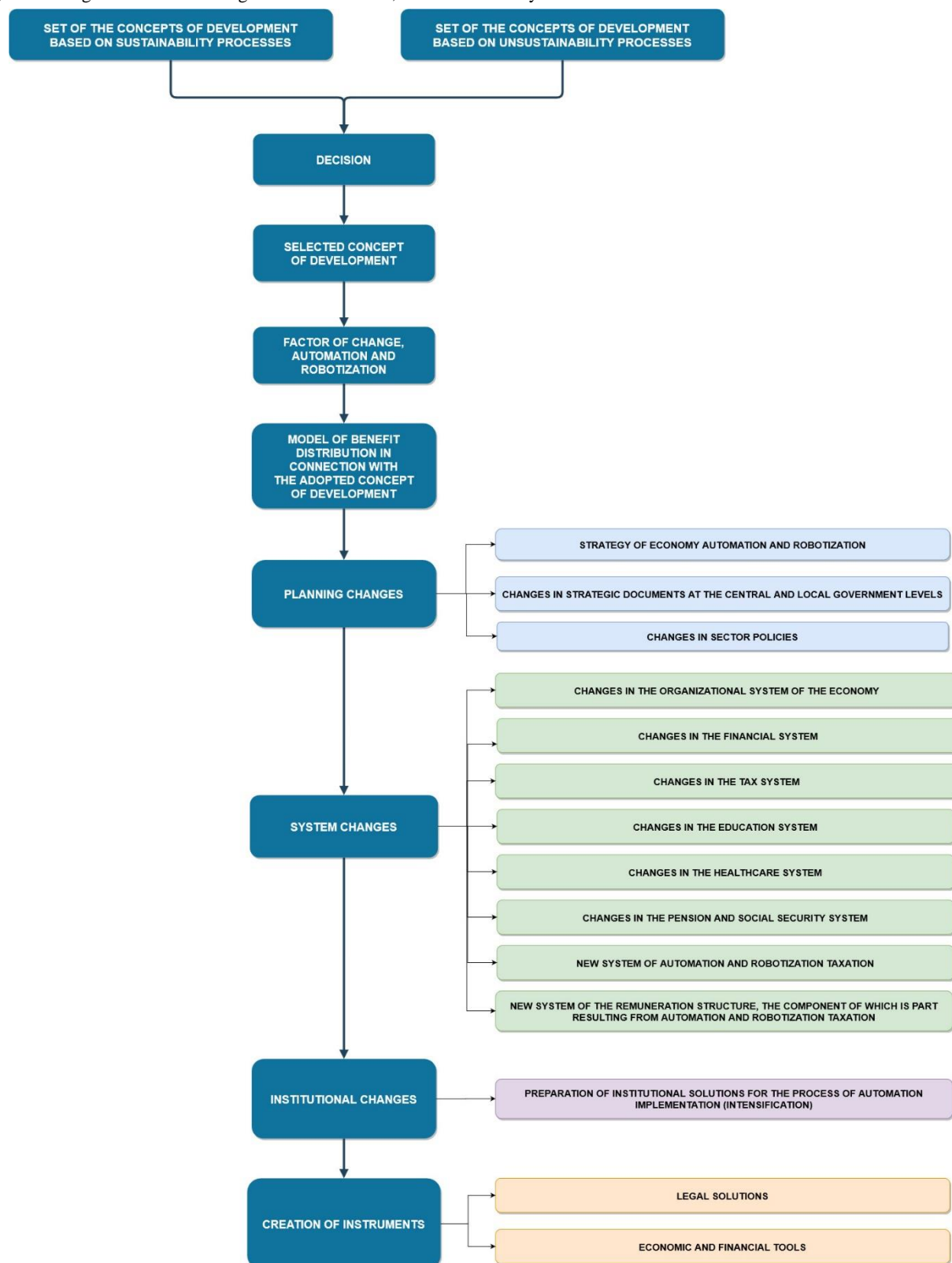
The factor of change, which is automation and robotization, touches on a number of structural, systemic, planning, tool, institutional, organizational changes, etc. It requires building a model of benefit distribution resulting from automation and robotization associated with the concept of development. In addition, it requires the creation of two system areas: the taxation system of automation and robotization, and the remuneration system, the component of which would be an addition from automation and robotization.

Revenues generated from the taxation of process robotization and automation can be fed into the income stream. Workplaces which shrink in some areas can be created in others by increasing efficiency in automated processes, for example by reducing the exploitation of today's employee, whose working week does not have to last 40 hours in a five-day working week, but e.g. 20 hours in a four-day working week. Thus, providing round-the-clock production or service support can generate up to six full-time jobs, not three. Financial participation in the remuneration should be provided from funds obtained from the taxation of automation and robotization, and the correct distribution of these funds. Such a solution will increase the efficiency of these employees, will not be a burden to the employer, and at the same time will create new jobs, improve the quality of life and ensure the structural order.

As regards the importance of the state and the implementation of sustainability processes in shaping the new socio-economic system with the use of automation and robotization processes, the following strategic actions are crucial:

- defining the tasks of the state as a generator and entity which finances main research;
- formulating strategic areas in the economy based on automation and robotization processes;
- creating system solutions for the broadly defined business sphere;
- developing a long-term plan for the national economy and transferring this area for development through short-term activities in business areas, in particular in the area of state-owned companies;
- developing a long-term plan for human capital, both in the area of shaping the labor market and – perhaps above all – in the area of knowledge and education, educational models and connections with the new socio-economic model;

Diagram 1. Diagram of the technological transformation, source: own study



- fair and responsible distribution of the benefits of automation and robotization in the social structure;
- linking the area of knowledge and education with the processes of automation and robotization to shape order on the labor market;

- opening up financing possibilities for automation and robotization processes;
- identifying crucial areas that will be subject to full automation, indirect automation, non-automated areas and areas protected against automation and robotization;
- laying the foundations for a new fiscal and tax system;
- developing social security solutions regarding guaranteed income and working time;
- preparing solutions for the pension and healthcare system;
- planning rules for the distribution of benefits between automated areas and areas that will not be automated;
- developing instruments to implement these processes in real terms;
- preparing legal solutions;
- developing solutions for increasing the implementation of automation and robotization processes in three areas:
 - 1) public,
 - 2) companies with the State Treasury participation,
 - 3) private business.

The subsequent step is to build an education strategy based on these areas that will take the absorptivity of individual areas of the economy for human resources into account.

The crucial area for the new socio-economic system using automation and robotization processes is the area of science and education, which will soon have to fulfill the requirements of the technology market. F. Piontek pays attention to the current trend: science changes its nature, there is a systematic departure from the sphere of *sofia* (wisdom) to the sphere of *techné* (skill). Meanwhile, the technology market based on automation and robotization processes is demanding. First of all, it needs the departure from narrowly understood specializations in favor of interdisciplinarity. Education in this field is not only a challenge, but above all a duty. It depends on decision-makers whether bureaucracy, obsession with grants and points become the main barrier to creating science and *sofia* (wisdom) as a base for education for the needs of a demanding technology market. The paradox of the technological economy is that it requires education in the general areas of science (including interdisciplinary areas, focused on quality based on logic, philosophy, the application of the rules of universal procedures and social competences), rather than, as is commonly believed, greater technical development in science and educational processes. Making mistakes in this area is irreversible, very expensive and can constitute a barrier on the Polish path to the development of the economy based on automation and robotization with features of innovation. Innovation cannot be officially programmed, it is a feature that is the result of a number of variables and requires a lot of investment. Short-

term education, so-called crisis education, patching holes in the labor market with education can be a road to nowhere. The strategy as a forward-looking document should definitely take into account the answers to the question about what should be done so that automation and robotization as well as the resulting guaranteed income do not push the crowds of society into the sphere of *lucky losers*. How can the process be conducted so that the benefits that automation and robotization already give today are distributed not only to the few but to all of us? How can the economy and society based on these processes preserve the value of work and the profits generated from automation and robotization processes contribute to prosperity, sustainability and development?

Conclusion

Modernity – and thus the processes of automation and robotization – can be compared to the element. We will not run away from them, anyway running would do nothing. When uncontrollable, however, these processes can be fraught with consequences. The important thing is that they are morally neutral in themselves, and are neither good nor bad. It depends on us whether and how we program them and in whose interest. Today, we need to think what should be done to ensure that automation and robotization, as well as the resulting income, do not push the crowds of society into the sphere of *lucky losers*. Will the distribution of benefits that automation and robotization give today affect the few or all of us? Will the economy and society based on these processes retain the value of work, and will the profits generated from automation and robotization contribute to prosperity, sustainability and development? Are decision makers ready today to prepare comprehensive solutions? The answer to these questions must be formulated today, because modernity will not pass us by.

Change in the policy of states will enable the integration of already existing, but very dispersed solutions regarding the implementation of automation and robotization processes described in government policies, sectoral strategies and undertaken in many initiatives. On the other hand, it will enable sovereignty, which in the face of contemporary crisis will become a priority and will be an opportunity to take targeted actions that will allow for the proper distribution of benefits and the development of sustainable processes.

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Impact of Entrepreneurship Activity Sustainable Development

Wpływ działalności przedsiębiorczej na zrównoważony rozwój

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Abstract

Sustainable development considers the development that achieves the present economic goals, without obstructing the future development in a sense of satisfying the needs of society and endangering the environment. Recently, the entrepreneurship phenomenon has been widely recognized as an important path towards sustainable development, positively contributing to the development of society. Thus, in the paper, the empirical evidence on linkages between entrepreneurial activity indicators and social development goals is provided. To examine the linkages, the data from the Global Entrepreneurship Monitor and Sustainable Development Goals Index were used. The empirical results suggest that entrepreneurship represents an important factor for fostering sustainability, particularly in opportunity-driven and innovative entrepreneurial activities. The results show, that both of them have a positive impact on sustainable development, while the necessity-driven entrepreneurial activity negatively affects sustainable development. This could be explained by the fact that necessity entrepreneurs are not likely to become the entrepreneurs to implement a promising business opportunity, but rather to earn an income. To achieve the sustainable development goals as well as entrepreneurship should become the national priority by introducing new policies and measures, that is, making the conditions, through which entrepreneurship could achieve positive contributions to the development of the society.

Key words: sustainable development, opportunity-driven entrepreneurial activity, innovative entrepreneurial activity, necessity-driven entrepreneurial activity, Sustainable Development Goals Index

Streszczenie

Zrównoważony rozwój to taki, który osiąga obecne cele gospodarcze, nie utrudniając przyszłego rozwoju w sensie zaspokajania potrzeb społeczeństwa i narażania środowiska. Ostatnio zjawiska przedsiębiorczości zostały powszechnie uznane za ważną ścieżkę do zrównoważonego rozwoju, która pozytywnie przyczynia się do rozwoju społeczeństwa. Dlatego w artykule przedstawiono empiryczne dowody na powiązania między wskaźnikami aktywności przedsiębiorczej a celami rozwoju społecznego. Do zbadania powiązań wykorzystano dane z Globalnego Monitora Przedsiębiorczości i Indeksu Celów Zrównoważonego Rozwoju. Wyniki empiryczne sugerują, że przedsiębiorczość stanowi ważny czynnik wspierający zrównoważony rozwój, szczególnie w przypadku działań zorientowanych na możliwości i innowacyjnych działań przedsiębiorczych. Wyniki pokazują, że oba te czynniki mają pozytywny wpływ na zrównoważony rozwój, a przedsiębiorczość zorientowana na konieczność negatywnie wpływa na zrównoważony rozwój. Można to wyjaśnić faktem, że przedsiębiorcy zorientowani na konieczność prawdopodobnie nie podążą w kierunku realizacji obiecujących nowych możliwości biznesowych, ale raczej w celu uzyskania dochodu. Aby osiągnąć cele zrównoważonego rozwoju, jak również przedsiębiorczość, powinny się one stać priorytetem krajowym poprzez wprowadzenie nowych polityk i środków, co oznacza stworzenie warunków, dzięki którym przedsiębiorczość mogłaby osiągnąć pozytywny wkład w rozwój społeczeństwa.

Słowa kluczowe: zrównoważony rozwój, działalność przedsiębiorcza zorientowana na możliwości, innowacyjna działalność przedsiębiorcza, działalność przedsiębiorcza zorientowana na konieczności, indeks celów zrównoważonego rozwoju

1. Introduction

The sustainable development is widely recognized as a path to achieve connections among economic, social, and environmental systems equally not only for the present, but also for future generations (e.g. Patzelt & Shepherd, 2011; Cobbinah et al., 2011). In view of various definitions and thoughts about sustainable development, the United Nations provides one of the most common used definition according to which the sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Emas, 2015). In other words, sustainable development implies such a development of a society that satisfies human needs with available resources, while not endangering natural systems and the environment. Sustainable development represents the way of production and consumption that takes into account the natural resources of the ecosystem within which these processes take place.

The sustainable development and entrepreneurship have been widely recognized in the literature and on a policy level as well as in business practice. The review of the literature on sustainable entrepreneurship shows, that it provides solutions for various environmental and social concerns (Hall et al., 2010). However, the research topic on sustainable development from an entrepreneurship perspective is relatively recent, merely present from 2002 and developed especially in the last decade (Kardos, 2012). Entrepreneurship phenomena has been addressed as an important path towards sustainable development by several authors (Cohen & Winn 2007; York & Venkataraman, 2010; Domańska et al., 2018). According to Stefanescu & On (2012), both entrepreneurship and sustainable development are considered as solutions, positively contributing to the development of society.

Considering that the topic on sustainable development and entrepreneurship is relatively new, there still exists research gaps on a holistic approach combining linkages between the entrepreneurship activity and the economic, environmental, and social goals of sustainable development (Dhahri & Omri, 2018) and on focusing on empirical findings. Referred to the above-mentioned gap, the purpose of this study is to provide additional empirical evidence on linkages between entrepreneurship and sustainable development. The research goal of the paper is to empirically test linkages between the entrepreneurial activity indicators and social development goals. Hence, the main research question is: what is the correlation and impact of entrepreneurial activity on sustainable development? The paper is structured as follows. First, a review of the concept of sustainable development and the relation with entrepreneurship are provided together with hypotheses development. Second, the research methodology and the data used

are described. Third, empirical findings with discussion are presented, followed by conclusions and implications for entrepreneurship and sustainable development.

2. Theory background and hypotheses development

The goal of sustainable development tends to economic efficiency (economic development), social responsibility (social progress) and environmental protection. The three elements are called the pillars of sustainable development and present so-called triple-bottom-line approach, merged in an integrated framework (Elkington, 1998; Hart & Milstein, 2003). The triple-bottom-line approach has been used from a different point of views and analysed on different levels of analysis. On the organizational level, it is the idea, that it is possible to develop an organization in a way that not only earns financial profits, but at the same time also improves people's lives and helps the planet from an environmental viewpoint. Using the holistic approach, the society is completely dependent on Earth's resources, and to maximize the quality of life, it uses economic models. The economy is managed by the society and is dependent on natural resources. Therefore, the pillars of sustainable development cannot stand isolated without affecting each other. The overall objective of sustainable development is to provide a framework for the design of policies and strategies of continuous economic and social progress by considering the scarcity of natural resources. Its implementation should be following specific opportunities, conditions and circumstances of different parts of the planet (Gerlach, 2003; Kardos, 2012).

To measure the results of sustainable development, several approaches, developed measures and indexes were used. To compare sustainable development on an international or global level, the Sustainable Development Goals (SDG) can be used, which measure and summarizes countries' current performance and trends on 17 goals referring their sustainable development (goals are provided in Table 1). Sustainable Development Goals are measured by the SDG Index. Its score signifies the country's position between the worst (0) and the best or target (100) outcomes. In the year 2018, according to the SDG Index, the best scored is Sweden, followed by Denmark and Finland, whereas the Democratic Republic of Congo, Chad and the Central African Republic rank last among the 156 countries included in the rating (Sachs et al., 2018).

Recently, the researchers around the world are investigating how entrepreneurship can affect the sustainable economy and thus sustainable development. Both entrepreneurship and sustainable development are considered as solutions to assure the future development of the entire society.

Table 1. The Sustainable Development Goals (Sachs et al., 2018)

Goal	Description
1. No poverty	Economic growth must be inclusive to provide sustainable jobs and promote equality.
2. Zero hunger	The food and agriculture sector offers key solutions for development, and is central for hunger and poverty eradication.
3. Good health and well-being	Ensuring healthy lives and promoting the well-being for all at all ages is essential to sustainable development.
4. Quality education	Obtaining a quality education is the foundation to improving people's lives and sustainable development.
5. Gender equality	Gender equality is not only a fundamental human right, but a necessary foundation for a peaceful, prosperous and sustainable world.
6. Clean water and sanitation	Clean, accessible water for all is an essential part of the world we want to live in.
7. Affordable and clean energy	Energy is central to nearly every major challenge and opportunity.
8. Decent work and economic growth	Sustainable economic growth will require societies to create the conditions that allow people to have quality jobs.
9. Industry, innovation and infrastructure	Investments in infrastructure are crucial to achieving sustainable development.
10. Reduced inequalities	To reduce inequalities, policies should be universal in principle, paying attention to the needs of disadvantaged and marginalized populations.
11. Sustainable cities and communities	There needs to be a future in which cities provide opportunities for all, with access to basic services, energy, housing, transportation and more.
12. Responsible consumption and production	Responsible production and consumption.
13. Climate action	Climate change is a global challenge that affects everyone, everywhere.
14. Life below water	Careful management of this essential global resource is a key feature of a sustainable future.
15. Life on land	Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss.
16. Peace, justice and strong institutions	Access to justice for all, and building effective, accountable institutions at all levels.
17. Partnership for the goals	Revitalize the global partnership for sustainable development.

The approach of sustainable entrepreneurship has been raised to address the contribution of entrepreneurial activities to solving societal and environmental problems. Gerlach (2003) points out the necessity of approaching the analysis of the role of sustainable entrepreneurs for implementing sustainable development from the perspective of innovation. Successful sustainable innovation is accomplished when entrepreneurial actors achieve competitive advantages, i.e. economic success by applying innovative environmental and/or social practices. Companies are increasingly recognized as a driving force for innovation, entrepreneurial spirit and competitiveness, therefore, are seen as one of the keys to achieving sustainable development (Kardos, 2012).

2.1. Entrepreneurship and sustainable development

Although both, sustainable development and entrepreneurship, are considered as the solutions for future development and progress, there are still relatively few articles, investigating both topics and their interconnections (Hall et al., 2010; Dhahri & Omri, 2018). Entrepreneurship in the context of sustainable development has been addressed through various streams in the literature, among which are eco-preneurship, environmentally orientated entrepreneurship, social entrepreneurship, sustainable entrepreneurship (OECD, 2010).

Dean and McMullen (2007) state how economic activity is environmentally disruptive, satisfying the material needs of people, because it requires the use and disturbance of energy flows and materials, causing a negative impact on the environment, known as environmental degradation. But on the other hand, environmentally relevant market failures (e.g., public goods, externalities, monopoly power, inappropriate government intervention, and imperfect information) might represent opportunities for entrepreneurs simultaneously achieving profitability while reducing environmental degradation of economic behaviour (Riti et al., 2015). Also, Cohen and Winn (2007) develop the argument that four types of market imperfections contribute to environmental degradation and at the same time provide significant opportunities for the creation of radical technologies and innovative business models that contribute to sustainable development. They show, how these opportunities establish the foundations for an emerging model of sustainable entrepreneurship, one that enables founders to obtain entrepreneurial rents while simultaneously improving local and global social and environmental conditions.

This research contributes to this important emerging research area in that it clarifies conditions through which countries and companies can move toward more sustainable products and services. Following the above reasoning, we state the first hypothesis:

H1: Between entrepreneurial activity and sustainable development there exist statistically significant correlation.

2.2. Start-up entrepreneurship and sustainable development

The particular subject of sustainable start-ups has received increasing interest with contributions from authors, such as Hockerts and Wüstenhagen (2010) and Parrish (2010), who investigated sustainability-driven entrepreneurship and start-ups. According to Hockerts and Wüstenhagen (2010), sustainable start-ups differ from conventional start-up companies in their pronounced value-based approach and intention to initiate social and environmental change in society.

For several years, entrepreneurship is recognized as a stimulus for solving sustainability problems (York & Venkataraman, 2010; Pacheco et al., 2010). However, as the literature is relatively new to linking entrepreneurship and sustainable development, there are several issues, although there is a general premise, that entrepreneurial activity aimed at economic, social and environmental goals, contributes to the achievement of sustainability in the society (Hall et al., 2010). The first issue represents the level of analysis. Entrepreneurs and opportunities are representing one level of analysis (Shepherd & Patzelt, 2011) while the second one represents a macro perspective (Cohen & Winn 2007; Dean & McMullen 2007). From a micro perspective, centre of analysis are individual entrepreneurs, who exhibit specific behaviours, among which are entrepreneurial intention (Kuckertz & Wagner, 2010), opportunity recognition (Patzelt & Shepherd, 2011), opportunity assessment (Shepherd et al., 2013) and entrepreneurial action (Meek et al., 2010). From a macro perspective, opportunities for sustainable entrepreneurship represent systemic imperfections or conditions (Pacheco et al., 2010) that make entrepreneurial opportunities possible to implement. On the other side, sustainable entrepreneurship should be reflected on a higher level of sustainable development on the macro level. Additionally, several authors discuss the nature of the value creation and outline the term sustainable entrepreneurship (Young & Tilley, 2006; Cohen et al., 2008; Tilley & Young, 2009; Muñoz & Dimov, 2015). Some studies revealed that it depends on entrepreneurs' characteristics and intentions, whether they pursue sustainable start-ups or not (Kuckertz & Wagner, 2010; Hall et al., 2010).

The second issue is related to the factors that drive entrepreneurial behaviour to sustainable development. In the literature, there can be found several factors, such as individual ones – prior knowledge (Patzelt & Shepherd, 2011), sustainability intention (Schaltegger & Wagner, 2011; Muñoz & Dimov, 2015) and sustainability orientation (Gibbs, 2009; Kuckertz & Wagner, 2010; Muñoz & Dimov, 2015). Other factors are contextual, among which are social norms (Meek et al., 2010; Muñoz & Dimov, 2015), the openness of the business context to sustainability practices (De Clercq & Voronov, 2011; Pacheco et al., 2010; Muñoz & Dimov, 2015) and the promotion

of the entrepreneurship ecosystem to pursue sustainable enterprises. Also, Dean and McMullen (2007) imply conceptualizations of sustainable entrepreneurship by proposing that environmentally relevant market failures represent opportunities for achieving profitability while simultaneously reducing environmentally degrading economic behaviour.

Furthermore, Youssef et al. (2018) state that proposing new services and products captures residual demand in the first step with a higher margin. The previous research has shown how green labelling was successful in developing these products in developed countries and the trend is following in developing countries. In their research, the authors came to the empirical results, which show that both formal and informal entrepreneurship are conducive to less environmental quality and sustainability in 17 African countries where the contribution of informal entrepreneurship is much higher compared to the formal one. In some cases, entrepreneurs may also face strong regulation that induces them to use more sustainable methods of production. In this case, opportunity entrepreneurs will take this opportunity to increase their market share or to enter new markets, which was not possible before the change of the regulation, and contribute to sustainable development. However, for necessity entrepreneurs, stronger regulation may represent such a barrier, that they may discontinue their entrepreneurship activity.

As there are numerous approaches to investigation on the linkages between entrepreneurship and sustainable development, in the paper, we will shift the perspective and use a holistic approach, analysing connections between entrepreneurship and sustainable development on a global level. In accordance with the above arguing, we state the following two hypotheses:

H2: Opportunity-driven entrepreneurial activity has a positive statistically significant impact on sustainable development.

H3: Necessity-driven entrepreneurial activity has a negative statistically significant impact on sustainable development.

2.3. Innovation, entrepreneurship and sustainable development

Entrepreneurship that aims at triple-bottom-line approach, obtains some characteristics, among which are social responsibility, competitiveness, progressiveness, knowledge creation and usage, innovativeness, dynamism and seeks for business benefits creating social value (Kriščiūnas & Greblikaitė, 2007). As revealed by Schaltegger and Wagner (2011), such an ambitious approach of entrepreneurship, which on one side attempts to contribute to the sustainable development of the organisation itself, and on the other side to create a significant contribution of organizations to the sustainable development of society as a whole, requires significant innovations. Additionally, Gerlach (2003) points out the necessity of

approaching the analysis of the role of entrepreneurs in contributing to sustainable development from the perspective of innovation. The focus lies on innovations that enhance sustainability (Kardos, 2012). A successful innovation that contributes to sustainable development is accomplished when entrepreneurs achieve competitive advantages by applying innovative environmental and/or social practices. However, Youssef et al. (2018) reveal, that the relationship between entrepreneurship and sustainable development becomes strongly positive when the levels of innovation and institutional quality are higher. Furthermore, they expose, that the opportunity recognition makes a basis for innovations, which play a key role in sustainable entrepreneurship. In line with the above discussion, stated is following the fourth hypothesis:

H4: Innovative entrepreneurial activity has a positive statistically significant impact on sustainable development.

3. Methodology

In the paper, the Global Entrepreneurship Monitor (GEM) database and Sustainable Development Goals (SDG) Index represent the data basis for the empirical testing of the hypotheses. The GEM database is the world's foremost study of entrepreneurship and the most recent secondary data were used for identification of the independent variables. Data given in this domain are collected on a yearly basis by the Adult Population Survey (APS), which is a comprehensive questionnaire, administered to a minimum of 2000 adults in each GEM country, designed to collect detailed information on the entrepreneurial activity, attitudes and aspirations of respondents (Bosma & Kelley, 2018).

For the dependent variable, the data from the SDG Index and Dashboards Report 2018 were used. The report is published in July 2018 and represent an annual overview of countries' performance on the 17 Sustainable Development Goals prepared jointly by the Bertelsmann Stiftung and the Sustainable Development Solutions Network (Sachs et al., 2018). The research is cross-country. According to the availability covering of national level of data, it is done on a sample of 46 countries. The countries and their value of SDG Index are shown below in Table 2. The average SDG Index Score of included countries is 70.1. In the sample, the highest SDG score has Sweden (85.0), followed by Germany (82.3), France (81.2), Switzerland (80.1), Austria (80) and Slovenia (80), while scores of Angola (49.6), Sudan (49.6) and Madagascar (45.6) are way below the average (70.1). The literature review shows mixed results on impact of entrepreneurship on sustainable development, and on one side it suggests that entrepreneurship leads to less conducive sustainability due to having a negative impact on the environment, but on the other side the literature also suggests how such a situation

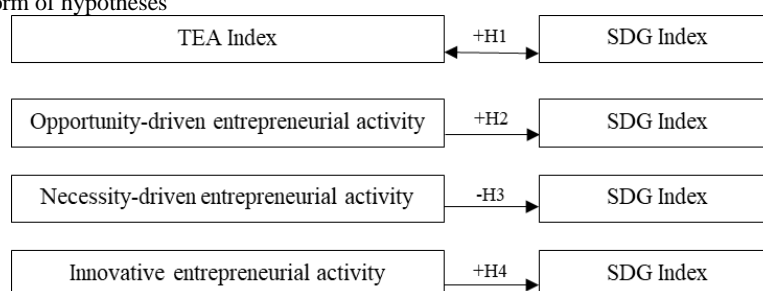
Table 2. SDG Index scores for research sample countries (Sachs et al., 2018, 23)

Rank	Country	SDG Index Score
1	Sweden	85
2	Germany	82
3	France	81
4	Switzerland	80
5	Austria	80
6	Slovenia	80
7	Netherlands	80
8	United Kingdom	79
9	Japan	79
10	Ireland	78
11	South Korea	77
12	Canada	77
13	Croatia	77
14	Luxembourg	76
15	Slovak Republic	76
16	Spain	75
17	Italy	74
18	Poland	74
19	Bulgaria	73
20	United States	73
21	Chile	73
22	Greece	71
23	Cyprus	70
24	Uruguay	70
25	Argentina	70
26	China	70
27	Brazil	70
28	Thailand	69
29	Russia	69
30	Peru	68
31	Colombia	67
32	Morocco	66
33	Turkey	66
34	Iran	66
35	Panama	65
36	Lebanon	65
37	Egypt	64
38	Saudi Arabia	63
39	United Arab Emirates	63
40	Indonesia	63
41	Qatar	61
42	India	59
43	Guatemala	58
44	Angola	50
45	Sudan	50
46	Madagascar	46

could represent the new opportunities for entrepreneurs to create innovative product and services. To examine those claims and relation of entrepreneurship to sustainable development, the following variables from the databases GEM (Bosma & Kelley, 2018) and SDG Index and Dashboards Report (Sachs et al., 2018) were identified and labelled as follows:

- x_1 —total early-stage entrepreneurial activity (TEA Index): percentage of the 18-64 population who are either a nascent entrepreneur (actively involved in setting up a business they will own or co-own; this business has not paid sala-

Figure 1. Graphical form of hypotheses



ries, wages, or any other payments to the owners for more than three months) or owner-manager of a new business (currently owner-manager of a new business, i.e., owning and managing a running business that has paid salaries, wages, or any other payments to the owners for more than three months, but not more than 42 months);

- x_2 —opportunity-driven entrepreneurial activity as the percentage of TEA Index: percentage of those involved in TEA who are either a nascent entrepreneur owner-manager of new business because of the good opportunities to start a firm in the area where they live;
- x_3 —necessity-driven entrepreneurial activity as the percentage of TEA Index: percentage of those involved in TEA who are either a nascent entrepreneur owner-manager of new business because there were no jobs or other sources of income;
- x_4 —innovative entrepreneurial activity: percentage of TEA who indicate that their product or service is new to some or all customers and is offered by few or no other competitors;
- y —SDG Index: dependent variable: measured by 17 goals, which are weighted equally in the common Index; the score signifies a country's position between the worst (0) and the best (100) outcomes.

The hypothesis H1 is going to be tested by the Pearson's correlation coefficient. The testing of the hypotheses H2, H3 and H4 is going to be done by the regression analysis. For the analysis, the SPSS Statistics statistical software was used. In Figure 1, the hypotheses are provided in the graphical form and the regression model is shown in its stochastic form. Regression model in a stochastic form for testing H2, H3 and H4 hypotheses:

$$y = \beta_0 + \beta_n x_n + e$$

where are:

y – dependent variable; β_0, β_n – value of the regression coefficients; $n=1, 2, 3$; x_n – independent variables; $n=1, 2, 3$; e – residual

4. Empirical results and discussion

In this section, the results of the testing hypotheses are presented and discussed.

To test the first hypothesis H1, the correlation analysis is made. Results are shown in Tables 3 and 4, where the descriptive statistics (Table 3) as well as results of the Pearson correlation (Table 4) are shown. The sample size is $N=46$.

Table 3. Descriptive statistics results

	Mean	Std. Deviation	N
total early-stage entrepreneurial activity (x1)	12.72	7.508	46
SDG Index (y)	70.0978	8.79597	46

Table 4. Results of correlation analysis

		x1	y
x1	Pearson Correlation	1	-0.579**
	Sig. (2-tailed)		0.000
	N	46	46
y	Pearson Correlation		1
	Sig. (2-tailed)		
	N		46

Taking the results into the account, there is a statistically significant correlation between entrepreneurial activity, measured by TEA Index, and sustainable development, measured by SDG Index. The correlation between variable x_1 (TEA index) and variable y (SDG Index) is negative, moderate (Keller & Warrack, 2000) and statistically significant at $p < 0.01$. The correlation is negative (-0.579), indicating that when SDG Index increases the total early-stage entrepreneurial activity rate decreases and vice versa. Based on the above presented results the hypothesis H1, that between entrepreneurial activity and sustainable development exists statistically significant correlation, can be accepted.

To test the hypotheses H2, H3 and H4 the simple linear regression was used. In Table 5, the results of the regression model 1 are presented to test the second hypothesis (H2) according to which the opportunity-driven entrepreneurial activity has a positive impact on sustainable development.

