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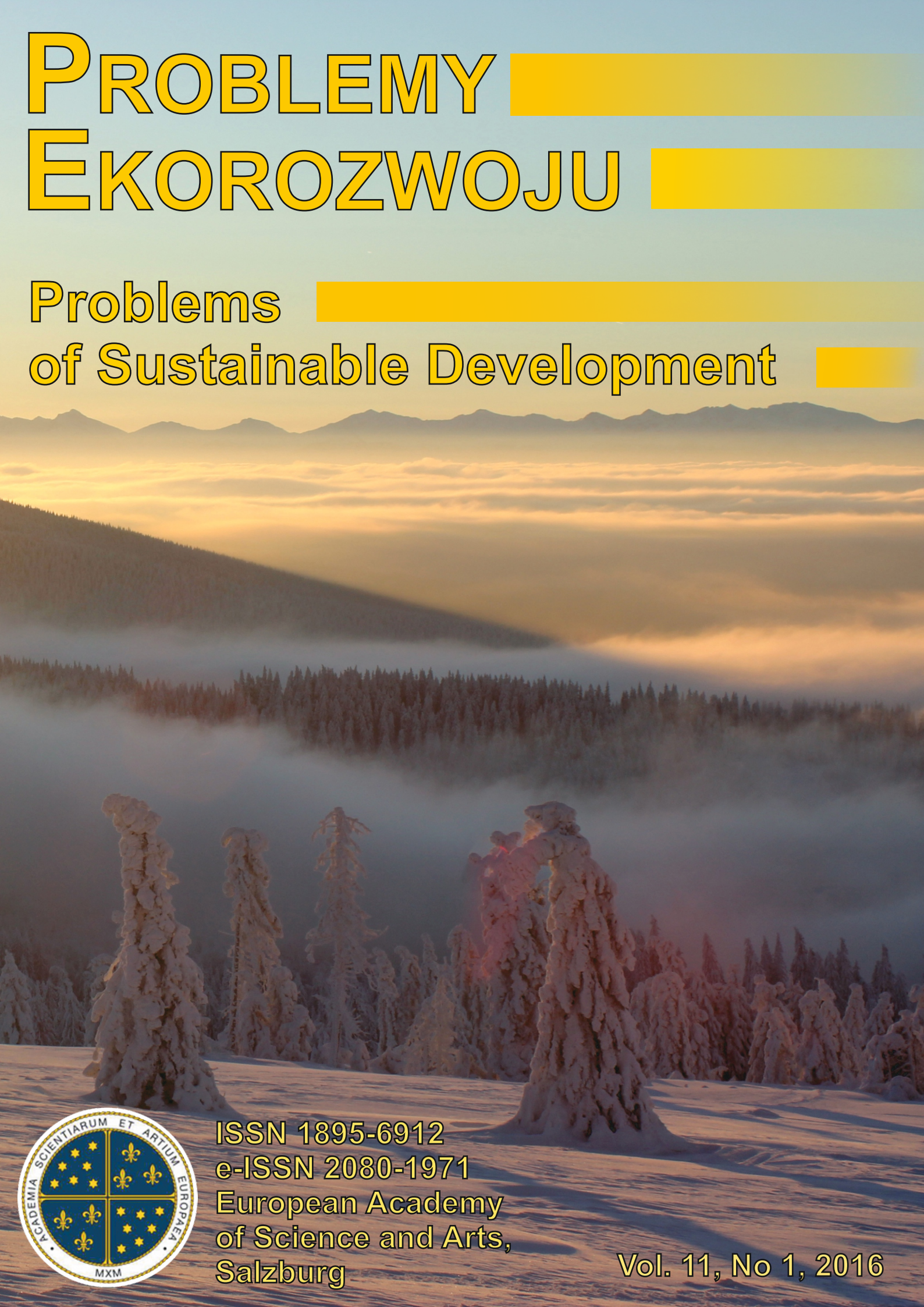
Problems of Sustainable Development



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EDITORIAL

Education and the Problems of Sustainable Development[1]

Edukacja a Problemy Ekorozwoju

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Abstract
Education for sustainable development has not featured strongly in the discourse promoted by the journal, *Problemy Ekorozwoju/Problems of Sustainable Development*. This paper provides a brief background to environmental education (EE) and education for sustainable development (ESD) and focuses on the theorization and pedagogies appropriate for ESD if perceived as transformative and political education. The obstacles that stand in the path of education for sustainable development are overviewed, and an attempt is made to suggest key questions that may underpin a transformative curriculum of education for sustainable development. It is hoped that the paper encourages further discussion in *Problemy Ekorozwoju* of issues around education for sustainable development.

Key words: environmental education; education for sustainable development; discourse; critical curriculum theorization; ideology.

Streszczenie
Jak dotąd, problematyka edukacji dla zrównoważonego rozwoju nie gościła zbyt często w czasopiśmie *Problemy Ekorozwoju/Problems of Sustainable Development*. Ten artykuł prezentuje podstawy zarówno edukacji środowiskowej (EE – environmental education), jak i edukacji dla zrównoważonego rozwoju (ESD – education for sustainable development). Szczególny nacisk położono na aspekty teoretyczne i pedagogiczne właściwe dla podejścia, w ramach którego edukację dla rozwoju zrównoważonego postrzegamy jako dokonującą zmian i polityczną. Przedstawiono przeszkody dla tak rozumianej edukacji. Podjęto także próbę sfomułowania kluczowych pytań, które wspierałyby przełomowy program edukacji dla zrównoważonego rozwoju. Miejmy nadzieję, że niniejszy artykuł przyczyni się do szerszej dyskusji na temat zrównoważonej edukacji.

Słowa kluczowe: edukacja środowiskowa, edukacja dla zrównoważonego rozwoju, dysputa, krytyczna teoretyzacja programu, ideologia

... it takes a lot of things to change the world:
Anger and tenacity. Science and imagination,
The quick initiative, the long reflection,
The cold patience and the infinite perseverance,
The understanding of the particular case and the understanding of the ensemble:
Only the lessons of reality can teach us to transform reality
Bertolt Brecht, *Einverständnis*

Introduction

The concept of sustainable development, formalised in the report, *Our Common Future* (The Brundtland Report, WCED, 1987), has stirred up fierce contestation over the last three decades, as might be expected of an attempt to fuse the concept of sustainability with the practices of development. The Brundtland Report's needs-based definition of sustainable

[1] This paper draws on previous publications by the author, in particular, Springett, D.V., 2010 and Springett, D.V., 2015.

development *(development that meets the needs of the present without compromising the ability of future generations to meet their own needs)* has entrenched within it the dynamic connection between social and environmental responsibility and harks back to the conception of the environmental problematic held to as part of the *environmental revolution* of the 1960s/1970s. The urgency of the sustainable development agenda requires a radical re-think of societal priorities, but the ideological struggle implicit in the concept, the contradictions embedded in it, are seen by some as too profound and too political to be resolvable – an *oxymoron* (The Ecologist, 1993, Rich, 1994), and a *dangerous liaison* (Sachs, 1993). It has been denounced as a cynical attempt to construct a *green cover* for business-as-usual and the ongoing exploitation of people and resources – a political façade for otherwise unacceptable corporate practices (Willers, 1994; Adams, 1995; Escobar, 1995; Paehlke, 1999). Indeed, the concept has become colonised by business, giving rise to the discourse of corporate social responsibility (CSR), now a powerful, even overpowering, strand in the sustainable development debate, characterised by Levy (1997) as an exercise in *political sustainability*. Some have advanced arguments in favour of dispensing with the term *sustainable development* altogether on account of its *vacuity* and *malleability* (Lélé, 1991; Sneddon, 2000) and its lack of *objective analysis* (Reboratti, 1999). Others perceive the concept as being political, radical and egalitarian, providing a *common currency* and bringing together conflicting vocabularies to a common though contested one (Jacobs, 1999). Sustainable development is, then, a vexed concept that attempts a balancing act across a deep ideological gap, an essentially political project that has given rise to a number of discourses that reflect the different interests struggling to maintain hegemony or to attain a voice. Dobers and Springett (2010) observe that discourses are, by their nature, problematic and contestable, open to interpretation and reinterpretation and governed by the motives and goals of those who develop the discourse. According to Foucault (1977), discourses are constitutive and productive: they construct reality. They are political and may be used to foster or legitimate particular interests, placing these beyond question and normalizing what is, in fact, contingent (Foucault, 1977). As Kureishi (2003) has put it: *After they've been told for a while, stories can turn into politics, into our institutions, and* '*it is important that they seem just the way things are, and the way they have to go on being* (Kureishi, 2003). The contestation around sustainable development calls for a stronger role for discursive democracy (Dryzek, 1994) and education has been perceived as the way of promoting the discourse and action that this requires.

The role of education

If we accept that discourses are *constitutive* and *productive*, that they construct reality, legitimating powerful interests and normalizing what might not, in fact, be good for people or for nature, then the role of education steps centre stage as a chief means of addressing the institutional, economic, social and environmental imperatives of sustainable development: a powerful tool to foster knowledge and understanding, to develop agency and to produce a new discourse. This may explain why it has proved a hard task to embed education for sustainable development securely in the curricula of schools and institutions of higher education. The earlier environmental movement emphasized the importance of education in helping people of all ages to understand the political causes of environmental problems and their interconnections with social problems. The environmental education movement arose as part of the popular, vernacular, quasi-communal style of community schooling in ecology, green lifestyles and intentional frugality that had also emerged in the 1950s and 1960s. This was linked to civil rights movements and the search for alternative life-styles, culminating in such initiatives as Earth Day and the establishment of the Club of Rome. As early as 1971, Commoner had underlined the political nature of the task in hand for educators, reminding us that: *The root cause of the crisis is not found in how men* [sic] *interact with nature, but in how they interact with each other; that to solve the environmental crisis we must solve the problem of poverty, racial injustice and war; that the debt to nature, which is the measure of the environmental crisis, cannot be paid person by person in recycled bottles or ecologically sound habits, but in the ancient coin of social justice*. These social movements and the concerns they raised, along with publications such as Carson's *Silent Spring* (1962) and Ward's *Spaceship Earth* (1966), helped to invigorate the environmental education movement (Springett, 2015)[2].

Environmental education/EE was also fostered by the new Environmental Education Associations that sprang up and by intergovernmental organizations such as the UN, UNESCO and UNEP and the IUCN. By 1969, a definition of environmental education was provided in the first issue of *The Journal of Environmental Education*:

Environmental education is aimed at producing a citizenry that is knowledgeable concerning the bio-

[2] Buckminster Fuller's *World Game*, 1961, Stewart Brand's *The Whole Earth Catalogue*, 1968-1972, and Paolo Soleri's *arcologies* are other possible precursors of the formal environmental education movement.

physical environment and its associated problems, aware of how to solve these problems, and motivated to work toward their solution (Stapp, 1969).

By 1971, the IUCN had issued the first internationally accepted definition of environmental education: *the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness among man* [sic], *his culture and his biophysical surroundings. EE also entails practice in decision-making and self-formulation of a code of behaviour about issues concerning environmental quality* (IUCN, 1971).

In 1972, the United Nations Conference on the Human Environment (UNCHE) produced the Stockholm Declaration *to inspire and guide the peoples of the world in the preservation and enhancement of the human environment* and established the International Environmental Education Programme, coordinated by UNESCO and UNEP. The UNESCO-UNEP conference held in Belgrade in 1974 delivered the *Belgrade Charter*, based on the *Stockholm Declaration*, and set up international and regional meetings on environmental education that culminated in the International Intergovernmental Conference on Environmental Education, held in Tbilisi in 1977. The *Tbilisi Declaration* provided goals, aims, objectives and guiding principles that already signalled the need for a transformative education. The focus was on education that would:

- foster clear awareness of, and concern about, economic, social and political interdependence in urban and rural areas;
- provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment; and,
- create new patterns of behaviour of individuals, groups and society as a whole toward the environment (UNESCO-UNEP, 1978, p. 3).

A major outcome of the United Nations Conference on Environment and Development (UNCED, 1992), which was based on the WCED outcomes, was *Agenda 21*, a blueprint for the future. Chapter 36 focuses on the role of education as a means of implementing the goals of *Agenda 21*, emphasizing that:

Education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues (…). It is critical for achieving environmental and ethical awareness, values and attitudes, skills and behaviour consistent with sustainable development and for effective public participation in decision-making. (UNCED 1992, Chapter 36, p. 2).

However, as Springett notes (2015), it was the NGO *Alternative Treaty on Environmental Education for Sustainable Societies and Global Responsibility*, presented at the Global Forum, in 1992 – the alternative Earth Summit – that provided a more explicitly critical and transformational set of principles. It brought a strong and open values position to the debate, calling for profound institutional change that would challenge the dominant social paradigm. It called for inclusive and participatory education at all levels, delivered through programmes that are holistic and systemic in approach and that take an interdisciplinary or multi-disciplinary stance, and are critical in their theorization. Its comprehensive goals come close to Huckle's ideal of *concrete utopianism* in education (2012) and include:

- Environmental education, whether formal, non-formal or informal, should be grounded in *critical and innovative thinking* in any place or time, *promoting the transformation and construction of society.*
- Environmental education is both individual and collective. It aims to develop *local and global citizenship with respect for self-determination and the sovereignty of nations.*
- Environmental education is not neutral but *is values based*. It is *an act for social transformation.*
- Environmental education must stimulate *solidarity, equality, and respect for human rights involving democratic strategies and an open climate of cultural interchange.*
- Environmental education should treat critical global issues, *their causes and interrelationships* in a systemic approach and within their social and historical contexts. Fundamental issues in relation to development and the environment, such as population, health, peace, human rights, democracy, hunger, degradation of flora and fauna, should be perceived in this manner (Emphasis added)[3].