Results show, that for variable x_2 (opportunity entrepreneurial activity) regression coefficient ($\beta_1=0.356$) is positive and statistically significant ($p=0.005$; $p < 0.05$). The correlation coefficient R between the dependent variable and the independent variable is 0.405. In addition, the determination coefficient ($R^2=0.164$) indicates that 16% of the variance of the

Table 5. Results of simple regression analysis of opportunity-driven entrepreneurial activity indicator and SGD Index

Model 1	B	Std. Error	Beta	t	Sig.
(Constant)	44.638	8.751		5.101	0.000
x2	0.356	0.121	0.405	2.937	0.005
R	0.405				
R square	0.164				
Std. Error of the Estimate	8.13375				
F-test (Sig.)	8.626*				

*note: statistically significant at $p=0.005$

Table 6. Results of simple regression analysis of necessity-driven entrepreneurial activity indicator and SGD Index

Model 2	B	Std. Error	Beta	t	Sig.
(Constant)	80.379	2.686		29.928	0.000
x3	-0.445	0.106	-0.535	-4.202	0.000
R	0.535				
R square	0.286				
Std. Error of the Estimate	7.51440				
F-test (Sig.)	17.658*				

*note: statistically significant at $p=0.000$

Table 7. Results of simple regression analysis of innovative entrepreneurial activity indicator and SGD Index

Model 3	B	Std. Error	Beta	t	Sig.
(Constant)	64.151	3.405		18.842	0.000
x4	0.226	0.120	0.273	1.881	0.067
R	0.273				
R square	0.074				
Std. Error of the Estimate	8.55803				
F-test (Sig.)	3.537*				

*note: not statistically significant, $p=0.067$

SDG Index (dependent variable) is explained by the independent variable, included in the model. Also, the F-test value of the model ($F=8.626$; $p=0.005$), indicates that a variable is significant, and thus indicates that the complete model is valid. The results of the regression analysis of the hypothesis H2 according to which the opportunity-driven entrepreneurial activity positively impacts sustainable development, can be confirmed.

Results show, that for variable x_3 (necessity entrepreneurial activity) regression coefficient ($\beta_1=-0.445$) is negative and statistically significant ($p=0$; $p<0.05$). The determination coefficient ($R^2=0.286$) indicates that 28.6% of the variance of the SDG Index (dependent variable) is explained by the independent variable, included in the model 2. The F-test value is large ($F=17.658$), what indicates that most of the variation in the dependent variable is explained by the regression equation and the p-value is 0, what infer that the model is valid. In regard to the results of regression analysis of the hypothesis H3, according to which the necessity-driven entrepreneurial activity negatively impacts sustainable development, can be confirmed.

In Table 7, the results of the regression model 3 are presented by testing the third hypothesis, according to which the innovative entrepreneurial activity has a positive impact on sustainable development.

Results show, that for variable x_4 (innovative entrepreneurial activity) regression coefficient ($\beta_1=0.226$) is positive, but too small to be statistically significant

($p=0.067$; $p<0.05$). The determination coefficient ($R^2=0.074$) indicates that only 7.4% of the variance of the SDG Index (dependent variable) is explained by the independent variable, included in model 3. The F-test value of the model ($F=3.537$; $p=0.067$) also indicates that a model is not valid. Thus, regarding the results of regression analysis for testing the hypothesis H4, according to which the innovative entrepreneurial activity positively impacts sustainable development, cannot be confirmed.

The above results could be explained by the fact that TEA considers entrepreneurs who run the business not more than 42 months and the reason might be that those entrepreneurs in early-stage of entrepreneurial activity are using less innovative solutions and less environment-friendly technologies and methods of production, which are not subject to high environmental standards. While on the other hand, according to the results, opportunity-driven entrepreneurial activity and innovative entrepreneurial activity show positive relations to SDG Index.

The results show that the opportunity-driven entrepreneurial activity has a positive impact on sustainable development, while the necessity-driven entrepreneurship has a negative impact on sustainable development what is in line with some previous research (Kuckertz & Wagner, 2010). As opportunity-driven entrepreneurs more likely to pursue their start-ups to implement an opportunity seen in their environment. In addition, they are more motivated

from their intentions and consequently are more sustainably and long-term oriented. As found by Youssef et al. (2018) in African countries, opportunity-driven entrepreneurship contributes to sustainable development. On the other side, necessity-driven entrepreneurs also pursue their start-ups, because in their environment there are not available job options. Those individuals do not become entrepreneurs to implement a promising business opportunity, but rather to earn an income. Consequently, they are not motivated by the opportunity, but by income for their surviving. So, they are more short-term oriented, unlike opportunity-driven entrepreneurs.

To achieve the overall objective of sustainable development, the countries should make special efforts to consider the implementation of SDGs as the national priority and integrate them into the national strategies. This requires transformations and improvement of many dimensions and sectors (e.g. changes in budgets, regulatory, procurement policies, energy use, land use, urban planning, education, research and development, etc.) in the national economy. Each transformation requires great support from policymakers (government) especially by introducing new policies and measures, private sector (business) and civil society. According to our empirical results in the research, it appears that entrepreneurship represents an important factor for fostering sustainability, but the success lies in opportunity-driven entrepreneurial activities as well as in innovative entrepreneurial activity.

5. Conclusion

Based on the literature review, the paper provides insight into the linkages between entrepreneurial activity and sustainable development. As the topic is relatively new, there are still many open questions and gaps to be fulfilled, mainly missing empirical evidence. Additionally, scarce empirical evidence provides mixed results regarding the impact of entrepreneurship on sustainable development. Therefore, our paper contributes to fill in the mentioned gap in the literature by providing a quantitative analysis of linkages and impacts between entrepreneurial activity and sustainable development on the international level. According to empirical results in our study, we confirmed the linkages between entrepreneurship activity and sustainable development. However, to get an in-depth insight into the linkages, we tested particular types of entrepreneurship and their impacts on sustainable development. In our study, it appears that particular types of entrepreneurial activity have a different impact on sustainable development. The results indicate that the opportunity-driven and innovative entrepreneurial activity positively impact sustainable development, while the necessity-driven entrepreneurial activity indicates the negative impact. Accordingly, our results provide strong support for

the argument that the entrepreneurial activity interrelates with sustainable development. The findings contribute to the entrepreneurial economic literature by providing an empirical approach, which confirms the assumption that entrepreneurship impacts sustainable development. This approach, not only contributes to the existing literature, but also conducts policy and managerial implications for implementing the sustainable development goals, by supporting particular types of entrepreneurial activity. However, the limitation of our study, by measuring only direct linkages between the mentioned concepts and the sample of countries provide the origin for future research directions. Regarding sustainable development goals, different indicators related to the economic, social, and environmental objectives could be analysed in future studies. Also, our study only examines the direct effects of entrepreneurship on the pillars of sustainable development. The process toward sustainable entrepreneurship is complex and it might take place through several steps. For this reason, as some of the previous studies also suggest, the entrepreneurship cannot simultaneously achieve sustainability goals without implementing appropriate ecosystem conditions. Thus, future studies might extend this research by employing mediating or moderating models to examine the conditions through which entrepreneurship could achieve these objectives.

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Evaluating the Social Sustainability Criteria of Supply Chain Management in Manufacturing Industries: A Role of BWM in MCDM

Ocena kryteriów zrównoważoności społecznej w zarządzaniu łańcuchem dostaw w przemyśle wytwórczym: rola BWM w MCDM

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Abstract

Supply chain management firms are gradually pressurized to incorporate social sustainability practices to address social issues. Though, the researchers emphasized on different dimensions of sustainable supply chain management (SSCM), i.e., social, environmental and economic but fewer considered the social aspect of sustainability. The purpose of this research is to take into account the social dimension of sustainability into manufacturing industries. The social dimension of sustainability as compared to other sustainable, has severe adverse impact across supply chains. In order to demonstrate the applicability and efficiency of social sustainability in supply chain management, a sample of 53 practitioners of Pakistani manufacturing companies has been selected to prioritize and evaluate the SCSS criteria by applying a decision-making multi-criteria method called the *best worst method* (BWM). The criteria of the study are ranked according to their average weight achieved through BWM. The criterion *employment practices* has been chosen as the most significant criterion while *cultural values* criterion is considered as least important. The results of this study are helpful for industry managers, practitioners and decision-makers to take the decisions for the implementation of social criteria to enhance the social sustainability that lead to sustainable development.

Key words: Supply Chain Social sustainability (SCSS); Best Worst Method (BWM); Multi-Criteria Decision-making Method (MCDM), Manufacturing Industries

Streszczenie

Firmy zarządzające łańcuchem dostaw są poddawane presji, aby wprowadzić praktyki zrównoważonego rozwoju społecznego w celu rozwiązania problemów społecznych. Chociaż naukowcy zwracają uwagę na różne wymiary zrównoważonego zarządzania łańcuchem dostaw (SSCM), tj. społeczny, środowiskowy i ekonomiczny, jednak należy zauważyć, że w najmniejszym stopniu dyskutowane są aspekty społeczne. Celem tych badań jest uwzględnienie społecznego wymiaru zrównoważonego rozwoju w przemyśle wytwórczym. Społeczny wymiar zrównoważoności, w porównaniu z innymi, ma poważny negatywny wpływ na łańcuchy dostaw. W celu wykazania możliwości zastosowania i efektywności zrównoważoności społecznej w zarządzaniu łańcuchem dostaw, wybrano próbę 53 praktyków z pakistańskich firm produkcyjnych w celu ustalenia priorytetów i oceny kryteriów SCSS poprzez zastosowanie wielokryterialnej metody decyzyjnej zwanej najlepszą/najgorszą metodą (BWM). Kryteria badania są uszeregowane według ich średniej wagi osiągniętej w BWM. Kryterium dotyczące zatrudnienia zostało wybrane jako najistotniejsze, natomiast kryterium wartości kulturowych jest uważane za najmniej ważne. Wyniki tego badania są pomocne dla menedżerów branży, praktyków i decydentów w podejmowaniu decyzji dotyczących wdrażania kryteriów społecznych w celu zwiększenia zrównoważoności społecznej, która prowadzi do zrównoważonego rozwoju.

Słowa kluczowe: łańcuch dostaw społecznej zrównoważoności (SCSS), najlepsza/najgorsza metoda (BWM), metoda podejmowania decyzji na podstawie wielu kryteriów, przemysł wytwórczy

Introduction

Regardless of the increasing stakeholder attentiveness on social sustainability matters, little is identified about what influences adaptation of practices of social sustainability in supply chain management and the advantages cultivated from such efforts. The foremost damage of the natural environment and the life of humans was done due to industrialization (Ogasawara and Yumitori, 2019). Therefore, for the organizations, it is a dire need to work collectively in sustainable supply chains (Galal and Moneim, 2016; Shibin, Gunasekaran and Dubey, 2017), keeping into consideration three various criteria of sustainability; environmental criteria, economic criteria as well as social criteria (Interlenghi et. al., 2017). Due to the increasing knowledge of social sustainability, developing community's responsiveness and policies of the government, the sustainable performance is progressively becoming a crucial organizational strategy (Hale, Legun, Campbell and Carolan, 2019). Literature to a much lesser extent has focused on social sustainability, which is unfortunate since not only all three measurements are genuinely needed to construct a sustainable business, but practices of social sustainability provide assistance to improve the other facets of sustainability.

A massive literature on sustainability is available, that covers all three dimensions, but researchers mainly emphasized on environment and economic sustainability. Yet, empirical studies on the specific factors and their outcomes in social sustainability implementation from an emerging economy are still rare. Scholar acknowledges the need for the reviews on social sustainability in developing economies, to take a broader view of the findings for theory and practices. To precise the disparity, this paper proposes, a unified assessment model developed to explore social sustainability in the vicinity of Pakistan's manufacturing industry. In this investigation, multi-criteria decision-making method (MCDM), the best worst method (BWM) was used to prioritize and evaluate the social sustainability (Mi, Tang, Liao, Shen and Lev 2019; Rezaei, 2016). We chose the Pakistan' supply chain of manufacturing sector due to the following two main reasons. Firstly, Pakistan's economy in large scale relies on its manufacturing sector which is the 2nd largest sector contributing to GDP after agriculture sector; meanwhile, this segment looks severe challenges, extending from workers' rights related to lousy employment practices, strike movements due to the work protection and health motives. Secondly, the manufacturing sector needs certain type of best practices described to social sustainability of manufacturing sector's supply chain to guide the existing and new entering companies in decision making relating to sustainability to reconstruct the negative social reputation. For all that, the triple-dimension (social, economic and environmental) to have sustainability in

supply chain management (SSCM) should be considered together, however, this study is exerting its focus on the social sustainability dimension for better understanding. Therefore, the outcomes of this research could be constructive as input for widespread management decisions in the supply chain. So, the purpose of this study is to determine the essential social criteria with the motive to propose a model to assess social sustainability in manufacturing industry's supply chain. Additionally, with the help of this study, the practical and managerial implications have been determined to keep into considering the developing economies and their regulatory compliance that influences on adoption of social sustainability.

2. Literature review

2.1. Sustainability in Supply Chain Management (SSCM)

Firms are gradually considered responsible for their environmental, social, and economic consequences due to their internal operations and by their contractors' operations over the past two decades. Sustainability in supply chain management (SSCM), which is concerned with integrating environmental, social and economic goals of firm's supply chain practices, has emerged as an approach to the sustainable outcomes in their supply chains (Yawar and Seuring, 2017). Managing the sustainability, however, continues to be challenging in global supply chain management system (Epstein, 2018).

Sustainability supply chain management (SSCM) is a set of methodologies and practices for achieving and managing a real harmonization between organizations (cross-organizational) and within the organizations (cross-functional) in supply chains. The main objective of sustainable supply chain management is to enhance customer service, profit generation, asset utilization and cost reduction (Huo, Gu and Wang, 2019); processes, information and resources that may lead to losing their direct control (Dias and Ierapetritou, 2017) due to the involvement of multiple decision makers. In other words, organizations in line with supply chains, can make their supply chain operations more sustainable by integrating their operations and work together (Jia, Gong and Brown, 2018).

Sustainable supply chain management may also be pronounced as the managing and controlling the funds, information resources operations and other activities with the aim to increase the profitability as well as the well-being of their employees, customers and society overall. At the same time, it also reduces any negative environmental influence (Das 2018; Shi et al. 2017).

Organizations' prospective societal and environmental impacts of supply chain processes are together tricky and difficult to cope (Wang, Singgih, Wang and Rit, 2019). Therefore, SSCM minimizes

Table 1. Previous Studies Available on Sustainability

Environmental Sustainability	Economic Sustainability	Social Sustainability	Environmental and Economic Sustainability	Social and Environmental Sustainability	Social and Economic Sustainability
15	0	2	85	2	0

the negative influence of supply chain operations and advances value of firm/ efficiency related to economic, social and environment issues that ultimately leads to sustainable development which has substantial impact on company's competitiveness. The main motive is to construct the essential abilities to strengthen the organizations' sustainable competitiveness and to strive for collective advantages of supply chain (Govindan, 2018; Manavalan and Jayakrishna, 2019).

The SSCM framework of decision making emphasizes on the five strategic areas that are material selection, designing of product, developing processes, delivery of finished products to consumers, and the managing the disposal of products at the end life the product (Kornuta et al. 2019; Rachih, Mhada and Chiheb, 2019). Although they developed the sustainability framework, it did not comprise of vibrant criteria containing the social dimension because, without this dimension, any action regarding sustainability is sure to be weak and unable to deal with social influence. The studies by Ahi, Searcy, and Jaber (2018) suggested the resource dependence theory, corporation resource-based view, and population ecology to establish an SSCM model considering essential supportive factors which are necessary for the employment of SSCM practices. The researchers investigated the association between economic, social and environmental performance to obtain economic capability in long-run within the context of SSCM. Still, the social sustainability criteria were addressed to a lesser extent when the framework was developed (Soundararajan and Brammer, 2018). Conversely, they did not draw abundant emphasis on social sustainability and its influence on organizations. Several studies suggested a framework for the management of quality, safety and sustainability in food supply chains, however, their studies did not comprise the dimensions of social sustainability (Manzini and Accorsi 2013; Nawaz, Linke and Kog, 2019).

Thorough literature review revealed that a worthwhile studies are available on corporate sustainability and organizational sustainability overall, but only a few studies focused only on the specific social sustainability dimension which needs further to be study especially in developing nations. So, the main focus of this study is to shed light on the organizational sustainability with specific emphasis on supply chain social sustainability.

Conforming to Table 1, very few studies have included social dimensions of sustainability. In principle, there are only two papers that has examined the social sustainability (Badri Ahmadi, Kusi-Sarpong and Rezaei, 2017) and (Hutchins and Sutherland,

2008), while only two studies focused on environmental and social sustainability (Tost et. al., 2018).

2.2. Supply Chain Social Sustainability Criteria (SCSS)

Additionally, to the environmental and economic sustainability of the organizational processes, social sustainability criteria should also be considered when firms are aiming and attaining the sustainable development and long-term survival. Worker's health, human rights, equity, diversity, and other social & security-related issues are imperative components when it moves towards sustainability of manufacturing sector and should be considered when assessing, for example, their vendors (Sutherland et al. 2016). Other scientists practice the same narrative for discoursing social issues in supply chain (Martínez-Blanco et al. 2014). It is challenging to determine widespread social sustainability measures and its dimensions due to absence of conceptual clarity, specifically in the operations and manufacturing segment in developing countries. So it's cleared that the managers of the supply chain are not thoughtful enough about the social concerns implied and how they can be analyzed and accomplished (Gopal and Thakkar, 2016; Spence and Rinaldi, 2014).

Till now, fewer studies have assimilated the social sustainability dimension in their SSCM framework while studying sustainability management practices. In most of the cases, the companies have less focused in social initiatives while working on overall corporate sustainability (Ahmadi, Kusi-Sarpong and Rezaei 2017). These endeavors do not shape the competencies and resources required to accomplish comprehensively and systematically the societal influence of supply chain in the direction of cultivating the social measures. Few studies which have assumed the preliminary step in ascertaining and scrutinizing some valuable criteria and dimensions related to social sustainability remained unsuccessful. Therefore, this study aims to assimilate the social sustainability of supply chain into a cohesive and more inclusive framework.

Even though several models by Kumar and Anbanandam (2019), Sierra, Yepes and Pellicer (2018), Ramezankhani, Torabi and Vahidi (2018); Hussain, Ajmal, Gunasekaran and Khan (2018), Arcese, Lucchetti and Massa (2017), Rajak and Vinodh (2015), Azadnia et al. (2015), Ciliberti et al. (2008) that have endeavored to study the dimension of social sustainability, but these efforts are not so helpful that they could support the organizations to shape the proficiencies and resources they need to cope with the social effect of their maneuvers systematically

Table 2. Identification of Social Criteria in the Context of SSCM of Manufacturing Sector Conforming to Literature.

#	Criterion Focus	Source
1	Aesthetics and degradation of community	Pan 2008; Balali et al. 2014
2	Business practices	Azevedo, Carvalho, Duarte and Cruz-Machado, 2012
3	Condition of work	Maxwell and van der Vorst 2003
4	Community Education & training influence	Axelsson et al. 2013; Shaiu et al. 2015
5	Cultural values	Shen et al. 2011; Jeong et al. 2014
6	Customer problems	Martínez-Jurado and Moyano-Fuentes, 2014
7	Economy and local development	Kucukvar et al. 2014; Resendez et al. 2014; Koo et al. 2009;
8	Economy and regional development	Labuschagne and Brent 2008;
9	Employment practices	Ciliberti, Pontrandolfo and Scozzi 2008
10	Enforcement	Sigala 2008
11	Health and safety at work	Closs, Speier and Meacham 2011
12	Influence of contractual stakeholders	Oruezabala and Rico 2012
13	Information disclosure	O'Rourke 2014
14	Local communities influence	Font et. al. 2008
15	Mobility and accessibility	Shang et al. 2004; Umer et al. 2016; Shaiu et al. 2015
16	Occupational Health and Safety management system	Kleindorfer et. al. 2009
17	Public opinion	Dasgupta and Edwin 2005; Zavadskas et al. 2015
18	Public management skills	Labuschagne and Brent 2008; Karami et al. 2017
19	Research, development and innovation	Labuschagne and Brent 2006,
20	Respect for the policy	Nishat Faisal 2010
21	Safety of the environmental	Shen et al. 2011
22	The cultural criterion	Axelsson et al. 2013; Shen et al. 2011; Jeong et al. 2014
23	Stakeholders Right	Wolf 2014
24	Urbanization services	Gilmour et al. 2011; Delgado and Romero 2016; Labuschagne and Brent 2006

and comprehensively. Since a more widespread and integrated model, with the purpose to facilitate the manufacturing sector, integrating social sustainability in supply chains is not available presently. In this study, 24 criteria of social sustainability were pointed out based on comprehensive literature review (see table 2).

3. Methodology

Table 2 depicting that social sustainability is a concept of multi-criteria, so, various criterion are mentioned in this table. Therefore, to measure the applicability of several criteria, we use Multi-Criteria Decision-Making Method (MCDM). There are numerous MCDM methods available. For more details, among others, we endorse the technique developed by Greco et al. (2005) and Triantaphyllou (2000). MCDM methods have been put on in numerous felids together with sustainable management in supply chain. For detailed information, we also endorse Seuring (2014). In this research the researchers use the Best Worst Method (BWM). It is a unique method which has not been used in this capacity before more than once, and that has inimitable improvement for this paper. The description of this method is explained in following section.

3.1. Best Worst Method

The best worst method (BWM) has been established to resolve MCDM issues by Rezaei (2015, 2016) that consist of pairwise assessment. BWM has two

main benefits when compared to other MCDM methods. First, it requires less number of pairwise contrast data matched to a full pairwise matrix and second, the outcomes produced by BWM are more reliable than the results produced by other MCDM method which is also the principal motive for using Best Worst Method BWM in this research. This method has already been used before in several studies in many studies conducted by Kusi-Sarpong, Gupta and Sarkis (2019), Schätter, Hansen, Wiens and Schultmann (2019), Aboutorab, Saberi, Asadabadi, Hussain and Chang (2018), Rezaei, Hemmes and Tavasszy (2017), Salimi and Rezaei (2016) to solve various real-world issues.

The BWM is structured as follows:

Step 1. First and foremost choose the set of decision-making criteria. The set of criteria is selected as follows $\{c_1, c_2, c_3, \dots, c_n\}$.

Step 2. The best criteria mean the most significant, most desired, and the worst criteria indicate the least significant, least desired. In these criteria, the decision-maker determines the best and worst criteria.

Step 3. The fondness of essential criteria, among others is decided based on a score between 1-9. Score 1 means identical preference between the best and worst criteria whereas rating 9 indicates the highest preference of the most significant criteria over the other. The outcome of this phase is the vector of Best-to-Others (BO) shown as $A_B = (a_{B1}, a_{B2}, a_{B3}, \dots, a_{Bn})$. Wherever a_{Bj} , designates the best criteria preference of "B" over "J" criteria and it can be assumed that $a_{BB} = 1$.

Step 4. The liking of all criteria over the worst criteria is known based on a score between 1 and 9. The outcome of this phase is the vector of others to worst (OW), which would be:

$A_w = (a_{1w}, a_{2w}, a_{3w}, \dots, a_{nw})^T$ where a_{jw} , shows the fondness of the "j" criterion over the worst criterion W. It also be presumed that $a_{ww} = 1$.

Step 5. The optimum weight ($w_1^*, w_2^*, w_3^*, \dots, w_n^*$) computed. The optimum weights of the criteria will fulfill the following prerequisites: for every pair of w_B/w_j and w_j/w_w , the best condition is where $w_B/w_j = a_{Bj}$. Consequently, to catch as close as possible to the perfect position, we should decrease the maximum among the set of $\{|a_B - a_{Bj}a_j|, |w_j - a_{jw}w_w|\}$, and the problem can be expressed as follows.

Min-max $\{|w_B - a_{Bj}w_j|, |w_j - a_{jw}w_w|\}$

Subject to

$\sum_j w_j = 1(1)$

$w_j \geq 0, \text{ for all } j$

Problem Eq. (1) can be shifted to the following linear programming problems:

Min ξ^L

Subject to

$|w_B - a_{Bj}w_j| \leq \xi^L, \text{ for all } j$

$|w_j - a_{jw}w_w| \leq \xi^L, \text{ for all } j$

$\sum_j w_j = 1(2)$

$w_j \geq 0, \text{ for all } j$

After resolving the problem Equation (2), the optimum weights ($w_1^*, w_2^*, w_3^*, \dots, w_n^*$) and ξ_L^* are attained. ξ_L^* can be perceived as a direct indicator of the evaluation system's reliability. The nearer the value of ξ_L^* is to Zero (0), the higher the reliability, and accordingly, the more consistent the evaluations become.

4. Application in Real-world

4.1. Social Sustainability in Pakistan

Currently, the global economy has been pushing to draw concentration on long-term sustainability development due to high increase in demand for energy, water, and mineral resources. In most of the conditions, the main concentration has been on the stability of the economy. Nevertheless, the sustainability of environment and social sector have the main influence on economy-related decision and policies that have a constructive and long-lasting economic effect. Pakistan is an emerging economy in South Asia. The country is still in its early phases in case of sustainability (Ahmad et al., 2019). From the past years, it has been an intense devotion to non-economic facets of growth in sustainability. In order to move sustainable development, many policies and guiding principles have been developed in Pakistan, but like various other developing nations, it has not been successful until now in its initiatives. The reasons behind this factor may consist of lacking enforcement of regulatory policies on the government

part and lacking of commitment at higher level of management to implement those measures on the side of corporations which lead to emphasize further on sustainability of economy. As an outcome, social activities have insert pressure at national as well as international level which has enforced the Pakistani manufacturing corporations to evaluate scientifically their direct and indirect social liability (Kapitan and Ikram, 2019). Investigation by Moroke et al. (2019); Mani et al. (2016) demonstrates that social issues have been predominantly challenging in emerging economies, so they need to conduct more in-depth research on the issue of social sustainability (Cerri, Thøgersen and Testa, 2019). This study is the initial step towards addressing the various severe negative impacts of manufacturing companies' supply chain processes on society in developing countries. So, this study is one of few conducted to examine social sustainability specifically in Pakistan.

In order to achieve applicability and usability of proposed framework and to provide inclusive assessment of social sustainability, a total sample of 53 practitioners of Pakistani manufacturing companies has been selected in diverse as chemical, electric and electronics, cement, telecom, tiles, automotive and motorcycle manufacturing companies with over more than 10 years of working experience. Total of 20 supply chain manager, 15 general managers, 3 finance managers, 15 assistant supply chain managers has participated in this study. Data has been gathered by conducting interviews and discussion with practitioners after enlightening them the motive of the study.

4.2. BWM Application

4.2.1. Decision Criteria Determination

First and foremost step is the identification of a set of criteria. The criterion was chosen after combining the review of literature and input from practitioners and decision-makers from manufacturing industry. At initial stage, above mentioned 24 social sustainability criteria were introduced to experts of their field for the purpose to evaluate at alternative times, as shown in table 2. They had also provided the guidelines how to fill out the questionnaire. Practitioners were asked to select 1 for more relevant criteria to their operations and 0 for irrelevant criteria. The experts in their professions were requested to mention other appropriate criteria according to their experience that may enhance the corporations' social sustainability in specific and organizational overall sustainability in broad. The researcher concurred with practitioners that criteria which are appropriate by minimum of 45 experts would be incorporated in 2nd review round. Two more criteria were proposed by two experts. Overall total of three interview rounds were conducted to improve the criteria set. Eventually, eleven social sustainability criteria were carefully chosen mentioned in table 3.

Table 3. Sorted out criteria for evaluation.

#	Social Sustainability Criterion	Description
1	Community education & training Influence (SSC1)	This criterion contemplates the impact and transfer of knowledge from the employer to its employees and community in which they run their operations
2	Cultural values (SSC2)	It relates to the preservations of society's intangible benefits of culture
3	Employment practices (SSC3)	This criterion observes the methods and programs relating to employees.
4	Health and Safety Practices at work (SSC4)	This criteria contemplates to both the Firm's focus on their operations and as well as on potential supplier operations of the Health and safety practices
5	Influence of contractual stakeholders (SSC5)	This criterion focuses on the attention of the potential suppliers who can insert force to their stakeholders involve to get incorporated into their operations
6	Information disclosure (SSC6)	This criterion involves the firms disseminating the information to their customers and other stakeholders relating to the material used and procedures employed during manufacturing processes and discharge of carbon.
7	Mobility and accessibility (SSC7)	It relates to adequate access to transportation services, various ways of non-motored mobility and or easy approach to nearby public services.
8	Occupational Health and Safety management system (SSC8)	It includes the welfare and health & safety of workers at work.
9	Research development and innovation (SSC9)	It comprises of technology development in infrastructure and innovation in processes to serve society in a better way.
10	Employees' rights & interests (SSC10)	This criterion considers the sustainable employment issues and with the factors that promote employee concerns.
11	Stakeholders rights (SSC11)	This criterion is related to society which has an interest in business and affected directly or indirectly by the operations of business.

4.2.2. Identification of the Best and Worst Criteria

All of the respondents in the second phase specified the most significant and the less meaningful social sustainability criteria, as the best and worst criteria by exercising a questionnaire. The results regarding the best and worst criteria are described in table 3.

4.2.3. Finding the Preference of Best Criteria over Others Criteria

In the 3rd phase, the responders were requested to identify the best criteria preference among other criteria by employing 1-9 measurement instruments. Table 5 is showing the feedback of one of responders.

4.2.4. Detecting the Other Criterion Preference over the Worst Criterion

In the next step, the responders were requested to identify the preference ratio of altogether criteria over the less significant criteria by through questionnaire, this time also using the measurement instrument of 1-9. Table 6 is also depicting the feedback of one of respondents.

4.2.5. Finding out the Optimal Weights of Criteria

In the final step, by resolving the BWM model for all of the 53 responders, the optimum weights of the criteria are computed. At next step, a simple weighted average for every criterion is calculated to get a single weight vector, and a simple weighted average as showing is table 7. Hereafter, the judgments are more uniform and highly reliable. In addition, the standard deviation (s.d.) for every criterion is shown in Table 7. Smaller numbers in standard deviation is

depicting the consistency and uniformity among responders.

5. Results and Discussion

Table 6 is showing* the final results of this study. The provided results demonstrate the understanding of managerial decisions strategically. According to table 3, the *Employment practices (SSC3)* has the maximum weight 0.291 of social sustainability criteria. Employment practices are much more significant criteria for the organization when they endeavour to attain social sustainability specifically and overall organizational sustainability in extensive. It is succeeded by *Community education & training Influence (SSC1)* with criterion weight of 0.120. The next criterion weight is 0.118 which represents the *Employees' rights & interests (SSC10)*. In order to improve the social sustainability in particular and overall sustainable development in general, it is the dire need to keep into consideration and need the serious attention on *the Employment practices* by the practitioners and decision-makers especially in manufacturing sector of developing countries. After the criteria on *Employment practices* has been established and executed, it will create the base for insertion and industrialized the other criteria, guiding to upgrading the whole program. These results further propose that if manufacturing concerns want to set up and enhance the social sustainability in their organizations, they must strategically focus and promote the influence of *Employment practices* by consorting with potential workers. It may strengthen the proficiencies and program competencies; create the ground

Table 4. Best and Worst criteria determined by experts 1-53.

Social sustainability criteria (SSC)	Experts Extracted as Best	Experts Extracted as Worst
Community education & training Influence (SSC1)	2,10,13,17,25	22,26,36
Cultural values (SSC2)	6,20,31,38	8,12,14,16,34
Employment practices (SSC3)	8,16,20,27,30,31	28
Health and safety Practices at work (SSC4)	5,18,22,24,31	16,31,35,18,21,32,34,22
Influence of contractual stakeholders (SSC5)	2,6,18,31	11,28,33,37
Information disclosure (SSC6)	11,18	1,5,22,27,24,38
Mobility and accessibility (SSC7)	13,27,25,21,33	4,8,11,17,18
Occupational Health and Safety management system (SSC8)	4,16,19,23,39	2,9,13,29
Research development and innovation (SSC9)	5,17,18,22,38	3,10,14,30
Employees' rights & interests (SSC10)	6,18,19,23,39	4,11,14,31
Stakeholders rights (SSC11)	7,15,31	6,14,20

Table 5. For expert 1, Best Criteria Preference over the other Criteria.

Social sustainability Criteria (SSC)	SSC 1	SSC 2	SSC 3	SSC 4	SSC 5	SSC 6	SSC 7	SSC 8	SSC 9	SSC 10	SSC 11
Most important SSC1	1	4	5	7	5	9	5	7	5	3	5

Table 6. For the expert 1, Preference of all Criteria over the Worst Criteria.