Since UNCED, much energy has gone into promoting, practising and critiquing education for sustainable development, with continuing involvement from the UN, UNESCO, UNEP and the IUCN's Commission on Education and Communication (CEC). 2014 marked the end of the UN's *Decade of Education for Sustainable Development* (DESD). The major outcome of the DESD is the plan for a Global Action Programme on Education for Sustainable Development (GAPESD), with the overarching goal *to generate and scale-up action in all levels and areas of education and learning in order to accelerate progress towards sustainable development* (UNESCO 2013).

The goals comprise:

- Advancing policy;
- Transforming learning and training environments;

[3] These can be can be accessed in full on: http://habitat.igc.org/treaties/at-05.htm.

- Building capacity of educators and trainers;
- Empowering and mobilizing youth;
- Accelerating sustainable solutions at the local level.

The scope of the *Global Action Programme* and the international involvement in preparing its goals appear impressive. However, there are questions about its implementation: Will structural and institutional impediments curtail its effectiveness? Will the GAPESD itself represent a form of institutional control over education for sustainable development, determining the social politics of how the ESD agenda is set? Robottom (2013, p.161) notes that the DESD *is marked by vigorous attempts to impose centrally developed curriculum packages designed for universal implementation*.

The earlier movement for environmental education had initially focused on education *about* the environment (providing information) and education *in* the environment (experiential education, such as Outdoor Education). Subsequently, activists advocated education *for* the environment (Sultana, 1989) and the importance of developing the political nature of environmental education with an understanding of the underlying causes of both environmental and social degradation. Huckle (2012), a leading educator and writer on environmental education and education for sustainability, has reminded us again, like Commoner over four decades ago, of the need to bring realism into education, tearing away the myths or evasions that sanitize much of our teaching and learning. The need to develop the political role of education *for* the environment became more pronounced after the Brundtland Report and the new focus on *sustainable development*. At the same time, the concept of *sustainable* development stirred divisions between educators who chose to focus on *education for sustainable development* (ESD) and those who preferred to advance *education for sustainability* (EfS) – largely on account of the *contradictions* innate in the concept of sustainable development. This paper focuses chiefly on education for sustainable development/ESD while taking account of the concerns of educators who prefer to focus on EfS (see Springett, 2010; 2015). The author's experience is in teaching at university level and providing courses for corporate staff. At this level, the contestation and the epistemological contradictions the ESD/EfS debate raises provide a distinct learning advantage. A key requirement of any course on sustainability/sustainable development is, in fact, to problematise the concepts of *sustainable development* and *sustainability* and to consider the contested ways in which they are framed and the reasons for this. In this way, the sustainability/sustainable development discourse itself provides a powerful way of understanding the role asymmetric power relations play in determining which constructions become legitimated, and the fundamental relevance of the discourse to learners' own lives encourages their engagement in the debate. It calls for a critical theorization that shapes the content of courses, different from courses that alert learners to *issues* and *solutions* without a grounding in the genealogy and politics of those *symptoms* of the ecological and social problematic.

The transformational role of education for sustainable development

The earlier focus on education *for* the environment took into account the ontological and epistemological challenges implicit in the theorization, development and delivery of EE as an agent of change. As noted, education for sustainable development may challenge the dominant social paradigm even more trenchantly, calling for social transformation as well as the transformation of education itself and requiring pedagogical approaches most likely to empower learners. Like education *for* the environment, EDS calls for a critical perspective, an overtly political stance that may encourage learners to understand and critique the way the world works. Since the earlier EE movement, educational systems have become increasingly managerial and commercial in their goals and approaches (Slaughter and Rhoades, 2004). The transformative goals of education for sustainable development may be dismissed by some as mere *utopianism*, but Huckle, (2012) perceives the goal of the educator as striving for *concrete utopianism* (p. 43), bringing, as noted above, greater *realism* to education, teaching and learning about the realities of how the world works.

Such a transformational role represents a serious challenge to the overall educational systems of countries. The exposure of ideology that education for sustainability may provide constitutes what Maher (1985) has termed *dangerous knowledge* that makes it difficult to fit comfortably in the formal curriculum. As Apple notes (1979), the formal education curriculum plays a key role in sustaining and reinforcing social hegemony, leading to the acceptance and reproduction of the ideology of the dominant social paradigm. It does this through the overt and the hidden curricula, perpetuating utilitarian attitudes toward nature while maintaining the class and societal division that serves the values and ideology of dominant social groups (and see, for example, Trainer, 1990; Fien, 1993; O'Connor, 1998). Trainer (1990) describes the curricula of schools and colleges, in their overt and hidden manifestations, as reproducing the socially and ecologically unsustainable values and practices of the industrial affluent society – promoting the desirability of economic growth and a competitive economy, the importance of individualism and competitive advantage, and market determination of economic and social priorities. O'Connor (1998) similarly notes that the education system *per-*

forms most activities that are necessary for the production of labour power (p. 149). Consequently, the emancipatory and change-agent roles of education for sustainable development are problematic for the *reproductive* function that education has assumed, alerting learners to the potentially hegemonic role of education and developing the skills to interrogate existing knowledge (Sultana, 1989).

Impediments to a critical agenda

This chapter argues, then, that education for sustainable development, to be effective and to assume the transformational role ascribed to it, requires a critical theorization and a critical pedagogy that empower learners to envision *a moral economy of social justice, citizenship and sustainability, based in social democracy* (Huckle, 1996, p. 15; Huckle, 2012). However, there are problems associated with the critical theorization advocated here, a major one being the question of how educators are to gain preparation for teaching critical perspectives if that perspective is generally lacking from their own professional development. There is also the question of political difficulties and possible career consequences for educators who promote a critical agenda for education for sustainable development (Springett and Kearins, 2001). Academics are constrained to seek publication in top tier journals in order to strengthen academic assessments and to compete for promotion and research funding, and forays outside traditional disciplinary boundaries represent risk. The ideological struggle between the curriculum promoted in increasingly commercial and managerial educational institutions, at whatever level, and the sustainable development agenda may be fearsome. For example, a critical agenda promotes a radical perspective on the need for fundamental systemic change to modes of production and consumption. What we have frequently seen, however, is a focus on the *management* of the agenda of sustainable development (Luke, 1999; Springett, 2006a; 2006b).

The fact that a critical pedagogy is openly ideological is, then, a major obstacle. That is not to say that the intention is to co-opt learners to a particular perspective, although detractors might claim this. The goals of a critical pedagogy are emancipatory, intended to foster a habit of critical inquiry that *prevents* such capture. The goal is to involve learners in thinking through both personal and broader societal issues and to *hold a mirror to the world and show it as it is and as it has produced and shaped its own nature* (O'Connor, 1998, p. 52) – again, what Huckle (2012) refers to as *realism* in education. This requires that we listen to voices that are seldom empowered and hear perspectives on sustainability and sustainable development that do not solely reflect the views of *management* at whatever level (Springett, 2006a; 2006b). Such education is openly *political* in intent: it does not claim the supposed *neutrality* of the orthodox curriculum that helps to reinforce societal hegemony in covert and purportedly neutral and unbiased ways (Apple, 1979; Fien, 1993; Huckle, 1996; O'Connor, 1998; Springett, 2010), nor perpetuate a *sanitised* picture of the world (Willmott, 1994).

It is, however, a tough challenge in today's educational environment, where institutional impediments to education for sustainable development are rife. Beder et al. (2009) maintain that many of the difficulties that have been encountered in transforming education arise from changes in its provision and delivery at all levels and from the increasing influence that neo-liberal politics and the corporate world have on the nature of education. These changes start at schools level. It is not difficult to find *environmental* components of the curriculum in schools – nature study and outdoor education have long featured on the curriculum, and the 1990s saw the rising popularity of *whole-school* approaches through such programmes as *eco-schools*, although Huckle (2013) warns us of the issues raised by the not-infrequent corporate sponsorship of such programmes. Beder et al. (ibid.) also reveal the ways and means by which corporates have attempted to capture childhood, creating *hyper-consumers* of their products and services and, in the longer term, submissive employees and passive citizens, more engaged with *what they have* than *who they are*. The formal education system itself has played a part in the transformation of *what education is for* since government funding, or the lack of it, renders schools vulnerable to the pressure of business selling its products to children via schools through sponsorships, competitions, communication technologies and classroom materials that help to grow brand loyalty. More broadly, the focus on *consumer choice* has seen increases in the privatisation of education and the provision of charter schools – often with corporate funding and involvement.

Teachers often feel besieged by the demands of time-consuming new testing regimes, lack of control over what is taught, additional *welfare* responsibilities for their students and uncertainty about their own futures where tenure is threatened and unionisation is discouraged. It takes little imagination to grasp that education for sustainable development is likely to struggle under these conditions. Corporate-sponsored classroom materials provide a distorted view of environmental, health and social issues (Beder et al., 2012; Huckle, 2013). Schools have been driven to shift the goals of education from *quality* to *efficiency*, imperilling the goals of education for sustainable development. As Beder et al. underline, business coalitions are powerful, capable of influencing government policy to transform schools into competing business enterprises and of engineering a narrowing of the curriculum to focus on numeracy and literacy, computer skills and a business-friendly view of history and society.

Concern about ideological premises that increasingly dominate the tertiary system of education has also been vociferously expressed. The tertiary education sector, as *conscience and critic* of society, might have been expected to take the leadership role in the discourse about sustainability and sustainable development and to embrace it as a moral responsibility: it is here that our teachers and leaders are prepared for their future roles. However, the increasingly reductionist turn the agenda of Higher Education has taken in recent years is characterized by competition and market-driven values that mimic the corporate ethos rather than a collaborative culture (Collini, 2003; Parks, 2013), resulting in the commercialization and commodification of Higher Education. Slaughter and Rhoades (2004), reviewing changes in American universities, identified this as *academic capitalism*; while Anderson (2014, p. 39) notes that, in the UK, *universities risk reduction to so many sales outlets for customers in need of livery for the market*. The UK report of The Higher Education Funding Council for England (HEFCE, 2008), and the *Browne Report* on Higher Education and Student Finance (2010), underlined the increasing bureaucratic control of higher education seen as a *market* in which consumer demand (not least the requirements of business) will be sovereign (Collini, 2010; McKibbin, 2010). These are not trends that are likely to encourage either a critical perspective or a focus on sustainability. Schools and Higher Education institutions are in danger of becoming *edu-businesses*.

While the limitations of this paper do not provide the scope to discuss in detail the means to translate theory into praxis, the critiques considered here do bear important implications for the role of the teacher. What kind of role are we to assume if we are to reflect the goals of a critical theorization, and what kind of pedagogical choices are to be made? There is strong consensus amongst educators that a holistic, interdisciplinary approach is to be preferred. It is also advocated that pedagogical choices, that engage teachers and learners in action methods, are effective approaches that help to shape their role(s) – not by narrow definition, but through providing for experiential learning and helping to create democratic learning contexts (Springett, 2010). Action methods may be regarded as a paradigm rather than a set of methods (Norton, 2008) – they give students a higher degree of control over their own learning and provide a basis for responsible decision-making. In terms of the role of the teacher, it is suggested that the teacher who combines action methods with an approach based in critical theory is akin to Gramsci's classification of the *organic* intellectual. The goal is to enable people to see the world in a new way through active participation in practical life (Gramsci, 1971)[4]. As Huckle has remarked (1996), such a process becomes a critical inquiry in its own right. It enables us to explore the complexities and implications of sustainability, taking account of the economic, political, cultural, technical, social and environmental forces that foster or impede its goals.

Conclusion and key questions for ESD

In the thirty years since the concept of sustainable development stepped centre stage in the environment and development discourses, the debate around the concept and the struggle to control it have been advanced by powerful forces, often in order to tame its potentially radical agenda and its central questions of values, justice, equity and a responsible relationship with nature. However, the genesis of the construct is contested: it is seen by some as arising from the capitalist means of production and consumption that is at the base of *un*sustainability and supporting the hegemony of that paradigm. This contestation suggests the need for a more dialectical approach to the discourse, not a two-dimensional, un-dialectic *map*, but something more discursive. Education for sustainable development has the potential to play an important role here. If freed from the ideology that supports the *status quo*, ESD might prove to have the power to develop such a discursive approach that eschews neo-classical economics, calling for a better understanding and treatment of nature, and a norm of social equity and eco-justice. Such an overall conception of *the good life* might address key questions that have been raised by writers from different milieus and disciplines, in particular, the eternal philosophical question of *How to live?*

We would ask ourselves, What is education *for*? Curricula would need to address the reality and causes of *un*sustainability and encourage reflection on fundamental questions about the capitalist economy of consumerism. Questions about our ways of being would be posed: *How Much is Enough?* (Durning, 1992; Skidelsky and Skidelsky, 2012), and *To Have or To Be?* (Fromm, 1976). Learners would be encouraged to discuss what a *sustainable* political economy would look like, meeting the needs of all of the world's people while conserving the means and conditions of production. They would be educated to aspire to a transformational role as agents of change and to envision the moral economy of social justice, citizenship and sustainability, based in social democracy, the agenda that Huckle (1996) sees as being at the heart of ESD. As he remarks, such a process becomes a critical inquiry in its own right. It enables us to explore the complexities and implications of sustainability, taking account of the

[4] In Gramsci's classification of intellectuals into *traditional* and *organic*, the former are seen as *functionaries* with close allegiance to their own tradition and craft, practising under what they believe to be a rhetoric of autonomy. *Organic* intellectuals, on the other hand, enable people, through the provision of an alternative ideological framework, to possibly resolve dual consciousness by seeing the world in a new way.

economic, political, cultural, technical, social and environmental forces that foster or impede its goals. Might we not envision a *republic* of sustainable development educators and learners, free from some of the current constraints on ESD and able to broaden the conversation to include much wider and more diverse audiences? Such a movement might, perhaps, be akin to that of the popular, vernacular movements of the 1950s and 1960s that fed into the formalisation of environmental education. No doubt we would find that different ontological, epistemological and pedagogical perspectives would be rife, along with matters of quality control of content and delivery, of measurement, assessment and evaluation – of '*control*' *per se*. However, the scope for a more interactive and critical curriculum, drawing on some of the themes cited in this chapter and available to a wider community, is considerable. Will it emerge to drive the much-needed revolution in education for sustainable development?

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Ecophilosophy in Modern East Asia: The Case of Hansalim in South Korea

Ekofilozofia we współczesnej Azji Wschodniej: przypadek hansalizmu w Korei Południowej

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Abstract

This article is devoted to examining the relevance of ecophilosophy for sustainable development, especially in the modern East Asian context. Framed as a response to environmental historian Mark Elvin's claim that allegedly eco-friendly philosophical and spiritual traditions like Daoism, Buddhism and Confucianism, had no effect in preventing environmental degradation in the long history of preindustrial China. Also that given this historical precedent, ecophilosophy – or any type of ideology as such – is likely to have no relevance in the efforts toward sustainable development now under way worldwide, the article argues the necessity of examining Asian countries that are farther along in industrialization than China, and which have witnessed the emergence of powerful ecophilosophy-based movements as a reaction to industrialization and its unfortunate side-effects. In particular, the article focuses on the remarkable case of the Hansalim movement in South Korea, which has represented arguably the most comprehensive attempt yet at formulating an ecophilosophy based on the East Asian traditions which is relevant and practical for today's world. While Hansalim's achievements as the operator of the world's largest community-based organic food cooperative have recently begun to gain recognition abroad, this article focuses on the ecophilosophy underlying the movement – for which food has been but a symbol – and analyzes it to be rich in implications, especially concerning the social pillar of sustainable development, localism, and the role of ecophilosophy.

Key words: ecophilosophy, East Asia, South Korea, Hansalim, organic food cooperative, the social pillar of sustainable development, localism

Streszczenie

Artykuł podejmuje kwestię roli, jaką ekofilozofia może odegrać we wspieraniu rozwoju zrównoważonego, szczególnie w kontekście współczesnej Azji Wschodniej. To odpowiedź na twierdzenie historyka Marka Elvina, według którego pozornie prośrodowiskowe tradycje filozoficzne i duchowe, takie jak taoizm, buddyzm i konfucjonizm, nie powstrzymały degradacji środowiska w długiej przedprzemysłowej historii Chin. Co więcej, także współczesna ekofilozofia – czy jakakolwiek inna ideologia – nie wydaje się mieć związku z działaniami na rzecz zrównoważonego rozwoju. Tymczasem przykład krajów azjatyckich, których rozwój przemysłowy jest wolniejszy niż Chin, wskazuje na prężny rozwój silnych ruchów opartych na ekofilozofii, stanowiących reakcję na industrializację i jej niefortunne skutki uboczne. Szczególnym przypadkiem jest ruch hansalizmu z Korei Południowej, który reprezentuje bodaj najbardziej wszechstronną próbę sformułowania ekofilozofii opartej na wschodnio-azjatyckiej tradycji, która wydaje się być odpowiednią i praktyczną także dla współczesnego świata. Podczas, gdy osiągnięcia hansalizmu, jako zarządcy największej światowej kooperatywy produkującej żywność organiczną stają się coraz bardziej znane, warto skoncentrować się na założeniach ekofilozoficznych przyjętych przez ten ruch – gdzie żywność jest symbolem – i przedstawić ich liczne implikacje, szczególnie te odnoszące się do społecznego filaru rozwoju zrównoważonego, regionalizmu i roli, jaką w tym wszystkim powinna odgrywać ekofilozofia.

Słowa kluczowe: ekofilozofia, Azja Wschodnia, Kora Południowa, kooperatywa żywności organicznej, hansalizm, społeczny filar rozwoju zrównoważonego, regionalizm

Introduction

There used to be a time when discussions of the East Asian traditions of ecophilosophy did not require an elaborate justification. A fundamental assumption in ecological thinking once used to be that the massive environmental destruction which has accompanied the progress of modern civilization is ultimately rooted in the anthropocentric philosophical and religious traditions of the West, whose basic premise, according to Lynn White, is *that nature has no reason for existence save to serve man* (White, 1967, 1973, p. 25). This assumption led a number of scholars to study non-Western philosophical and spiritual traditions in search of alternative views on the proper relationship between humanity and nature, and not a few went on to seek their answers in Eastern philosophy. Yet since the 1960s and 70s, when views such as White's were accepted more or less as orthodoxy, there have been a number of new developments. To begin with, industrialization spread to numerous Asian countries, and the environmental destruction they experienced proved to be just as acute, their presumably non-Western philosophical and spiritual traditions notwithstanding. Moreover, with advances in scholarship on East Asian history, there have been attempts by some scholars to supplant the romanticized views of its traditions with what they consider more realistic ones. A representative example has been Mark Elvin, one of our foremost authorities today on the environmental history of China. In his recent magisterial work synthesizing a generation of scholarship on the subject, the Cambridge-trained Sinologist concluded that, even before the 20th century, the trend in China for four thousand years had been one where humans exploited nature to the point of its near exhaustion, and that the traditions such as Daoism, Confucianism, and Buddhism in the end had no appreciable effect in retarding or arresting the process (Elvin, 2004). Based on this conclusion, Elvin went so far as to question whether ideology as such – ecophilosophy included – has any relevance, not just in the East Asian context, but more generally in the worldwide efforts now under way toward making sustainable development a reality.

Those who wish to discuss the East Asian traditions of ecophilosophy are thus left today with two options. One is to approach their study purely as an academic exercise, without explicitly addressing the questions concerning their practical utility and relevance such as raised by Elvin. As the recent anthology edited by Callicott and McRae shows, *comparative environmental philosophy* remains in this sense a thriving field of academic inquiry (Callicott, McRae, 2014). Yet those who are still concerned with the relevance of the East Asian traditions of ecophilosophy – or of ecophilosophy in general, in fact – are left with no other option but to attempt to address the views such as Elvin's and, if they so choose, elaborate in what ways such traditions have been or can be relevant. In this article, we seek to pursue the second approach.

We would like to begin by suggesting that the history of preindustrial China, which is the main basis for Elvin's generalizations, may not be the best source of data for examining ecophilosophy's possible relevance for sustainable development. As well known, modern environmentalism, which has been a major force behind the growing acceptance of sustainable development as a new, more desirable development paradigm, emerged in part as an ideological reaction to industrialization. As Ramachandra Guha (among others) have noted, what has distinguished modern environmentalism from the general love of nature, which has been common enough in many traditional cultures, is an acute sense of crisis, and the very concept of ecophilosophy has been embraced by environmentalists and others sympathetic to their cause as an ideological weapon to be used in their struggle (Guha, 2000). The evidence of ecophilosophy's relevance, in short, is not to be sought in the history of humanity's preindustrial past, but more properly in what it has been able to do since industrialization and what it may yet be able to do in the future. In this sense, China indeed may not be the best place to investigate the relevance of the East Asian traditions of ecophilosophy for sustainable development: it is a country still undergoing industrialization and one where ideological dissent has been thus far little tolerated; any generalizations based on Chinese experience on the issue of ecophilosophy's relevance or the lack thereof are likely premature. What seems more appropriate instead are case studies focusing on Asian countries where industrialization has reached a more mature stage, and where ecophilosophy has had a chance to play a more noticeably prominent role (Kaczmarek, 2012; Hłobił, 2012).

This article is devoted to analyzing the Hansalim movement in South Korea as one such case study. As an Asian country with a relatively mature industrial economy, South Korea satisfies the criteria just mentioned. And despite Hansalim's centrality in the history of Korean environmentalism, and despite the recognition it has begun to receive abroad for its contributions toward sustainable development – in 2014 the Hansalim Association was one of the Gold recipients of the One World Award jointly given out by Rapunzel and the International Federation of Organic Agriculture Movements (IFOAM) – its story remains relatively little known to the outside world. While the story of its progress thus constitutes an important missing chapter in the annals of modern environmentalism, there are more reasons for focusing on Hansalim than from the interest of historical doc-

umentation alone. Other mature industrial economies of East Asia include Japan, Hong Kong, and Taiwan. While there have also been attempts by environmental activists in these countries to draw upon the East Asian philosophical and spiritual traditions, we know of no other instance of an *intellectual* movement aimed at formulating as comprehensive an ecophilosophy for the modern times as *Hansalim* or one that has been able to play as extensive a role in practical terms. In fact, Hansalim may be said to have been a living experiment in how to formulate an ecophilosophy that is relevant and practical for today's world, and analyzing its achievements and their contributing causes can help shed light on some of the central issues concerning sustainable development. Among such issues are (1) how to think more rigorously and creatively about the relationship of the *social* pillar of sustainable development to the economic and ecological, (2) how to balance the conflicting demands of localism and globalism, and finally (3) why ecophilosophy may indeed matter. Before moving on to examining these issues, a brief narrative of Hansalim's origins and progress will help situate them in their proper context.

Origins and Progress

As Guha among others have documented, in Western countries which were affected by industrialization early on, the first wave of modern environmentalism appeared as early as the nineteenth century. In Britain in particular, which was the first country to experience the Industrial Revolution, environmentalism originated primarily as a movement in literary, artistic, and philosophical circles, where ideological reaction to industrialization first set in. The progenitors of South Korea's Hansalim were also primarily poets, writers, and intellectuals. Yet in contrast to the early British environmentalists, who enjoyed the secure comforts of living in a country then near the height of its imperial power, and under a government which was among the most liberal for its time, the early experiences of Hansalim's founders were shaped by a vastly different set of circumstances. When they were born, their country still remained under Japanese colonial rule, which began in 1910 as part of Japan's growing militarism and imperial ambitions in East Asia and ended with its defeat in WW II in 1945. Even with the end of colonial rule, full independence did not follow, as the Soviet Union and the United States respectively claimed the northern and southern halves of the country as their protectorates, thus marking the beginning of division into two Koreas, and eventuating in a devastating war (1950-1953) which was the first overtly hot spot of the so-called Cold War. The chaos and grinding poverty of the postwar years then set the stage for a military coup led in 1961 by General Chung-hee Park, who would remain the country's president for nearly twenty years until his assassination in 1979. President Park was successful in implementing economic programs that would lead his country out of poverty and set it on the course to becoming a developed industrial economy at a pace that has been described as a *miracle*. Yet as with most military dictatorships of the time, Park's regime was also characterized by a widespread disregard for human rights and a brutal repression of dissent. As might be expected, most of those who later became the founders of Hansalim remained throughout the 1960s and 70s dissident intellectuals and anti-government activists protesting their country's military dictatorship.

As studies have shown, it has not been unusual for environmental activism in Asia to be *part of a larger social movement opposing authoritarianism and advancing more direct forms of democratic participation* (Lee, So, 1999, p. 11). While this remained true of many other environmental groups in Korea, what distinguished Hansalim was that its birth was precisely due to the decision on the part of its founders to end their confrontational relationship with the government. According to one of its principal intellectual founders, Chi-ha Kim, he experienced a spiritual awakening and epiphany while serving a prison term in the late 1970s, which led him to abandon his former identity as a dissident poet and anti-government activist and embrace an entirely different way of relating to the world, as it were. The original sentence he received for his anti-government activities had been death penalty; though it was later commuted to life imprisonment, his close encounter with death and declining health from which he continued to suffer while in prison led him to develop a deep interest in something far more fundamental than politics: the problem of existence itself. Through meditation and readings, he began exploring the very concept of life, eventually delving into the life sciences, ecology, the ecophilosophy of various Western schools, and especially the Eastern philosophical and spiritual traditions (Kim, 2008). He came to conclude that the hardship his country experienced in the modern times had been the symptoms of a much larger phenomenon and a more fundamental ill: a misguided attempt at – or a mistaken version – of modernization which had abandoned what he would eventually call the *Life Principle* or *Saeng-myung Sa-sang* in Korean (Hansalim, 1990a, 1990b). In contrast to the traditional Eastern view of the universe as an organic, living, interconnected whole, where nature and humanity, society and individual, were considered part of a seamless continuum and not distinct or opposing entities, the modern mechanistic view of the universe has insisted on the separateness of everything, whereby nature and other human beings came to be seen as objects, and hence ultimately easy prey to all forms of exploitation.