Criteria	SSC 1	SSC 2	SSC 3	SSC 4	SSC 5	SSC 6	SSC 7	SSC 8	SSC 9	SSC 10	SSC 11
Least important criterion SSC	9	6	5	3	5	1	5	3	5	7	5

Table 7. The BWM Results: For criteria weights of respondents.

Criteria	Average Weight	Standard Coefficient
Community education & training Influence (SSC1)	0.120	0.019
Cultural values (SSC2)	0.010	0.022
Employment practices (SSC3)	0.291	0.030
Health and Safety Practices at work (SSC4)	0.034	0.010
Influence of contractual stakeholders (SSC5)	0.107	0.034
Information disclosure (SSC6)	0.102	0.030
Mobility and accessibility (SSC7)	0.0368	0.040
Occupational Health and Safety management system (SSC8)	0.120	0.029
Research development and innovation (SSC9)	0.046	0.035
Employees' rights & interests (SSC10)	0.118	0.032
Stakeholders rights (SSC11)	0.0272	0.021

for other criteria to be executed and initiate some innovations in operations.

In order to reduce the hostile social effects of manufacturing processes and to enhance the social sustainability, monitoring these actions would be a substantial step that should be taken, according to Xu et al. (2019), Dendena and Corsi (2015). Further, *Research development and innovation* (SSC9) scored the value 0.108 and stands at 4th position in criterion selection process. The consequence of this outcome is that production industries need to focus and execute the *Research development and innovation* (SSC9) after pondering and establishing the most significant criteria SSC3, SSC1 and SSC10 respectively to attain social sustainability in the supply chain. While *Influence of contractual stakeholders* (SSC5) having the weighted average value 0.107 and stands at fifth positions according to weighted average value. SSC7, SSC11 and SSC9 having weighted average score 0.368, 0.272 and 0.46 are positioned at 7th, 8th and 9th rank correspondingly.

Health and Safety Practices at work (SSC4) has a weighted average score of 0.034. which stands at 10th position. It is surprising having such result, It is

uncertain why the responders evaluated this criterion as less significant. One of the reasons it may be is that manufacturing concerns in Pakistan do less invests on wellbeing of employees and workers' health related matters. It may be possible that they have already developed highly graded criterion, which means that there is need to draw attention to less flourished criteria. For more effective, it also indicates that *occupational health & safety management system* is further suitable for production industry in Pakistan and organizations in other emerging economies which are facing labour market instability, to assist them by managing sustainability in their operations related to supply chain. Therefore, it is showing that the production industry in Pakistan is quite in its beginning stage when the matter comes for the applicability of social sustainability, meanwhile the concentration and the highest possibilities originate from more basic initiatives related to partnering. It is, hence, further research needed to confirm the results. Social sustainability criteria SSC2 as *Cultural values* is categorized at 11th position with weighted average score 0.010 which is least significant in criterion selection process.

The outcomes of this research are contradictory to past studies on social sustainability criteria. For instance, previous reviews by Azadnia et al. (2015); Carvalho, Domingues and Sampaio (2019); Crane et al. (2019) have ranked the *Occupational Health and Safety management system* at highest position, but in this study it has been ranked at 2nd lowest position. The outcomes of earlier studies are not surprising, as the comfort and security of the employees, who are the most significant assets of any organization, and the matter is to achieve viable development. In another study conducted by Badri Ahmadi et al. (2017), *Employment practices* was ranked at lowest position in social sustainability criteria. That study was conducted in telecom industry to select sustainable supplier. But in this study, the *Employment practices* is ranked at highest position which is contradicted with previously mentioned study however the outcome of this study related to *Employment practices* is matched with the study conducted by Kusi-Sarpong, Gupta and Sarkis (2019). Similarly, stakeholders' rights were ranked high in study conducted by Ahmadi, Kusi-Sarpong and Rezaei (2017), but in this study this criterion stands at lower average position. Due to rare empirical studies on the basis of which we could base our findings, it is the fact that studies on social sustainability in supply is in its infancy stage. It all depends upon managers/practitioners, which criteria they have to prioritize and focus and which social criteria they have to defer. Nonetheless, the ultimate goal and viability of the programs involved may help practitioners to choose and apply specific social sustainability criteria in supply chain.

6. Conclusion and Recommendations for Future Research

The manufacturing concerns, due to their operations, have an immense negative impact on global environment and society by throwing their pollution and other chemical hazards in open-air, particularly in emerging economies like Pakistan. To deal with these issues, a number of manufacturing concerns have taken many initiatives. Moreover, several studies have addressed the sustainability broadly, but those studies have not focused specifically on social sustainability in supply chain. Only few studies incorporated the social sustainability dimensions in their SSCM models, and they only concentrated on some facets of supply chains.

The established frameworks in diverse and isolated forms do not support when capabilities and the resources required to handle the social influence of manufacturing concerns to attain sustainable operations systematically and comprehensively matters. Assimilation of these various models in one comprehensive model to support manufacturing sector incorporating the social sustainability in supply chains does presently not exist. In order to overcome this situation; this study has been started by reviewing

the existing literature related to sustainability in supply chains to find out the potential criteria within the manufacturing sector; various reviews were conducted by experts to identify and recommend a comprehensive model.

According to results, the most important criteria is *Employment practices* and least important criteria is *cultural values*, while *health & safety practices* has been ranked at 2nd least important criteria, which need to be re-tested again in order to explore the reasons. A suggested model can be helpful to enhance organizational capability needed to develop corporate sustainability. Mainly, the model can assist supply chain practitioners to compute the effect of social sustainability in manufacturing concerns more effectively.

There are many limitations in this research; therefore further research is obligatory. These limitations provide the foundation for the further improvement in this specific area of study. The main and first one limitation is that this research is of exploratory in nature and comprises of only manufacturing sector, so it is difficult to generalize the findings. More deep analysis is needed to open new insights into social sustainability in supply chains. Other manufacturing or services sectors may also be taken into consideration for broader implication. This is a cross-sectional study and covers a single period of time. Longitudinal study may also be recommended to check whether the criteria may modify over time due to priority changes according to the need of the organizations. It is also recommended to use other MCDM frameworks along with additional model of social sustainability to compute weighted average scores and match them with the BWM results of this study. It may be clear that further research is required on social sustainability in emerging economies.

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Carbon Sequestration in Soil as a Sustainable Way of Greenhouse Effect Mitigation

Sekwestracja węgla w glebie jako zrównoważona metoda ograniczania efektu cieplarnianego

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Abstract

Due to natural mechanisms of transformation the carbon compounds contained in the atmosphere into the humus, soil is an important factor controlling the concentration of atmospheric CO₂. The mass of carbon contained in organic matter accumulated in the surface layer of the Earth's crust is greater than the mass of this element in the atmosphere or biomass of all the organisms living over the globe. Over the recent years, much attention has been paid to the role of soils in limiting the reasons of climate changes, considering the possibility of increasing carbon sequestration in this matrix. This way of approaching the problem of the greenhouse effect, which does not require an involvement of complex and expensive technological solutions aimed at capturing and storing the atmospheric CO₂, and additionally contributing to improving the quality of soil and water environment, and soil productivity is fully sustainable and combines the environmental, economic and social issues.

Key words: climate change, soil functions, carbon cycle

Streszczenie

Dzięki istnieniu naturalnych mechanizmów transformacji związków węgla zawartych w atmosferze w związki próchniczne, gleba stanowi istotny czynnik kontrolujący stężenie atmosferycznego CO₂. Masa węgla zawartego w materii organicznej nagromadzonej w powierzchniowej warstwie skorupy ziemskiej jest większa niż masa tego pierwiastka w atmosferze lub biomasie organizmów żywych. W ostatnich latach wiele uwagi poświęca się roli gleb w ograniczeniu przyczyn zmian klimatycznych, poddając pod rozagę możliwości zwiększenia w nich sekwestracji węgla. Taki sposób podejścia do problemu efektu cieplarnianego, nie wymagający wprowadzania złożonych i drogiej rozwiązań technologicznych nakierowanych na wychwytywanie i magazynowanie atmosferycznego CO₂, a dodatkowo przyczyniający się do poprawy jakości środowiska gruntowo-wodnego oraz produktywności gleb jest w pełni zrównoważony, gdyż łączy ze sobą zarówno kwestie środowiskowe, gospodarcze i społeczne.

Słowa kluczowe: zmiany klimatyczne, funkcje gleby, obieg węgla

Introduction

The data of the International Panel on Climate Change indicate that the annual global greenhouse

gas (GHG) emissions have been rising since the Industrial Revolution (IPCC, 2013). The main factors increasing the anthropogenic greenhouse gas emissions are population growth, economic growth, fos-

oil fuel consumption and land use change. The increase in GHG emissions in the years 1970-2000 was about 1.3%/year, and in the years 2000-2010, 2.2%/year. Carbon dioxide has the largest share in the total greenhouse gas pool – 65% of the CO₂ emissions come from the combustion of fossil fuels and industrial processes, while 11% from agriculture and forestry (IPCC, 2013).

The consequences of growing greenhouse gas emissions are the effects of climate change, including the changes of the weather patterns, rising sea levels and extreme weather phenomena. According to the IPCC (2018) if the current level of concentration and the amount of greenhouse gas emissions are maintained, the temperature on Earth at the end of this century will rise by more than 1.5°C, compared to 1850-1900. At the same time, the ocean water temperature will rise and the ice cover will still be melting. It is estimated that the average sea level will increase by 24-30 cm by 2065 and by 40-63 cm by 2100. Most of the climate change effects will persist for centuries, even if the greenhouse gas emissions can be stopped.

This is one of the most important challenges from the perspective of sustainable development, since consequences of climate change will touch all the people in every country. That's why among 17 most important Sustainable Development Goals, introduced by the UN in 2015, we can find goal named Climate action, which is calling all societies to fight global warming.

In order to reduce and/or mitigate the potential negative effects of temperature rise on ecosystems and the economy, it is necessary to take the measures to reduce the concentration of CO₂ in the atmosphere. The main strategies that can be used for this purpose are: reduction of global CO₂ emissions to the atmosphere, development of the alternatives to the fossil fuels as well as carbon capture and its long-term storage in geological formations, oceans and terrestrial ecosystems (Olejnik & Sobiecka, 2017).

Carbon sequestration in terrestrial ecosystems includes CO₂ storage in plant biomass and soils. These processes are referred to as phytosequestration and soil carbon sequestration, respectively (Post and Kwan, 2000). In terrestrial ecosystems, carbon storage occurs mainly through the photosynthesis, as well as in the form of soil organisms and dead organic matter. Lal (2008) described several scenarios for the carbon sequestration in terrestrial ecosystems, which include soils, grasslands, forests and wetlands. Soil ability to store carbon is greater than that of plants and the atmosphere (Cel et al., 2016). By maintaining this huge amount of carbon, the soil prevents or delays the accumulation of carbon dioxide in the atmosphere. On the other hand, even a small increase in the soil carbon content, can have a significant impact on the overall carbon (CO₂) balance in the environment (IPCC, 2000). According to European Environmental Agency (EEA, 2019)

healthier soils and a sustainable land and soil management, are the necessary conditions to deal with climate crisis, produce enough food and adapt to a changing climate.

Soil role in the carbon cycle

Soil is a major component of the terrestrial ecosystem (Banwart et al., 2017), which comprises the surface part of lithosphere transformed by physical, chemical and biological processes. Soil is still weakly understood matrix which plays an essential functions for the global *ecosystems* (Balestrini et al., 2015). However, the importance of soil role in the ecosystems cannot be overestimated, which was emphasized by the initiator of the Polish pedologic school prof. Sławomir Miklaszewski (1907) in the sentence that can be translated: *There is no soil without life, nor life without soil* (cited by Dobrzański & Zawadzki, 2005). Biomass production, matter cycling, habitat for biological activity, filter and buffer for water and carbon sequestration are the main soil function in terrestrial ecosystems (Banwart et al., 2017). The latter can be considered a key soil function for climate regulation, as well as plays a crucial role in regulating the soil's ability to perform other environmental functions (Weismeier et al., 2019).

The soil is the largest terrestrial carbon reservoir estimated at about 2,344 Gt of organic carbon retained in the layer up to 3 m, 1,500 Gt in the layer up to 1m and 615 Gt stored in the upper 20 cm layer of the soil profile (Stockmann et al., 2013). This accounts for 80% of carbon resources in terrestrial ecosystems.

Stockmann et al. (2013) report that the amount of CO₂ emitted into the atmosphere annually is estimated at 8.7 GtC, while only 3.8 Gt of CO₂ remains in the atmosphere during the year. This leaves an outstanding balance of 4.9 Gt C/year, which is believed to be retained in land and sea systems (forests, soils, oceans, etc.). The researchers indicate that soil can be considered as the key CO₂ storage system that can provide the necessary climate regulation services. Understanding the role of terrestrial systems, including soil, in the carbon cycle caused that the special attention was paid to the potential of these systems for carbon sequestration and storage (Post and Kwon, 2000). It should also be noted that the organic carbon stored in soils may undergo mineralization, as a result of which significant amounts of CO₂ are released into the atmosphere (Weismeier et al., 2019). In addition, the binding of CO₂ in soil leads to an increase in the humus content, which will bring additional benefits, among others: improvement of the physical, chemical and biological properties of soils. For example, the improvement of water properties and the sorption capacity of the soil enable to increase the amount of water and ions available to plants and binding the pollutants. As a consequence, primary biomass production will increase, and more CO₂ will be absorbed from the atmosphere.

A larger inflow of plant biomass will provide an additional substrate for the newly formed humus compounds (Weismeier et al., 2019).

Soil carbon sequestration was defined by Olson (2013) as a process of transferring the atmospheric CO₂ into the soil through plants, plant residues, and other organic solids in order to be retained in the soil organic matter (humus). According to the Soil Science Society of America, sequestration involves storing carbon in a stable solid form in soil as a result of direct and indirect atmospheric binding of CO₂ (Burras et al., 2001). Direct binding relies on the natural conversion of CO₂ into inorganic compounds in soil, such as calcium and magnesium carbonates. Indirect sequestration occurs when plants produce biomass through photosynthesis. This biomass is ultimately transferred to the soil and, after decomposition, indirectly sequestered as an organic soil substance. The amount of sequestered carbon in soil reflects the long-term balance between the CO₂ uptake and release mechanisms (Lal, 2008).

According to ICPC (2013), agricultural soils have a sequestration potential of up to 1.2 Gt of carbon per year, but it is also estimated that around 50% of agricultural soils have already been degraded around the world, which suggest that there is the chance for increasing carbon sequestration in these soils by their reclamation. Since the time when the natural ecosystems were started to be transformed to agroecosystems, the soil organic carbon stocks have declined by an average of 30-55% (Batjes, 2013). Implementation of a carbon sequestration strategy in soil should enable recovering 50-60% of the original soil carbon content, leading to the restoration of productivity of agricultural and degraded land (Lal, 2004). Hansen et al. (2013) indicate that arable land could sequester at least 10% of the current annual CO₂ emissions, which are estimated at 8-10 Gt/yr.

Thus, taking into account the global carbon cycle soil plays an ambiguous role in the emission of greenhouse gases, being the emitter and *absorber* simultaneously. Finally, the role of soils in mitigation the climate change depends on the balance of emissions and retention of greenhouse gases. This balance is determined by many factors, including the properties of soil and organic matter reaching it, climatic conditions, as well as the method of cultivation and fertilization.

Factors influencing the content and quality of soil organic matter

From a geological point of view, sequestration is the binding of CO₂ over a very long time scale. From the point of view of human time scale, the carbon binding in soil in a form of mineralization-resistant compounds can be treated as sequestration. The humus compounds characterized by a complex structure, and the humus bound in organic-mineral connections

(these connections are considered as the basic mechanism for protecting the humus against mineralization) are deemed to be permanently carbon binding compounds. The binding of carbon in the biomass of soil microorganisms is also important. Despite its low durability, the dead cells are the substrate for formation of humus compounds.

The condition of humus in soils is determined by many factors, while the quantity and quality of humus have a significant impact on the basic soil properties that determine their fertility (Goh, 2004). The main factors affecting the content of organic matter in soil include environmental factors, such as types of climate and plant cover, and soil properties (Chabbi et al., 2009) – and in the soil under cultivation – also the anthropogenic factors, including the way of land use, cultivation systems (Wiesmeier et al., 2013), fertilization (Kundu et al., 2007) and degradation processes (Lal, 2004).

The course of soil-forming processes and plant growth are mainly dependent on the climate, including the temperature and amount of precipitation. Precipitation determines the net primary productivity and thus the amount of plant residues flowing into the soil. In addition, humid conditions may intensify the weathering of primary minerals, which promotes the formation of mineral surfaces stabilizing soil organic carbon (Doetterl et al., 2015). Temperature significantly affects the degradation of organic matter by the microorganisms that are highly sensitive to temperature (Conant et al., 2011, Davidson and Janssens, 2006). Numerous studies indicate a decrease in soil organic carbon (SOC) content with increasing temperatures (Jobbagy and Jackson, 2000; Koven et al., 2017). In general, the soils in humid and cool climate zones are characterized by the highest content of organic C. According to Dixon et al. (1994), 58% of 787 Pg of carbon contained in the forest ecosystems is accumulated in the forests located in the climate zones characterized by a relatively cool and humid climate. Moving from a colder to warmer climate conditions, the content of organic matter in the soils of comparable types decreases, which is caused by an increase in the mineralization rate with the growth of the temperature. It is estimated that in comparable soil types and environmental conditions, along with a decrease in temperature by 10°C, the content of organic matter increases 2-3 times (Koven et al., 2017). The type of vegetation influences the distribution of organic carbon content in the soil profile. In the 1 m layer of meadow and forest soils, ca. 42% and 50% of carbon, respectively, is accumulated in the surface layer with depth of 0.2 m.

Soil type and texture have a significant impact on the content of organic matter, because they determine the water-air conditions that are remarkably important for the intensity of degradation processes. For example, high rate of organic matter decomposi-

tion is typical for sandy soils, which have lower water retention and higher aeration in comparison to the soil with heavier granulometric composition (Koven et al., 2017).

The content of organic matter is also significantly affected by the chemical stabilization of organic matter, which is correlated with a clay content (Torn et al., 1997). This is due to the occurrence of chemical or physicochemical bonds between the organic substance and clay minerals, making it more resistant to the mineralization processes.

Due to the seasonal time-changing impact of soil-forming factors, the properties of soils in natural habitats remain in a state of relative equilibrium. In the soils of natural ecosystems, the inflow and mineralization of organic matter remain in a steady state for hundreds or thousands of years (Wardle et al., 1997). However, this balance can be disturbed by the human activity, leading to significant soil carbon losses in a relatively short time (Post and Kwon, 2000; Strassmann and Fischer, 2008). It was noted that after including the soils into agricultural use, especially when they are used as arable soils, the immediate and rapid reduction of soil organic matter appears. According to Mann (1986) the organic C losses can be up to 40% in 20 years, half of which is observed in the first 5 years. This pattern can occur regardless of the climate conditions, soil and vegetation types. There are several mechanisms leading to the carbon content decrease in the arable soils: (1) in these soils, compared to the natural ones, there is a smaller inflow of fresh organic matter, since a significant part of the produced biomass is removed from the ecosystem in the form of a crop (Imhoff et al., 2004); (2) the chemical composition of the crop biomass differs from the native vegetation in terms of the C content in mineralization-resistant buds – crop biomass contains low amount of this form of carbon (Kong et al., 2005); (3) changes in the soil physical properties caused by mechanical cultivation (higher aeration) accelerate mineralization (Collins et al., 2000), and as a result of intensive mineralization, more labile C fractions are created, which are more susceptible to degradation, because they do not form connections with clay minerals (Six et al., 2000); (4) the lack of plant cover in the fields causes significant C losses due to the increased water and wind erosion (Trimble and Crosson, 2000).

In general, the rate of organic carbon content decrease slows down when the soil organic matter levels reach a state of new equilibrium, which depends on the cultivation system (West and Post, 2002) and the amount of organic matter supplied to the soil in the form of crop residues and organic fertilizers (Kirchmann et al., 2004).

Strategies for increasing the soil carbon stocks

The factors promoting carbon sequestration in the soil can be divided into two groups: (i) that increase

ing the inflow of fresh organic matter – a substrate for humus formation, and (ii) that reducing the losses of humus compounds (Fig. 1). The losses of humus in soil are caused by the mineralization and erosion processes. The factors limiting the losses include: cultivation type – conservation tillage and no-till farming, regulation of soil and water conditions, and, the introduction of ground-cover plants on the soil threatened by erosion. The increase in the biomass inflow may result from an increase in soil productivity, changes in the cultivation system, proper selection of fertilizers and the crop rotation plants. In addition, the change in land use – such as afforestation, permanent grassland or reclamation of degraded soil – increases the global carbon sequestration in soil (Wiesmeier, 2019).

Afforestation of marginal (poor quality) lands is considered an effective way to increase the carbon sequestration (IPCC, 2013; Lamb et al., 2005). The potential for C sequestration by afforestation of marginal soils depends on the local climatic conditions and the species of the planted trees, and equals to 3 Tg C/yr in Norway, 6 Tg C/yr in New Zealand, 9 Tg C/yr in Sweden, 107 Tg C/yr in Russia and 117 Tg C/yr in the USA (IPCC, 2013). Special attention is paid to the renewal of degraded tropical forests (Lamb et al. 2005). Lal (2005) estimates that 350 Mha of tropical forests have been converted to land used in another way, and the next 500 Mha have been degraded to varying degrees.

Improvement of the carbon sequestration in soils can be achieved by changing the soil use type. The results of fields study showed that 20-40 years after the conversion of arable land to grassland the organic carbon content in the top 0-30 cm soil layer was increased by about 20 Mg C/ha (Conant et al. 2001). The opposite practice involving the conversion of permanent pasture into arable land resulted in the loss of 40% of the original SOC resources within 25 years (Poeplau et al., 2011). Renewing the forest on degraded areas can significantly increase the Earth's carbon pool (Lal, 2005).

Integrated nutrient management has a significant impact on the efficiency of carbon sequestration in agroecosystem (Lal, 2004). The intensity and direction of transformation of the humus compounds in soil is affected by the availability of minerals such as N, P, S, Mg and Ca (Hines 1998). The lack of these elements can seriously disturb the transformation of organic matter leading towards the intensification of mineralization and inhibition of humification process. Paustaiian et al. (1997) showed that the C:N ratio significantly influences the intensity of C sequestration in soil. Too high C:N may inhibit sequestration. Thus, an increase of the rate of this process in soil can be achieved by nitrogen fertilization. Liebig et al. (2005) indicated that fertilization with high doses of N, compared to non-fertilized soil, increased the C sequestration by 1.0-1.4 MgC/(ha·yr).

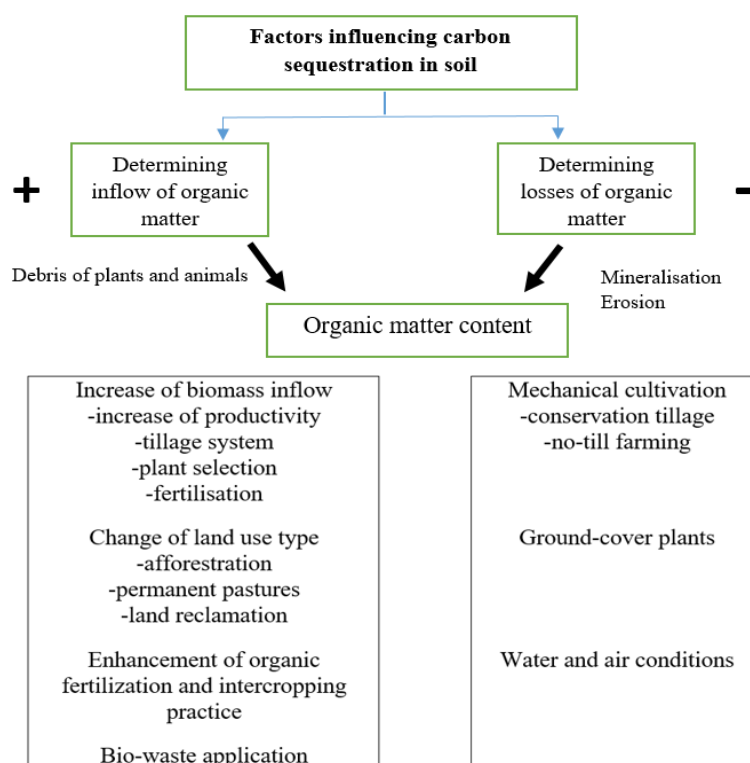


Fig. 1. Factors influencing carbon sequestration in soil

The direct effect of mineral nitrogen on the C sequestration is connected with the growth of the humification rate, while the indirect one is related to the increase of biomass yields that leads to an increase in the loading of biomass being the substrate for humus formation. The intensity of SOC sequestration depends both on the frequency and the chemical forms of nitrogen used for soil fertilizing.

The influence of mineral nitrogen on the rate, and hence the direction, of the organic matter transformation in soil is reflected not only in the content, but also in the quality of the newly formed humus compounds (Dorado et al., 2003). Cvetkov et al. (2010) indicate the special importance of nitrogen fertilization when using green manure and straw. The addition of mineral nitrogen to the plant residues introduced into the soil accelerates their decomposition, optimizes the use of released nutrients and promotes the formation of more persistent organic substances. Organic fertilization plays a significant role in the strategy of carbon sequestration in the arable soils. The organic carbon content in the soils fertilized with manure is significantly higher compared to the non-fertilized soils and the soils fertilized with NPK (Jenkinson, 1990; Witter et al., 1993; Christensen, 1996; Korschens and Muller, 1996). Nevertheless, the contradictory opinion on the impact of manure can be found. For example, Gong et al. (2009) noted the increase in the soil organic matter (SOM) content, while Simon (2008) observed the stabilization of SOM or SOC in the soil fertilized with manure. The diversity of the results should be attributed to the

impact of the factors regulating the conversion of organic matter in the soil (e.g. soil type, climate conditions, plant selection). Most of the cited authors showed that the increase in the content of organic matter in soils is proportional to the dose of manure, and it is observed primarily in the soil layer up to 30 cm. The results of many years of fertilization experiments in Europe clearly indicate an increase in the SOC pool at a depth of 0-30 cm under the influence of manure, compared to mineral fertilizers; however, the extent of the increase was different in particular countries: in Denmark, the sequestration of C was 10% higher in 100 years (Christensen, 1996), in Germany by 22% in 90 years (Korschens and Muller, 1996), in United Kingdom (Rothamsted) by 100% in 144 years (Jenkinson, 1990), and in Sweden by 44% in 31 years (Witter et al., 1993). Additionally, the changes in the SOM content due to the manure application were accompanied by the changes in the humus quality indicators. Schulten and Leinweber (1991) showed that the content of lignin and fatty acids is higher in the soil fertilized with manure compared to the non-fertilized soil. Within the humus compounds found in the soils fertilized with manure, an increase in the humic acid content was observed. At the unchanging content of fulvic acids, this increase resulted in the growth of the ratio of carbon contained in particular acid forms ($C_H:C_F$ ratio) (Dorado et al., 2003; Cvetkov et al., 2010). Gregorich et al. (1997) showed a smaller share of C bound in the aromatic compounds in the total amount of C associated with the clay fraction in the soils fertilized

with manure. In the elemental composition of the humic acids found in the soils permanently fertilized with manure, insignificantly lower contents of C and O, higher content of H and N, lower internal oxidation degree, and higher number of functional groups were observed, compared to the humic acids sampled from the non-fertilized and NPK fertilized soils (Watanabe et al., 2007).

Different bio-waste, including sewage sludge, compost, green waste can be used as the source of external organic matter. Diacono and Mantemuro (2010) report that 8.1%, 4.2-6%, 3.8%, and 3.7% of carbon introduced with manure, sewage sludge, composts and straw biomass, respectively, was sequestered in soil.

The impact of crop residues (straw) on increasing the SOC resources is well documented (Neill, 2011). Many researchers underline the complexity of straw decomposition in soil, which depends on the chemical properties of biomass, soil conditions, including temperature and humidity which determine the biological activity. A direction of the plant residues conversion is largely determined by the value of C/N ratio, and the content of easily degradable compounds. The plants contain usually the same groups of compounds, but differ in quantitative composition, e.g. maize straw is characterized by a high proportion of hemicelluloses and starch (42%), alfalfa biomass – proteins (16%), and wheat straw – cellulose (42%). The research of Lemke et al. (2010) showed that the post-harvest residues of alfalfa, followed by wheat and maize, undergo the transformation processes the fastest.

Wiesmeier et al. (2019) underline the significant role of selection the plant species used in the crop rotation and ground-covering in the increase of the SOC content. West and Post (2002) showed the increase in the organic C content in the soil with permanent crop rotation system compared to monoculture, in continuous cropping in relation to the system of 3-year crop rotation – fallow, and in the crop rotation with a large variety of cultivated plants. The researchers, based on global databases (67 years of experience), stated that increasing the crop diversity can cause significant accumulation of organic matter and achieving a *new* state of equilibrium after 40-60 years.

The appropriate selection of the plant species in the crop rotation increases the stability of soil structure, the efficiency of nutrient and water uptake, and the crop yielding. Particularly beneficial effects on the improvement of carbon balance and soil properties were noted in the crops in which the papilionaceous plants, capable of binding the atmospheric nitrogen, were included (Mazzoncini et al., 2011).

Involvement of intercrops as green fertilizers and ground cover plants into the crop rotation increases soil richness in organic matter (Bryant 2013). The intercrops are harvested for fodder or plowed as

green manure before sowing the next plant. The ground cover plants also increase the inflow of organic residues to the soil that are the starting material for humification. Moreover, these plants increase biodiversity as well as reduce the losses caused by erosion and stress associated with lack of water (Lal 2004). Poeplau and Don (2015), while analyzing the literature data, showed that the average annual SOC sequestration under cover crop conditions was from 0.32 Mg/(ha·yr), which corresponds to the values measured for the soil fertilized with manure and similar to the soil from the arable land changed into the forest. Additionally, they showed that carbon sequestration is long-term (potentially over 100 years), and that 50% of the total impact of cover crops on the SOC stocks will become apparent in the first two decades. The relatively high sequestration ratio combined with the large surface areas of the agricultural lands that can be potentially available for covering by the plants, enable to state that these practices are a sustainable and effective means of mitigating the climate change.

On arable land, tillage is of key importance for the level of carbon sequestration. Negative SOC balance is recorded on the soils with traditional tillage (plowing). The conservation tillage and no-till (non-plowed) farming favor the soil carbon sequestration. The simplified cultivation techniques (shallow cultivation without turning the furrow) reduce the soil aeration and limit mineralization of organic matter. If the inflow of carbon to soils increases, e.g. due to leaving all the crop residues in the field, an improvement in the carbon balance in soil can be expected (ECCP, 2003). Continuous implementation of this practice for many years may cause that the C sequestration will take place until the new balance value in soil is established, which will be achieved after about 20-30 years (Lugato et al., 2018). In such a cultivation system, carbon will be more permanently bound in the soils the higher the content of colloidal clay is (Merante et al., 2014). The simplified tillage system with leaving 30 to 70% of crop residues in the field (conservation tillage) is recommended for non-live-stock farms (Ranaivoson et al., 2017).

The transition from traditional tillage to the no-tillage system increases the SOC resources (Mrabet et al. 2001). The no-tillage system affects the SOC resources in two ways: (i) by reducing the disturbances which favor the formation of stable soil aggregates; the aggregates protect the SOC associated with them against an intense mineralization (Six et al., 2000); (ii) by modifying the local edaphic environment (bulk density, pore size distribution, temperature, air-water regime), which may limit the SOC biodegradation (Kay and Vanden-Bygaart, 2002). The rate of accumulation of organic carbon resources in the soils under no-tillage system is estimated at 300-800 kg SOC/(ha·yr) (Paustian et al., 1998).