Released from prison following President Park's assassination, Kim joined up with some of his former cohorts to launch in the 1980s what they initially called the *Life Movement*. Kim was not the only for-

mer activist, it turned out, who had come to feel that the angry protest of a political dissident might be too limited a form of activism, that there had to be a way of addressing society's ills on a more fundamental level. Il-soon Jang, who along with Kim co-founded the Life Movement, had been particularly active in leading agrarian and labor protests in the 1960s and 70s. Yet towards the late 70s, he came to feel that such protest movements had had a limited success at best (Hansalim, 1990c; MSI, 2006; Shin, 2007; Yoon, 2010). As he and Kim reflected together on the causes, they came to conclude that the fundamental problem had been, once again, the habit of thinking in terms of separation and opposition, and not interconnectedness and cooperation. The agrarian protests, in particular, had taken place under the assumption that urban consumers were the enemies of farmers, that their interests were opposed. Kim and Jang came to conclude that the true solution to the problem of rural poverty did not lie in pitting farmers against urban consumers, but the opposite: promoting a more cooperative and symbiotic relationship between them and making them see that such a mutually beneficial exchange process was the norm in nature, where life could not exist without countless such exchanges taking place throughout the ecosystem (Hansalim, 1990b).

The Life Movement grew and expanded in two directions. First, it continued to grow as an intellectual movement, as more and more intellectuals who were attracted to its basic tenets began to join and add their own elaborations. While Chi-ha Kim claimed himself to be heir to the neo-Confucian school of Donghak, the Life Movement remained open to all sources of ideas, Eastern and Western, that could help fill out its intellectual edifice. Political scientist Soon-hong Moon, for example, thus became the first noted advocate of ecofeminism in Korea, while also serving as the translator of a number of key contemporary environmental publications from Europe and North America (e.g., Moon, 2006). As an intellectual movement, one of the Life Movement's principal achievements became supplying environmental activism in Korea with a comprehensive ecophilosophy and fundamentally transforming it thereby. Before the Life Movement, environmental activism in Korea had been little concerned with conserving nature; it consisted almost exclusively of advocacy for the people's rights against a corrupt government-industry combine believed to be responsible for pollution-related health hazards. It had been, in short, a movement to protect people, and the very concept of ecology had been left out. The Life Movement is credited with helping consolidate and energize what could have remained disjointed acts of protest and launch a veritable nationwide environmental movement in Korea based on ecological principles (Shin, 2007; Ku, 2009).

Nor did the founders of the Life Movement limit themselves to influencing others through their writings and lectures alone. Having renounced activism based on confrontation, they pursued a new form of activism more consistent with the Life Principle. Most notably, they organized in the late 1980s a national association of organic food cooperatives that could help promote a symbiotic relationship between farmers and urban consumers and educate the public concerning the Life Principle (MSI, 2006). As they saw it, there could not be a more potent symbol than food to illustrate the interconnectedness of everything in nature and the exchange processes that made life possible. Put succinctly, food was life and life became food. And nothing seemed more indicative of the destructiveness of the mechanistic view of the universe, which had perverted the order of things, than the uses of harmful pesticides and chemical fertilizers to increase the crop yield, which was to poison life itself in exchange for economic gains, and the increasing mistrust and confrontation between the producers of food and their consumers, who in reality were life-dependent partners (Hansalim, 1990a, 1990b, 1990c).

The name adopted for this cooperative association was Hansalim, which may be best rendered into English as *Living Together*. Just as living together could mean coexisting in nature, working together to save one another from destruction, and cohabiting and maintaining a common household, Hansalim signifies all three. It is now the term generally used to represent, in place of *Life Movement*, both the food coop association and the general intellectual principles formulated by Kim, Jang, and their cohorts.

Three Pillars of Hansalim: Social, Local, and Philosophical

By 2014 the sponsors of the One World Award was to note of Hansalim: *The biggest community-supported agriculture organization in the world. On 2,000 farms the association produces health food products for 1.6 million people. The product distribution is organized by 21 distributing coops, 180 health food stores and a sophisticated delivery system*. Concerning the award itself, they explained: *The objective of the award is based on the three pillars of sustainable development: ECOLOGY, ECONOMY and SOCIAL ASPECTS* (One World Award, 2014). While it is certainly possible to analyze Hansalim's contributions in terms of the three generally accepted criteria of sustainable development, a more fruitful analysis of its fundamental principles and their relevance for the worldwide debates on sustainable development may require slightly different headings. For the three pillars of Hansalim may be said to have been its emphasis on the *social*, *local*, and *philosophical*.

(1) *Emphasis on the social*. As Kevin Murphy has recently noted, of the three pillars of sustainable development, *the meaning and associated objectives of the social pillar remain vague* and *it has been de-*

scribed as the most conceptually elusive pillar in SD discourse (Murphy, 2012, p. 15). The term *(ecologically) sustainable development* was originally coined as part of an effort to reconcile the conflicting demands of economic development and environmental protection; if our thinking on the social pillar of sustainable development lags behind that on the economic and the ecological, it is in part because it has been historically a later addition (Pak, 2014). Moreover, the trade-off between economic development and environmental degradation is intuitively easy to grasp, while the relation of either, let alone both, to social changes is extremely complex, which might further go to explain why a good part of sustainable development discourse has continued to focus on issues relating to the trade-off between the economic and the ecological. Still, some scholars have suggested that the key to making sustainable development possible lies precisely in social changes. According to sustainable economist Tim Jackson, for example, arguably the most important driver of economic growth today and also the principal cause of accelerated depletion of the natural resources and environmental degradation is consumerism, which is fueled to a great extent by status anxiety, a social phenomenon, if there ever was one (Jackson, 2008). People keep buying things they do not really need in order to keep up with the Joneses and corporations depend on their continuing to do so. If society could be organized on a new basis so that people may satisfy their need for status through some other channel than consumption, or better yet, seek the affirmation of self-worth through some other criterion than social status, genuinely sustainable development, Jackson maintains, may yet be possible (Jackson, 2009). The question, of course, is how to bring about such social changes, and here Jackson's answer stipulates another type of trade-off: it is the job of government, says Jackson, to encourage and reinforce new behavior among citizens, thus making an ever intrusive government the necessary price for a more sustainable lifestyle (Jackson, 2008).

Hansalim suggests an alternative way of thinking about the social pillar of sustainable development. The keen interest of its founders in the social has been due to two main reasons. In the first place, they began as activists seeking greater social justice under a military dictatorship; as related, some of them came to embrace an ecological movement while seeking a solution to address society's ills on a more fundamental level. Second, while remaining open to new sources of ideas, they have also tried to remain faithful to their understanding of the East Asian philosophical and spiritual traditions. As numerous scholars have argued, the *Arcadian* tradition in Western environmentalism – popular among the early British environmentalists and still a powerful ideological font – has arisen as a protest against a virulent form of anthropocentrism allegedly central to the Western tradition, but it too assumes an essentially adversarial relationship between nature and human beings (Pak, 2012). If the Western tradition has by and large insisted on the right of human beings to subdue nature so it no longer poses a threat, Arcadian environmentalism flips the emphasis around to argue the right of nature to be protected against human intrusion. According to the Arcadian tradition, human civilization thus constitutes the antithesis of nature, and it is against this notion that the modern *Utilitarian* school of environmentalism has been arguing the need for regarding human civilization as an extension of nature, not its antithesis, and nature and human society as constituting a continuum, and not standing in an adversarial relationship. According to Hansalim, the tradition in the East – before it was eclipsed by imported alien thinking contrary to its principles – has always been to regard human society as an extension of nature and its improvement as dependent on an ever more faithful adherence to the principles of nature (Hansalim, 1990a, 1990b). It is highly relevant that Hansalim claimed itself to be heir to the neo-Confucian school of Donghak. While Confucianism was originally based on the principles of Daoism – Confucius's commentaries on the book of *I Ching* may well constitute the largest extant body of writing we have from Confucius himself – its particular focus came to rest on the importance of proper social relations and ethical conduct. The Donghak school originated in late 19th-century Korea in part as a reaction to Western learning which had begun to infiltrate East Asia – Donghak literally means *Eastern Learning* – but more fundamentally as an attempt to reinterpret and revitalize the Confucian tradition which had for centuries remained at the core of Korean society (Cumings, 1998, p. 115-120). In the Hansalim interpretation of Donghak, all things share attributes of divinity, since it is through them that the Divine realizes itself; given this shared divinity, nothing is inherently superior or inferior in the universe – human beings are not superior to non-human beings and even non-living beings are not inferior to living beings – and the same cosmic principle of equality should be the foundation of a proper society, and not social hierarchy, as in the traditional interpretation of Confucianism (Hansalim, 1990a). With its radical egalitarian philosophy, Donghak eventually became the ideological basis for one of the most widespread peasant rebellions in Korean history. Hansalim went farther than Donghak in many ways, especially in its attempt to overcome the gulf between Eastern and Western learning – again, cooperation, not opposition – but remained faithful to its spirit in linking the cosmic with the social, or in more up-to-date terminology, the ecological with the social.

Like Jackson, Hansalim believes that social changes are key to sustainable development. According to its founders, the tendency of modern society to emphasize economic gains at the expense of everything else has been greatly exacerbated by the replacement of

an economy based on various interlocking social relations with one that operates through the impersonal mechanism of the market (Hansalim, 1990a). In a simple barter economy, for example, the producer of food deals directly with its consumer, and knowing the consumer as a person, is far more likely to refrain from using, say, poisonous pesticides; moreover, the fact that the producer of food in turn requires the goods and services provided by other members of the community all the more reinforces the necessity of a relationship based on trust and fairness (Moon, 1992). In the modern market economy, food is essentially a commodity that is exchanged for money, and with a number of intermediary – whole, retail, and so on – buyers and sellers in between, it becomes almost irrelevant for the producer to think about the human being that eventually consumes the food. And what the producer of food requires in order to purchase the goods and services provided by others in a market economy is, again, money; he or she is thus given all the more reasons to focus on earning more money, and not producing better or safer food. Hansalim's organic food cooperative association has been an attempt to emulate trust-based social relations reminiscent of a direct barter, but adapted to be fully operational in modern society. Its membership comprises both producers and consumers, who meet regularly to agree on proper levels of annual production and land use, safety standards, acceptable levels of carbon footprint, and so on – and pricing necessary to make it all work while being fair to both producers and consumers. Many members also participate in events held throughout the year to educate themselves and the public about the ecophilosophy of Hansalim.

Unlike the view such as Jackson's – and he is by no means alone in espousing it – that intrusive government intervention is a necessary trade-off for sustainable development, Hansalim does not advocate greater government action. If it truly had its way, it would prefer to see a society consisting mainly of autonomous local communities, with minimal to no interference from government. That is to say, not only does it prefer to see nurturing social relations replacing the market, but much of the formal apparatus of government as well.

(2) *Emphasis on the local*. Communal relations such as emphasized by Hansalim presumably presuppose people living in relatively self-contained communities which are reasonably compact. The idea of localism is not new nor is it exclusive to the Eastern tradition. Localism, for example, was central to a number of non-Marxist socialist traditions before they were eclipsed by Marxism: the utopian socialist Charles Fourier, for example, advocated the world population being reorganized into autonomous *phalanxes* consisting of a few thousand souls maximum each, where people would learn to rely on gratifying personal relations. The idea of a stateless society that functions mainly through voluntary associations was of course also central to several schools of anarchism. In more recent times, softer varieties of localism have been embraced by modern environmentalists, and various arguments in their behalf have become a mainstay in sustainable development discourse. Thus, for example, Arné Naess, the principal founder of the deep ecology movement, observed that *increased local autonomy reduces energy consumption* (Naess, 2008, p. 146), while *localism* and *municipalism* now constitute foundational concepts in social ecology (Merchant, 2005; O'Connor, 2008).

Though Hansalim was influenced by deep ecology and other varieties of Western ecological thinking, its emphasis on localism actually predated its encounters with them. In fact, the idea of self-sufficient, autonomous rural communities had been embraced by the Donghak peasant rebellions of the late 19th century, and was popular also among dissident intellectuals and anti-government activists in Korea in the 1960s and 70s (Lee, 2007). Those who went on to found Hansalim had been active in the agrarian protests and farmers's cooperative movements long before Hansalim; as has been seen, it was their lack of success in such endeavors that led some of them to embrace ecophilosophy as a solution (Hansalim, 1990b; Ku, 2009).

One of the oldest challenges for localism has always been preventing autonomous local communities from becoming isolated from one another, and in the worst case, chaos and conflict resulting from each community being left free to pursue its own interest. While this problem remained largely unsolved in the earlier, localism-based socialist traditions, Marxism eventually bypassed the problem, in a manner of speaking, by relying on centralized state bureaucracy in place of localism. Hansalim may have found a different type of solution. As its founders came to realize, the previous attempts at creating autonomous rural communities in Korea had failed precisely because of the problem of isolation and the lack of coordination among them (Hansalim, 1990a). Their solution was to create a movement that remains rooted in local communities, but which is unified on the national level by virtue of a powerful shared ideology. Hansalim's organic food cooperative association is designed to illustrate the workings of this model: while its local chapters remain community-based, they are unified nationally by the ecophilosophy of Hansalim, with its members voluntarily regulating their own behavior according to a common code of ethical conduct. This way, the Hansalim model has been able to challenge the view that the behavior change required for sustainable development cannot take place without intrusive government intervention. With their days of anti-government activism behind them, what Hansalim's founders deliberately sought were *extra*-governmental solutions – solutions, that is, where government becomes by and large irrelevant.