Prospective solutions for soil carbon sequestering

The afore-mentioned practices used in agriculture management can significantly increase the potential of soil for carbon sequestration. This potential can be further increased by new technologies that include precision agriculture, exploitation of unused land resources and the existing biodiversity, plant and microbial biotechnology, and chemical technology. Precision farming uses information technologies that allow adjusting the intensity and timing of agrotechnical operations to the potential demand of plants and field habitat conditions. Over time, the widespread use of precise methods in agriculture can be targeted at the technologies enabling the increase of carbon sequestration in soil. In addition, precision farming can reduce the CO₂ emissions to the atmosphere through reduced energy consumption. Metting et al. (2001) indicate that the technological solutions for precision agriculture and forestry should include: development of the sensors detecting the presence of pathogens, which will enable for early application and precise dosing of plant protection products, development of the precision fertilization technology (how much, when and where fertilization is needed) based on the geoinformation systems, developing efficient just-in-time irrigation systems that maximize the water efficiency.

The promising solution for the enhancement of SOC sequestering is the use of native plant species (e.g. resistant to acidification, salinity, drought) in the reclamation of degraded soils (Lal, 2015) and developing the perennial cereals. Perennial grasses selected for breeding, such as wheatgrass, are characterized by deep and extensive root systems. Higher proportion of dry weight allocated underground, compared to the conventional annual crops, is typical for these plants. The supply of organic residues to the soil is much higher than in the case of planting grasses than annual plants. In addition, perennial plants would significantly reduce the need for tillage and reduce the negative impact of this practice on the SOC resources and soil erosion. Larger and deeper root systems can also reduce nitrate leaching to the groundwater and atmosphere (in the form of N₂O) (Crews and Rumsey, 2017). Modification of annual plants through targeted breeding and selection in order to increase the accumulation of photosynthesis products in the roots and to obtain varieties with deeper roots system may be another option.

Increasing the soil carbon sequestration can also be achieved by selecting the existing biodiversity and improving microbial-plant symbioses, e.g. mycorrhizal fungi, nitrogen-binding bacteria and the production of soil conditioning microbial inocula (Metting et al., 2001). It would be extremely valuable to develop the ability to obtain the mycorrhizal fungi (and other non-cultured microorganisms) in pure culture. These fungi form symbiotic systems with all the important forest tree species and most of

agricultural crops. Mycorrhizal symbiotic systems increase the efficiency of water accumulation and nutrient uptake (phosphorus and microelements). Attention is also paid to the possibility of using the bacterial inocula and humic materials that facilitate the formation and stabilization of soil aggregates. This provides protection against the physical degradation of organic-mineral bindings.

The development of innovative, *smart* fertilizers and soil quality improvers, as well as the use of plant growth regulators are other potential solutions leading to the increase carbon sequestration in soil. The term *smart* refers to the fertilizers that release the nutrients in the control way. The future *smart* fertilizer should be able to release the nutrients in response to the plant demand expressed by sending specific molecular signals.

Conclusions

The recently observed increase of the GHG concentration, among which CO₂ is the most important, causes an enhanced interest in the capture and storage of atmospheric carbon in the soils of various ecosystems as a means of mitigating climate change. Soils are the largest terrestrial carbon reservoir, and carbon occurs in them in relatively persistent connections, which is why the soils can be treated as a potential CO₂ sequestration site.

Increasing the soil carbon resources also brings additional benefits, such as improvement in the physical, physicochemical and biological properties of soils, increase in soil productivity and enhanced ability to perform other ecosystem functions.

Application of adequate agrotechnical measures that favor carbon sequestration in soils can significantly increase the pool of soil organic matter, but the best solutions differ depending on the climate conditions and soil type. Thus, the sustainable land management, suited to the local conditions is crucial for obtaining satisfactory results in long-term carbon storage in soils. Afforestation of poor quality soils, change from arable use for permanent grassland, optimization of plant selection in crop rotation, use of the cover crops, reduction of mechanical soil cultivation by using simplified and no-tillage farming, and application of organic and nitrogen fertilization are the agricultural practices of greatest importance for increasing the potential of agroecosystem soils for carbon sequestration. Adoption of such measures on a large scale seems to be viable and highly efficient, especially when the different practices favoring carbon sequestration are used together. An increase in carbon pool in soil organic matter will not only improve the atmospheric air quality but will also have the positive social and economic outcomes related to the increase of soil fertility and the groundwater quality, as well as to the possibility of managing of different types of organic waste which can be used as a source of external organic matter.

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The Path of a Saint: Buddhaghosa's Argument for Sustainable Development

Ścieżka świętego: argument Buddaghosy na rzecz zrównoważonego rozwoju

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Abstract

A philosophical investigation of sustainable development has much to contribute to the study of philosophy of religion because religion has significant effect on human behavior. In Indian philosophy, to be precise, early Buddhist Philosophy argues for individual suffering and its solution. Notwithstanding, there is an argument that Buddhist philosophy does not motivate an individual to make efforts for sustainable development or preservation of natural resources. Therefore, one cannot contemplate the problem of sustainable development under early Buddhist philosophical framework. To refute this view, I have attempted to analyze Buddhaghosa's notion of virtue. In this paper, I have argued that, there is a significant implication of the study of virtue for the area of sustainable development. This, consequentially, imparts significance to the balanced consumption of natural resources and balanced consumption of natural resources is vital for sustainable development.

Key words: early Buddhism, sustainable development, religion, Buddhaghosa, natural resources

Streszczenie

Filozoficzne badanie zrównoważonego rozwoju ma duży wkład w studiowanie filozofii religii, ponieważ religia ma znaczący wpływ na ludzkie zachowanie. Mówiąc precyzyjniej, w filozofii indyjskiej wczesna filozofia buddyjska opowiada się za indywidualnym cierpieniem i rozwiązaniem. Niezależnie od tego istnieje argument, że filozofia buddyjska nie motywuje jednostki do podejmowania wysiłków na rzecz zrównoważonego rozwoju lub zachowania zasobów naturalnych. Dlatego nie można kontemplować problemu zrównoważonego rozwoju we wczesnych buddyjskich ramach filozoficznych. Aby obalić ten pogląd, próbowałem przeanalizować pojęcie cnoty Buddaghosy. W tym artykule argumentowałem, że badanie cnoty ma znaczący wpływ na wspieranie zrównoważonego rozwoju. W konsekwencji nadaje to znaczenie zrównoważonemu zużyciu zasobów naturalnych, a zrównoważone zużycie zasobów naturalnych ma zasadnicze znaczenie dla zrównoważonego rozwoju.

Słowa kluczowe: wczesny Buddyzm, zrównoważony rozwój, religia, Buddaghosa, zasoby naturalne

Introduction

There is an established link between environment, society and economics. For instance, agricultural policies can recommend the overuse of chemical fertilizers and that can be the cause of water pollution and land degradation (Baker, 2006, p.19). My intention in making a reference to the Baker argument that elucidates upon the link between the environment, economy and society is to show that our environment is deeply affected by our thoughts, which manifest in

action and become habits. Thinking and working towards sustainable development is not possible single handedly. It is our collective responsibility. Further, when we talk about collective action then, religion always takes a dominant position because philosophy of religion has a deep influence on human beings. Notwithstanding, Indian Buddhist philosophy has been looked upon as one that provides the solution of individual suffering only. Here, individual suffering refers to suffering which is caused by individual's set of desires and inclinations (Prakash,

2018). Therefore, it is said that, early Buddhist philosophy does not talk about the natural resources or sustainable development. To refute this interpretation, I have delved into an authoritative early Buddhist text, Visuddhimagga, written by Buddhaghosa in the 6th century.

The Buddhist text, Visuddhimagga, concerns itself with the manner in which one can purify his mind and end suffering. It is true that there is no direct reference to natural resources, in the text, because at that time the society had not deliberated upon the degrading state of natural resources and its significance for man. Notwithstanding, in this paper, I have argued that if one follows the recommended path of Buddhaghosa then, there will be no exploitation of natural resources. The paper focusses upon the first chapter of Visuddhimagga. The chapter, titled *Sila* (virtue), deals with the concept of virtue and the nature of virtue. In the paper, I have argued as to how Buddhaghosa's recommended path of a saint is also an equally significant step for sustainable development.

The Path of a Saint: Buddhaghosa's perspective

In the first chapter of Visuddhimagga, Buddhaghosa has explained the nature of virtue. He defines virtue by saying that virtue can be understood as a function which is accomplished by discontinuing the misconduct in terms of action (Nanamoli, 1956, p. 12). Therefore, for Buddhaghosa, the manifestation of virtue can be seen in terms of bodily purity, verbal purity and mental purity. For early Buddhists, virtue can purify not only the physical, but verbal and mental also. There are mainly four types of virtues mentioned in the text. These are virtue as volition, virtue as consciousness-concomitant, virtue as restraint and, finally, virtue as non-transgression (Nanamoli, 1956, p. 10). I will discuss all the four types of virtues in this section and, in next section, I will argue that it will be easy to achieve the goal of sustainable development if one follows Buddhaghosa's mentioned path of a saint.

In the first argument, Buddhaghosa has argued that virtue is a volition. In early Buddhist philosophy, *cetana* is often translated as *volition* or *intention* (Keown, 1992, p. 220). Buddhaghosa writes that, virtue as volition refers to the volition present in one who follows the five precepts. Before going to the explanation of the five precepts, let us discuss the notion of volition in early Buddhist philosophy. In early Buddhism, intention of action plays an important role. The original Sanskrit term *karma* literally means *action* and, according to the early Buddhist theory of action, one will have to face the consequences of one's actions. Further, we need to understand that, sometimes action does not produce immediate effect. In the popular Buddhist understanding, the law of *kamma* is an option wherein an individual acts in such a way as he wishes, to shape his future.

In other words, the fruits of our actions contribute key dimensions to our future life. Thus, we are responsible for our actions and the future world. Again, for Buddhism, our personality is the effect of our set of past desires and inclinations. Early Buddhists argue that our actions shape not only our future but also our personality. Therefore, one has to be very careful while performing any action and, for all actions, intention is very important because action cannot be judged merely by itself. Intention plays a significant role in it. Buddhaghosa, with reference to the first virtue, writes that the intention of performing the following five Buddhist moral precepts is important. These five noble precepts, known as *Pancasila*, are – (1) abstain from killing, (2) abstain from stealing, (3) abstain from telling lies, (4) abstain from living immoral life and (5) abstain from consuming intoxicants. These constitute the basic teaching of Buddha and are accepted by all schools of Buddhist philosophy. Among the five noble precepts, the first is very significant for the problem of this paper. Further, the other four precepts are essential for self-purification so that one can restraint himself from any immoral act in any kind of mental state. Therefore, I will focus upon the first precept only in my attempt to analyse Buddhist contribution towards sustainable development. The first precept, that is non-violence or non-killing, is known as *ahimsa*. It is a prominent and common concept in all Indian religions. It means positive love in the form of compassion and friendship towards all beings - in thought, word and deed. In Buddhism, killing in any form is prohibited. Life is dear to all creatures. All living beings, irrespective of age, sex, size, from the time of their conception in the mother's womb are under this precept's purview. This precept wards off the scope for recent ethical issues – not only capital punishment, but also euthanasia and abortion. It is significant to note that these five moral precepts are prescribed for both the householders and renunciates.

The second virtue is *virtue as consciousness concomitant*. Here, consciousness concomitant is mental state or *cetasika*. According to early Buddhism, *cetasika* has four main characteristic properties. *Firstly*, it arises together with consciousness. *Secondly*, it perishes together with consciousness. *Thirdly*, it takes the same object as consciousness and, *finally*, it shares a common physical base with consciousness. Consciousness and mental properties function in the same manner. In Buddhism, there are different kinds of consciousness and mental states. Buddhaghosa writes that *virtue as consciousness concomitant* expresses itself as self-discipline in one who follows the five precepts. Therefore, this virtue is a mental state with the essential characteristic of non-covetousness.

Third virtue is virtue as restraint and it should be elucidated upon as restraint exercised in five different ways: restraint based upon the rules of community

(Patimokkha), restraint due to mindfulness, restraint due to knowledge, restraint due to patience and restraint due to energy (Nanamoli, 1956, p. 11). Let us, herein, understand the notion of patimokkha. Uposatha is the term used to describe the day of full fasting as observed on the days of new moon, waxing moon, full moon and waning half-moon. In these days, everyone gathers in a meeting hall and recites the patimokkha. In this special meeting, a senior monk solemnizes the ceremony and all monks confess their sins. The process of this ceremony is as follows - the senior monk asks the other monks to accept or declare the offence which they have committed or keep silence (Sebastian, 2004). Basically, this ritual gives an opportunity to accept and rectify mistakes. It is called patimokkha because it is the virtue of training in precepts: for it frees the monk or nun who protects it, guards it and sets him/her free from the pains of the states of loss etc. (Nanamoli, 1956, p. 19). My main intention in elucidating upon the concept of patimokkha is to show that Buddhism emphasized purity – purity of thought, purity of action and Upasatha ceremony is all about purity. It is significant to note that Buddhism believes in correction and transformation and Upasatha ceremony is one of the strongest examples of this aspect. Buddhism proposes that a person possesses great deal of freedom and he/she can act accordingly. Notwithstanding, if he/she commits any mistake then, he/she should confess it and try to reform himself/herself.

The last virtue is known as virtue as non-transgression. This virtue suggests that one should practice non-transgression, through the medium of body or speech, of the precepts of virtue that have been undertaken for purification. However, one may ask about the benefit or utility of practicing virtue. Buddha, according to the Visuddhimagga text, responded that virtue leads to non-remorse and this leads to the complete extinction (Nanamoli, 1956, p. 12).

For Buddhaghosa, discipline is the first step towards Nirvana and, therefore, one has to follow this path strictly (Nanamoli, 1956, p. 16).

Discipline- Restraint- Non-remorse- Gladdening- Happiness- Tranquility- Bliss- Concentration- Correct Knowledge- Dispassion- Fading Away of Greed- Deliverance- Knowledge and Vision of Deliverance- Complete extinction

Buddhaghosa has argued that everyone in this world is equal and true path of a saint necessitates looking upon everyone equally. He mentions the story of an old monk in his book. Once upon a time, an elderly man was on his way, from one place to the other, begging for alms. At the same time, a woman who had a fight with her husband was going to see her relative, on the same path. She saw the monk and laughed loudly. After some time, her husband approached this elderly monk asking about his wife's

whereabouts. The monk said that he had no idea whether it was a man or a woman, but that he had seen a couple of bones going towards the other side (Nanamoli, 1956, p. 23-24). This story helps us understand that, according to early Buddhism, everyone is equal and diversity is found only at the apparent level. Reality is different at the apparent and ultimate level. Therefore, everyone should follow the path of a saint. Buddhaghosa's ethical teaching has significant implications for the concept of sustainable development. In the next section of this paper, I will argue the same point.

Buddhaghosa's Argument and Natural Resources

In this section, I will argue as to how Buddhaghosa's notion of virtue supports sustainable development. Buddhaghosa's idea of the first virtue exhibits that volition or intention is important for the observation of the five precepts. As we have discussed above, Buddhists have used the word *intention* for *volition*. Western philosopher, Gilbert Ryle, had a similar kind of conception of *agent* and *action*. According to Ryle, if one acts intentionally then his action is voluntary (Ryle, 1963, p. 68). In order to explain this further, let us take an instance of a boy who arrives late at school. After the investigation of his school teacher, it turns out that the boy left home at the usual time, did not get delayed on his way to the bus stop and caught the usual bus. However, the bus broke down and could not complete the journey. The boy tried his best to reach the school on time. There was nothing else that he could have done for remedying the effect of the breakdown of his vehicle. Even though he ran as fast as he could, he could not reach the school on time. In this example, the boy's late appearance was not the result of his failure to do what he was capable of. In fact, he was prevented by the situation which was not under his control. Ryle writes that when a person does something voluntarily and tries to finish it, then his action certainly reflects some quality of the mind (Ryle, 1963, p. 72). Ryle points out that the distinction between voluntary and involuntary applies to both the mental and physical. For instance, if something just reminds me of my sister, then I think of her involuntarily. Alternatively, I can start to think about her deliberately. In the latter case, a volition has occurred because it is a voluntary mental event. My main intention in discussing Ryle's notion of mind is to put forth that volition does not refer to a passing or weak desire to perform an action. Volition refers to a strong desire or intention to perform an action. As Ryle has illustrated, one has to act out his desired action as far as possible and that is called strong intention. Therefore, when Buddhaghosa refers to the first virtue as volition, it refers to a strong desire or intention to follow the five precepts.

Let us understand as to how these precepts are significant for sustainable development. Among the five, the first precept is very significant for the purposes of our paper. It asks one to abstain from killing. It argues that a person, who wants to achieve the ultimate truth, has to abstain himself from killing any sentient being. Early Buddhist philosophy has a very different attitude towards the notion of sentient beings. Many Buddhist scholars have argued that sentient being refers to living beings only. Visuddhimagga has also said that the first precept is all about restrain from killing living beings. However, there is an argument that, in many Buddhist traditions, grass and trees are also looked upon as sentient being (Prakash, 2018, p. 219). In this paper, I will not elaborate upon the limitation of the notion of sentient being in Buddhist philosophy. Also, when I use the term sentient being, I will refer to living beings only and not grass and trees. This is so because I want to demonstrate that, even if we exclude grass and trees from the category of sentient beings, we can argue for the preservation of natural resources, if we follow the path of a saint or make efforts for the cessation of our own suffering. According to early Buddhism, intention is significant for any action. For instance, one can kill an ant without intention. Thus, if an ant died because X unknowingly stepped upon the creature, then this action will not lead to any bad fruits. Therefore, for Buddha, in order to illustrate the act of killing, one needs to show the intention to kill and the consequent death of a living being (Adam, 2006, p. 228). Adam writes that Buddhists adopted the pragmatic approach when it came to action. Notwithstanding, Buddha has maintained that one should avoid killing or harming any living being to the greatest degree possible (Adam, 2006, p. 228). Now let us understand the act of killing. There are two ways in which one can kill a living being. Firstly, by means of physical attack or weapons and, secondly, by finishing all the resources of particular living beings. For instance, if someone endeavors to finish or overuse the natural resources, he is working towards finishing the lives of many other living animals and creatures, who are dependent on these resources. For instance, deforestation can cost many wild animals, millions of insects and other living beings their lives. According to the Buddhist notion of non-violence, if an individual is using the natural resources for one's own survival, then his act is non-violent. However, if one is exploiting the natural resource with the knowledge that his act would take the lives of many other creatures, then his act is violent. All of us are aware of the fact that, slowly, we are exhausting our natural resources. Also, if we fail to preserve our natural resources then, not only will we kill many living creatures but also we will not have anything left for the future generations. Therefore, if a person intends to follow the first precept, he needs to circumvent both types of killings and renounce deforestation, which will result in saving the

natural resources. Nelson writes that Buddha abjured moral indifference to the fate of other creatures (Nelson 2006, p. 2009).

The second virtue, *virtue as consciousness concomitant*, argues for the preservation of natural resources for the benefit of both other creatures and future generations. As discussed earlier, consciousness concomitant or mental states play a significant role in action. Appearance of mental states is always dependent on the desire and inclination of the person. According to Buddhism, purposive activity is behavior with a mental cause. For instance, suppose I have (form) the intention to strike someone. It means that my mind is in a certain state and my action is merely the effect of this *mental state*. Early Buddhism contends that mental state causes not only a particular kind of behaviour but also other mental states. Guenther writes that, according to early Buddhism, one performs an action mainly due to passionate desire. *Action* and emotion or mental state play a crucial role in human suffering. The selection of an object is completely dependent upon individual temperament (Nanamoli, 1956, p. 453). Guenther writes that action and the emotion are the main reasons for our existence in this world and emotions also influence one's future existence (Guenther, 1991, p. 9). Here, it is clear that mental states play a significant role in action. Therefore, if one possesses ethically wrong desires, he will indulge in immoral acts. Here, by referring to the Buddhist notion of consciousness concomitant, I wish to demonstrate the essential relationship between mental state and action. According to the second virtue, if an individual puts a lot of effort in the practice of the first virtue, then (eventually) the individual can control his mental states, which arise with his mind. In this manner, the individual can, to a great degree, avoid killing or harming others.

The third virtue is virtue as restraint. This virtue is basically prescribed for monks and nuns, but it holds significance for common man or family persons also. In this regard, Buddhaghosa has given importance to both accepting the mistake and rectifying it or vowing not to repeat the same. Buddhist philosophy believes in rectification of errors. Therefore, even if a person has committed a crime or mistake, he is asked to acknowledge it and vow not to repeat it. The application of this virtue, against the backdrop of this paper, lies in firstly realizing that we have been exploiting the natural resources and are in a dangerous situation. Secondly, we need to analyse the situation and correct our error immediately. We should work towards sustainable development and stop exploitation of natural resources.

The last virtue advocates that one should demonstrate a strong determination towards the above mentioned five precepts. Buddhaghosa has argued that one should abstain from misconduct of both action and speech. This virtue shows that our determination regarding the five precepts should be robust. The

path of the saint, or an individual who desires to work towards the complete cessation of suffering from his life, lies in the above suggested direction of virtues. In this paper, my main contention is that, if one follows the path of the saint he can contribute towards sustainable development. Therefore, as early Buddhist argues, the removal of suffering is significant or the only goal of our life. What we see as real, is not real in the ultimate sense. Correspondingly, we also have to make efforts for the preservation of natural resources, for the present and future generations, and this step can be taken together with working for the removal of our own suffering.

Conclusion

In this paper, I have argued that Buddhaghosa argument for the notion of virtue is very much significant for the notion of sustainable development. However, I would like to admit that there is no direct reference to natural resources in the Buddhaghosa's text Visuddhimagga and the path of the saint is recommended for an individual to break free from the cycle of birth and rebirth or suffering. Notwithstanding, I have argued that if one follows the path of a saint, which is endorsed and illustrated by Buddhaghosa, he/she will end up protecting our natural resources and offering significant contribution towards sustainable development.

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The Philosophy of Perceiving the Human Environment from the Perspective of Environmental Social Psychology and Environmental Sociology (Implications for Sustainable Environmental and Health Security)

Filozofia postrzegania środowiska człowieka z perspektywy społecznej psychologii i socjologii środowiskowej (implikacje dla zrównoważonego bezpieczeństwa środowiskowego i zdrowotnego)

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Abstract

Environmental issues constitute more and more eagerly undertaken scientific issues. It is probably due to the contemporary situation, in which the threats to the environment inhabited by people are increasing. Importantly, the problems of this type are not only examined within the framework of environmental or ecological sciences but also the social sciences and humanities. There is nothing strange about it; after all, the society in which a person lives is a crucial element of the human environment. Every person's life takes place in a particular environment, the state of which affects people, their psychophysical health and well-being, the fulfillment of life necessities, behavior, and functioning in society. Such issues are discussed within the framework of environmental social psychology and environmental sociology. This article is devoted precisely to these disciplines. The publication briefly presents the essence of these environmental social sciences (starting from the characteristics of environmental social psychology, and then moving to environmental sociology). However, their essence was shown from the perspective of a specific, concise philosophy (vision) of perceiving the human environment that can be found in these social sciences. The human environment can be understood in various ways, not necessarily coinciding with what is considered the environment in natural sciences. This vision of perception of the human environment in the publication is a useful criterion for the interpretation and division of these disciplines into two basic variants – traditional (typical humanistic and social, currently applicable) and postulated model (socio-natural). It is also able to guarantee sustainable environmental (ecological and health) security.

Key words: environmental social psychology, environmental psychology, environmental sociology, philosophy of environment, human environment, environmental (ecological) security, health security

Streszczenie

Zagadnienia środowiskowe to coraz chętniej podejmowana obecnie problematyka naukowa. Wynika to zapewne ze współczesnej sytuacji, w których zagrożenia dla zamieszkiwanego przez ludzi środowiska są coraz większe. I co ważne tego typu problemy badane są nie tylko w ramach nauk środowiskowych czy ekologicznych, ale również w obrębie nauk społecznych i humanistycznych. I nie ma w tym nic dziwnego, przecież społeczeństwo, w którym żyje człowiek, to ważny element ludzkiego środowiska. Życie każdego człowieka przebiega bowiem w pewnym środowisku, którego stan oddziałuje w odpowiedni sposób na ludzi, ich zdrowie psychofizyczne i samopoczucie,

realizację potrzeb życiowych, czy zachowanie i funkcjonowanie w społeczeństwie. Tego typu zagadnienia podejmowane są w ramach społecznej psychologii środowiskowej i socjologii środowiskowej. Właśnie tym dyscyplinom poświęcono niniejszy artykuł. W publikacji przybliżono zwięźle istotę tych środowiskowych nauk społecznych (poczynając od charakterystyki społecznej psychologii środowiskowej, a następnie przechodząc do socjologii środowiskowej). Natomiast ich istotę ukazano z perspektywy pewnej zwięzłej filozofii (wizji) postrzegania ludzkiego środowiska, jaką można odnaleźć w tych naukach społecznych. Środowisko człowieka bowiem może być różnie rozumiane, niekoniecznie zbieżne z tym co za środowisko uznaje się w naukach przyrodniczych. Owa wizja postrzegania środowiska człowieka stanowi w publikacji użyteczne kryterium interpretacji i podziału tych dyscyplin na dwie podstawowe odmiany – tradycyjną (typowo humanistyczno-społeczną, obecnie obowiązującą) oraz na model postulowany (społeczno-przyrodniczy). Jest on w stanie zagwarantować również zrównoważone bezpieczeństwo środowiskowe (ekologiczne i zdrowotne).

Słowa kluczowe: społeczna psychologia środowiskowa, psychologia środowiskowa, socjologia środowiskowa, filozofia środowiska, środowisko człowieka, bezpieczeństwo środowiskowe (ekologiczne), bezpieczeństwo zdrowotne

Introduction

Environmental issues are currently one of the main problems of the modern world. Issues related to the functioning and proper shaping and use of the environment, previously reserved for sciences in the field of environmental protection and ecology, penetrate social sciences and humanities. And so they should. Nothing stands in the way for socio-humanistic issues to also penetrate back into ecological and environmental sciences, appreciating the importance of psychosocial conditions that shape the human environment. This approach will be applicable in this article, in which the human environment will be treated and interpreted much more broadly. Not only as a natural environment (as naturalists often do), or a narrowly understood social or socio-cultural environment (as perceived by the representatives of environmental social psychology¹ and environmental sociology) but also as a systemically related, holistic socio-natural environment.

At the same time, the article recognizes that the human environment, in addition to its socio-cultural component (i.e., artificial, built on nature transformed by people), also includes a closely related natural environment (being a product of nature), creating a total natural environment of human life. Therefore, environmental and natural issues may be of interest to social sciences and humanities, and especially environmental social psychology and environmental sociology, on which this article is focused.

The publication also refers to some extent to the philosophy of the environment, although in a broad sense, showing only a particular philosophy (vision) of a balanced perception of the human environment. Therefore, it is an approach that tries not to create unnecessary threats in the human environment, consisting in maintaining a state of relative and dynamic

balance between the natural environment and the human socio-cultural environment. This balance should be considered as a desirable state of environmental (ecological) and health security, positively shaping people's living environment and optimally affecting their psychophysical well-being, naturally, while maintaining a good state of nature (and thus in the spirit of sustainable development).

1. The concept of the environment

There is no doubt that human life, all life processes, and activities, individual (biological) as well as socio-cultural development and activity, always take place within some environment (Bańka, 2002: 19). The concept of the environment, which was introduced into the scientific language through ecology, and thus identified with the natural environment, is now also used in a context other than typically biological one and also functions in social sciences, humanities, and other sciences, as well as in everyday language (e.g., social or cultural environment, work environment, etc.). In general terms, *environment* can be defined as the totality of (closely interrelated) elements, phenomena, processes and material (animate and inanimate) and immaterial (e.g., social or cultural relations) factors, both natural and anthropogenic, occurring in a specific space, creating the combined environment and living conditions of individual organisms (e.g., Mazurski, 2009: 260; Olaczek, 1999: 249). Such a definition can be clarified by replacing the word *individual* with the word *human*, and then we have a definition of the human environment, which in the case of people is a socio-natural environment.

In the case of the natural environment – in the definition presented above – it includes living (biotic) and non-living (abiotic) components of nature. The former creates a biological environment (composed

¹ This environmental branch of social psychology is sometimes also called *social environmental psychology* (Bańka, 2002 – as translated and cited in: Bielak, 2012, p. 7, 16). Although this expression seems to be more linguistically accurate, this article replaces it with the term more often

used in international mainstream (and scientific literature): *environmental social psychology* (e.g., Canter, 1988; Sabourin and Lamarche, 2009). Both terms can be used interchangeably.



Figure 1. Human environment in terms of environmental (social) psychology, source: author's own study

of organic matter, organisms, living), and the latter physical one (composed of elements of inanimate matter; physicochemical; dead, a habitat for living organisms). However, in the case of the human environment, these are not only natural, material, and spatial elements, but also people in different relations with each other and with the things that surround them (socio-cultural environment) (Bańka, 2002: 19).

Therefore, we are dealing here with a socio-natural (or more specifically socio-cultural-natural) environment of the broadest and complex dimensions, because it integrates with itself various types of environments, consisting not only of natural but primarily of social and cultural components constituting the material and immaterial effects of human activity. These include, for example, people and their behavior, social institutions and groups, cultural elements (e.g., norms, values, beliefs, ideas) as well as objects constituting the product of human activity (e.g., Olechnicki and Załęcki, 2002: 214). The latter is located in the appropriate physical (material), designed, transformed space built up by people, adapted to their needs (physical and spatial environment, physical and spatial surroundings; physical and spatial environment).

2. Problems of the human environment in terms of environmental social psychology and environmental sociology. From traditional socio-humanistic to socio-natural interpretation

Nowadays, natural environment issues are increasingly exposed in social sciences. On the one hand, this results from the ecological crisis of the modern world and attempts to repair such an unfavorable state of affairs. On the other hand, from an absolute fact that human life, both in its individual and social dimensions, always takes place within some environment. When it is shaped in a certain way, it can positively or negatively affect a person. It especially concerns human well-being, psychophysical health, the fulfillment of life needs and activities, supporting the development or degradation of human behavior – as pointed out by environmental psychologists (Bańka, 2002: 25) – and the proper functioning of a human being in society (which is the domain of environmental sociology).

Here, it is worth to briefly introduce the essence of these two environmental disciplines in the field of social sciences (starting from environmental social psychology, and then moving to environmental sociology, because the boundaries between them are quite fluid). However, their essence will be shown from the perspective of a concise vision (philosophy) of perceiving the human environment present in these social sciences. This approach to the human environment will be a useful criterion for the interpretation and division of these disciplines into two primary varieties – traditional (typically humanistic and social and, in principle, currently applicable) and the postulated (socio-natural) model – of a systemic or holistic nature, having a significantly broader humanist-ecological dimension of a biosocial character.

Given this criterion, environmental psychology can be interpreted in a narrower or broader perspective. It is perceived in different ways (e.g., Stokols and Altman, 1987; Bell, Greene, Fisher and Baum, 2001; Bańka, 2002; Steg, van den Berg and de Groot, 2012; Gifford, 2014). In general, it is defined in this first aspect as a psychological discipline examining the relationships between a human being and the physical (physical-spatial) and social environment (Bańka, 2002: 25). This type of understanding of this branch of psychology is dominant so that it can be considered as a binding model of perception of environmental psychology. According to this approach, the human environment is perceived as a physical-spatial (material-spatial) environment built (or transformed) by people, constituting the basis for a social environment, conditioned psychosocially. The physical environment is a habitat for society, but it is also an active element, affecting the human psyche and society. The human environment is simply a physical and spatial environment plus a social environment (see Fig. 1). However, there are interactions between these two components of the human environment (physical and social), because they are not passive but active. Consequently, they both shape the human psyche.

Currently, in the context of environmental psychology understood in this way, various – already recognized – psychological and ecological concepts (usually by James J. Gibson or Roger G. Barker) are used. Furthermore, although they differ fundamen-

tally, they do not have to be mutually exclusive (Bańka, 2002: 81-83). Their common feature is that they emphasize *natural* and *naturalistic* (that is, *real*) studies of human behavior in the *natural* environment in which people live, in contrast to the *artificial* environment (e.g., laboratory or abstract space). The *natural environment* understood in these concepts is not, however, the equivalent of a *natural environment* (animate and inanimate), as is the case directly in natural ecology or biology, or material-spatial or physico-chemical elements of the environment studied by physicists or chemists (Lubiszewski, 2012: 268). Depending on the concept, it can mean any real environment in which a particular person lives (e.g., the large-city environment of a resident of the capital – e.g. Gibson, 1972, 1977, 1979), or – in terms of methodology (e.g., Gifford, 2016) – an environment free of the researcher's influence (e.g. Barker, 1968, 1978, 1987). In psychological and ecological concepts, it is generally assumed that the true human psyche and behavior are an inseparable part of the environment (it becomes present in interactions with the environment), and to understand them we need to know the environment of human life in which a person is embedded (Bańka, 2002: 81-83) – see footnote 2.

However, there are no obstacles to understanding and interpreting environmental psychology much broader than before. What is more, one can add the natural environment, in addition to the physical (physical-spatial) and social environment, to its research subject. Environmental psychology understood in this way could then be defined as a psychological discipline examining relationships and connections between a human being and the physical (physical and spatial), natural and social environment of his/her life (own definition). According to this approach, environmental psychology, in addition to the social environment mentioned above, would include the combined effects of the bio-physical environment (natural and physical-spatial) on humans – including their behavior and psyche.

Psychology perceived in this way; some authors may consider ecological psychology² understood in the biosocial sense (for it includes natural influences on

the physical and social environment of a human being) and distinguish it from environmental psychology (not including issues regarding the impact of nature on a human being). Accordingly, ecological psychology, as opposed to an environmental one, would cover the issues of the natural human environment, while the latter version of psychology – only the physical (physical-spatial) and social environment. Such a distinction is, however, quite artificial and debatable because currently in the scientific literature in the field of humanities and social sciences there is a tendency to replace the adjective *ecological* with the term *environmental* or to use them interchangeably (even in the names of individual sub-disciplines), e.g., ecological ethics – environmental ethics, ecological philosophy – environmental philosophy. The environment can have various dimensions, including both natural and non-natural aspects (physical, social, cultural, etc.). The concept of the environment in social sciences has, moreover, been adapted from natural sciences (biological, ecological), and the natural environment of human life includes both natural elements (creations of nature) and artificial elements that are products of human activity. Therefore, one can use the concept of environmental psychology in a broader sense and also mean natural (biological) areas of the human environment, next to those of a physical (physical-spatial) and social nature³.

The above-mentioned environmental psychology (especially according to a narrow non-natural approach) is often combined with the tradition of social psychology (a discipline found where psychology and sociology meet, which investigates mental processes and the behavior of people in social situations, Koger and Winter, 2010: 95-130). Hence the term *environmental social psychology* (Bańka, 2002; see footnote 1). The subject of interest in the environmental branch of social psychology is focused on the physical and spatial factors of the environment, socio-cultural factors, as well as mutual interactions and relationships between them. Studies of environmental social psychology understood in this way cover three areas. The first relates to the impact on the human psyche and behavior of physical and spatial representations of the environment (such as

²One may encounter the name *ecological psychology* as opposed to *environmental psychology* (but often for a reason other than the one indicated above). This type of approach does not have to be wrong, and is acceptable, but only if one first define or strictly explain the understanding of the first expression, which may be used by various psychological schools. Otherwise, it can lead to misunderstanding. The concept of ecological psychology – as a proper name – includes at least two psychological orientations. This name is always referred to as the ecological theory of perception of James J. Gibson, and usually also the ecobehavioural concept of Roger G. Barker (although the name of environmental psychology in the case of the latter scientist is also used in psychological terminology). As already noted, the adjective *ecological* used in their

names (and theories) largely coincides with the adjective *environmental* (in practice identifying the semantic meanings of these terms in a sense characteristic of traditional environmental psychology). The understanding of the human environment within the fields of ecological psychology is also no different from that developed within (narrowly understood) environmental psychology. For this reason, varieties of ecological psychology can be treated as trends in contemporary environmental psychology.

³However, this does not change the fact that in the *strictly* scientific sense, the use of the name of ecological psychology would be fully justified if these connections between people and their physical and socio-natural environment were studied using the knowledge of modern ecology (biology).

sound, shape or space), taking into account the short-term adaptive effects of such impacts on the life of the individual and entire human groups or larger communities. The second research area focuses on the factors of the physical and social environment influencing self-esteem, well-being or sense of development, identity, control over the environment, and freedom of action. The third area covers the issues of practical applications of psychological knowledge regarding human functioning in the environment (and its individual dimensions), especially in the aspect of health protection, work, education, development, recreation, politics, etc. (Bańka, 2002: 26). Some psychologists within this area (or these areas) may also take up some issues in the field of the natural environment and its protection, e.g., in the context of the impact on a human being of contamination, pollution, devastation, disasters or other adverse factors. However, they are most often interested in the designed environment, constituting a socio-cultural product of a human being (Bańka, 2002: 19). It happens because a human being does not appear directly in the natural environment (unaltered, primary).

However, there is nothing to prevent one from adding and to these factors and emphasizing the natural factors of the environment that affect people, both in individual (on their psyche, personality, psychophysical health, also shaping behavior and attitudes towards the environment and ecological awareness, etc.) as well as collective dimension, through the groups or communities people co-create in the areas mentioned above. A human being is organically related to nature, and in this way, one supplements and links environmental social psychology with its socio-natural version (or natural and social version). Such an interdisciplinary supplement is also possible since in social psychology, within its theoretical approaches, the evolutionary trend is used (although it is less popular), and it takes into account biological and cultural conditions (in explaining social behavior of people like the effect of biological and cultural evolution).

Nowadays, there are various varieties of environmental psychology, understood and called in many ways (e.g., ecopsychology), which is only at the stage of shaping. These varieties study the impact of nature on the development of the human personality, psyche, and emotional sphere. They also emphasize human interdependence with nature and strive to rebuild ties with it and maintain positive relationships (Ciszek, 2013: 32; Winter, 1996). These are necessary for people to be able to feel happiness, develop properly, and shape their psychophysical health. Separation of a modern human being as well as, in a broader dimension, detachment of the social environment from nature leads to many fears, addictions, and other mental problems. In the social dimension, it can translate into disruptions to the functioning of entire communities. Such considerations and re-

search could be included in the broadly understood, interdisciplinary environmental social psychology. Currently, there is a noticeable trend of approaching environmental social psychology to environmental sociology. It results, for example, from the fact that nowadays, the boundaries between social psychology and sociology are becoming more fluid. Traditionally – referring to the classic psychological literature – it is pointed out that the fundamental difference between social psychology and sociology lies in the fact that psychology examines an individual in a group. In contrast, sociology focuses on the group as a whole (Allport, 1924: 10). It can be said that social psychology examines a human being in society, while sociology – a society in a human being (social aspects or elements present in the individual – a social being). At present, however, in practice, such relationships and conditions often overlap and interact with each other. These peculiarities are also evident in the aspect of already described environmental social psychology and environmental sociology, which is worth discussing below.

Environmental sociology, unlike traditional environmental social psychology, directly covers issues related to the natural environment of people, examining socio-environmental interactions in sociology, using its theoretical positions and methods. This branch of sociology is generally defined as a sociological discipline that studies the interactions between the environment and society (Catton and Dunlap, 1978: 44; Bowden, 2017: 2). The social environment could also include its material physical and spatial environment created by people. Then one could say that environmental sociology is a sociological discipline examining relations, dependencies, and relationships between the individual and the social, physical, and spatial, and natural environment of his/her life (own definition). As part of these interactions, the impact of the natural environment on society is recognized. Although the main subject of its interest is the general relationship between society and the environment, environmental sociologists particularly emphasize the study of social factors creating environmental problems and their social effects and efforts to solve them.

Also, in this type of detailed sociology, much attention is paid to the environmental conditions of specific social processes that can cause social problems (e.g., Matczak, 2000, 2001; Czartoszewski, 2003). These relations between society and the environment can also be undertaken within specific institutions and structures or subsystems, such as law, culture, economy, politics, as well as group behavior (society's attitudes towards the environment, the state of ecological awareness, consumption, etc.), showing their relationships with environmental conditions and possible consequences related to it (e.g., environmental consequences of waste disposal and recycling or the impact of environmental conditions on people's lives in their place of residence, work, life-

style, or public health, etc.) (e.g., Redclift and Benton, 1994; Schnaiberg and Gould, 1994; Martell, 1994; Irwin, 2001; Redclift and Woodgate, 2010; Gross and Heinrichs, 2010; Hannigan, 2014; King and McCarthy Auriffeille, 2014; Gould and Lewis, 2015; Burns and Caniglia, 2015; Bell and Ashwood, 2016; Carolan, 2017; Cole, 2017).

These numerous socio-environmental relations are usually studied by researchers and theoreticians of this discipline in the following currently popular thematic areas (Cole, 2017):

- Climate change – the human, political, and economic causes of these changes and their impact on people, and especially on specific aspects of social life, such as behavior, culture, lifestyle, public communication and transport, the health of human populations, and other effects of such interactions.
- Economy and the environment – it is particularly relevant here to study the relationship between the economic model of a given society (state) and the environment (and climate change referred to above), especially in the context of the acquisition and recovery of natural resources in production processes and methods (e.g., between a capitalist economy based on continuous growth or a sustainable model that results in an appropriate state of the environment);
- Energy and the environment – this type of relationship results from the previously mentioned areas; the relationship between fossil fuel combustion in the energy industry as a significant factor in global warming and climate change is evident here. One could notice the impact of the economic model on these adverse changes (e.g., coal-based economy). Not without significance is the ecological awareness of specific populations and their ideas affecting the appropriate behavior and attitudes of people towards energy consumption, as well as the impact of energy policies that shape behavior and the state of the environment.
- Politics, law, and public policy, in the context of relations with environmental conditions and problems – institutions and structures shaping corporate and individual behavior having an indirect impact on the state of the environment are taken into account. Within this area, sociologists are also trying to determine by what mechanisms laws regulating emissions and pollution are enforced, their scope of influence, and how people work together to shape them. Also examined here are forms of power that may favor or hinder society in this field.
- Social behavior and the environment – the relationship between various social behaviors that shape the state of the environment is examined, as well as how environmental conditions shape social behavior. The following issues are cur-

rently particularly popular in sociological research:

- consumption – in this area there is a significant convergence between environmental sociology and the sociology of consumption, since consumer behavior, and especially consumerism, may cause various types of problems for the environment; proper shaping of consumer attitudes can also contribute to beneficial solutions that improve environmental conditions;
- transport, household energy consumption, waste management, and recycling are issues that also translate into an appropriate state of the environment.
- Inequality and the environment – sociologists pay attention to the manifestations of various types of social inequalities and their relationship with environmental issues. Their research shows that income, racial, and gender inequalities (especially environmental racism) mean that specific populations that experience them more often are more likely to experience the adverse effects of a degraded environment, such as pollution, proximity to waste, and lack of access to natural resources. Reactions of specific populations and institutions are also examined here, as well as in the global perspective of entire populations within individual nations, to their different relations with the environment, in case they are somewhat privileged and well-off.

In addition to the above (Cole, 2017), one can also add (or separate and clarify) other areas, e.g.:

- Activity for the environment and environmental awareness – social activity within (or for the benefit of) environmentally friendly non-governmental organizations, associations, etc., or in informal arrangements that aim to protect the environment and shape positive attitudes towards nature and its elements, and to promote knowledge about the environment; as well as research into people's ecological awareness.
- Social institutions and the environment – a section covering the institutional dimension of environmental protection, concerning the activity and functioning of social institutions responsible for the state of the environment and its security.

From the analysis of the areas (sections) presented above, it can be concluded that environmental sociology exceeds traditional environmental psychology (its narrower interpretation), approaching its postulated extended version. Previously practiced environmental psychology could also be interested in the natural environment, in the context of some unfavorable factors for human health and life, stemming from the destroyed nature, although it mainly focused on the physical (physical and spatial) environ-

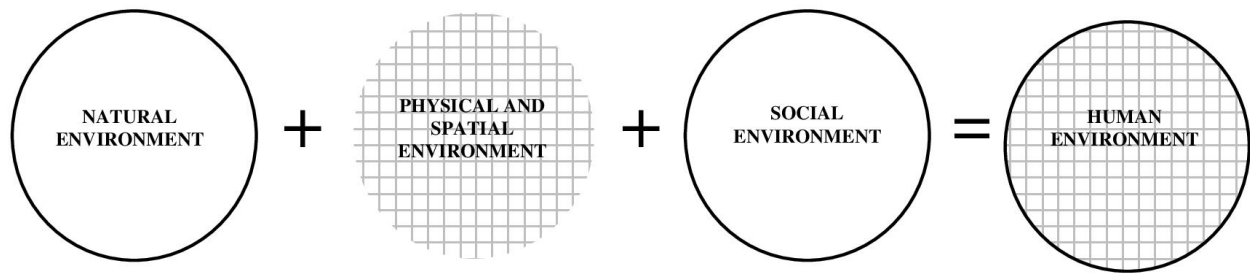


Figure 2a. The human environment in terms of traditional environmental sociology, source: author's own study



Figure 2b. The human environment in terms of traditional environmental sociology

ment. In the case of environmental sociology, we are dealing here directly with the study of the impact of the natural environment on the human environment and all kinds of problems and related issues, studied within the mentioned areas. As part of this branch of sociology, the environment is recognized here as a social or socio-cultural environment, including the physical and spatial environment of a human being and the natural environment. It can, therefore, be concluded that the concept of the environment – from the perspective of environmental sociology – is a social environment plus a physical environment plus a natural environment, which is the background of the occurrence of relevant social problems. This type of philosophy (vision) of perceiving the human environment could be graphically presented in the following two ways (see Figures 2a and 2b).

However, given the perception of the relationship between society and the natural environment, environmental sociology can also be interpreted in two ways: narrower and broader. In the narrower approach, which is currently dominant, the natural environment is perceived as an element affecting social life, including every human being (so it is, to a certain extent, an active element). The natural environment is, however, recognized as something detached from the social environment, and it does not allow capturing the full dynamics of that environment and – most importantly – it distorts the image of perception of the overall human environment and the vital role of nature in it. Hence the ideas to build a new

and more complete systemic model of environmental sociology (interpreted more widely than today) (e.g., Bowden, 2017: 5) or another broader perspective created from the borderline between social and environmental sciences, highlighting the interrelated psychosocial and natural conditions of the human environment (e.g., Ciszek, 2009: 95-99; Ciszek, 2013).

In such a vision, the socio-cultural environment is perceived as built-up over the natural environment, and somehow embedded in it (see Figures 3a and 3b)⁴. Nature is not only a habitat, but an active foundation on which the biological functioning of the social world is based, and more. This approach is legitimate because, in order for life to exist at all, life-giving nature had to be created first, which still maintains human life, gives people a place to live; people also derive food, energy and all animated and inanimate vital elements from it, indispensable to individual and social existence and further development. Nature is here an active element (and not just a static space occupied and transformed by human populations), and what should be emphasized, also affecting various non-biological aspects of the social world, as well as specific cultural processes. For example, the specificity of the natural environment affects the development of various forms of material and non-material culture of people (e.g., the creation and development of sailing culture in coastal countries) (Ciszek, 2009: 95-99; Ciszek, 2013: 176-182, 194). Therefore, people live in a socio-natural envi-

⁴ This type of thought can be illustrated in variants of Figures 3a and 3b, in which blue (symbolizing nature) and yellow (symbolizing society) are combined (mixed) and give green, which figuratively shows the overall human environment. In contrast, in traditional environmental sociology (or in environmental social psychology), the

natural biophysical environment was not treated as an integral part of the human environment, but as a relatively active habitat for social phenomena occurring within it, i.e., as two overlapping, but separated two-colored planes (Bowden, 2017: 5).

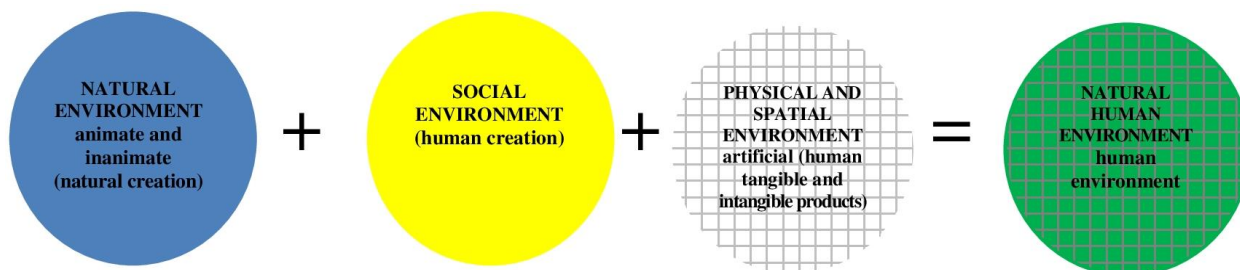


Figure 3a. The human socio-natural environment in terms of the postulated model of environmental sociology and psychology (psychosocial foundations of environmental security), source: author's own study



Figure 3b. The human socio-natural environment in terms of the postulated model of environmental sociology and psychology (psychosocial foundations of environmental security, source: author's won study

ronment, and not only in a social environment (e.g., Dołęga, 2003: 7-10; Bubolz and Sontag, 1993: 419-448). Consequently, one should speak about a holistically and systemically understood socio-cultural-natural environment, and not just a narrowly defined social environment that affects the human social world and the life of each of us (Ciszek, 2013).

To sum up, environmental sociology studies interactions with the biophysical environment (animate and inanimate), but it does so in a rather separable way, unlike environmental psychology. Environmental psychologists have rightly pointed out that people should be studied in their natural living environment within which they are embedded, but the problem is that they have focused on physical and spatial issues of the social environment (see Fig. 1). It is, therefore, necessary to combine the psychological and sociological approach (see Figures 2a and 2b) and study the natural human environment taking into account natural aspects that are inseparably fused with the social environment (see Figures 3a and 3b).

More and more often, there are demands for such supplementation of sociological knowledge with knowledge in the field of ecology, which would enable environmental sociology to be transformed into ecological sociology. It would use not only sociological theories but also those in the field of ecology. It could examine, e.g., the impact of changes and evolution in the natural environment on the development and evolution of human societies (as specific socio-ecological and adaptive systems), while using the achievements of ecology as a biological science (Bowden, 2017: 2-14; Bowden, 2018), linking them with the need to protect the environment. This type of approach could be complemented especially by the achievements of interdisciplinary (natural and

social) human ecology, which has been successfully developed for many years in Poland (e.g., Wolański, 2008).

Given such a broadly interpreted vision of environmental sociology, it can be said that the overall human environment consists of two broadly understood and systemically related environments: the natural environment (a product of nature) and the social environment embedded in it, surrounded by a physical and spatial environment (i.e., a socio-cultural product of a human being). At the same time, the natural environment is one essential component that is a product of nature. In contrast, the other social and physical environments make up the other component – artificial, being the result of socio-cultural human activity (in the material and non-material sphere), which could be considered in the ecological sense a non-biological way of a human being adapting to the surrounding environment. What is more, human activity in the field of culture affects not only the social but also the natural environment. Only this natural element plus the artificial (human or socio-cultural) element integrated with it constitute the **natural human environment** (see Figures 3a and 3b). For wild plants or animals, nature is their natural environment, while in the case of people – the natural environment is not only nature but also their artificial (socio-cultural) environment, which was created based on nature transformed by them and adapted to their needs (and total conditions). For a human being as an organism belongs to nature (being subject to natural laws). At the same time, as a social being and, above all, as a human person belongs to the social and cultural environment to which he/she is subject (social and cultural laws and rules), but at the same time is its autonomous creator (he/she is therefore

not only the object of this environment's influence but above all the subject⁵. Indeed, without nature, there would be no human, but without culture, there would be no human person. It can be concluded from such the philosophy of environment that in the case of people, both types of environments need to be protected. Then we will guarantee ourselves and world security, or, more specifically, environmental (ecological) security (Ciszek, 2013: 229-237). We touch upon here with the issue of environmental security, also called ecological security (and health security associated with it).

3. Socio-natural environment and sustainable human security (environmental and health security)

The vision of the human environment from the perspective of environmental sociology discussed here, as well as previously characterized environmental social psychology, very well fits into the currently important issue and problem, which is ensuring environmental (ecological) security.

This variation of security can be defined as *a permanent state free (of negative effects) of threats that violate the dynamic balance in the natural (socio-natural) environment, enabling (positive) ability to maintain it continuously, ensuring the existence, further development and a sense of such state*⁶ (own definition).

According to the definition of environmental (ecological) security and comments made before, the natural and artificial environment (human or socio-cultural) only taken together constitute the **natural environment of human life - the human person (human environment)**. As a result, it is necessary to ensure such conditions of development in the political and socio-economic sphere of human civilization that the two dynamic elements – natural (creation of nature) and artificial (human creation) – remain in relative dynamic balance (see Figure 3a and 3b). Such a desirable condition could be considered synonymous with **homeostasis**. On the other hand, disturbing this balance in favor of either of these two factors will always prove **detrimental (unfavorable) for human security**. Nevertheless, trends maintaining this balance will prove to be **positive (beneficial) for human security** in the long run (even when they entail some restrictions on development or generate significant financial outlays). This principle should form the basis for the development of the concept known as **sustainable development**, in which environmental security fits very well. For a human being needs for life and further development

a culturally transformed natural environment tailored to his/her needs, which entails the destruction of its resources. However, the destruction must be rationally justified and strictly controlled, because an excessively transformed and destroyed natural environment can lead to a barrier of civilization development and, in an extreme case, even annihilation of humanity. It is also worth preserving the wild deposits of natural heritage. The human social environment is not in a vacuum but is built up and embedded in (animate and inanimate) nature (Ciszek, 2013: 235). Therefore, any realistic concept of environmental security should have a sustainable dimension. In the concept of sustainable environmental security understood in this way, taking into account both natural and artificial elements of the human environment, in addition to *strictly* ecological (natural) conditions, there are also psychosocial ones. It is not surprising since the human life environment is a socio-natural environment (Ciszek, 2018). Achievements in the field of environmental social psychology and environmental sociology (next to natural sciences) may contribute to research on environmental security and the development of a more comprehensive and sustainable concept. These environmental social sciences show the role and impact of the physical and natural environment on the functioning of the human psyche and personality as well as the behavior of people and the social world they create. These can also contribute to shaping ecological awareness and pro-environmental attitudes, and it will have a positive impact on the state of the environment and an appropriate level of security, which in the case of people is conditioned by both complex and related natural and psychosocial factors.

It is worth mentioning that the concept of environmental security presented above also integrates issues of human health (health security). The ecological balance in the socio-natural environment in a proper way affects the health of the individual and the entire population (society). Therefore, environmental security is conducive to protecting and shaping human health (and can and even should be treated as its vested interest – Ciszek, 2017). It is difficult to effectively implement any vision of health security without first ensuring the appropriate quality of the environment surrounding a human being (environmental security is a necessary condition for health security). Therefore, health security is an effect of environmental security, oriented after all on maintaining existence and further development, which in the case of people, always concerns their life and health. It can even be stated that such (bro-

⁵People, through the help of culture, mastered nature, without which they cannot survive, but at the same time crossed the world of nature, opening themselves to a new horizon of being – a sphere of the human spirit that prevents them from returning to nature in pure form (*strictly* biological, impersonal). Therefore, people cannot be reduced to biological beings that are part of nature. Besides,

people at the current stage of their development are strictly dependent on the socio-cultural environment.

⁶On the other hand, *security* (general security) could be defined as *a permanent state free (of negative effects) of threats, enabling a beneficial ability to maintain it continuously, ensuring the existence, further development and a sense of such state* (own definition).

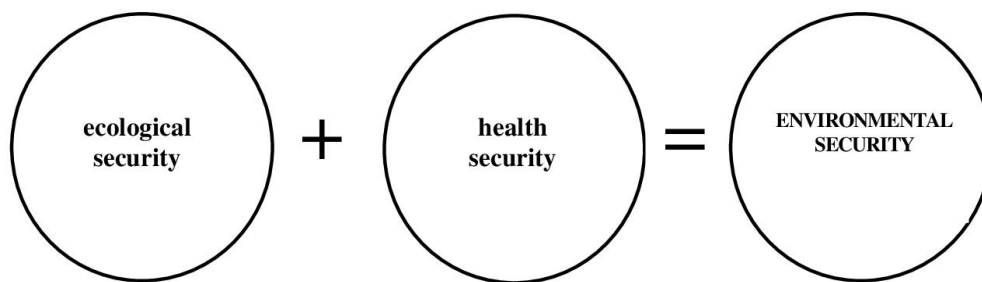


Figure 4. Components of broadly understood environmental security, source: author's own study

adly) perceived **environmental security** consists of (narrowly taken) **ecological security** (understood as protection and shaping of the natural environment) **and health security** (protection and shaping of human health) – see Fig. 4. Although many authors use the term environmental and ecological security interchangeably, this distinction is also possible and correct. After all, such broadly understood **environmental security** (as **ecological and health security**) very well fits into its definition previously formulated. It could be supplemented (by the expression in brackets) as *a permanent state free (of adverse effects) of threats that violate the dynamic balance in the natural (socio-natural) environment, enabling (positive) ability to maintain it continuously, ensuring the existence, further development (including health and life⁷) and a sense of such state* (own definition).

Conclusions

To sum up, this article shows that the human environment is not only a narrowly understood psychosocial, social or socio-cultural environment (as social psychologists or sociologists usually claimed) or a shallowly understood natural environment (as biologists perceived it), but a comprehensively understood socio-natural environment. Only such a broadly perceived environment in the case of people as both natural and social beings, or more precisely persons (psychophysical beings), is suitable for their natural living environment. Therefore, it should be recognized that any natural or psychosocial reductionisms hamper the proper and multidimensional understanding of the specificity of the human environment. It also applies to issues related to the development of sustainable environmental security, which we will never provide to people if we do not simultaneously take care of these two essential and inseparably integrated components of the human life environment. Namely, its natural plane (as a product of

nature) and the socio-cultural dimension (artificial product of human being), blended into nature transformed for human needs. When a balance is maintained between these components, then we will ensure a sustainable level of environmental security and an appropriate level of optimal development for currently living people and their next generations. This type of environmental (ecological and health) security concept also fits very well with the idea of sustainable development. Moreover, nothing prevents it from being undertaken as one of the branches of environmental sociology (or environmental social psychology) or as an area independent of it, although closely related to it.

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⁷It should be borne in mind that *existence* is a broader concept than *life* (which may be included in it). For existence concerns not only living beings (e.g., human or other organisms) but also inanimate beings (the existence of inorganic elements of nature necessary for its functioning). *Health* on the other hand, is closely related to the concepts

of life and development (often contained in them), because its lack or illness hinders life and optimal development of human being (organism), and can even lead to his/her death (non-being); and in the positive version – health is conducive to life support and development.

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Town-planning Organization of the Baku Industrial Region: 19th – 20th Centuries

Organizacja urbanistyczna regionu przemysłowego Baku: XIX – XX w.

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Abstract

The article considers the emergence in the modern town-planning practice of Azerbaijan complex planning systems require comprehends to historical experience, especially the end of the nineteenth beginning of the twentieth centuries.

The industrial revolution started in the middle of the 19th century in connection with the development of the oil industry accelerated the process of urbanization in Absheron also in Baku the centre of population concentration and various types of labour activity. The purpose of the study is to present Baku oil district at the turn of the 19th-20th centuries to reveal communications and interactions between social, demographic and other processes as a complex organism with all contradictions inherent in the epoch of rapid development of capitalism which has received the material expression in the form of the newly developed planning system.

Key words: industrial region, socio-economic factors, architectural appearance, locality, Baku, planning structure, transport, settlement system

Streszczenie

W artykule przedstawia się stanowisko, według którego pojawienie się nowoczesnej praktyki planowania urbanistycznego w złożonych systemach planowania Azerbejdżanu wymaga zrozumienia doświadczeń historycznych, zwłaszcza końca XIX i XX w.

Rewolucja przemysłowa rozpoczęła się w połowie XIX w. w związku z rozwojem przemysłu naftowego, przyspieszając proces urbanizacji w Absheron, a także w Baku, centrum koncentracji ludności i różnego rodzaju aktywności zawodowej. Celem badań jest przedstawienie dzielnicy naftowej Baku na przełomie XIX i XX w. w celu ujawnienia komunikacji i interakcji między procesami społecznymi, demograficznymi i innymi, traktowanych jako złożony organizm, charakteryzujący się występowaniem licznych sprzeczności, wynikające z epoki szybkiego rozwoju kapitalizmu, którego materialnym wyrazem jest nowo opracowanego systemu planowania.

Słowa kluczowe: region przemysłowy, czynniki społeczno-ekonomiczne, wygląd architektoniczny, Baku, struktura planowania, transport, system osiedleńczy

1. Introduction

Tasks for protecting the historic and cultural monuments of the Republic of Azerbaijan is the preservation of the historical and cultural heritage and associated with the development of industry, science and technology founded in the middle of the 19th and beginning of the 20th centuries. The period of formation of the industrial architecture of the Baku oil region covers the time interval, starting from the second half of the 19th century to 1920s. The heritage of this era is still poorly studied, whereas it has reflected the great scientific and technical ideas of modern times which are embodied in a brilliant art form.

The considered industrial region of the studied period entered limits of historically developed planning kernel of Baku and along with the urban development for many years defined its architectural appearance. In modern conditions of conversions of the central regions of the city, the identification of the historical role of the developed planning structure will help to make recommendations for improvement and preservation of integrity and expressiveness of the urban environment.

2. Methodology

The methodological approach applied in this article based on the theoretical researchers used in modern town-planning science. The main conclusions testify how specific historical, political, economic and social changes can influence on assessment of an urban situation on the example of the Baku oil region (Barles, 2015).

In this research, the source database was used, which was composed of both unpublished and published materials and documents extracted from the funds of the National Archive Department of Azerbaijan Republic, as well as data contained in the studies conducted in the 1920, the manuscripts of which are stored in the scientific archive of the Institute of History of the Azerbaijan National Academy of Sciences. An important historical source was the periodicals related to the considered period.

The article is the revised and supplemented version of one of the chapters of the author's dissertation for the degree of Doctor of Philosophy in architecture.

3. Socio-economic factors of influence on the spatial transformation of the industrial region

Emergence in the modern town-planning practice of Azerbaijan of various planning systems leads to the necessity of comprehending of historical experience, especially the end of the 19th the beginning of the 20th century.

The industrial revolution that began in the middle of the 19th century has accelerated the process of urbanization in Absheron as well as in Baku the population centre concentration and various types of labor activity. The rapid growth of the city brought a set of the problems which are going beyond traditional methods of the architecture of the feudal Muslim

city. Expansion of oil industry required the development of the extensive territories including a rural environment along with the city. Therefore, it becomes necessary to present the Baku oil region generally, to reveal communications and interactions between its separate elements, to consider as a complex organism with all contradictions inherent in the era of rapid development of capitalism which has received the material expression in the form of the newly established planning system.

In the territory of Azerbaijan of that period the location of an industry was marked by extreme unevenness. Industrial enterprises were concentrated in several places, most regions of the country remained agrarian and there was a sharp distinction in their development.

By the end of the 19th century, Baku industrial region was one of the largest producing regions not only in Azerbaijan but also in all Russian Empire in general. There were no analogues like this area, both in the pace of development and in the form of the architectural and planning bodies, at that time. Although oil began to be extracted in various parts of the empire near such cities as Grozny, Mozdok, Ukhta and in the Crimea and these developments had private character and couldn't give an impulse for the creation of planning system, like the Baku oil district.

Besides, the development of oil-producing territories needs of creation of industrial centres for oil refining in the early 1970s of the 20th-century worried best minds of Russia. So, in the article *Where to build the oil plants?* Mendeleyev, D. pointed to the creation of the main two processing centres in Nizhny Novgorod and the Black Sea coast closer to the national consumer where production of the reprocessing plants could successfully compete with *the American kerosene* in the world market and that would be much more expedient, than their concentration in one place. The similar picture was observed in the USA where in the 1990s of the 19th century oils was extracted in the huge territory of 15 states and its processing located in the 3rd of them (SAIH, 1935). Although Mendeleyev, D. and other scientists repeatedly proposed to disperse oil processing, but this did not work by a number of reasons – absence of perfect means of transportation, and the most important – unwillingness of businessmen who wanted to keep Baku as the main centre where by means of concentration of industrial production in one place they achieved the maximum profits in domestic markets of the country.