(3) *Emphasis on the philosophical*. We are thus brought back to our initial question: does ecophilosophy have any relevance in our efforts toward sustainable development today? We have seen that in the case of Hansalim the answer has been a resounding positive. According to Eder, Hansalim's appeal has been essentially an *emotional* one, and the movement is *incapable of sustaining a modern environmental movement* because it lacks *rationalism and consistent scientific rigor* (Eder, 1996, p.113). We now have reasons to question the premise which was operative in Eder's study almost twenty years ago that *rationalism* and *consistent scientific rigor* are what best sustains a modern environmental movement. For all our advances in the scientific studies of environmental problems and other sustainability-related issues since, the public interest in such problems and issues is nowhere near what it once used to be, especially in countries like the United States. What is lacking in the United States today especially compared to the 1960s and 70s is not scientific knowledge, but a viscerally emotional connection the public once felt toward environmental and sustainability-related issues (Pak, 2012). While the social remains the least adequately explored pillar of sustainable development, Murphy has been able to identify from his survey of the existing literature four issues that scholars agree on as particularly urgent: *equity*, *awareness for sustainability*, *participation*, and *social cohesion* (Murphy, 2012). Apart from the equity issue, the urgency of the second and third issue – and also to an extent the fourth – seems to confirm that in our discussions of sustainable development, the public has been largely left behind and that forging a public consensus in its favor has now become a major challenge in moving forward.

It is sometimes too easy for scholars and scientists to forget that those who have the time and training to study and evaluate the so-called scientific facts remain a tiny minority in any society. And even for those who have the time and training, it may yet take several mental leaps to arrive at a concrete program for action based on the scientific facts. The public persuasion required for great changes in history has therefore tended to rely on symbols, rituals, and narratives that can tap into deep emotions by relating the facts in a manner accessible to the public. One cannot hope to improve upon naturalist and sociobiologist E. O. Wilson's elegant formulation: *No matter how much we see, or how beautifully theory falls out to however many decimal places, all of experience is still processed by the sensory and nervous systems peculiar to our species, and all of knowledge is still evaluated by our idiosyncratically evolved emotions. (…) Art is in our bones: We all live by narrative and metaphor*. (Wilson, 2000, p.358) Among the virtues of ecophilosophy such as Hansalim's is that it can help orchestrate emotionally-charged symbols, rituals, and narratives in the most comprehensive and effective manner, with stories that are cosmic in scale, deeply moral in implications, and practical in application. While not everyone might find such stories persuasive, others may not be persuaded by anything less.

Nor, of course, are the uses of ecophilosophy limited to persuading the public. As a number of authors and authorities have noted, *the presentation of SD issues without reference to their interpillar relationships may be described as 'bundling', 'artificial', and 'false'* (Murphy, 2012, p. 20). To use Eder's terms, *consistent scientific rigor* requires restoring coherence to our now much fragmented sustainable development discourse, and ecophilosophy like Hansalim's, by virtue of its efforts toward comprehensiveness, challenges us to think more deeply about how our extant ideas on the multifaceted aspects of sustainable development may be brought together to form an interactive whole.

Conclusion

While creating and operating *the biggest community-supported agriculture organization in the world* is not an insignificant achievement, Hansalim entertains no illusions about its accomplishments. The success of its organic food cooperatives has been in fact a source of growing concern for some of its key members, who worry that the food business might absorb most of its energy, at the expense of its bigger objectives, which is to bring about social changes consistent with its ecological principles. Moreover, Hansalim is fully aware that sustainable development is now essentially a global issue, though its strategies have been traditionally geared toward mobilizing the sentiments and initiatives of those within Korea, especially through reliance on symbols, rituals, and narratives of indigenous origin (MSI, 2006). Yet if the story of Hansalim's own progress teaches us anything, reliance on symbols, rituals, and narratives of indigenous origin may not be a source of weakness but strength. The creation of one universal ecophilosophy for all of humanity may yet be possible, but given the world's linguistic and cultural diversity, and given the growing interest in localism, such philosophy many need to be retold in local dialects, as it were, with the help of indigenous symbols and metaphors. To borrow the language of Donghak, the Divine may prefer to express itself in a rich variety of tongues. In this sense, Hansalim has already been contributing to the global efforts toward sustainable development by remaining faithful to its local roots. One of the most effective ways in which it can now further contribute may be to let its own story become more widely known, so that those in other parts of the globe would be further inspired to draw upon to their own local traditions and participate in creating rich varieties of ecophilosophy which are much needed by today's world.

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The Concept of *Nobilis Barbarus* in the Light of Contemporary Ecological Challenges

Koncepcja *Nobilis Barbarus* w świetle współczesnych wyzwań ekologicznych

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Abstract
The concept of the noble savage present in Western culture expresses the belief in the nobility of human nature which impels man to lead life in harmony with nature, oneself and other people. The article distinguishes and examines four different ways in which this concept is approached. These are: classical approach, naturalistic approach, Arcadian approach, and ecological approach. The study makes an assessment of the concept of the noble savage, and demonstrates that it is incompatible with contemporary state of research on human nature and with man's activity in the world. The assessment focuses on the ecological approach to the concept of the noble savage (the so-called ecological Indian), which entered mass culture and shapes false beliefs about man's capabilities in relation to nature.

Key words: noble savage, *nobilis barbarus*, ecological Indian, pristine myth, ecological crisis

Streszczenie
Obecna w kulturze zachodniej koncepcja szlachetnego dzikusa wyraża przekonanie o szlachetności natury człowieka, która uzdalnia go do prowadzenia życia w harmonii z przyrodą oraz w zgodzie z samym sobą i drugim człowiekiem. Artykuł niniejszy wyróżnia i charakteryzuje cztery ujęcia tej koncepcji: ujęcie klasyczne, ujęcie naturalistyczne, ujęcie arkadyjskie i ujęcie ekologiczne. Opracowanie to dokonuje oceny koncepcji szlachetnego dzikusa, wskazując na jej niezgodność ze współczesnym stanem badań na temat natury człowieka i stylu jego aktywności w świecie. Ocena ta koncentruje się na ekologicznym ujęciu koncepcji szlachetnego dzikusa (tzw. ekologicznego Indianina), która weszła do kultury masowej i kształtuje nieprawdziwe przekonania na temat uzdolnień człowieka w odniesieniu do przyrody.

Słowa kluczowe: szlachetny dzikus, *nobilis barbarus*, ekologiczny Indianin, mit dziewiczej przyrody, kryzys ekologiczny

Introduction

The concept of *nobilis barbarus* (the noble savage) has been present in culture for millennia. It expresses the belief in the nobility of human nature which impels man to lead life in harmony with nature, with oneself and other people. In the Euro-Atlantic culture, this concept is often presented in opposition to the concept of the civilized man who is believed to be alienated from the natural environment, and thus unable to form harmonious relationships with nature and other people.

Although the very concept of the *noble savage* was first used in this sense only in modern times, it is possible to distinguish four basic ways in which it is viewed in Western culture. These are: 1) classical approach; 2) naturalistic approach; 3) Arcadian approach, and 4) ecological approach. There are many indications that all these approaches are incompatible with the contemporary state of research into the

nature of man. In the ongoing debate on this subject, many scholars believe that the concept of the noble savage is just another myth that has no foundation in real life. In view of the fact that the concept has gained prominence and is applied in developing conservation strategies in many Third World countries, it seems necessary to assess how truthful and reliable it is. After all, the rich European tradition shows that implementing even most noble ideas which are based on a false anthropology brings about even more serious problems instead of solving them.

Nobilis barbarus in the classical approach

In European literature, Homer was the first to make a clear distinction between savage tribes and the Greeks who were a civilized people. When describing the beginnings of European civilization in *The Iliad*, he mentioned names of some Greek heroes who had defeated representatives of the most savage peoples – a tribe of centaurs (Homerus, 1974). In ancient thought, human savagery was contrasted with the Greek civilization. Two opposing views on the evolution of civilization clashed in this thought. The first one was a myth about four ages of mankind attributed to Hesiodus. According to it, the earliest period of human history referred to as the Golden Age represented the highest level of cultural development. It was characterized by carefree happiness. Man did not have to work, did not suffer, he lived in a world where there was no violence, the earth provided food in abundance, the climate was mild, and people who did not grow old spent their time enjoying themselves (Hesiodus, 1978; Ovid, 1998). As time went by and man entered the Silver Age, and then the Bronze and the Iron Age, his morals were gradually degrading and the level of existence declined. The other belief which was in opposition to the concept of cultural regression was that of a gradual progress of culture over time. This belief was well illustrated by Plato in *Protagoras,* where the progress of Greek civilization was explained with the gods' interference. According to Plato, the gift of law and a sense of shame, that were given to man by gods, were the prerequisites for building social and political order necessary to create *polis*, where Hellenic civilisation developed (Plato, 2008, Plato 1998). The idea that development of culture is a process of continuous improvement was also widespread in Roman thought (Lucretius, 1975).

Hellenic culture from the very beginning stressed the widespread savagery of peoples neighbouring Greece who were described as barbarians. The Greek literature, however, also pointed to the existence of uncivilized tribes that were characterized by innate nobility and gentleness. Homer was one of the first to write about them in his *Iliad*, when he described a tribe of the long-living, milk-nourished Hippomolgi as most just men (Homerus, 1974). This view was repeatedly alluded to by Herodotus even though he believed in a mythical geographical pattern according to which the level of a people's culture and its remoteness from Greece were reversely proportional (Flory, 1987). Consequently, the further away some people lived from Greece, the more barbaric lifestyle they should lead (Williams, 2012). To confirm this principle, Herodotus gave numerous examples of extremely barbaric peoples, but at the same time he pointed out to the existence of noble savage tribes. A people living in Ethiopia, the farthest land known to the Greeks at that time, is a good case here. Ethiopia is presented as a paradise inhabited by a tribe of ennobled primitives, where gold is found in great abundance, and huge elephants, and ebony, and all sorts of trees; the men living in this country are the tallest in the world, the best looking, and longest-lived (Herodotus, 1965).

The concept of *nobilis barbarus* is best visible in the description of a tribe of the Argippaeans who were presented by Herodotus in marked contrast to the wild and aggressive Scythians. He portrayed them as a people living very simple life, feeding on only fruit and rejecting violence. Neighbouring tribes respected the Argippaeans and did not harm them as they were looked upon as sacred. When they fell out, they also asked them to make up the quarrel and those who flew to them for refuge were safe from all hurt (Herodotus, 1965). In a similar way, Pliny the Elder in his *Natural History* depicted a tribe of noble savages which he called the Arimphaeans. They also did not eat meat, lived on forest berries, they had mild manners, and were deemed a sacred race and so they were left unmolested even by the savage tribes among their neighbours (Pliny, 1961).

The concept of *nobilis barbarus* is also present in Roman literature, which made references to the myth of the Golden Age of Mankind and identified it with living in a happy land of Arcadia, which was to become extremely popular in European literature several centuries later. One of the first Roman poets to write about harmonious coexistence of man and nature and introduced the myth of Arcadia to Latin literature was Vergil, who drew upon Theocritus' pastoral poems (Theocritus, 2002; Vergil, 1999). It was Ovid, however, that explicitly combined the myth of the Golden Age with the myth of Arcadia, a place where he set the events of his *Metamorphoses.* He described the lost Golden Age when nature and man coexisted harmoniously. At that time, man had not known law yet, but his undisturbed mind told him how to act. His speech was simple and sincere, his soul pure and his deeds righteous. All felt secure, people did not have high expectations, and nature provided them with everything they needed (Ovid, 1998). In a similar vein, Horace wrote about an idyllic life close to nature. He not only praised such life, but he lived it himself. One of the most beautiful descriptions of a simple, safe and honest life in the countryside, far away from a city life spoilt with greed and lust for power, can be found in the epod

Beatus ille, qui procul negotiis... (Horace, 1994). The concept of *nobilis barbarus* was also alluded to by Tacitus, though in a slightly different context. He praised the noble savagery and rigid manners of Germanic tribes, contrasting them with the inhabitants of declining Rome, who lived in luxury and debauchery (Tacitus, 1999).

Nobilis barbarus in the naturalistic approach

The naturalistic view of the noble savage concept is connected with getting to know the customs of unknown peoples. The development of this concept had been helped by millenarian movements, which at the turn of the millennium awaited the revival of corrupt mankind and return to the primal innocence of the prelapsarian condition, and the restoration of the Golden Age (Goff, 1982). People in Europe were convinced that their world was utterly corrupted, and that an idyllic world inhabited by noble, untainted by sin savages could be found in the Orient (Lie, 2004). This belief was based on, among others, travel accounts which were brought to Europe by Marco Polo. When describing his adventures, Marco Polo often idealized the noble character of Asian peoples contrasting them with depraved Europeans, and in this way reinforced the myth of *nobilis barbarus*. For example, he praised fidelity of spouses when describing the Hindu custom of sati in which a recently widowed woman buried herself on her deceased husband's funeral pyre (Polo, 1976). Similarly, he praised fidelity of married couples in his account of the Mongols' customs (Vogel, 2012).

However, it was geographical discoveries of the 15th and 16th century that played key role in popularising the naturalistic approach to the concept of *nobilis barbarus*. Christopher Columbus' *Diary* and the work of Pedro Mártir de Anghiera, a historian of the Spanish conquest, entitled *De Orbe Novo* (1530) shaped the views of Europeans about the tribes inhabiting the New World that were uncorrupted by civilisation. Descriptions of virgin nature and customs of the newly discovered peoples were in line with the desire to find a terrestrial paradise, a desire Europeans had held for centuries. Many were convinced that the nobility of peoples in America resulted from the fact that they had descended from Adam and Eve before the first humans committed the original sin (Campbell, 1991).