Almost along with the development of oil industry of Russian Empire, there was an intensive development in USA and analogy can be seen at the rate and scale of the work being developed. But the functional and spatial organization of the developed territories was different decided. Thus, in the USA at the regions where the oil industry was developing, *telegraph and telephone, without being state regalia follow the entrepreneur almost everywhere and facilitate his work. Similarly, the railway in case of success quickly goes to him* (Savitsky, 1973). Thereby, around good crafts settlements were

quickly formed, before in tents and hastily assembled wooden houses, then very quickly built up stone houses with accurate zoning with the allocation of administrative centre as well as local government and economy. The first institutions in such a new geographical unit were the post office, bank, media, the trading facilities (Chamber of Commerce or Board of Trade) and it immediately liaises with all relevant institutions in other parts of the country. The disappearance of individual settlements in case of the loss of oil-bearing lands is also easy. In the areas of the oil production, the absolute spontaneity and lack of planning were observed. In 1865s, on the place of the Goldman's farm, the town of Pitol arose, in which by the end of the same year there were 15,000 inhabitants during a year this settlement ceased to exist. After its decline, the oil boom moved to the region of Tidiout and Trayemph Hil where inhabitants before were engaged in logging. For 1860-1873s 76 wells were drilled here. But they soon suffered the same fate (Romanovski, 1869). In the Russian Empire throughout more than half a century the centre remained in Transcaucasia, in particular, in the city of Baku. Geography, compactness of the territory of the Baku oil region, as well as the time of exploitation, the full cycle of industrial oil production has made it possible to develop strong urban links characterizing the region as a unit.

At the end of 19th the beginning of the 20th century urban planning of several European cities has changed significantly. Appearance and promotion of innovative industrial enterprises have caused the evolution of the previous socio-economic structure caused by the agricultural economy. For several years, the plants, housing for workers, numerous public and private buildings for new society were built. For the first time, evolution and expansion of the city have been planned on paper before realization. The projects drafted by schedulers didn't concern individual construction sites and covered the parts of the city and the adjacent areas. A new road network is laid along which new building and constructions are being built destroying parts of the historic city. During this period a series of analytical, design and regulatory documents were developed, which allow following the transformation of an intensively developing historical town and the surrounding areas where in 50 years inflow of numerous of a population and the introduction of industrial activities generated a modern rational urban agglomeration.

Establishment of new production relations has defined the town-planning principles of the organization of development of Baku and the adjacent oilfield territories. Complex economic changes required planning identification and the spatial solution. In the former system, the attempt to differentiate public processes on production and non-production is observed. Development and formation of the city begin; allocation of the industry in a separate zone is planned. The city ceases to exist as an autonomous entity and gives way to the integrated system of settlements which later became known as Baku industrial district (Abramov, 1971). There comes that

turning point when not separately taken city or the settlement, but a system of the settlements connected among themselves by diverse forms of communications can be an object of research. The most important town-planning problems of this period are a concentration of the population, changes of the environment and traditional way of life, the functional organization of territories, the combination of new social and technological changes.

4. The concentration of population

Such phenomena as urban concentrations, the continuous increase in urban population, the development of industry and transport, the destruction of old towns and the rise of unsanitary conditions on the urban outskirts have been observed everywhere wherein the 19th century accustomed new industrial territories. Thus, in the 1850s with the population over 10.000 inhabitants lived in the cities of the world, twice more people than in the 1800 (Bunin and Savarenskaya, 1979). In Baku, population growth has been closely linked with exploration and development of the oil-extracting industry, expansion of its borders and rapid growth of production. Family lists, police data, address table information, censuses 1897, 1903 and 1913 statistical data of the oil industry – all this gives an opportunity to fully restore the picture of the rapid population growth in the city and the fields.

If we take period between 1903 and 1913 and compare the speed of a gain of the Baku population to growth of the population for the same term of such big cities as St.Petersburg, Moscow, London, Berlin, Paris, Vienna and New York, then we will see that Baku occupies first place in this issue of the largest cities (Alishevki, 1950). The great demand for the workforce for providing and development of the industry has caused the powerful influx of the population to the city. Certainly, that at escalating oil production, with the expansion of oil processing and an increase of export, the population of the city should grow serving both the oil industry and other types of the growing industry and trade. But the dependence of population growth on the increase of industry in comparison of data on oil production with the number of workers employed only in the oil industry is particularly vividly expressed (Table 1).

Table 1. The growth in the number of oil workers and oil production (in tons)

Year	Number of workers	Oil production
1898	20500	8103
1899	25500	8753
1900	32000	10006
1901	37000	11191
1902	31500	10606
1903	27700	9955
1904	31800	10263
1905	33500	6845
1906	42500	7480
1907	48726	8018

This table is the schedule of the fluctuations in the number of oil workers per year depending on the state of the oil industry (Ivanitsky, 1930). Hence, that crisis of 1901 didn't slow to affect the number of workers in 1902-1903 and on overcoming this crisis in 1904 the number of workers immediately rises. These data once again confirm the fact that concerning of the population growth the Baku oil region entirely submitted to laws of capitalist development. Located near the city, industrial settlements: Sabunchi, Surakhani, Binagadi, Bibi-Heybat etc. were replenished, generally due to the alien population. It occurred firstly because the inflow of the alien population was faster than the growth of local population, secondly, as these settlements turned into the centres of trade lands there was a great opportunity for employment.

In order to have an idea of the socio-urban structure of the Baku Oil region, data on the number of working personnel and density of their distribution can be used.

By the end of the 19th century, the territory of the Baku oil region was subdivided into four zones: city, suburbs, trade settlements and trade. For example, if to consider the number of the working population on specific weight in each area, then the following tendency is absolutely defined the farther district from the city centre, the greater proportion of the working population table 2 where resettlement of the working population around the city is shown by suburbs, trade settlements and crafts, made on a census of 1903 can serve as the proof (Table 2).

Table 2. The settlement of the working population in the territory of the Baku oil region according to the census of 1903

District	Number of workers in %	
	Total	Including the oilman
1. In total around the city	18,0	0,9
2. In total on suburbs	33,2	5,5
3. In total on trade settlements	33,5	11,9
4. In total on crafts	62,9	39,1

The table shows how the percentage of the population of the trade area was rapidly different from the urban one and the difference existed in the rates of population growth in the crafts. And already according to a census of 1913 the percentage ratio of industrial workers who lived directly on crafts in trade settlements and in suburbs made: on crafts – 25,1%, in trade settlements – 61,7% and in suburbs – 13,2% (Baku at the Census 1903).

In the trade and factory area, the population arrived nearly 5 times quicker, than in the city and housing stock was immeasurably smaller. There was a problem of placement of large working masses near the place of employment. Therefore, this has influenced the emergence of new differentiation of distribution of labour according to professional characteristics. Thus, the largest number of industrial workers was concentrated on the factory and trade territories. Therefore, speaking about the formation of a town-

planning situation of this area, it is necessary to track as well as where the person making the main frame of the population growth was concentrated.

Apparently, from given to a census of 1913, the main part of workers lived in trade settlements, i.e. in those villages existed on Absheron before the development of oil industry there. These settlements were also the first base where the alien working population accommodated.

By his order in 1882 and 1890, the tsarist government sanctioned the seizure of 5325 tithes (≈ 5804 hectare) of land in the eleven villages of Absheron (NA). The growth of the territory of a city spot occurred due to inclusion in city line of many villages which are in a zone of influence of the city. In 1902, the Baku governor has raised before the commander-in-chief of the civilian part in the Caucasus the issue of including the square of the village of Kishly and part of the villages of Ahmedli and Zikh into the outskirts of Baku. The residents of the village of Kishly were attached to the residents of Baku. A year later, the governor announced a second decree on the abolition of the settlements of Balakhani, Sabunchi, Romana and Zabrati and on the seizure of their allotment lands, including those in the oil area and with the residents attributing for the account in the city of Baku (Figure 1).

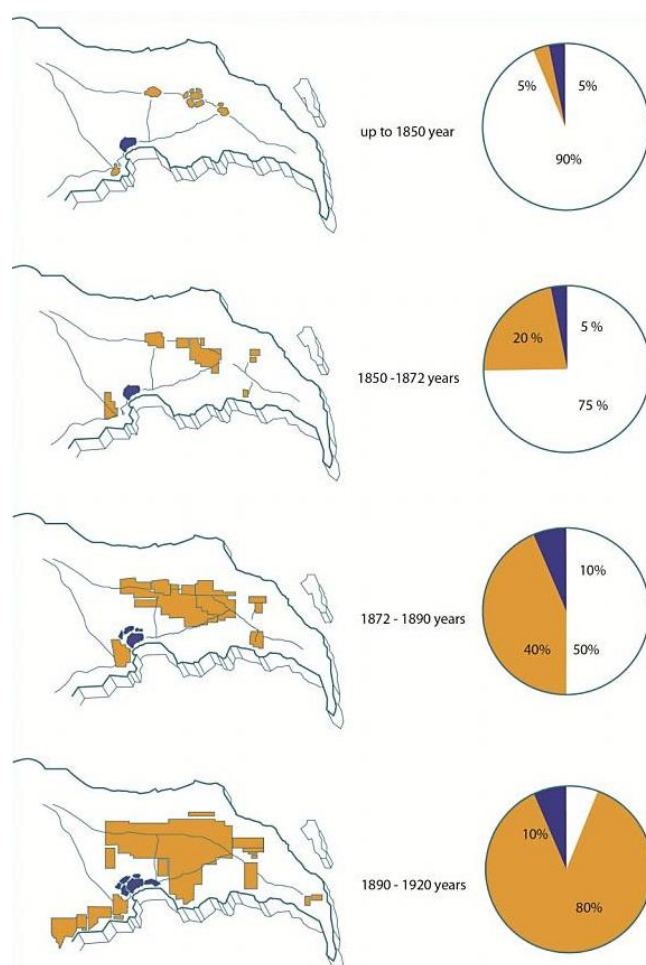


Figure 1. Dynamics of development of oil-bearing lands of Absheron peninsula

Essentially, the petition of the governor was already overdue. By this time the villages of Balakhany, Sabunchi and Zabrat were not peasant settlements anymore. According to the same governor: *the former Tatar villages of Sabunchi, Balakhany, Romana and Zabrat which were once remote from each other by fields in places with vineyards and now merged to the continuous square with the most intensive industrial life* (SAIH).

In 1903 in Sabunchi, Romana and Balakhany villages lodged up to 10000 people of the alien population whereas the indigenous population of all three settlements was estimated in 5000 people. At the same time in trade settlements, housing stock growth was extremely slow, moreover, the territory of the number of trade settlements was reduced in connection with the expansion of the oil-bearing areas from year to year.

Increase in population and territorial growth of the city has led to the essential complication of all functional and spatial organization of the area. Misunderstanding by the city authorities of the ongoing processes and insufficiently detailed accounting of the area population has led to serious disproportions in development of planning structure of the city and the industrial region gravitating to it.

5. Change of the environment

Depending on the location of natural oil deposits on the Absheron peninsula the drawing of the industrial region is defined. Along with the development of oil-field technologies, the tendency of adaptation of the planning structure to the landscape forms is replaced by an active transformation of the relief. Using salt lakes for waste industrial waters and formation of new reservoirs for this purpose violated the ground-water regime, which contributed to a change in the surrounding flora and fauna.

The labor congestion in the limited territory of the city and in small settlements was also defined by dependence on natural resources. Thus, the settlements which have entered a trade semicircle of the city and testing strong economic inclination to it began to differ markedly from the settlements located out of this semicircle which kept their traditional isolation, the primitive nature, life, an agricultural form of labour and the planning organization. Not only life of villagers, the traditional form of labour, territorial boundaries of allotments have changed here as well as the habitat and a landscape.

Considering international practice that the scale of urban land has been expanding because the speed of urban development has increased due to population growth that contributes to the improvement of planning in the construction of new urban areas. The development of industrial resource cities in the transformation stage based on the circular economy was considered as the breakthrough point.

The system of resettlement within the Baku industrial region formed interlinked groups of settlements centred on the city itself; in the south-east the Balakhany-Sabunchi trade territory, in the west of Bibi-Heybat fishery. For industrial settlements of the re-

gion, the solution of communications is on the forefront, their role and active participation in the organization of production of the area increases.

Till the 90s of the 19th century development of trade territories spontaneously occurred without consideration of technological and functional requirements of oil production. Spontaneously there were also spatial outlines of the inhabited places. The location of the expanding production territories and settlements depended on and submitted to the developed structure of private land holdings, coincidences of land speculation, and the main requirement was the convenience of placement plots in relation to the existing transport routes. The Baku oil region in this period represented a group of close located inhabited places of various sizes with high population density. But their growth remained uncontrollable and communications didn't add up to a rational system. The absence of clear zoning and dispersal of housing stock caused a set of inconveniences for further development of the Baku oil region. All this forced the district engineer of the Caucasus mountain region Gavrilov to send in August 1899 the report to the Caucasian Mining Department, to which a consolidated plan of oil-suitable sites was attached, compiled on the basis of information on state-known oil-bearing lands of the Absheron peninsula, to which it was considered an additional 1628 tither 499 square kilometres (approximately 1,900 hectares) of state oil-bearing lands. This quantity did not exhaust the entire stock of state oil-bearing lands on the Absheron peninsula and it represented only the lands of 4 villages – Balakhany, Sabunchi, Romana, Bibi-Heybat that seized in the treasury for the needs of oil production (SAIH). (Figure 2, 3).

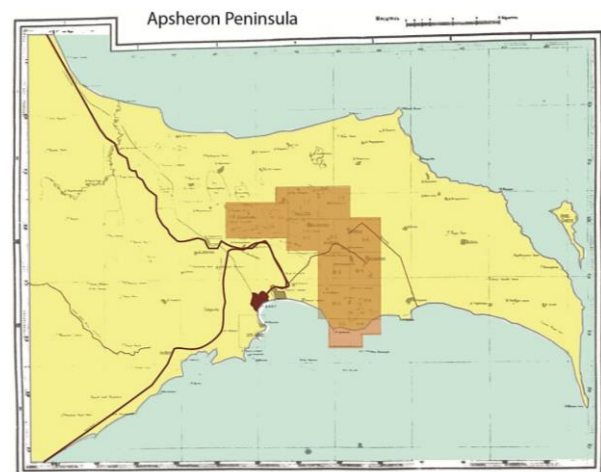


Figure 2. Consolidated plan for oil fields of Absheron in 1899 available for oil development

The purpose of drawing up such plan is to give, firstly, the number of lands that the state treasury has on the trade areas of the Baku oil region, and secondly, which of the same lands are located near the currently existing fields, are gradually depleted.

In developing the plan for the Absheron oil-bearing lands of 1899 several tasks were also aimed at resolving the current planning situation. One of the main objectives was cutting of sites which about 3-4

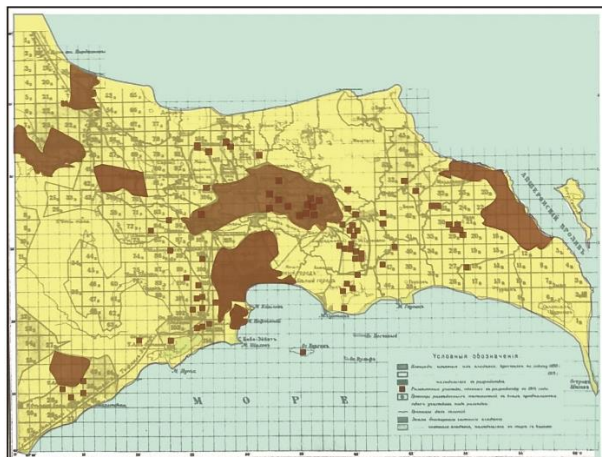


Figure 3. The map of the oil-bearing lands of Absheron peninsula in 1911

tithes (4 hectares) on average were supposed to reduce. Also, the attempt considering climatic and topographical characteristics of the area to organize the territory of crafts has been made, applying the advanced technology of production and storage and transportation of oil (NA). On this plan, according to the numbering of each fishery, all boreholes which for 1st January 1895 were in operation, drilling or paving and almost all oil wells inactive and finally abandoned have been shown. The plan showed not only the state of crafts at that time as well as indicated to the possibility of developing operational works on them.

The outline of the main territorial distribution schemes on its effective use and creation of the program of more detailed inspections was one of the important results of this work. It was expected to build the village, development of communication routes, the existence of the complex network of water and gas pipelines and power lines connecting the city with fishing areas with a dense network of engineering structures, sometimes extremely disadvantageous position for the city. But the lack of detailed geological researchers, the absence of an opportunity to plan development of the area, made the work schematic and unconvincing. There weren't more attempts to consider the Baku oil region as the coherent whole. And only in 1911 the geological map of the Absheron peninsula at the request of *Nobel brothers Partnership* has been made by Dr. Anderson who carried out surveying works on the investigation of oil-bearing lands.

6. Functional organization of the territory

The emergence in the second half of the 19th century of mechanical means has facilitated and accelerated mass movements of people and cargo have made possible the growth and use of remote oil-bearing lands. Technological requirements associated with the operation of new mechanical means have generated the serious difficulties connected with the discrepancy of the roads which have developed counting on pedestrian and the cartage. The decisive indicator of each site is the time spent on regular trips

from home to the place of employment. The developing town-planning system was oriented not by the geometry of space and for the time necessary for overcoming these spaces on the available vehicles. The indicator of overcoming long distances is not only the effective use of mechanical transport as well as the information link allowing to significantly increase the radius of possible contacts within the industrial area. Means of mass communications such as phone, radio, telegraph enabled contact between the trade territories and the city located at considerable distance from each other. Therefore, permission of City Duma which has followed in 1886 for the unhindered construction of a telephone network and the location of the main facilities in the factory area of *Black city* in the villages of Bailov, Bibi-Heybat, Kishla and Balakhany supplemented the system of multistage engineering communications forming the oil region with a centre in Baku as a whole.

In 1895 the engineer Lindley proposed the water supply project of extensive territory of the central and north-west part of the Absheron peninsula that covered the area about 500 sq.km. The project assumed the use of the equipment latest for its time, materials and structures. The well-organized system of underground galleries, reservoirs, pipelines, water intake and distribution constructions, pumping stations could be relatively easy to master as the areas grew. In 1925 professor Ivanitsky wrote that the Baku shollar water supply system is an example of the big engineering network project which is gradually constructed for the city but was the system of the water supply of the whole area.

The water intake for the city and the industry was carried out in 186 km from Baku near the settlement of Shollar and was led along concrete water pipes by the section of 1200×1700 mm to the station Sumgait where by means of pumps began to rise to the city reservoirs. The trade areas of Balakhany, Sabunchi, Romana, Surakhani were fed up through the Balakhani water-supply net with a length of 14 km and diameter of 500 mm ending directly to the east from city reservoirs. 2 other powerful lines with a diameter of 500-700 mm from the same reservoirs were used by a factory district and Bibi-Heybat (Abdulrahimov and Abdullayeva, 2013). The solution of shollar water supply system as water grid for the whole area proves that the Baku oil region at the end of 19th and beginning of the 20th centuries was considered and planned as the uniform town-planning system.

7. Urban development of Baku as the center of the industrial region

The peculiarity of the Baku oil region is the powerful and branched industrial complex concentrated in Baku that becomes its core. This contributed creating the central planning system transforming a shape of the city itself in space.

The central historical part located behind a fortification as well as the feudal city in the fortress



Figure 4. Dynamics of functional development of urban lands

ceases to play a role of the main business centre, turning into an element of urban development. In two kilometres to the east from which a new factory zone is being laid, which turns into the centre of extensive and very active industrial hub.

At the end of the 19th century in the city layout the tendency leading to attempt of zoning urban areas on the one hand which goes from stratification, the complication of city life, and with another from the merge of the newly built-up areas and their joining to urban areas is traced.

These processes lead to noticeable changes in the architectural and planning organization of the city and the industrial region.

Thus, the spontaneous development of urban areas for industrial purposes led to deformation of the gen-

eral layout of the city and distortion of functional ties between the factory and other urban areas.

The consecutive analysis of the plans of Baku made in the second half of the 19th century gives an idea of the stage-by-stage partition of the territory. In the initial development of urban areas of this period, the extreme fragmentation and sharing on a part are observed. The historical city ceases to be a metropolis, it's planning structure remains static and closed, preservation of traditional tenor of life is characteristic of this part of the city (Figure 4).

Outside the walls, there is an increasing growth of the city, although there is unplanned development and attempts to create sustainable links between the individual parts of the building. Several areas of the

new building which have appeared on plans except for central administrative, trade, factory and Sea department on the Bailov cape were or designed residential. In the projects of the city at the end of the 19th century two planning poles of gravity appeared, a rapidly developing large industrial in the east and naval in the west, that had to take some functions that overloaded the central district. But the settlement of the admiralty naval port on the Caspian Sea developed independently and didn't depend on the city both in economic, political, administrative and planning terms. This was due to the geography of the territory occupied by it, located in the southernmost tip of the Baku bay and directly bordering in the south-west on Bibi-Eybat crafts, it had no stable connection with urban development that in turn interfered with the development of the city in the western direction.

At that time the central historical district could no longer focus on the functions inherent in the rapidly developing industrial city. Through the streets connecting the downtown with the Bazar Square in this area, a brisk trade was developed as well as in the south-eastern direction adjoining to Torgovaya Street. Another part of the area mainly was residential.

Appropriable for the functions of citywide importance was factory area the so-called *Black town*. The whole business life of the city was concentrated here, the factory district, in general, became the main transport hub of the city and agglomeration. The functions of the city centre, first, assuming the organization of service get on the territory of the industrial zone and actively extend across all territory of transport and communication system of the area.

8. Factory area

The prerequisites of the development of this region belong to the second half of the 19th century mainly as a warehouse area with a lot of piers and barracks. The impetus for the creation of a factory area was the publication on 17 February 1872, of a law on the abolition of the pay-off system in the exploitation of oil sources. The numerous small plants emerged in the 60s of the 19th century was located and built chaotically on sites of residential quarters of the city. In the early 70s, they irregularly occupied large areas of urban land. This neighborhood with housing estate did not contribute to its growth, or to favourable living conditions. The matter is, that factory constructions occupied considerable areas and represented through the organized but generally uncomfortable territory along these directions with capital building and the factory pipes which are constantly letting out soot and smoke (Fatullayev-Figarov, 1986).

The connection between the oil fields and the city was mainly eastward along the routes of 3 parallel tracks of Balakhani, Surakhani and Telefon (nowadays streets: Fizuli, D.Aliyeva and May 28). In 1870 the administration of the Baku province has raised the issue of diverting sites for the construction of

plants in the urban forcible land. For this purpose, in the urban forcible land in 2 miles from the city plots of 2000-2500 sq. (approximately 4300-5000 sq.m.) with wide streets between them are given to manufacturers for the construction of plants. Transfer of the plants was made in the spring of 1876 (Abdullayeva, 2004). This area is very quickly built up and settled has formed the factory area which has been named *the Black city*. One of its major advantages was the location: direct proximity to the sea coast, to the port, railway junction, as well as to the central position in the general scheme of the Baku oil region, played an important role in the future development of the city and its agglomeration (Figure 5).

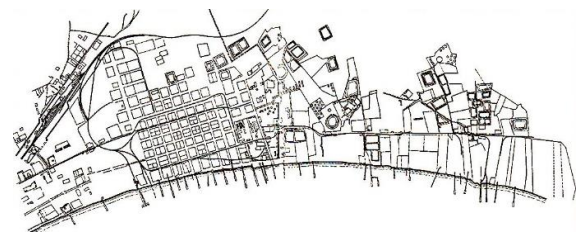


Figure 5. Plan of a production zone

Architectural and planning decision of the regular planning of the factory area was the first experience in the town-planning practice of Russia. On the plan of Baku of 1878, we can clearly see how on a flat relief the dense grid of streets with a width of 12-20 seedlings is designated. The area of all the streets was about 58% of the total territory of the site and quarters. During the reconstruction of Baku in the 1920s of the 20th century professor A.P.Ivanitsky wrote that this plan isn't rational and causes considerable over-expenditure on amenities, that it could be justified only in the central business-trade and administrative part of the city where various forms of traffic of the transport movement are concentrated (Ivanitsky, 1930). But the uniqueness of this area, its exclusiveness was that during the considered period it concentrated the highest for the industrial city objectives in various areas which were achieved due to spatial concentration of urban functions. Thus, the specifics of this city centre not consisted in what functions were its part, and not in the frequency of visits of its objects as well as in the maximum placement in its territory of the functions dominating in development of the industrial city.

It should also be noted that benefit from the experience when planning the factory area was directly adopted already from a ready standard of the American industrial cities. In 1923 in the *Kommunalnaya zhizn* magazine wrote: Baku is considered to be the city of the American fold where the large percentage of streets from the total building area follows from conditions of traffic meaning this part of the city (Smirnoff, 1923).

At the end of the 19th-century throughout Russian Empire, there was a fast process of concentration of production, monopolistic associations were created. The oil industry was one of the most monopolized branches of the heavy industry. Oil production, processing of its vehicles and the oil market

gradually concentrated in hands of a few the largest monopolistic associations. The large capitalist enterprises were established in the form of joint-stock companies. They have received in the 80s and especially 1990s development and to the end of the century represented the main form of the enterprises. There were necessary new lands convenient for exploitation. The closest to *Black city* were the lands of the settlement of Kishla where another industrial town soon arose. The development of the industrial zone in the east was very favourable both to the city authorities and entrepreneurs; close location to the resource base, it wasn't necessary to allocate large sums for the organization and development of new territories to lay communications. A favourable ecological factor was also taken into account, the direction of the dominating winds was considered indicates the advantage for the city of the concentration of the industrial enterprises here.

White City is so called the new part of the factory area was built unplanned in official documents of 1908-1909 it was indicated that in recent years there has been a rapid growth of the *White City*, in which new plants are being built, whereas: *the lack of bridge, squares, narrow streets, etc., causes significant inconveniences for industry and harm business*. The development of new lands for the factory area went eastward along the seashore and was completed by the construction of a weaving factory of the millionaire Taghiyev with a small settlement for employees. This position of the borders and planning of the factory area was maintained until the 50s of the 20th century (Abdullayeva, 2004).

If at the first stages of the development the factory area had regular planning and has been located at a distance approximately on 2 km from the city then over time it grew into urban development. Due to the chaotic process of the formation of the area insufficient consideration of the diverse social and economic interests of the city, there were complex contradictions arose in the construction of industrial and residential areas. Until the reconstruction of the master plan of the city intended for 2005, this area located in the railway and water transport hub with a central position regarding the plan of Baku remained as industrial. And in one of the subsequent master plans of the city till the 1980s the problem of reconstruction of the factory area wasn't raised.

The planning structure of the city was constantly adapting to the changing conditions of development of the production, the city borders were rapidly expanding, construction of railway tracks, numerous quays, the laying of new streets and roads adapted for mechanized modes of transport. All this has activated the town-planning role of Baku as the centre of the industrial region. And if on the plans developed till 1900, it is possible to observe aspiration in a certain order but in subsequent years the principle of the seizure of free lands becomes dominant.

9. Production urban areas

Besides the factory area, other urban areas are included in the system of industrial territories. The coastal strip representing the most valuable territory for the city is captured by numerous piers encumbering it along the Baku bay from the Shikhov cape in the West to *White city* in the east. If in the initial stage of development of the city growth tendencies aside from the sea than on the plan of 1878 along with the very considerable advancement of building towards land are shown (from the sea), growth tendency along the sea on the separated pieces of the coastal territory of the city is shown.

On 23 August 1901, by a special meeting of the City Duma it was decided that the boundaries of the territory of the Baku trade port should be the coastline from cape Shikhovo through the Bibi-Heybat oil-field; the centre of Baku; the factory area to the cape of Sultan or Zikh and from there through Peschany Island, Wulf, Nargen to Shikhov cape (NA). There was an external pipeline passed from there, connecting the Bibi-Heybat trade area with the factory area. Also, burdensome for the city there was a passing across the coastline of railway access roads to port with only one passage under them for communication of all urban areas and the centre with the factory area. None of the plans starting from 1878 to 1918 despite the outlined expansion and improvement of the coastline did contain instructions on the need to localize the port in a certain place.

The system of industrial territories of the city included a large part of the Zavokzalny district. The deadlock branch of the Transcaucasian railway which has formed the railway hub in the centre of Baku with the switchyard located near the settlement of Baladzhary, passenger and commodity stations as well as with the available branches to industrial institutions of the factory area and the port was an incitement for creation in this urban area of a number of the constructions serving railway transport: depot, mechanical workshops, warehouses of the equipment and oil products.

As the main means of freight transportation, the railway from the beginning has rigidly caused placement of the urban industry. Having set the directions of the main labour gravitation, it influenced not only the external outlines but also the internal organization of the city plan. With the advent of the railroad, suitable construction has appeared. A number of projects were designed to resolve the newly formed districts – Zavokzalniy (architect Fon der Nonne), Veer (architect M.G.Gadzhinsky) etc. (Lifshits, 1925).

The revealed scheme of distribution of industrial constructions on urban lands gives a figurative representation of planning structure of the city where the coastline and a branch of railway tracks act as core elements. And if the sea predetermined the structure of the primary plan of the historic city, the railway became that spatial factor that predestined further dynamics of the formation of the capitalist Baku plan (Figure 6).

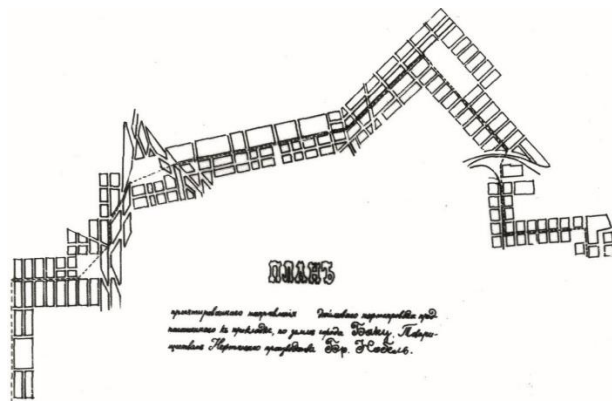


Figure 6. Designing the direction of the oil pipeline projected for laying on the ground in Baku, the brothers Nobel oil production company in 1897

10. Transport system

Transport becomes an urgent necessity-without it can't be realized the most important functional connections within the overgrown city.

Baku had to get a new form, to find an organic compliance to its changed content. The unplanned expansion of the urban area contributed to the emergence of long distances which had to be overcome daily by the population. There was a need for extensive use of intraurban mechanized vehicles. Transport problems of the city are put on the first place; they are given an urban forming character.

In 1873 the company Absheron Railway was organized in Baku to build a gauge road with a length of about 48 kilometres to connect the city with fishing. And on 16 July, the project of building the so-called *oil site* of the Transcaucasia railway was approved. It was put into operation on 20 January 1880, and connected Baku to Balakhani-Sabunchi and Surakhani trade areas.

The longest was the factory line connecting the city with crafts. The railroad track laid outside the city line already then accumulated the basic prerequisites for the formation of Big Baku. Its stations and transfer knots become the centres of social activity. The railway line along with the industrial territories and coastline formed a clear pattern, in which a new planning axis is clearly visible, which divides the *bowl* of the amphitheatre into two almost equal parts. On plans of 1898-1918s, it is visible as the projected new rigid grid of street networks is badly adapted for a relief in mountain places (Figure 7).

All city roads of this period can be divided into 2 systems: the old system of streets of the 60-70s of the 19th century, representing extremely dense and narrow passages of the feudal city through which the neighbouring are connected by traditional quarters (*mahalle*) with private dead-end branches (*dalanas*), carrying function of distributors. Of course, such system of urban roads could not satisfy the traffic of the rapidly developing capitalist city. This system couldn't provide suburban communication and traffic with trade areas. The new system of streets which has developed by 90s formed a one-dimensional grid of wide transit. Two of these systems both had the

sharply expressed characteristic planning tracing combined with each other, represented the transport scheme inconvenient for the city.

So, Telefonnaya Street (nowadays 28 May) having good capacity the main road convenient on the arrangement, directed parallel to the seashore, having main industrial function, supplied with drives and access roads of the Transcaucasian railroad connected the central regions of the city with the station and the factory area in an old part of the city, rested against narrow Karantinnaya Street (nowadays A.Aslanova) which serves as its continuation and couldn't accept also quarter of its traffic. Balakhanskaya Street in the Zavokzal area was about 15 meters wide, within the Central district lost its importance where it narrowed to 4-4.5 meters (Ivanitsky, 1930).