The myth of the noble savage was also popularised thanks to the efforts of Vasco de Quiroga – Bishop of the Diocese of Michoacán and the Dominican Bartolomé de Las Casas, both of them working actively for peaceful evangelisation of the Native Americans. Their efforts were supported by the Jesuits who created a social system in South America that can be regarded as the implementation of the Arcadian myth. Inspired by Thomas Moore's *Utopia*, Jesuit Reductions were one of the greatest social experiments in human history which helped to develop a completely new, orderly and peaceful social structure. Their main aim was to assimilate hundreds of thousands of the native people into Western culture while maintaining their simple and noble lifestyle. Jesuit Reductions were a kind of model of social relations built on Christian values, which was supposed to be a response to the decadence afflicting Europe. They were also a peaceful alternative to slavery imposed on the natives by the Spanish and Portuguese (Cro, 1990).

Nobilis barbarus in the Arcadian approach

The third approach to the concept of the noble savage was especially popular between the 16th and 19th centuries. On the one hand, the popularity of this approach stemmed from the fascination with ancient literature and the emergence of Romantic literature extolling a simple life close to nature. On the other hand, it was a consequence of philosophical debates about human nature. The first works of modern literature which dealt with this subject were *Arcadia* (1504) written by Jacopo Sannazaro and *The Countess of Pembroke's Arcadia* (1586) by Philip Sidney. The Arcadian myth became very popular in European culture in the 17th century (Gerbino, 2009), which is evidenced by rich literature, music and painting of that period. William Shakespeare's *Midsummer Night's Dream* and two paintings by Nicolas Poussin entitled *Et in Arcadia Ego* (Green, 1985) deserve a special attention in this respect. The seventeenth-century Polish literature also evoked the myth of Arcadia and happy noble living in harmony with nature. This is well illustrated by Mikołaj Rej's *The Life of the Honest Man* and Jan Kochanowski's *The Midsummer Night's Song*.

The concept of *nobilis barbarus* was revived and popularized in European culture also as a result of philosophical debates on the state of human nature (Pinker, 2003; Flynn, 2008). These debates were inspired by atrocities that Europe had experienced during the wars of the 16th and 17th centuries. Thomas Hobbes in *Leviathan* (1651), which was published shortly after the Thirty Years' War had ended, concluded that the state of nature was not good. In *De Cive*, he described man as *homo bellicous* – a being fighting a continuous war of all against all (*bellum omnium contra omnes*) (Hobbes, 1999). A completely different view on the state of human nature was presented by the British philosopher Anthony Ashley Cooper, who proclaimed that man was inherently good and the moral sense was innate to him (Cooper, 1977). Similarly, Jean-Jacques Rousseau believed in the noble nature of man. He was of the opinion that human evil was a consequence of the negative influence of civilization. He claimed that *man, however, is naturally good; what then could have depraved him to such a degree, unless the changes that have happened in his constitution, his improvements, and the light he has acquired. Let us*

cry up human society as much as we please, it will not be the less true that it necessarily engages men to hate each other in proportion as their interests clash (Rousseau, 1761).

Currently, there is a debate about who first coined the term *noble savage* in the meaning presented here. The literature often points to J-J. Rousseau who used the expression *bon sauvage* in 1755. Modern research, however, suggests that the term *noble savage* had earlier been employed by John Dryden in his play *The Conquest of Granada by the Spaniards*, which had its premier already in 1670 (Ellingson, 2001). Dryden praised the freedoms that living in a state of nature gives to man: *I'm as free, as Nature first made man, 'ere the base Laws of Servitude began, when wild in woods the noble Savage ran* (Dryden, 1995). And then some scholars believe that Dryden borrowed this phrase from a French explorer of North America, Marc Lescarbot, who had written about *bon sauvage* in *Histoire de la Nouvelle-France* (1609) some years before Dryden (Ellingson, 2001; Hames, 2007).

Ignoring those disputes about the origin of the term *noble savage*, it must be stated that the concept was greatly popularised and consolidated by the Romantic literature of the 18th and 19th century. The works of popular American writer James Fenimore Cooper (1789-1851) are particularly noteworthy in this regard. Cooper was the author of a popular series of adventure novels in which he presented a romantic and idealistic picture of the 18th-century America. His novels express the belief that close contact with unspoilt nature brings out the best qualities in man. Hence, the Indian characters of his novels often embody the concept of *nobilis barbarus.* Similarly, white trappers living far away from civilization in harmony with nature become noble, righteous and happy. Cooper presents them as nature lovers who kill animals only in self-defence or to secure the necessary supplies for a simple life in harmony with nature.

Nobilis barbarus in the ecological approach

The way the concept of the noble savage is viewed today differs from how it was perceived in the past. While all the approaches focus on the harmonious coexistence of man and nature, the first three emphasise nature as the dominant element that allows the development of culture, ensuring the harmonious coexistence of man and nature. The ecological approach, on the other hand, emphasises the dominant importance of culture; nature can develop to the extent that man choosing some kind of a lifestyle permits (Łepko, 2003). Man has to limit his use of natural resources, this being a prerequisite for harmonious coexistence. Today, nature is dependent on the good will of man. The technology of our civilisation makes it possible not only to disturb harmony of nature, but also to disrupt the homoeostasis and destroy all beings living on Earth.

A contemporary, ecological approach to the concept of *nobilis barbarus* has its source in the experience of the fragility of nature and the rapid and irretrievable disappearance of the last pristine areas on our planet. Alluding to the earlier approaches to the noble savage concept, Henry David Thoreau initiated a new one, the aim of which was to shape a nature-friendly, simple lifestyle that he described in his book *Walden or Life in the Woods* (1854). In his numerous publications, Thoreau urged the consumer American society to follow the Indian community lifestyle which he held up as a model of the care for nature. He was convinced that the civilized man was able to change his lifestyle, and the Indian style of presence in nature could be very helpful in this respect.

The concept of the ecologically noble savage introduced by Thoreau was greatly popularised by the 19th-century Romantics and Primitivists in their paintings and literary works. Numerous editions of their works reinforced the model of the nature-friendly Indian in the public consciousness. Much in this regard was done by an American diplomat and best-selling writer Ernest Thomson Seton (1860-1946) as well as Charles Alexander Eastman (1858-1939), a writer and social activist born in the Sioux tribe (Krech, 1999).

The Ecological Awakening in the 60s and 70s of the twentieth century contributed to the dynamic development of environmental movements that employed the concept of the ecological Indian present in culture, contrasting it with the Westerner's consumer lifestyle. With the development of mass culture, which popularized this concept, the ecological Indian permanently became part of the social consciousness, becoming a model for shaping ecological relations between man and nature. This is well illustrated by a social campaign organized in the United States as early as 1971 under the slogan *People start pollution. People can stop it* (Krech, 1999).

The stereotype of the Indian living in harmony with nature was perpetuated by film productions, especially Kevin Costner's screen version of Michael Blake's novel *Dances with Wolves* (1990) and a popular screen version of James F. Cooper's novel *Last of the Mohicans* (1992). The Hollywood science fiction production *Avatar* (2009) can be interpreted in a similar vein. Although the film is set on a fictional planet of Pandora, inhabited by a local tribe Na'vi, its message is clear. In contrast to the noble Na'vi who live in perfect harmony with nature, humans are greedy and cruel, their lifestyle being the antithesis of harmonious coexistence with nature. However, among the colonists from Earth there is a group of people who share the Na'vi customs and confirm Thoreau's thesis that the civilized man can learn a lot from *savages* and is able to change his lifestyle to a more nature-friendly one.

Ecological fallacy of the concept of *nobilis barbarous*

In each of the described approaches, accepting the concept of the noble savage is connected with acknowledging that man by his very nature is willing to form harmonious relationships with environment and other people. This view of human nature is obviously attractive as it shows man as good and noble, which may explain the popularity of the concept for over almost three thousand years of our civilization. Much, however, seems to indicate that such a view of human nature is not true. Even before the publication of *Leviathan* (1651) where Thomas Hobbes wrote about the militant nature of man, Michel de Montaigne questioned the innate nobility of savages and gentleness of human nature. In an essay *Of Cannibals* (1580) inspired by cruel customs of the Tupinabá tribe, Montaigne claimed that the natives of South America were neither more noble nor more barbarous than their contemporaries in Europe (Montaigne, 1980). A similar opinion was expressed by Jean de Léry in a book that describes his journey in Brazil *L'Histoire d'un voyage fait en la terre du Brésil*.

One of the first American environmentalists, George Perkins Marsh, when characterizing the relationship between man and nature stated: *The action of man upon the organic world tends to derange its original balances (...), man is everywhere a disturbing agent. (...) Man pursues his victims with reckless destructiveness; and, while the sacrifice of life by the lower animals is limited by the cravings of appetite, he unsparingly persecutes, even to extirpation thousands of organic forms which he cannot consume* (Marsh, 1874).

Nowadays as well, many scholars question the idea of the noble savage and claim that man by nature is not peacefully predisposed to another person or to nature. William Balée is convinced that human nature is destructive and man is more of *homo devastans* than *homo ecologicus* (Balée, 1998). René Dubos shares this opinion about the destructive tendencies of man. In his view, *like the tendency to kill, the tendency to waste and to foul the nest seems to be inscribed in the genetic code of the human species* (Dubos, 2010).

A similar opinion about human nature is expressed by an Austrian biologist Irenäus Eibl-Eibesfeldt. He asserts that man's destructive presence in the world results from actions aimed at achieving rapid and instant success, actions which are innate to human nature and which he calls *the trap of short-term thinking* (German *Die Falle des Kurzzeitdenkens*). He believes that man has an inborn tendency to ignore far-reaching consequences of his actions (Eibl-Eibesfeldt, 2000). This worked in the distant past when human population was small, and the technology employed by man was primitive. However, because of fast pace of human evolution in recent millennia, natural selection has not kept up in developing natural restraints on short-sighted exploitation of nature. Additionally, the widespread use of dynamically-developing technology has brought about a contemporary ecological crisis. Therefore, human nature seen in this way, i.e. with the rooted strategy for immediate success that does not take into account long-term consequences of actions, contradicts the view that man is innately predisposed to harmonious coexistence with nature (Łepko, 2003; Kłeczek, 2013).

Peter Farb, who also believes that the current condition of our planet is largely a consequence of the destructive nature of man, states: *It appears to be a characteristic of the human* [evolutionary] *line – perhaps the one that accounts for its domination of the earth – that from the very beginning Homo* [sapiens] *has exploited the environment up to his technological limits to do so. But until recently the harm this exploitation could cause was limited, for ancient man's populations were low and his technology primitive* (Farb, 1970).

Modern discoveries in the field of environmental history provide numerous examples of destructive human activity; man has always destroyed nature, regardless of the times he lived in, his religion or the culture he came from. This is confirmed by many studies carried out in different parts of the world (Stępnik, 2012; Oates, 1999). Because of the scope of this article, only the examples that will help to determine the truth of the concept of the ecological noble savage will be given here. This concept in its modern counterpart *the ecological Indian* functions in common social consciousness, and even constitutes a reference point for developing conservation strategies in many Third World countries. The discussion on this issue has been going on for years (Harkin, Lewis, 2007; Redford, 1999; Register, Le Blanc 2013), but it became especially heated following the publication of two important monographs *The Ecological Indian: Myth and History* (2000) by S. Krech and *Collapse. How Societies Choose to Fail or Succeed* (2005) by J. Diamond. The climax of the discussion was a conference *Re-figuring the Ecological Indian* organized at the University of Wyoming in 2002. During this conference many arguments in favour of and against this concept were presented (Hames, 2007).

In literature, this issue is sometimes presented as *America's Pristine Myth* (Denevan, 1992). Supporters of the ecological Indian concept claim that in pre-Columbian times, America was a virgin continent where man lived in perfect harmony with nature. To prove their point, they evoke descriptions of a state of nature written by European explorers of newly discovered lands. By contrast, opponents argue that the concept of the ecological Indian is a myth that defies the facts. The excellent condition of nature in

America in the mid-18th century that is portrayed in those accounts, was not a consequence of the ecological nature of the Indians, but rather of radically reduced human pressure caused by a drastic decline in the Indian population. Modern research confirms this view. The population of both Americas in the late 15th century was approximately ten times bigger than in the mid-17th century. The decrease in the number of the New World's indigenous inhabitants was mainly due to diseases brought from Europe. It is estimated that in 1492, the Indian population numbered about 53.9 million whereas in 1650 it was 5.6 million (Denevan, 1992).

Archaeological data prove that in the pre-Columbian times Indians significantly changed the Americas' landscape. They reduced the area of virgin forests and changed their composition, increasing the size of grasslands. Farmland, houses, cities and transportation routes were already quite common in the American landscape at that time. All these interferences in nature had a considerable influence on the soil, micro-climate, water management and wildlife populations (Denevan, 1992). The scale of landscape changes is well illustrated by the development of pre-Columbian cities, which in their size and organization could compete with European cities at that time. Many of those American cities had a population of over 50 thousand inhabitants, and Tenochtitlán inhabited by about 250 thousand people was larger than Paris and London. The extensive transportation system of the Inca and Maya empires well deserves an attention here. The Incas built a unified and integrated system of drained roads with the total length of approximately 40 thousand km. A good example of the scale of changes inflicted on the landscape is a system of causeways built on wetlands by the Maya peoples. The longest causeway was more than 100 km long, and on a tropical savannah Llanos de Mojos, the system of causeways used for transportation covered more than 1,600 km (Denevan, 1992).

One of the most dramatic examples of Indian interference in the natural environment is what happened to the Anasazi civilization. The Anasazi had lived in what is now Colorado, New Mexico, Utah and Arizona to finally disappear for two centuries before the arrival of Europeans. The Anasazi became extinct due to an ecological disaster which was brought about by their irresponsible attitude to nature (Diamond, 2005; Childs, 2007).

Opponents of the concept of the ecological Indian refer to numerous studies documenting the degradation of nature in the New World, and maintain that the state of environment in the Americas was much better in 1750 than in 1492. In their view, however, this improved condition of nature was the consequence of declining Indian population, rather than their pro-environmental attitude. It appears that the Indians, like Europeans, transformed and destroyed nature proportionally to their numbers and technological capabilities. Consequently, the concept of the noble ecological savage is more of a modern myth than a reliable scientific theory (Buege, 1996).

Conclusion

The awareness of a deepening ecological crisis forces people to take intensive efforts in order to restore the homoeostasis of our planet. However, all environmental initiatives must be based on reliable information about the endangered environment as well as about man who destroys it but is also able to protect it. Mistakes made in this area often lead to counter-productive consequences. It is therefore important to make an accurate assessment of man's natural capabilities in the context of his relationship to nature. Only then will it be possible to develop a strategy for handling the ecological crisis, a strategy that will take into account both the limitations and potential of man and consequently, will enable to effectively prevent the ecological crisis.

Taking this into consideration, it seems crucial to evaluate the concept of *nobilis barbarus* which figures prominently in contemporary culture. After all, it forms the basis for shaping the environmental awareness of young generation and implementing endangered species protection programs in the Third World countries. It seems that man is far more complicated than proponents of this concept suggest. Modern research defies the idealised image of man as an altruistic pacifist who lives in harmony with oneself, other people and nature. This does not mean, however, that we are *homo devastans* and must destroy everyone and everything around. Human nature does not determine the choices that an individual makes. In fact, they are conditioned in many different ways by biological, economic, political, religious, cultural, and even aesthetic factors. Many believe that in the course of man's evolution, human nature has been enriched with altruism and culture, which gives hope for suppressing inborn aggressive tendencies (Dennis, 2009). A realistic approach to human nature that takes into account its destructive tendencies, must allow for human rationality and morality, which counterbalance those tendencies. There is no doubt that the civilized man with the help of technology is easily able to conquer nature. But this will be a Pyrrhic victory that will eventually turn against him for the simple reason that focusing on positive account of profits and losses in the short term, he forgets about long-term consequences of his actions.

A French biologist and environmentalist René Dubos believes that several thousand years of documented human history justify some optimism about the fate of our species. Although human history contains instances of wanton cruelty and destruction of nature, it also provides many examples of altruism and self-sacrifice, qualities well-respected and practised. *One must be blind, ignorant, or prejudiced not*

to recognize that man's genetic structure enables him to be generous and creative as well as aggressive and destructive. The relative importance of bestiality and humanity in human affairs is largely determined by the human choices, decisions, and actions which influence social patterns (Dubos, 2010). The distinction between so-called *big conservation* and *little conservation* introduced by Janis Alcorn underlines that environmental projects in order to be effective must be adapted both to natural conditions of the area and to the culture of the peoples living there (Alcorn, 2005; Boucher, 2011). If we naively assume that the tribes inhabiting tropical forests of Africa and South America are noble ecological savages and on this basis start to implement endangered species protection projects, the effectiveness of such projects is to be seriously doubted (Oates, 1999).

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Discourses of Ecology and the Sketches of Creative Ecology in the Context of Sustainable Development

Dyskursy ekologiczne a zarys ekologii kreatywnej w kontekście zrównoważonego rozwoju

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Abstract

The paper deals with the different discourses of ecology, including creative ecology, in the context of sustainable development. The author presents a classification of the ecological discourses as follows: meta-ecology, area ecology, educational ecology, linguistic ecology, ecology of novelty, technological ecology, epistemological ecology, approach ecology, political ecology, and ecology of visuality. Additionally, every branch of ecology has been divided into 3 sub-branches. According to the author, ecology has become a problem only after human activity has started to threaten for the very human environment including natural and *ipso facto* for human being, i.e. for social sustainable development. The extension of ecology discourse could be treated as the result for both of the mania of nature protection and of *invasion* of cultural area into natural one. The ecological discourses are also often incommensurable, since they stem from very different scientific rims despite analogous terms (ecology) and approaches (environmental). Even in the cases when they do not deal with the nature and natural environment, the laws of nature and the relationships between the organisms within it, serve as a model for an ecological discourse. Some features are characteristic for different discourses of ecology: 1) reference to certain environment; 2) suggested protection of a natural or cultural area; 3) systematic approach; 4) the attitude that the parts of a system are fighting for their survival like the organisms in the nature; 5) dynamic approach towards both the system and its parts under the evolution; 6) conviction that the human activity should be regulated and limited. Creative ecology could be treated both: as a branch in ecology of novelty and as a kind of meta-discourse, since every discourse requires creative thinking.

Key words: creative ecology, ecological thinking, classification of ecologies, creative and cultural industries, discourses of environment

Streszczenie

Artykuł omawia różne dyskursy ekologiczne, włącznie z ekologią kreatywną, w kontekście zrównoważonego rozwoju. Przedstawiono klasyfikację dyskursów ekologicznych uwzględniając: meta-ekologię, ekologię przestrzeni, edukację ekologiczną, ekologię lingwistyczną, nową ekologię, ekologię techniczną, ekologię epistemologiczną, ekologię polityczną i ekologię wizualną. Ponadto w ramach każdej z wymienionych dyscyplin ekologii wydzielono 3 sub-dyscypliny. Zdaniem autora, ekologia stała się problemem, gdy ludzka aktywność zaczęła zagrażać środowisku i *ipso facto* samemu człowiekowi, w tym społecznemu filarowi rozwoju zrównoważonego. Rozszerzenie dyskursu ekologicznego bywa traktowane jako *odchylenie* ochrony środowiska i *inwazja* sfery kultury w sferę natury. Dyskursy ekologiczne są zwykle niewspółmierne, ponieważ wywodzą się z różnych nauk, pomimo analogicznych terminów (ekologia) i podejść (do środowiska). Jednakże, nawet w przypadku gdy nie dyskutują one przyrody i środowiska naturalnego, praw natury i relacji pomiędzy organizmami – i tak służą za model dyskursu ekologicznego. Można wskazać tu na cechy charakterystyczne dla różnych dyskursów: 1) odniesienie do środowiska; 2) sugerowana ochrona naturalnej lub kulturowej przestrzeni; 3) podejście systematyczne; 4) przekonanie, że części systemu walczą o swe przetrwanie w sposób analogiczny do organizmów w przyrodzie; 5) dynamiczne podejście wobec zarówno systemu, jak i jego podlegających ewolucji części; 6) przekonanie, że ludzka

działalność powinna podlegać regulacji i być ograniczona. Kreatywną ekologię można traktować zarówno jako dziedzinę nowej ekologii, jak i rodzaj meta-dyskursu wymagającego kreatywnego myślenia.

Słowa kluczowe: ekologia kreatywna, myślenie ekologiczne, podział ekologii, przemysł kreatywny i kulturowy, dyskurs środowiskowy

Introduction

Usually, the discourse of ecology refers to natural order under the attack of human activity. First of all, it means that the nature is an environment of human being, who is also a part of nature to be protected. As a result, the discourses of environment and of ecology cover each other. However, these discourses are not monolithic. Besides natural environment, we deal with the social, economic, cultural environments and the correspondent scientific discourses including one of sustainable development. Similarly, the scholars speak about the different ecologies including urban, educational, linguistic, technological, epistemological, political and other ecologies. Despite the fact that the most of these ecologies are meta-discourses, i.e. do not deal anymore with the nature and the organisms within it, they appeal to certain analogy concerning basic ecological discourse. First of all they speak (at least in metaphorical way) about the environment and its agents that fight for survival. Although the agents of certain ecosystem are the competitors, the cooperation in different forms is even more important. Finally, the ecological discourses refer both to the mutations of the organisms and dangers for the whole system, collapse of which threatens the organisms within it and their sustainable development. As a result, the ecological thinking appeals to both systemic and dynamic approaches.

The theorists of sustainable development (Hull, 2008) refer to certain analogy between natural and social environments, as well as to the fact that human being is a part of natural eco-system. However, some of them (Heilig, 1997) present the arguments that the term *sustainability* reflects a biologistic approach not proper for development of human society. The concept of creative ecology is a kind of the ecological discourses that refers to human activity beyond natural order. On the other hand, human creativity depends on the natural processes inside and outside us. By defining the creative ecology, Howkins (2009) refers to free thinking, circles and cores of creativity, creative niches, creative education, and changes of the ideas. On the one hand, creative ecology deals with certain environment of the creative workers. For example, it could be the social or economic environment of creative industries analysed by Howkins elsewhere (2013). On the other hand, such characteristic of creative ecology as creative thinking penetrates all human activities. As a result, we can speak about creative ecology as a kind of meta-discourse.

Almost all researchers of creativity face the questions about the environment (Baltrėnas *et al*., 2015; Lee *et al*., 2015; Dul, Ceylan, 2014), the limits (Kačerauskas, Tamošauskas, 2015; Kulbytė, 2014; Yang, 2012), and the ethics (Steen, 2015; Gino, Wiltermuth, 2014; Skorupa, 2014; Valivonytė, 2013) of creativity, although not all of them reflect these questions in the perspective of ecological thinking. First of all, I shall analyse the different ecological discourses and suggest certain classification of them (1. Etymology, origin and classification of the ecological discourses). Later, I shall analyse the certain ecological discourses from the perspective of creativity (2. Towards creative ecology: The ecological problems in the perspective of creativity). In this way, the aim of the paper is to present the sketches of creative ecology.

1. Etymology, origin and classification of the ecological discourses

The term *ecology* stems from two Greek words *logos* and *oikos*. While *logos* refers to scientific discourse, *oikos* means a home, i.e. environment of a home, certain home order and finally balance of incomes and outcomes within a home (a kind of sustainable development). As a result, etymology of ecology refers to certain relationship between a human being and his (her) environment created by him (her). Even speaking about natural environment of human activity we understand this environment only in the perspective of human creativity. The paradox is as follows: ecology has become a problem only after human activity has started to threaten for the very human environment, including natural and ipso facto for human being, i.e. for social sustainable development. Not by accidence, economy and ecology refer to the same ancient word, *oikos*. However, as distinct from ecology, economy has been developed since hundred years. On the one hand, industry has wasted the natural environment of human being. On the other hand, the human being has started to consider the nature as his (her) home to be nourished.

Hironaka, Schofer (2000) showed that the interest in environmental protection ipso facto in ecological approach has emerged only in the beginning of the 20th century[1]. It could be treated as a response to the challenges of natural sustainable development. For ex-

[1] According to Hironaka, Schofer (2000), the indicators of ecological approach are as follows: 1) the number of national parks, 2) chapters of international environmental nongovernmental organizations (INGO), 3) state memberships in intergovernmental environmental organizations

ample, the number of national parks has increased from 40 by 1900 to 7 000 by 1990 worldwide. We face similar dynamics of INGOs and IGOs. Similarly, *the numbers of environmental impact assessment laws grew from only 1 in 1969 to more than 50 by 1990* (Hironaka, Schofer, 2000, p. 98). Additionally, the environmental ministries grew from 1 in 1971 to at least 109 by 1995. This dynamic of interest towards natural environment and ecology shows both the response to the challenges raised by human economic (industrial) activity (Petersen *et al.*, 2008) and the attempt to make nature as a subject of governmental policy. In other words, nature has become a human home (*oikos*), the order of which and especially the relationships with which should be regulated by governmental policies. The extension of ecology discourse could be treated as the result both of the mania of nature protection and of invasion of cultural area into natural one.

Figure 1 exhibits at least 10 areas of scientific ecological discourses, each of which is divided into 3 sub-areas. It does not mean that there are only 30 scientific ways to develop the ecological ideas and this list is finite. The branches of science develop in very different and often unpredicted ways, which do not intersect each other. The ecological discourses are also often incommensurable, since they stem from very different scientific rims despite analogous terms (ecology) and approaches (environmental). What concerns approach, all these discourses appeal to certain environment, but not necessary natural. Even in the cases, when they do not deal with the nature and natural environment, the laws of nature and the relationships between the organisms within it, serve as a model. As a result, at least two features are characteristic for different discourses of ecology: 1) key word ecology and 2) systematic approach when the components of the system (*oikos*) have been treated as the organisms that both collaborate with each other and compete trying to survive.

In Figure 1, the basic discourse of ecology has been indicated as area of ecology that covers first of all country side ecology (Wang *et al*., 2013; Zhao *et al*., 2011) and marine ecology (Baziuke *et al*., 2014; Taelman *et al*., 2014). Such areas as country side and marine are the most untouched by human activity. Anyway, discourse of ecology even in these *untouched* areas presupposes always human activity in two senses: 1) human activity threatens natural system; 2) regulation of natural system including regulation of the relationships with it is already a human activity. Urban ecology has been developed in twofold ways. On the one hand, it deals with the rests of natural environment (such as parks or several trees) in urban space (Caruso *et al*., 1993) that is under the danger of pollution followed from human activity. On the other hand, urban ecology deals with the social groups analogous to the animal groups that should survive (Cohen-Rosenthal, 2004) in such anthropological environment as city.