In this regard, it is necessary to highlight those aspects of the formation of the planning system of the city which are associated with its industrial development. The emergence of mechanical transport and a new system of street networks influenced the development vectors of urban areas. So, the automobile and railway movement were sharply oriented towards the crafts and the factory area (Balakhani main road, Belgorod main road, Bailov-Bibi-Heybat main road). The considerable degree of tension is obtained by city streets running parallel to the main transport links between crafts, the port and the factory area. Forming external main road, they were equipped with the mechanized means of transport and provided suburban communication between the outermost sites of the Baku oil region. Outside the town, they were laid along new routes with good throughput and the possibility of using mechanical means of transportation, but the existing network of streets was more often used for building inner-city streets. These included all the main roads connecting the Bibi-Heybat trade with the factory area passing through the central part of the city.

Movement, directed perpendicularly to the sea, was given less importance. Radial streets generally had intracity character, except for Stanislavskaya (nowadays Azadlyg Avenue) and Balakhansky (nowadays Fizuli St.) that have access to Balakhansky main road connecting the city with crafts of Balakhansky and Surakhansky group and Shemakhinskaya street (nowadays Moskow avenue) going from Lower boulevard through Surakhansky main road connecting the city to Binagadinsky crafts.

The necessity of establishment of the more convenient link between industrial regions, the railway and port has led to the streets which are main roads improved and put in order in the first place, regardless of whether they passed through the central areas or on the urban outskirts. Thus, in the remote areas among full off-road terrain, there was a new type of the paved street with the sidewalk.

With the increased mobility of the population on a regional scale, the transfer of passengers from the residential part to the industrial one has turned an extremely acute and urgent issue.

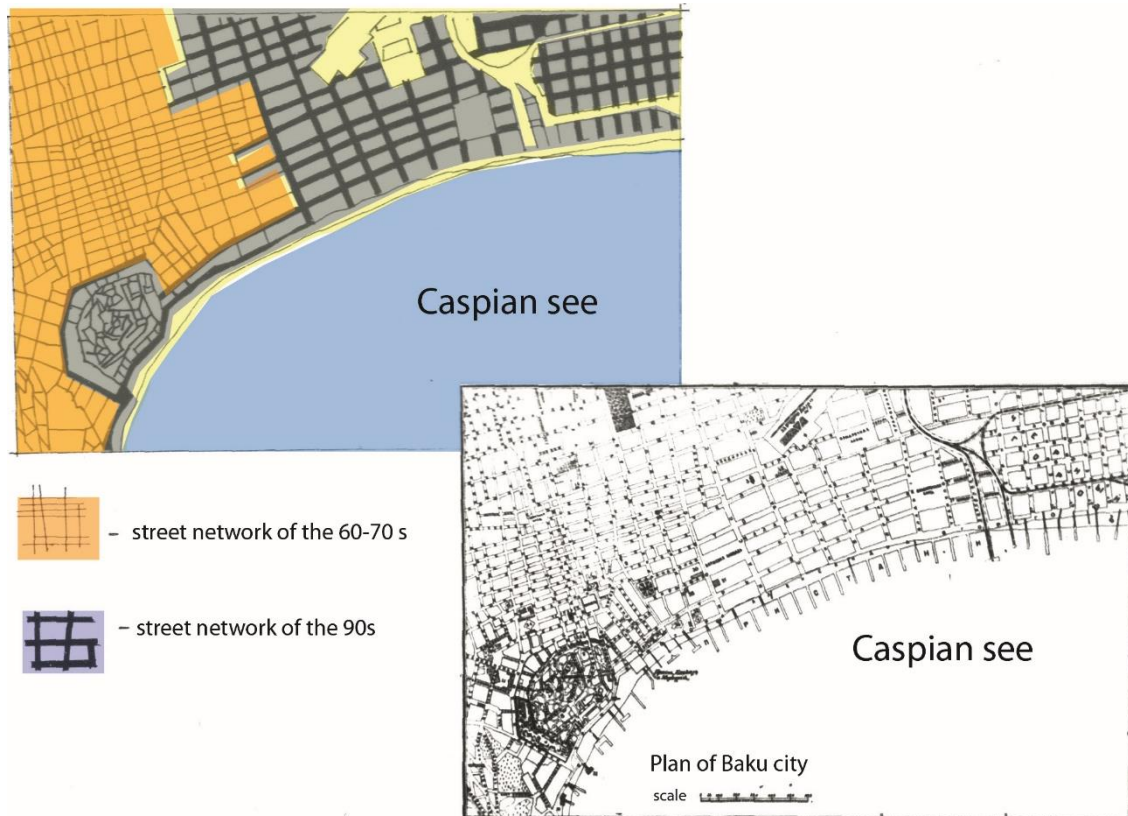


Figure 7. Conflict of the transport network. The appendix to the guidebook of the city of Moscow in 1913

It became aggravated by the fact that the railway had not enough links due to the transit passenger and commodity streams have laid down the additional load of the outdated street network. The increase in distances that needed to be overcome to get from a residential part of the city to an industrial zone could be overcome only by the emergence of a new type of transport on streets.

In 1889 the horse-drawn tram belonging to Joint-stock company of the horse railroads which purpose was the connection of remote industrial parts of the city has begun to work. The horse tram had four lines. On the scheme made based on data of the Baku background calendar for 1897 (Baku Reference Calendar, 1986) from four lines of the horse tram – three starting point had Privokzalnaya square which represented a knot of heavy traffic. The station has turned into the main transport hub, the active movement of both horse-drawn and mechanical transport depending on the type and the characteristic was observed here as well as the time spent to the destination depended on planning development of the city. The location of the station on the deep input of ways of the main line of the Transcaucasia railroad within the central building at this historical stage was very beneficial to planning development of the city.

Works on planning and settlement of the urban area done during 1880-1920s unite identical approach to design of the urban plan where the main problem of transport communications that is typical for all developing industrial cities of that period as the crucial importance was gained by streets, but not quarters

and residential areas with their domestic, public and cultural ties (Bunin and Savarenskaya, 1979). For example – planning of new trade settlements the factory area as well as the new urban areas created generally for the alien population represented the scheme of street networks.

11. Conclusion

The turn of the 19th and 20th centuries is a time of great changes formation of new town-planning trends. During this period in the territory of modern Azerbaijan, the processes which considerably changed the image of the feudal cities and settlements began to gain strength.

The solution of town-planning problems during the considered period is defined by the influence of socio-economic factors, the concentration of the population, interrelation of the natural artificial environment, the functional organization of the territory. The sharp increase of the population has led to an essential complication of all spatial organization of the Baku oil region. Misunderstanding by the city authorities of the happening processes and insufficiently detailed accounting of demography of the area have led to serious disproportions in development of the city and the areas traversed to it. Along with the development of technology, the adaptation of the forms of settlements to landscape is replaced by an active transformation of the relief. The trade semi-circle of the city had included 11 settlements testing strong economic inclination to it which

sharply distinguish from the settlements located out of this semi-circle which preserve the traditional isolation, the pure nature, life, an agricultural form of labour.

The emergence in the second half of the 19th century of new means of transport has facilitated and accelerated the mass movement of people and freight, made possible growth and use of remote oil-bearing lands. A number of the projects carried out at the turn of the 19th-20th centuries, such as consolidating plan of sites suitable for developments of oil, the project of tram network the city-settlements-trade, the project of water supply of the central and north-west part of the Absheron peninsula prove that the Baku oil region was considered and planned as unified town-planning system.

The establishment of capitalist relations of production determined new town-planning principles for the organization of Baku and the adjacent territory. The city has ceased to exist as autonomous entity and gave way to the integrated system of settlements. In the formed system the attempt to differentiate social processes on production and non-production is observed in the article.

The types of industrial settlements and their classification based on the nature of planning interconnections of the main functional zones (city, suburbs, fishing settlements and fisheries) are identified.

The paper examines the question of the main planning and volume-spatial characteristics of the functional zones making the structure of trade settlements.

A detailed presentation of the principles of the functional and spatial organization of these types of settlements, the peculiar features of planning structures of industrial settlements associated with the feudal remnants existing in the social structure of Azerbaijan of that time are shown.

The peculiarity of distinguishing design and planning development of 1890-1918s despite their sketchiness, separation consists in an attempt of the solution of problems of regional importance, the creation of new town-planning relations in the form of the system of industrial settlements.

Rapid growth and the formation of a city and an industrial region are defined as socio-economic factors from which the following contradictory directions are distinguished: expansion of the urban area due to accession near the lying agricultural settlements and the creation of new urban areas, change of a landscape and environment, increase the production area followed by a decrease in the area of historical settlements on the one hand and increase in population density on the other.

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World Experience in Public Administration of the Transformation of Energy-dependent Regions in the Context of Their Sustainable Development

Światowe doświadczenie w administracji publicznej i transformacji regionów zależnych od energii w kontekście ich zrównoważonego rozwoju

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Abstract

The article is devoted to the research of the world positive and negative experience in public administration of the transformation of energy-dependent regions. The research is carried out in the context of the sustainable development of energy-dependent regions, which is one of the key global agendas for the transition of all countries to a low carbon economy and the reduction of greenhouse gas emissions, in the context of the UN Sustainable Development Goals to 2030.

The authors analysed the institutional features of the experience of just transformation in Australia and Poland, the shortcomings of the transforming process of energy-dependent regions in European countries such as the United Kingdom and the Netherlands, and also some initial directions for further energy transition in the German and Czech regions.

Key words: world experience, public administration, just transformation, energy-dependent regions, sustainable development, advantages and disadvantages

Streszczenie

Artykuł poświęcony jest badaniu światowych pozytywnych i negatywnych doświadczeń odnoszących się do administracji publicznej i transformacji regionów zależnych od energii. Badania przeprowadzono w kontekście zrównoważonego rozwoju regionów zależnych od energii, który stanowi jeden z kluczowych elementów w globalnym przejściu wszystkich krajów na gospodarkę niskoemisyjną i redukcji emisji gazów cieplarnianych, biorąc pod uwagę Cele zrównoważonego rozwoju ONZ do 2030 r.

Autorzy przeanalizowali cechy instytucjonalne przykłady sprawiedliwej transformacji w Australii i Polsce, niedociągnięcia procesu transformacji regionów zależnych od energii w krajach europejskich, takich jak Wielka Brytania i Holandia, a także kilka kierunków możliwej dalszej transformacji energii w Niemczech i Czechach.

Słowa kluczowe: światowe przykłady, administracja publiczna, sprawiedliwa transformacja, regiony zależne od energii, zrównoważony rozwój, zalety i wady

Introduction

In recent years, the concept of *just transition* or *just transformation* has emerged in European countries, the essence of which is to plan the processes of sustainable public administration development of territories (regions), which will be affected by the process of fossil fuels abandonment in close comparison with social justice and fair employment, ensuring a decent life and a fair living for all workers and communities.

In today's economic environment, the theme of energy-dependent regions transformation as a main part of ecologic component of sustainable development is one of the key global agendas. For instance, in 2015, the International Labour Organization published *Guidelines for a Just Transition Towards Ecologically Sustainable Economy* (International Labour Organization, 2015) to help the countries in transition to a low carbon economy and achieve their planned strategic goals for reducing greenhouse gas emissions in the context of the UN 2030 Sustainable Development Goals.

It is well known that an important principle of managing the processes of fair transformation is the broad social dialogue between all stakeholders in this process (Zelinska, Fedorovych, Andrusiv, Yurchenko, 2019): not only representatives of state authorities and local self-government, but also civil society, scientific, expert, business and information environment. In addition, this process is part of structural changes in the economy (as a part of economic component of sustainable development), so it is important to remember that some changes occur quickly and dramatically (possibly caused by the effects of war, recession, or dramatic technological change), while other structural adjustments – such as industrialization or transition from the sphere manufacturing to the service industry can take decades.

The European integration vector of development chosen by the Ukraine requires the transformation of national energy policy through climate change in the world, environmental challenges, increasing greenhouse gas emissions, inefficient and irrational use of depleted resources (Zablodska, Sieriebriak, Kolomytseva, Dzhumageldiyeva, Rohozian, 2019). Therefore, in this context, the positive and negative conclusions reached by the countries with experience in the transformation of energy-dependent regions will could play in the future an important role in correcting certain tasks, goals and priorities in the formulation of documents related to the sustainable development of territories in a strategic dimension.

Institutional and public administration features of just transformation experience of the world energy-dependent regions

1. Australia

For most of, the metallurgical works of the City of Newcastle, the Latrobe Valley region, and the

nearby coal mines, were a landmark pillar of Australia's industrialization and the flagship of Australia's largest corporation, VNR. A significant amount of workforce (16,000 people in the 1960s) and a direct impact on employment have made this enterprise the basis of the economy of this city and the energy-dependent territory of New South Wales region.

Coal mining and electricity, which have formed the basis of the mill's operations, have also been important sites for local identity for many decades (Jones S., Tee C., 2017). However, due to technological aging and the relatively small scale of production that could not compete with similar East Asian enterprises, the metallurgical plant and adjacent coal mines began to encounter difficulties in the early 1980s. At that time, the Australian Government provided targeted financial assistance for restructuring ecological projects, which led to the suspension of the coal and metallurgical sector and, consequently, a significant reduction in the workforce, forcing local workers to reorient and to work in the field of services (Newcastle Herald, 2009). Despite the fact that the possible closure of the city-forming enterprise was announced in two years, this news was extremely traumatic for the city and for the whole region.

The whole process of region transformation in the sustainable development terms has been controversial in many aspects. Yes, it had tremendous support from the country's prime minister, but planned ecological projects aimed at just transformation received too little public funding but did not take into account the influence of the economic and social components of the sustainable development of this territory. These developments gradually began to bring together three levels of government (national, regional and local), as well as business, trade union and community groups, at meetings where consensus and prospects for regional sustainable development were anticipated, taking into account the interests of each stakeholder.

However, attempts to build new sustainable development strategies for Newcastle based on tight control of the national government have failed. As a result, the management of all Latrobe metallurgical and coal industries, without waiting for external assistance, merged and used two years before the final closure of their business entities to assist their employees in finding another job: first of all, career counsellors and recruitment, individual retraining programming professionals, discharged employees and senior employees who go on pension (this type of corporative responsibility was rare for Australia) (OECD, 2016).

Finally, the overall process of the just transformation of the Latrobe Valley region was able to achieve its operational purpose with the help of agreements reached between national and regional authorities in the **public administration process**, which were embodied in the National Territorial Transformation

Program, 5000 new workplaces were created, but many people, who were unable to retire, were still unemployed (Murphy, 2014). Finally, most of the proposals for the sustainable development of new industries in the **energy-dependent** region, the formulation of cluster policies and strategies for highly skilled workers have failed (Gunasekara, 2008).

1.1. The advantages and disadvantages of proposed public administration process of the Australian region transformation:

It is fair to say that some of the proposals for the **public administration** of the Latrobe Valley region transformation have positives: in terms of job creation, as well as in terms of attracting all key stakeholders to solve common problems in the region.

However, the lack of funding and lack of autonomy to attract foreign investment has undermined the potential for innovative development, local entrepreneurship and a more sophisticated economic structure. In general, the weaknesses of the proposed transition of region also included the lack of alternative work for workers and the unwillingness to retire many older workers without adequate compensation. The proposals for the country's gradual abandonment of coal production have continued in Australia's current energy program, but the conflicting goals of the public policy about the sustainable development influence have hindered its successful implementation. During the 2014-2016 periods, the international authorities in the interregional forums discussed with the Australian authorities' issues related to the future sustainable development of its low carbon environment and how to manage the equitable transformation of coal regions with the gradual transition of workers to this area.

However, again, as in 1997-1999, major changes were due to corporate business decisions, this time taken overseas (Snell, 2018). In November 2016, French energy company Engie, whose executives bought a management stake in Australia's VNR, announced the decision to close all its plants to reduce carbon emissions and reduce the company's high operating costs in the context of sustainable development program. The announcement of the closure again came as a big shock to all workers, trade unions and local communities, but this time the government responded by setting up *the Latrobe Valley Economic Facilitation Fund*.

To help the affected workers and their families, this fund has proposed the following public initiatives:

- the gradual transition of all workers to new workplaces in other industries (related to economic and social elements of the sustainable development), the provision of legal services and the development of new skills for all affected groups in the region;
- a financial support for retraining: under a collective agreement, VNR employees were entitled to retraining funded by the company. For contract workers, the government agreed to provide

subsidized support for retraining or further training;

- a scheme of workers transfers to workplaces to the power stations and factories in other regions, agreed with the trade unions and the regional public authority; gave other employees the possibility of early retirement;
- the economic and social public administration initiatives aimed at ensuring the sustainable development of the region. In view of the fact that the just transformation has demanded and continues to require ample employment opportunities, it has been announced that a special economic zone of the *Latrobe Valley* region with appropriate financial incentives has been announced.

2. Poland

In the early years of the **public administration process** of transformation the **energy-dependent** regions and the entire coal industry in Poland, the toolbox was very limited. The first two social security instruments for miners introduced in 1993 were holidays and social assistance payments. The vacation was a form of early retirement for miners, to which bonuses and special allowances for hard work were added, and the payment of social assistance was, in fact, a form of voluntary dismissal (paid over two years to miners who remained more than three years before retirement age) (Karbownik, Bijańska, 2000). Such payments stimulated the process of reducing employment at coal enterprises and allowed the closure of the most unprofitable mines.

Since 2002, and especially after Poland's accession to the EU in 2004, public administration and political stability have begun to emerge in the country as the EU has begun to directly influence the processes of strategic planning for sustainable regional development. However, it did not bring a significant improvement for the coal industry: wage arrears dating back to the 1990s were eliminated, but the elimination of unprofitable mines ended and thus stopped the reduction of labour. According to EU legislation, the subsidization of the coal industry ended in 2003, so since the state aid has only been granted to the economic projects related to the closure of coal enterprises.

However, since 1993, the country has embarked on a path of just transformation of the entire coal industry; a list of main software tools of the public administration process is given in Table. 1.

It should be emphasized that the implementation of concrete measures for the public administration of the energy-dependent regions transformation and the entire coal industry of the country was at a rather low level until 1993-1998, which immediately preceded the reform. Previous measures aimed at limiting employment in the coal industry have proved ineffective (due to the lack of new skilled workers). In order to ensure the profitability of the real sector of economy as a part of sustainable development in Poland

Table 1. The main public administration tools for the transformation of the energy Poland industry, built by authors according to (Makiela, 2002; Paszcza, 2010; Przybylka, A., 2013).

<i>Years</i>	<i>The name of tool</i>	<i>The implementation results of proposed measures</i>
1993-1998	The coal restructuring program, The bankruptcy program for coal enterprises, State program for the transformation coal mining regions in a market economy and international competition for the period 1996-2000.	Designed as the first steps in the process of the transformation of coal industry, they focused only on its profitability. The provisions of the data programmatically described the technical features of the transformation of coal regions, without solving the accompanying problems in the socio-economic and financial spheres, so they were unable to achieve positive results.
1998-2002	Poland's Coal Industry Reform Program for the period 1998–2002.	The most sophisticated and ambitious program to expand the number of tools available for a fair transformation of the industry and the introduction of greater support for coal companies.
2002-2003	Program for Transformation of Coal Mining Regions in Poland for the period 2003-2006.	The provisions of program provided a pool of anti-crisis actions, the primary role of which was given to the process of privatization of individual coal enterprises with a simultaneous gradual reduction of labour force; it has been expanded and updated in another strategic document.
2003-2006	The Coal Transformation Program and the Polish Coal Transformation Strategy 2007-2010 formed on its basis.	The documents gradually restricted access to the coal resources in 2004-2006 and justified the need to close some coal enterprises by 2010.
2007-2015	Poland's Coal Mining Transformation Strategy for 2007-2015.	The strategy's provisions focused on the transformation of coal enterprises, increased investment in research activities, increased production efficiency, which led to increased employment (trying to maintain a balance between the economic, social and environmental sphere of sustainable development of the whole country and its regions).
2015-2018	Strategy for the Development of Polish Energy Policy by 2040. (valid)	According to the strategy, coal will remain the most important source of electricity generation by 2040, although its role will gradually decline. In 2030, coal will account for nearly 60% of electricity production, though by 2040 its share will be reduced to less than 30%. The implementation of this document faces strong opposition due to potential negative environmental impacts due to ecologic component of the Poland's sustainable development.
2019	National Energy and Climate Plan for 2021-2030. (valid)	Provisions of the strategy are made in full accordance with the concept of sustainable development. Gradually abandoning coal, Poland will ensure a just transformation of the region's industries through the transition from thermal generation to renewable energy sources, which will provide additional profitability. The implementation of these measures will also help reduce energy poverty and air pollution. Under such conditions, the expected increase in electricity demand against the background of the diminishing role of coal will be covered primarily by gas, wind and solar, and subsequently by nuclear generation.

(Rohozian Yu., Zablodska I., Tatarchenko O., Zavoyskih Yu., Korsakova O., 2017), there was a need to introduce stronger motivation for the transition of workers from the coal industry to the enterprises of other industries (to implement the concept of sustainable development, it was envisaged to offer first-rate work at those people-oriented enterprises and to preserve the stability of social and cultural systems, including reducing the number of conflicts between former employees of energy enterprises) (Faliszek, 2011). At the same time, the preparatory process for accession to the EU has accelerated, so the need to reduce the size of government subsidies as a part of public administration police for the mining sector (through EU competition laws) has become urgent. In all previous public administration instruments, up to 1998, the measures to mitigate the effects of the

transformation of energy industry were devoted almost exclusively to miners whose jobs were at risk due to the elimination of mines: they were offered early retirement or special wage allowances. However, the amounts offered were not high enough to attract new, more skilled workers, so the result of these measures implementation aimed at reducing social tension is considered negligible.

The authors of program, provided in 1998 (*Poland's Coal Mining Reform Program for 1998-2002*) have chosen a different strategy all prospective miners have been offered higher amounts of compensation and wages for their fair transition from mining to other workplaces. This program and all the following strategic documents, based on its provisions, contained two important aspects:

1. Presence of a special law: for the first time, the programs were confirmed by a special law on mining, adopted by Parliament, which clearly defined the objectives, tools for social mitigation of the transformation of coal regions and the whole industry, sources and conditions for financing the program, as well as control its implementation.
2. Scale: the programs began to include sustainable priorities such as environmental protection, cooperation with mining communities and other regions in the context of the EU standards implementation (in view of the ongoing process of Poland's accession to the EU). Now when creating the transport infrastructure, preference was given to more environmentally acceptable transport and enterprises (Lorenz, 2011).

At the same time, the economic viability of the energy industry remained the main goal of all subsequent strategic documents, although its role would gradually diminish. According to the 1998 program, the viability of coal industry had to be ensured primarily by reducing employment, which reached about 105,000 workers by 2002 (of the total 243,300 mine workers). The authors of the following documents suggested that this goal could be achieved through voluntary redundancies as a result of a social package adoption for miners (approximately 65,000 workers) and by reaching retirement age (approximately 40,000 workers). It should be noted that this worked: the total number of beneficiaries of the social mining package from 1998 to 2002 was 67,000 workers, and the total number of workers subject to redundancies was 102,600 people.

An important role in mitigating the social impact of employment cuts was given to the local authorities in selected *mining communes*, which were intended to help create jobs in the regions. In addition, there was mitigation measures formed in the so-called *social package of the mining industry*.

The social package contained three types of tools, referred to as *security* and *activation*:

- a) Miners vocation: The main *safeguard* instrument was the miners' vocation in the form of early retirement (those employees who were not more than 3 years old before acquiring legal pension rights were entitled). Initially, she was paid 75% of its monthly salary, and after the employee reached legal retirement rights, the miners began to receive full payments;
- b) Social assistance: another *activating* instrument is a voluntary redundancy cash benefit – 65% of the average monthly salary, paid monthly during the period of employee retraining and job search, but not longer than two years. After employment outside the mining sector, recipients of social assistance were awarded a single monetary com-

pensation in the amount of an average salary for 14 months of work. The proposal only applies to those who have been hired within two years of being fired from the coal industry;

- c) Retraining: all former miners, both underground and terrestrial were entitled to a retraining course in order to increase their performance outside the mining sector (Karbownik, Bijańska, 2000).

2.2. The advantages and disadvantages of implementing the public administration programs from 1998-2006

The main factors are:

- Trade union representatives were always involved in the process of preparing the public administration tools, which enabled the implementation of a rapid and large-scale employment reduction program without significant social upheaval;
- The incentives offered to the miners were successful, the number of miners who took advantage of this proposal turned out to be even slightly higher than expected. Almost 37,000 workers took vacations, nearly 30,000 chose early retirement. In total, there were a reduction of 67,000 workers in the coal industry, while labour productivity increased by 40% between 1998 and 2002 (Kaczorowski, Gajewski, 2008);
- *Active labour market policy* in the form of payments was only theoretically *active*. The idea behind the event was for former miners to invest in their own new business or at least receive financial support for their professional training. However, with the exception of one elective course, there was no comprehensive support for such workers in the difficult job search process (Karbownik, 2005);
- One-time payments to employees were difficult to manage. The first wave of an evaluation survey (conducted in 2001) showed that many former workers spent their money on household items, meaning they were unable to invest or save money. Thus, the economic situation systematically worsened after the miners were laid off: in 2003, 5.8% of former workers stated that they could not afford to cover even basic necessities (food, clothing); while in three years 12.8 % said they also encountered this problem;
- Social assistance turned out to be a bad move as it did not attract much attention among the mine workers in total only 419 people chose this option. This was contrary to the expectations of the authors of program, who considered this assistance in combination with the payment of bonuses (if hiring a new job) the most attractive incentive and the most motivating option (Turek, Karbownik, 2005). However, the need to look for a new job within two years seems to

have been perceived by employees to be an excessive risk, given the lack of experience of such a job search and professional competence.

The main public administration directions of the energy-dependent regions transformation in the countries of South-Western Europe

1. Great Britain

South Wales is one of the poorest regions of the UK. At the beginning of the XX century, energy production was the basis of local industry, employment, and local identity. In 1921, about 270,000 people were directly employed in the coal mines regions, accounting for more than 20% of the UK's total employment (Merrill, Kitson, 2017). However, the gradual decline and eventual collapse of the coal mining regions over the next 70 years has led to persistent high levels of unemployment, poverty and labour migration (Morgan, 2008). By 1939, the number of employees in the mines was less than 129,000, but fluctuated around 113,000 by the end of the 1950s, and subsequently, the mines lost another 15,000 jobs. Overall, in the 1960s, 50,000 workplaces were eliminated and less than 30,000 remained in the 1970s (Government of Wales Statistics and Research, 1998).

Finally, in the middle of the 1980s, thanks to a public program of the most state-owned coal industry closing, an aggressively-minded UK government saw a prolonged but unsuccessful strike by national miners. Following the collapse of the strike, the government closed most of the mines remaining in the Valleys in South Wales (Fothergill, 2008), which deprived the region of alternative employment opportunities for the population and significantly weakened the impact of unions that could do nothing.

During this long history of the decline of the energy industry, various public administration programs have been created to transform the energy-dependent regions as territories of other industries and to enable local residents and workers to adapt to this transition. However, none of these documents could change the structural economic decline of the region, even if some provisions were implemented.

Between 1934 and 1976, a British Labour government implemented policy initiatives to promote the development of the energy economy. Their provisions were superficially similar to successful regional transformation plans adopted in other countries, whose main industries were also severely declining, but still included elements of a just transformation in the sustainable development conditions: retraining allowances and relocation for former miners; free housing; development of transport infrastructure and industrial development projects; an effective water supply and sanitation system began to be created in conjunction with local systems for recycling used water; a full-fledged local economy was developed in the framework of small communi-

ties and small businesses, providing diversity and self-sufficiency (Merrill, Kitson, 2017). However, these initiatives failed to provide the people and workers of South Wales with decent working and living conditions.

1.1. The disadvantages of implementing the South Wales State Public Transformation Programs

The main factors are:

1. Absence of a public administration policy for planning the just transformation of the **energy-dependent** region.
2. Lack of correlation between the provisions and components of the proposed transformation and the economic, social and environmental spheres of development, lack of cooperation and coordination between key stakeholders.
3. Ignoring the economic and ecological features of each territory included in South Wales.
4. Insufficient funding for key initiatives.
5. The national government's unwillingness to the mine workers in general, their hostility to any trade union initiatives.
6. Implementation of the public administration initiatives based purely on the principle *from top to bottom* and their focus on subsidizing the energy companies, not on comprehensive solutions to the problems associated with the process of region transformation.
7. Insufficient attention to transport and information infrastructure costs, cluster development or local innovation in the sustainable development spheres.

2. The Netherlands

Limburg is a province in the south of the Netherlands that experienced a significant and rapid growth in energy production in the 1950s. As a result, the regional economy of Limburg has become heavily dependent on coal and gas production through increased employment and income. In 1965, approximately 75,000 workplaces were at the coal mines and enterprises, together accounted for just over a third of Limburg's total labour force.

However, since the middle of the 1960s, a coal production and employment rates began to decline rapidly due to the inability of Dutch coal mines to compete with overseas coal producers and due to intense competition with low-cost European natural gas enterprises. In 1974, the last Dutch coal mine closed. The unemployment rate in Limburg in the period 1960-1984 was just over 20% (Gales, Holskens, 2017).

With the decline and final closure of coal production in Limburg, regional unemployment was high. By 1990, the structural public administration policy, aimed at diversifying the economy of Limburg and improving its results, reduced unemployment to almost half its peak level. It was a major achievement, as regions that are losing so much of the dominant

industries are quickly entering a long-term stagnation or permanent decline.

In the early 1960s, key public administration policy makers began to anticipate and accept the inevitable decline in demand for Limburg coal. This adoption became the official policy of the Netherlands in 1965. The gradual control over the economic downturn over the coming decades allowed the costs associated with the decline of the coal industry to be amortized over a long period rather than appearing unexpectedly and suddenly. It gave the government, individuals and companies the time to prepare and adapt (Caldecott, Sator, Spencer, 2017).

The relatively high level of consensus among coal mining trade unions, mine managers/ owners and government representatives has been decisive for the successful just transformation of the region and the achievement of relevant objectives. Consensus on the probable future of the energy industry was particularly important. Obviously, all key stakeholder groups sought to avoid unpredictable and lightning-fast costs, so they all shared a common interest in ensuring proper planning for the industry's gradual decline and at the same time supporting other industries, creating additional employment opportunities for all those involved in the process, resulting in large-scale cooperation between all parties on the process of equitable transformation of coal territories (Gales, Holskens, 2017).

At the same time, the cabinet of the Netherlands has taken on an important role in retraining the region's coal miners to work in new and more advanced industries (agriculture, machine and shipbuilding and light industry for calculations of the functional purpose of each enterprise, taking into account demographic prospects, regional economic specifics and even the realities of macroeconomics), which has helped to shape a highly centralized approach to the sustainable development and structural adjustment policy of the region, which turned out to be quite successful.

All key stakeholder agreements reached were reflected in the *Common National Structural Adjustment Program for Coal Regions*, which was characterized by a number of benefits. The vision of the public administration and program developers as to the issue has been relatively stable over the decades and has been widely supported by relevant stakeholders and has therefore been financially supported. In addition, this document is consistent with the practice of sustainable territorial development, which has resulted in a significant mitigation of the worst effects of the region transformation for miners. The key actions of the *Common National Structural Adjustment Program for Coal Regions*:

1. Reaching an agreement with the coal companies on the timing of each mine closure and final exit from the market.

2. Providing these companies with the state subsidies to start their activity in the new industrial sectors of the region.
3. Significant increase of funding for regional education, especially in higher education institutions (including the creation of new universities and colleges).
4. Significant increase of investment activity in the infrastructure of region, especially environmentally friendly transport;
5. Direct assistance to businesses in the transition from coal by promoting innovation, accelerating the transfer of knowledge and developing new skills, opportunities and knowledge of workers in new industries;
6. Promoting family employment between miners (it was a great risk because the miners' children no longer wanted to follow local traditions and work in the same industry as their parents);
7. Generous social packages, including the possibility of early retirement for senior workers;
8. Creating the economy and social opportunities for retraining young workers. Emphasis was placed on assisting former employees of the coal enterprises in new workplaces;
9. Broad support for the sustainable development of the region and the regional business clusters. For the most part, this tool has been implemented through public administration support and funding from public authorities to improve collaboration with the large enterprises in the region to share innovation/ research and knowledge (Kasper, Knotter, 2013).

2.1. The advantages and disadvantages of a public administration policy of the Limburg just transformation

The main factors are:

- The representatives of public and regional administration constantly interacted and addressed serious external problems (an important factor of success was the fact that the interaction between the authorities started before the outbreak of the coal industry crisis, which made it possible to carry out highly efficient planning of process). Yes, they jointly managed, coordinated and funded properly the activities for the establishment and implementation of the *Common National Structural Adjustment Program for Coal Regions*, jointly with employers and trade unions;
- The representatives of public authorities invested considerable funds in order to support transport and information infrastructure, higher education and training, and to promote the innovation of private enterprises (especially through cluster interaction) in order to quickly rebuild the territories of region and ensure the decent work of former coal workers;

- In line with the Dutch tradition of *social partnership*, trade unions have played a leading role in the sustainable development and implementation of socio-economic policies for the transformation of the coal region, which facilitated prompt responses to the emerging changes through consensus, as all necessary consultations were carried out directly in the workplace (Caldecott, Sator, Spencer, 2017);
- The country is characterized by a sufficiently high level of industrial relations culture, which facilitated the fair and almost conflict-free transition of energy enterprises workers to the new workplaces, as they were supported as much as possible and provided considerable compensation to those who decided to leave the labour market.

3. Germany and the Czech Republic

Today, the subject of the regional just transformation has become one of the key global agendas. In 2015, the International Labour Organization published Guidelines for a Just Transition Towards Environmentally Sustainable Economies and Societies for All. One of the main goals of this document is to help countries transition to a low carbon economy and achieve their planned nationally agreed targets for reducing greenhouse gas emissions and the UN Sustainable Development Goals by 2030.

The positive results of such a dialogue can be observed in some EU countries. Thus, in Germany, the process of structural transformation of the energy sector by the public administration policy began in the middle of the last century. Since then, employment in the coal industry has decreased from 750,000 workers in 1957 to 20,000 workers in 2018. The country's last coal mine was closed last autumn. German politicians realized in time that there was no single industry that could replace coal mining. This requires strategic diversification of the economy. As a result, renewable energy facilities, technoparks and universities have begun to be built on the site of former production facilities. The most famous is the example of the city of Dortmund, where an artificial lake (Phoenix-See) was built on the site of a former steel mill, around which a modern quarter with business centres and private homes grew (Vondrova, Venert, Ginya, Dudeu et al., 2019).

Germany is a useful example of transformation by public administration policy. It is the first in the world to begin the process of complete abandonment of coal in the energy sector and plans to complete it by 2035-2038. In order to improve the social and economic situation in the mining regions, the government has taken a course on the sustainable development including education and science, technological innovation, infrastructure development, environmental and cultural projects. Now the Ruhr region, which was the center of energy production, has

become one of the most innovative, and the environmental situation there has improved significantly. Our countries are very different in their abilities, but Ukrainians could learn useful lessons from the German experience and take it into account during developing their own transformation plan (Shults, Prytula, Samilo, Maslov, 2019).

Similar processes are occurring in the Czech Republic. In October 2015, at the initiative of public and local representatives, the Czech government decided to develop a strategy for the economic restructuring of three energy-dependent regions - the Ústecký, Karlovy Vary and Moravian-Silesian regions. As a result, the program Re: START was developed. Its initial action plan foresees an allocation of € 1.5 billion for the sustainable development of the territories over the first three years. Strategy defines business, innovation and social stabilization as central elements of transformation.

As a result, several *innovation centres* have been opened to stimulate business in the regions, training programs have been implemented for local people and city leaders (*Místa zblízka*), and mobilization platforms have been created to work on rehab options for the region (Vondrova, Venert, Ginya, Dudeu et al., 2019).

In addition, Germany and the Czech Republic are one of the countries implementing the Coal Regions in Transition Platform of the European Commission Platform for Coal Regions. Created at the end of 2017, it now brings together 19 coal regions in seven countries of the European Union. The main purpose of the Platform is to provide a financial and technical support to the coal mining towns and territories.

Conclusions

The public administration policy of the just transformation energy-dependent regions is closely linked to the loss of well-paying workplaces that require relatively low skills. In addition, in traditional coal mining areas, an employment in these workplaces is directly linked to the employee's social status. These factors will impede the transition of miners to new workplaces, since achieving such benefits requires significant, longer efforts. As the experience of represented countries shows, the diversification of the transformation instruments of the energy-dependent regions and the sphere as a whole will lead to at least some miners opting for short-term profit (one-off payment) rather than long-term re-qualification for benefits.

Given the confrontational discourse that is typical of any transformation process in public administration dimension, it is difficult to reach long-term consensus among key stakeholders (government, trade unions, and employers) on the strategic direction of change. In such circumstances, negotiations are usually conducted discreetly (separately with each

party). In Poland, it has resulted in the lack of effective tools for implementing and evaluating just transformation, which has undermined the chances of reaching consensus. As a result, any strategic refinement of public administration policy that could potentially be beneficial to the mining sector was impossible. Therefore, the implementation of such a policy must be preceded by a thorough scientific evaluation of all the features of the process of just transformation of the energy-dependent regions and the industry as a whole, taking into account the sustainable development features of each region and the mountain communities (if any), which will be primarily affected by this process.

If a country has an energy-dependent economy, rapid transformation of this type of industry is virtually impossible. For this reason, it is necessary to create in advance conditions for balanced and sustainable development of regions and communities, which should include support for alternative, labour-intensive sectors of the economy, increased investment in transport infrastructure to stimulate labour mobility or improve the education system. In the EU countries, it has been made possible through the attraction for foreign capital and the use of the EU funds, which has helped to develop transport and information technologies, to improve the urban passenger transport system. Therefore, it is important to ensure parallel sustainable development pathways to monitor the reduction of the coal industry and to evaluate the real impact of this process on the development of related industries.

The public administration process of just transformation of the energy-dependent regions in the represented countries, for the most part, is still incomplete. Although sustainable development elements were generally observed in countries, the social losses from the proposed programs were quite high, especially for the coal workers. The public administration instability, fragmentation of political parties, and the intense social tensions that accompanied the initial periods of transformation created barriers to long-term sustainable development programs. In addition, the lack of broad positive experience in other countries of the world forced the public administration developers of strategic documents to constantly experiment, which did not contribute to a just transformation of the regions. Also, the territorial aspect of the transformation was also an important cause of emerging problems because it did not take into account the balance between all sustainable development components of the energy-dependent regions and those territories that are part of them. An employment reduction, which initially took the form of exhaustion, soon had to be supplemented by other tools, and early retirement schemes and generous payments to miners made it possible to close down the most unprofitable mines, but at the same time create greater social problems as a professional inertia among miners.

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Air Purification in Sustainable Buildings

Oczyszczanie powietrza wewnętrznego w budynkach zrównoważonych

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Abstract

This paper concerns the issue of indoor air purification techniques in sustainable public buildings and the residential sector. One of the requirements of sustainable construction is to reduce the energy costs, minimize waste, improve the well-being of users and create green space. The most important certification systems for green (ecological) buildings such as LEED or BREEAM also include the assessment of the indoor environment in terms of the air quality, noise level, building acoustics and energy consumption. Traditional air treatment and purification systems require the use of numerous devices, air transport systems, which are energy-consuming. It is necessary to clean or replace the working elements periodically. The alternative is biophilic installations (green walls) based on the natural properties of plants for removing gaseous pollutants, particulate matter and even bioaerosols from the air. Plants improve humidity, regulate the carbon dioxide concentration, ionize the air and suppress noise. However, the processes of photocatalytic degradation of gaseous compounds are a very promising method of removing impurities, due to low costs, mild process conditions (temperature and pressure) and the possibility of complete mineralization of impurities.

Keywords: indoor air quality, sustainable buildings, phytoremediation, photocatlysis, innovative materials

Streszczenie

Praca dotyczy zagadnienia technik oczyszczania powietrza wewnętrznego w zrównoważonych budynkach użyteczności publicznej i sektorze mieszkalnym. Jednym z wymogów budownictwa zrównoważonego jest ograniczenie kosztów zużycia energii, minimalizacja powstawania odpadów, poprawa samopoczucia użytkowników oraz tworzenie zielonej przestrzeni. Najważniejsze systemy certyfikacji zielonych/ ekologicznych budynków takie jak LEED czy BREEAM obejmują również ocenę środowiska wewnętrznego w zakresie jakości powietrza, poziomu hałasu, akustyki budynku i jego energochłonności. Tradycyjne systemy uzdatniania i oczyszczania powietrza wymagają wykorzystania licznych urządzeń, systemów przesyłu powietrza świeżego i zużytego, które są energochłonne. Konieczne jest ich okresowe czyszczenie lub wymiana elementów roboczych. Alternatywą są instalacje biofiliczne (zielone ściany) oparte na naturalnych właściwościach roślin do usuwania z powietrza zanieczyszczeń gazowych, pyłów a nawet bioaerozoli. Rośliny poprawiają wilgotność, regulują stężenie dwutlenku węgla, jonizują powietrze i tłumią hałas.

Natomiast procesy fotokatalitycznej degradacji związków gazowych są bardzo obiecującą metodą usuwania zanieczyszczeń, ze względu na niewielkie koszty, łagodne warunki prowadzenia procesów (temperatura i ciśnienie) i możliwość całkowitej mineralizacji zanieczyszczeń.

Słowa kluczowe: jakość powietrza wewnętrznego, zrównoważone budownictwo, fitoremediacja, fotokataliza, materiały innowacyjne

1. Introduction

The rapid progress of civilization in recent decades has forced a change in the human behavior and activity, translated into the length of time spent indoors during the day by the inhabitants of developed countries (Pawłowski, 2011). The available scientific data indicate that people stay in the space of the indoor environment for 90% of the day. This time is devoted to studying, working, social and home responsibilities, entertainment, exercising and resting (Tham, 2016). It is therefore obvious that people expect to have a safe indoor environment around them, as well as comfortable conditions for learning and working. Unfortunately, this comfort is often understood by designers, builders and architects as ensuring the proper indoor temperature and limiting the escape of heat. Ensuring proper air quality is hardly remembered. The results of numerous international studies indicate a strong influence of the indoor air quality on health, well-being as well as on the work efficiency and learning achievements (Kelly et al., 2019). Poor air quality is responsible for numerous diseases of the upper and lower respiratory tract, headaches, rhinitis, allergies and skin changes. Uncontrolled long term exposure to airborne mutagens may result in increased cancer incidence (passive smoking). The most well-known phenomenon associated with poor air quality is the so-called sick building syndrome (Kotzias et al., 2017).

It is estimated that the construction sector is currently responsible for 50% of global energy consumption during the year. This energy is used for heating, lighting and also for air treatment for ventilation and air-conditioning systems (HVAC). This energy comes mainly from the combustion of conventional fuels and significantly contributes to the global air pollution. Carbon dioxide and other greenhouse gases contained in flue gas have an impact on the intensification of the greenhouse effect phenomenon. In relation to the natural environment, construction is typically a consumer. Striving to stop further environmental degradation through the continuous increase of building structures is reflected in a change in the approach of designers and architects to the construction process. It is a pro-ecological direction in which the construction process is currently perceived on many levels, i.e. through the perspective of the building's life cycle from its erection, through use, periodic renovations to demolition (Bauer et al, 2010).

Sustainable construction enables to create such an internal space that ensures the required air quality, high standards of use and environmental friendliness at the same time.

Among Sustainable Development Goals, adopted by the UN in 2015, there are few which apply in the context of sustainable buildings. They are: Goal 3: Good health, Goal 9: Industry, innovation and infra-

structure and Goal 11. Sustainable cities and communities. If energy is to be taken into account, Goal 7: Affordable and clean (renewable) energy, should also be considered (UN, 2015). The most important one is Good health, since living in an unhealthy environment will limit the possibilities of realizing all Sustainable Development Goals (UN, 2015). The aim of this work was to characterize the air quality improvement techniques that are used in sustainable buildings.

2. Sustainable architecture

Sustainable architecture is the use of the design strategies that help reduce the negative impact of buildings on the environment during their construction and, more importantly, long-term use. Such buildings are called green, ecological or sustainable (Bielniak et al., 2013). The sources of modern ecological construction should be seen in the assumptions of the policy of harmonious development of humanity in accordance with the principles of sustainable development. This idea is currently the widest formula defining the relationship of man and his activities with the natural environment.

According to the definition in the Brundtland Report (1988), the sustainable development should be understood as a way of managing an environment in which meeting the needs of the present generation will not reduce the ability of future generations to meet their needs. This means that the consumed resources should be compensated on an ongoing basis by introducing new resources of similar value and utility. This specific leveling of deficiencies or shortages of consumed natural resources in the appropriate time frame is difficult to implement in the case of the construction sector. Therefore, in the definition of the sustainable development adapted for the needs of ecological construction, it is acceptable to use a significant amount of raw materials as long as they are renewable or occur on Earth in inexhaustible quantities. Sand is an example of such raw material. Due to the rapid economic development of China and the Middle East countries and the gigantic construction investments carried out by these countries (the Three Gorges Dam, Dubai Palm Island complex), there is a real threat of shortage of this material (Marchwiński and Zielonka-Jung, 2014).

A certain amount of waste mass and pollution generated by building infrastructure is also acceptable, provided it does not exceed the planet's self-regulation level. Ultimately, it can be said that the concept of sustainable building is not the same as the assumption of its autonomy and self-sufficiency as required in the Brundtland Report (Firląg, 2018).

For many years, sustainable buildings have constituted a rather small share of the sector in relation to the buildings constructed using the traditional technologies. The main reason for this state of affairs

should be seen in the high costs of building such facilities. Currently, sustainable buildings are gaining popularity because there are many beneficial sources of financing for this type of investment. The incentive includes numerous non-returnable funds that cover even the costs of the entire project.

The sustainable development assumptions can be implemented both in housing and, increasingly, in the public utilities sector. These are office buildings, cultural facilities, hotels, shopping malls and even religious facilities.

In order for a building to be sustainable, it should:

- be characterized by low demand for usable energy for heating and ventilation,
- use renewable energy sources,
- minimize waste production and maximize its reuse,
- ensure low water consumption and its recovery,
- use low-processed building and finishing materials,
- ensure creation of a space rich in greenery;
- improves the well-being of users by ensuring proper indoor air quality, lighting and acoustics (López et al., 2019).

3. Air purification techniques in the sustainable buildings

The indisputable fact is that the indoor air quality affects the health, well-being, work performance of room occupants and, in the case of children, also the rate of knowledge acquisition and cognitive skills (Midouhas et al., 2018). The issue of obtaining the right indoor air quality in sustainable buildings is complex because it is determined by three groups of factors of a physical, chemical and biological nature. The sources of chemical and biological pollution should be sought both in the external air, which is introduced into the building by natural or mechanical ventilation, as well as in the internal environment itself (Kotzias et al., 2017).

Along with the outside air, particulate matter with absorbed heavy metals, polycyclic aromatic hydrocarbons and other volatile organic compounds are inadvertently introduced into the buildings (Massey et al., 2016; Morawska et al., 2017). The infiltrating air is also a source of tropospheric ozone, nitrogen oxides and non-methane volatile organic compounds. In contrast, indoor activities like cleaning, cooking, smoking, the operation of HVAC systems, off-gassing from household products, paints, furnishing materials, and building materials are considered to be the main endogenous sources affecting the indoor air quality (Dudzińska et al., 2010). The most known group of chemical impurities in indoor air corresponds to volatile organic compounds (VOCs). These compounds include aliphatic and aromatic hydrocarbons, aldehydes and ketones. Some of them, such as benzene, toluene, ethylene, xylenes (BTEX) and formaldehyde, have been suggested to be possible carcinogens, mutagens and teratogens. Long-term exposure to VOCs can result in acute and

chronic adverse health effects as eyes irritation, sensitization reaction of skin and respiratory tract, and neurological problems (WHO, 2010). In turn, the basic source of biological bioaerosol and carbon dioxide are the users themselves (Lunegas et al., 2015).

One of the main features of a sustainable building is its energy efficiency. Thermo-modernization ensures a reduction in the demand and heat consumption for heating while improving the thermal comfort of the building. As part of thermo-modernization, the most common solutions include: insulation of walls, roof, floors on the ground, replacement of window and door joinery, use of mechanical ventilation with the heat recovery and replacement of the heat source itself. However, such activities have a negative impact on the indoor air quality (Steinemann et al., 2017). The building becomes so tight that the natural supply of fresh air is stopped. The relative humidity of the air increases, which contributes to the biological growth of molds, fungi on building structural elements and can even lead to their destruction through biological corrosion (WHO, 2009). In the absence of a sufficient stream of fresh air, the gas and dust pollutants are concentrated. The consequences of this state of affairs are felt by users – often complaining about chronic health problems and permanent fatigue due to the concentration of carbon dioxide exceeding the recommended hygiene standard which is 1000 ppm (Lunegas et al., 2015).

By design, a sustainable building is to be environmentally friendly but also it has to fulfill this function in relation to its users. Appropriate comfort of staying in a room depends on: the quality of the internal air, internal temperatures, humidity, proper lighting, acoustic comfort, as well as elements of equipment.

Unfortunately, the air in most rooms needs cleaning. Several air purifying techniques are available on the market. The most popular are filtration, sorption, and ionization. Their disadvantage is often masking of pollution, rather than their elimination from the air. They also do not allow the emission control and often, e.g. air filters, are a source of secondary pollution themselves. That is why, currently the so-called passive air purification techniques, which include photocatalysis and biofiltration became more and more popular.

4.1. Mechanical ventilation with heat recovery

The traditional way of ventilating rooms in ecological buildings is ineffective because the insulated building envelope and modern window joinery block the infiltration of the outside air and prevent the operation of gravitational ventilation. Therefore, currently the most commonly used technique for refreshing the air in sustainable buildings is a mechanical ventilation system with heat recovery. The air blown into the rooms is pre-purified outdoor air, which is distributed around the building through a

ventilation duct system. The air flow forces the fans to work. In addition, in this system there is a possibility of heat recovery from used air. Undoubtedly, a great disadvantage of this solution are high investment and operating costs, which include periodic inspections of the installation, replacement of filters, energy consumption for operation of fans. (Han et al., 2014)

The air filters are the heart of the mechanical ventilation system. These are usually disposable fabric duct filters. Depending on the location in the air transmission system, these can be pre-filters, recirculated and exhaust air.

The primary function of filters is to remove dust from air, i.e. remove solid particles with different aerodynamic diameters. Pre-filters are the least effective, whereas the HEPA and ULPA filters show the highest efficiency.

Pre-filters are used to remove the plant pollen and coarser atmospheric particulate matter and its particles. HEPA and ULPA filters remove fine particulate matter from the air, i.e. PM10, PM2.5 as well as bacteria, fungal spores, and tobacco smoke particles with the efficiency above 99.999%.

In balanced buildings, the dust free air requires additional purification from harmful VOCs, odors, allergens, particulate matter from resuspension as well as ionization or even disinfection. These treatments can be carried out using so-called special filters. Carbon filters are used to remove VOCs and odors, which retain chemical compounds due to the phenomenon of chemisorption. This type of filter is cheap and easy to dispose of after use. In turn, electrostatic filters effectively remove fine particulate matter and can be used to disinfect air. In addition, they can ionize the air negatively, which positively affects the health and well-being of users. Photocatalytic filters are the most advanced type of special filters, which remove fragrances, VOCs and can disinfect air. The frequency of replacement of individual filter sections is different and depends on the degree of contamination of the air being cleaned. It is recommended that this type of filter, with the exception of electrostatic filters, should be serviced for up to 6 months (Liu et al., 2017).

4.2. Potted ornamental plants

Ornamental plants have been a part of the interior of both work and leisure spaces for centuries. Originally, plant arrangements were only meant to improve the aesthetic value of a space. The possibility of using plants to improve the indoor air quality has been the subject of scientific research for only less than four decades. However, their results are so promising that phytoremediation is currently being promoted as a sustainable technique for improving the air quality (Darlington et al., 2010). Moreover, it should be emphasized that in the case of indoor air, the role of plants is not limited to the function of removing impurities, i.e. purification (Horr et al.,

2014). Plants also constitute a source of emissions of useful chemical compounds into the air (oxygen, some VOCs), create and regulate elements of thermal comfort (temperature, humidity). They can also be used to support conventional cooling systems in HVAC (Feng et al., 2014; Raji et al., 2015). In addition, phytoncides produced by most plant species can be used for air disinfection. The mechanism of phytoremediation of pollutants from the indoor air is so complicated that it still needs to be clarified as it covers the processes occurring both in the underground (roots) and aboveground (leaves, stems) parts of plants. The effects of specific pollutants on plants have been studied mostly under controlled laboratory conditions: single items, small cubic capacity of the exposure chamber, controlled temperature, RH, controlled concentration of the pollutant. In addition, the experiments were conducted in the absence of additional abiotic and biotic stress. Plants under the real conditions, as living systems, do not act selectively on the individual pollutants but at the same time activate a complex system of phytoremediation. It consists of phytovolatilization and phytofiltration in the leaf zone, phytodegradation and phytoextraction by shoots, as well as rhizodegradation and rhizostabilization by root system.

What is known for sure is that the single potted plants alone are unable to remove enough pollutants to improve the indoor air quality in commercial buildings. Studies have now moved onto green walls (living walls, indoor vertical gardens) which boast a higher density of plants and increased purifying properties.

VOCs are a serious source of health problems for room users. Safe concentrations of many of these chemicals are regulated only in workplaces. Dangerous formaldehyde, benzene, toluene, and xylenes, after penetration through stomata can be accumulated in tissues in an unchanged form, metabolized and incorporated into cellular structures or undergo biotransformation with the participation of microorganisms inhabiting the phyllosphere and rhizosphere. The absorption of VOCs by substrate particles has also been reported. In most cases of the tested ornamental plant species, the effectiveness of VOCs air purification increased along with the concentration of pollutants in the air and was best carried out during the daytime conditions. Even a long-term exposure of plants to high VOC concentrations did not inhibit their growth (Dela Cruz et al., 2014; Kim et al., 2018; Soreanu et al., 2013). A list of the most recommended plants for VOC remediation from the indoor air is shown in Table 1.

There may be many chemical compounds with oxidizing properties in the indoor air. However, ozone is the most important for plants. In rooms, it can come from both infiltration and arise *in situ*, it is removed mainly through stomata. The speed of the process depends on the plant species (Abbass et al., 2017).

Table 1. Recommended ornamental potted plants for VOC removal from the indoor air

Plant name	Latin name	Pollutants removed
Devil's Ivy	<i>Epipremnum aureum</i>	xylene, benzene, formaldehyde, trichloroethylene
Dwarf Date Palm	<i>Phoenix Roebelenii</i>	formaldehyde, xylene
Peace Lily	<i>Spathiphyllum</i>	benzene, formaldehyde, trichloroethylene, xylene
Philodendron	<i>Philodendron scandes</i>	formaldehyde
Spider Plant	<i>Chlorophytum comosum</i>	formaldehyde, xylene
Chrysanthemums	<i>Chrysanthemum morifolium</i>	ammonia, benzene, formaldehyde, xylene
Rubber plants	<i>Ficus elastic</i>	xylene, benzene, formaldehyde, trichloroethylene
Boston Fern	<i>Nephrolepis exaltata</i>	formaldehyde and xylene
Areca palms	<i>Chrysalidocarpus lutescens</i>	benzene, carbon monoxide, formaldehyde, trichloroethylene, xylene
Dracaena	<i>Dracaena Deremensis</i>	xylene, trichloroethylene, and formaldehyde
Ficus/Weeping Fig	<i>Ficus benjamina</i>	formaldehyde, trichloroethylene and benzene
Snake Plant/Mother-in-Law's Tongue	<i>Sansevieria trifasciata</i>	formaldehyde, trichloroethylene, benzene and xylene
Aloe Vera	<i>Aloe vera</i>	formaldehyde
English ivy	<i>Hedera helix</i>	formaldehyde and benzene
Flamingo Lily/Fleur	<i>Anthurium andraeanum</i>	formaldehyde, ammonia, xylene, toluene
Lady Palm	<i>Rhapis excelsa</i>	formaldehyde, ammonia and xylene
Chinese Evergreen	<i>Aglaonema</i>	formaldehyde, xylenes
Bamboo Palm	<i>Chamaedorea seifrizii</i>	formaldehyde, trichloroethylene and benzene

In many urbanized areas, particulate matter PM₁₀ and smaller fractions are the main air pollutants. Three main pathways can be distinguished by which the PM particles can affect the metabolism of the plant. There are:

- direct deposition on the leaf surface,
- blocking stomata in leaves or being absorbed by leaf tissues,
- deposition on the growing medium of a plant and indirect influence through changes in its chemistry.

The effectiveness of the PM removal by plants is proportional to the mixing of the aerodynamic diameter of dusts and is passive. The mechanism itself has not been fully understood. The key role is played by waxes, which cover the leaf blades. In addition to the dry PM deposition on the leaf surface, the reactions between the particulate matter components, e.g. hydrophobic PAHs, electrostatic interactions of adsorbed heavy metals and waxes cannot be excluded. It is also possible to use the PM components for plant metabolism (Gawrońska and Bakera, 2015; Pettitt et al., 2017).

The issue of the effectiveness of plants in removing the excess carbon dioxide from the indoor air is still debatable. Some researchers claim that CO₂ assimilation is rather small (Gubb et al., 2018), while others, on the contrary, believe that they reduce the ventilation costs (Tudiwer and Korjenic, 2017). Torpy et al. (2014) indicate that the rate of CO₂ removal from the air by the tested plants depends on the species and lighting conditions (intensity and time).

The presence of indoor plants has a positive effect on the regulation of relative humidity (RH), which is particularly beneficial during the heating period. At

the same time, the growth of RH by plants does not generate the conditions for the development of mold fungi even in very airtight rooms (Tudiwer and Korjenic, 2017; Irga et al., 2018).

When using houseplants for air purification, determining the effectiveness of the phytoremediation process under real conditions is an important issue. While the results of the tests carried out under model conditions are extremely promising, translating them into the conditions naturally occurring indoors is no longer as spectacular. Model tests are usually carried out on individual plants of a given species under controlled conditions, i.e. temperature, humidity, lighting. Usually, plants are exposed to only one pollutant, which never actually occurs.

Many factors influence the effectiveness of green walls in rooms. If high efficiency of such installations is expected, appropriate conditions for the plant growth should be provided. One of them is lighting. Plants require access to light of the appropriate wavelength and intensity for their growth and maintenance of proper condition. In practice, this involves additional financial expenditure on the implementation of lighting installations because the amount of natural light reaching through the glazed surfaces inside the buildings is definitely too small. Similar requirements apply to the irrigation and fertilization systems.

However, it should be remembered that biophilic installations, with the current state of knowledge, can be rather a support, less often an alternative to the traditional air purification techniques. Hence, it cannot be expected that they will have as high pollutants removal efficiency as conventional mechanical systems.

Green walls perfectly match the principles of sustainable construction. They do not require additional energy to operate, as they are the passive systems. The costs of refreshing treatments for plants with vascular plants are incomparably lower than the periodic air filter replacement in HVAC systems. The plant that needs replacement constitutes green waste that is easy to dispose of. The presence of plants in the immediate vicinity of people positively affects their well-being and has a calming effect. Creating open green space in offices is currently one of the strongest trends in the interior architecture (Moya et al., 2019).

4.3. Photocatalysis

Photocatalysis, according to the IUPAC definition, is a catalytic reaction involving the absorption of light by a photocatalyst or substrate. A photocatalyst is a substance that promotes reactions in the presence of light and is not consumed (Ren et al., 2017). The definition of photocatalysis distinguishes between two main processes. In the first of them, as a result of the radiation of the appropriate wavelength (energy), there is photo-excitation of the catalyst and its interaction with the adsorbed reagent in the basic state – it is so called sensitized photoreaction. However, if the substrates are excited with radiation, which will then interact with the catalyst in the basic state, this is known as catalyzed photoreaction (Lorencik et al., 2016). Heterogeneous photocatalysis, involves examining the interaction processes between a solid state photocatalyst and a liquid or gas phase, containing reagents and reaction products. Photocatalytic degradation processes are a very promising method of removing the inorganic and organic pollutants from the indoor air due to low costs, mild process conditions (temperature and pressure) and the possibility of complete mineralization of pollutants to the main products: CO_2 and H_2O (Nath et al., 2016).

Photocatalytic materials and techniques for air cleaning are based on the principle that the radiation of suitable wavelengths can be absorbed by many semiconductors, which facilitates the creation of reactive oxygen species that can decompose the air pollutants.

TiO_2 is the most commonly used semiconductor with photocatalytic activity. WO_3 , ZnO , ZnS , CdS and SrTiO_3 are slightly less popular. Anatase is a mineral, which works in the UVA range. In the form of nanoparticles, it is the most photocatalytically active form of TiO_2 in chemical degradation reactions. Currently, many studies aiming to shift the range of actinic radiation towards visible light by TiO_2 doping with different metals are underway (Binas et al., 2017). The efficiency of photocatalytic oxidation of pollutants in the indoor air is affected by: the type and concentration of the pollutant and its affinity for

the photocatalyst, chemical interaction and competition among gaseous pollutants, resulting in different rates of photocatalytic degradation, relative humidity, temperature, intensity and wavelength of light source, catalyst poisoning.

In practice, the use of photocatalysis in indoor air purification manifests itself in the use of photocatalytic paints, building materials (concrete, cement, mortar, tiles, glass, silica coatings) and finishing (fabrics) with the addition of TiO_2 and air purifying modules (Huseien et al., 2019). Photocatalytic paints are characterized by the contents of photocatalyst which, when irradiated, favors the oxidation of inorganic (NO_x) and organic gaseous air contaminants (formaldehyde, BTEX). They can also provide self-cleaning activities and show bactericidal properties (Galenda et al., 2018). In terms of appearance and the method of application, they do not differ from traditional the painting products.

Incorporation of TiO_2 into concrete revealed the self-cleaning properties and contributed as green material implementation in engineering constructions.

Photocatalysis has been shown to exhibit the capacity to disinfect the indoor air from a variety of pathogens, including bacteria, fungi, and even some groups of viruses. Photodesinfection can result in one of two outcomes, which are pathogen inactivation due to the cell membrane damage or lysis which refers to the breaking down of the cell integrity.

Purification modules can be installed in portable devices – air purifiers or HVAC systems. Photocatalytic reactor systems can be classified according to their configuration. The most popular types of these appliances are plate, annular, honeycomb monoliths, and fluidized-bed systems. Their efficiency depends on the area coated with photocatalysts, amounts of light sources (UV lamps) and air flow (Zhang and Haghighat, 2015).

One of the limitations of using photocatalysis in air purification is the formation of potential reaction by-products. Most studies on the photocatalytic removal of VOCs and inorganic compounds were conducted in model systems that are very simplified and do not reflect the real conditions. The indoor air is a mixture of hundreds of chemicals that interact with each other. Therefore, under normal operating conditions of photocatalytic devices, the formation of so-called undesirable reaction by-products may occur. They can be formed as either intermediate products or secondary emissions. What is important, some of these photocatalysis by-products might even be more harmful compared to their parent compounds. That is why the formation of such contaminants should be avoided wherever possible. The intermediate products come from the incomplete photocatalysis of certain pollutants. However, secondary emissions are formed due to the photooxidation of the supporting material in which the photocatalysts are embedded.

4. Conclusions

Ensuring proper indoor air quality in residential and public buildings is currently one of the most important problems and challenges faced by architects, builders and sanitary engineers. Public awareness of the effects of breathing polluted air is constantly increasing. This translates into an increase in the demand for technologies that will both clean the air of chemical and biological pollution, but also give it the properties that will create an appropriate indoor climate. Bearing in mind the need to protect the resources of the natural environment, more and more newly constructed or modernized buildings are ecological facilities where, both during their design, construction and, most importantly, exploitation, the demands of sustainable development are met.

Biophilic installations, innovative materials, including photocatalytic, ensure proper indoor air quality. However, it should be remembered that due to certain limitations, their efficiency is not as high as in the case of the conventional air purification systems.

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