However, so called meta-ecology is the most remote from the subject of natural environment. It could be divided into three sub-areas sometimes incommensurable: Philosophy of ecology, Ecological ontology and Ecological thinking. The first one deals with the ecological ideas in history of philosophy (Paden *et al*., 2013; Botha, 2003; Zimmerman, 1993) or with philosophical considerations on ecosystem, part of which is human being (Christensen, 2014; Colyvan *et al*., 2009). The systemic ecology analyses the issues of a system in general, as well as the questions of the mutual relations within a system (Cohen-Rosenthal, 2004). The ecological ontology or ecological cosmology deals with the abstract principles of the universe and with relations between these principles (Cranwell, 2010). Although the discourse of ecological thinking can neglect philosophical tradition and philosophical methods, it deals with most general questions, how to think in ecological way (Howkins, 2009). In other words, the certain thinking or viewing is the first in the ecological movement.

Educational ecology deals with relationships between the teachers and the students, as well with educational environment. The different perspectives of it result from the three parts of educational ecology: ecology of learning, ecology of teaching (Pennington, Hoekje, 2014; *Rusby et al.*, 2013), and teaching ecosystems (Cokadar, Yilmaz, 2010). Linguistic ecology treats the components of the language as the parts of certain ecosystem that should be under protection. Since there are very different regions in linguistic areal, we have ecology of language in general (Fowler *et al.*, 2011) or ecology of certain language, ecology of the concepts or ecology of logic (Gabora *et al.*, 2008), as well ecology of the metaphors (Richards, 1936; Newell, Cousins, 2014).

Ecology of novelty presupposes an idea that every novelty should be harmonized with tradition. In other words, novelty should serve sustainable development. On the other hand, every novelty emerges in a certain system of views, believes, attitudes, aims etc. As a result, this cultural environment should be open enough to encourage the new ideas, while these ideas should not be too destructive towards the system of culture. It seems, ecology of discovery is a part of physical geography (Fitzhugh, 2001). Nevertheless, we discover and invent only after we have a correspondent request, i.e. a social niche for it[2]. The same may be said about ecology of innovations,

(IGO), 4) environmental impact assessment laws, 5) national environmental ministries.

[2] A good example is discovery of America supposedly discovered by the Vikings some hundreds ago. This discovery had been made actual by the surplus of population in Western civilization and by a need of new regions for the extension of this civilization by the end of 16th century.

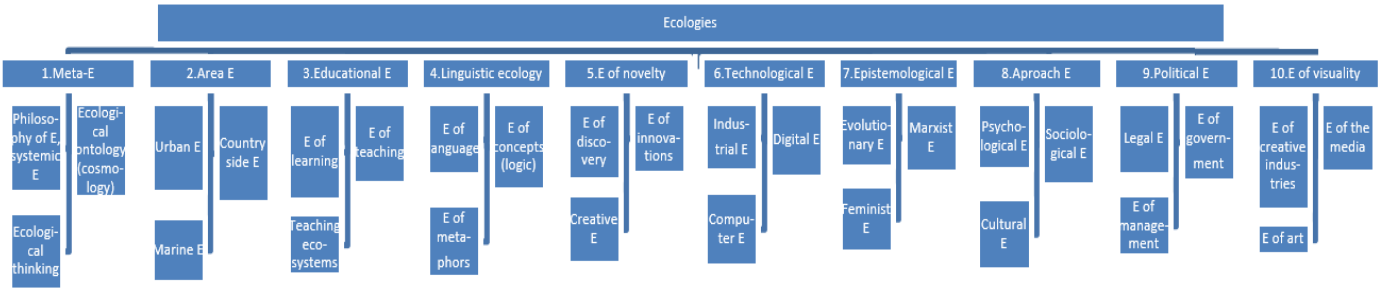

Figure 1. Classification of the ecologies

usually developed in technological discourse. Creative ecology could be treated both: as ecology of novelty and as a kind of meta-discourse since every discourse requires creative thinking (Howkins 2009).

The mentioned 3 branches of technological ecology do not exhaust all possible ecological discourses in technologies. Industrial (Newell, Cousins, 2014), digital (Bruni, 2015) and information (Johri *et al.*, 2014) ecologies being inseparable could be treated as the parts both of technological knowledge system and of corresponding discursive systems. Additionally, these ones like any ecological discourse are inseparable from social attitudes and aims to be preferred. As a result, the ecological discourses function also as the crossing points of different scientific knowledge. This issue leads to epistemological ecologies that prefer certain scientific point of view: evolutionary (Cranwell, 2010; Fitzhugh, 2001), Marxist (Newell, Cousins, 2014), Feminist (Tschakert, 2012) etc. This list could be added by psychoanalytic, phenomenological, structuralistic and other ecologies. Epistemic ecologies divide the system of ecological knowledge into the discrete (incommensurable) regions. On the one hand, this *narrowness* of the different *episteme* is a condition of any scientific discourse. On the other hand, it threatens to the very system of ecological knowledge. We have a similar situation in so called approach ecologies that use the different scientific approaches of psychology, sociology, cultural studies etc. However, approach ecologies deal first of all with the systems of the corresponding sciences and the niches for their development. So epistemic and approach ecologies deal with the subjects from the different levels.

Political ecology deals with legal system, as well with levels of government and management. Legal ecology results in at least two kinds of systems, including hierarchy of national legal acts with the constitution above and the whole of ecological initiatives to be regulated by legal means. Similarly, ecology of government deals with the effective principles of government and with still ecological environment to be governed. Sometimes, the certain areas of social life should be free from governance in order to keep them ecological. Not by accidence, ecology of management (so called micro-governance) usually prefers *soft* control instead of *hard* one.

Visual or pictorial turn (Mitchell, 1994) in postmodern culture results the ecology of visuality (Gibson, 1979; Ivakhiv, 2007). Since most of the creative industries (CIs) like the arts and the media are visual, they could be attributed to the same class. We can speak about an analogy to ecology of visuality, even in the case of audio culture (such as music industry or radio media). Ecology of the media could be developed in twofold ways. On the one hand, it deals with cultural and social context (system) of the media and the relationship between the different media that should survive like any organism[3]. On the other hand, the media channels (at least some of them) reflect the natural ecological system (Cottle, 2004). Similarly, ecology of the CIs deals with their economic, social and cultural environment (Lange *et al.*, 2008; Sunley *et al.*, 2008). Besides this, ecology of the CIs deals with the creative niches for the cultural products (Bourdieu, 1993) in the social environment. Ecology of art deals both with the art system and with place of art in the life-world.

2. Towards creative ecology: The ecological problems in the perspective of creativity

Table 1 exhibits some ecological problems related to creative approach. As mentioned before, the creative ecology could be understood in twofold ways: as a meta-strategy applied to the different ecological discourses and as one autonomous branch in the family of the ecological discourses. By analysing the creative problems, I shall have in mind both moments. On the one hand, I shall analyse the specific problems in the different scientific contexts in order to sketch the creative ecology. On the other hand, the creative ecology is a frame for interpretation of these problems. Table 1 covers not all ecological discourses mentioned in Figure 1. First, some of the mentioned ecological discourses are hypothetical. Second, not all of them are useful for sketching the creative ecology. The succession of analysis is the

[3] The example of the dead media is the telegraph.

Subjects	Problems	References
Ecological cosmology Ecology of love and death Evolutionary ecology	What are the perspectives of ecological cosmology? What current does the universe possess – a creative or a destructive? What is the relationship of creative (eros) and destructive (thanatos) principles? What is the role of chaos (destruction) in the evolution? What is the primary and secondary organising principle – eros or thanatos? Why does the ecological order require a balance of the existence of life forms with their death? May we talk about the ecology caused by death? What is the sense of evolution – creation or death? What about the agents of thanatos in society? What kind of dialectical connection is between killing and creation? How does eros enable evolution? What is the sense of the thanative moments in our lives? What are the deeper and more expanded ecologies of being and inter-relations? What does ecology refer to? What kind of dialectics is among thanatos, eros, and ecology? What is evolutionary ecology?	Cranwell, 2010
Systemic ecology; Ecological thinking; Industrial ecology	Is the industrial environment (IE) a kind of social environment to survive? If all ecologies reflect the relationships, what kind of relationship does IE presuppose? What about entropy – is it a problem or a solution? How to treat pollution in the perspective of IE? What is ecological thinking? How to coordinate consumption tendency and an ecological imperative to use less? What is the hierarchy of material use and reuse?	Cohen-Rosenthal, 2004
Teaching ecosystems	What is the role of community atmosphere during learning and teaching?	Cokadar, Yilmaz, 2010
Ecology of language (EL)	What kind of activity does EL presuppose? What is the environment of language? What kind of interactions do we have in language system? What do complex dynamical systems of language refer to?	Fowler *et al.*, 2011
Ecology of concepts (logic)	What is the context of the concepts – the internal structures or life-world? What about the factors of conceptualization? What role of worldview is in the process of conceptualization? What is the condition of existence of the concepts and categories?	Gabora *et al.*, 2008
Evolutionary ecology; Ecology of invention and innovation	What is the relationship between technology and social evolution? What is the difference between invention and innovation? What is the content of evolutionary ecology in the context of systemic and epistemic uncertainty, parametric and strategic variability?	Fitzhugh, 2001
Ecology of innovations	What is innovation? How to understand the innovations in certain epistemological context? What kind of network and collaboration do the innovations presuppose?	Adkins *et al.*, 2007
Industrial ecology (IE); Marxist ecology (ME); Urban (political) ecology (UE); Ecology of metaphors	What kind of ecologies emerge in the context of social metabolism and urban ecosystem discourses? Are the industrial systems analogous to the organisms and in what terms? What are the epistemological differences between the ecological perspectives of IE, ME and UE? What are the organismic qualities of the city and mass-balance model? What is ontological base of industrial ecology in the context of urban metabolism? What is the model of UE? What does ME emphasize? What is the condition of metaphors' surviving?	Newell, Cousins, 2014
Psychological ecology; Ecology of visuality	What is the relationship between perception of oneself and one's environment? What about the environment of visual perception?	Gibson, 1979
Political ecology; Feminist ecology (FE); Legal ecology	What role does the feminist political ecology have? What characteristics of social relations does FE refer to? How does the climate discourse encompass the legal questions? What does the right-based discourse cover? What are the right questions about?	Tschakert, 2012

Subjects	Problems	References
Ecology of CIs governance; Ecology of the creative industries (CIs); Ecology of culturepreneurship	What are the limits of governance ecology towards the CIs? What is the definition of CIs? What is the environment of CIs – cultural economy, state or society? What is role of social and geographic space in the development of the CIs? What about gentrification? What are the reasons of creative places' attractiveness? How to define the term culturepreneur? What kind of context does it presuppose? What are the factors of culturepreneurs' ecology? May we treat self-governance as an ecologic niche in CIs?	Lange *et al.*, 2008
Ecology of design	What does innovation in design involve? What is the role of design market? What values do the CIs refer to? What is the role of the designers in cultural environment?	Sunley *et al.*, 2008
Ecology of the media; Ecology of cultural (TV) production	What is the production ecology in the context of the media? What is cultural production? How to manage cultural production within the creative industries? What kind of policy should be used towards cultural production? Why are the themes of surviving (sex, violence and death) the most attractive ones in TV production? How should TV channels survive in the context of *rating thinking* (Bourdieu 1998) of TV channels' competition? What do the TV producers pursuit?	Cottle, 2004 Bourdieu, 1993

same like in Figure 1, i.e. from more abstract and general discourses to the specific ones.

Usually, the philosophical discourse is considered to be the most general. In his philosophical considerations, Cranwell (2010) raises the questions about cosmological order and its creative impulses – eros (principle of love) and thanatos (principle of death). On the one hand, the cosmological order needs a balance and stability (sustainable development) for evolutionary creativity; on the other – it needs the changes presupposed by thanatos. Hence, the niche of love's ecology is namely death. As a result, ecological cosmology serves theodicy, i.e. justification of good and omnipotent God in the environment of world's evils. Unlike Platonic considerations[4], ontological ecology attributes systemic characteristic to the evil and to its source of death that has creative outcomes.

Cohen-Rosenthal (2004) raises the question about ecological thinking in an industrial environment and consumer society. Similarly, we can raise a question about the role of art in an industrial environment and consumer society. On the one hand, art having vague perspectives of consuming is a secondary product of human activity, i.e. a kind of pollution. On the other hand, art disturbs this economic thinking and creates a niche for alternative life-art. Not by accidence, Cohen-Rosenthal speaks about the role of entropy in systemic ecology. In other words, entropy as a kind of system's death could be a solution for the system (industrial or consumer) to be renewed.

A kind of ecological thinking has been developed in ecology of both teaching and learning (Cokadar, Yilmaz, 2010). Teaching and learning are inseparable in the same creative eco-system. It is not enough to say in phenomenological manner that a teacher should be intentional and a student should be open. We can speak about the niches of learning in teaching and vice versa. In this way, we face also a kind of creative entropy while changing the roles between a teacher and a student. However, this dynamics is not as dis-balance of education system, inseparable from the social environment, but as the result of renewal of it.

Ecology of language (Fowler *et al.*, 2011) and ecology of concepts (Gabora *et al.*, 2008) face similar logical problems. First of all, there a question arises in both of them: what is the environment of language in general and of concepts in particular. Is it a linguistic system, human thinking (and viewing) or life-world? Actually, the interaction of these different environments (systems) creates the niches for human activity that changes the systems in turn of both logic and ontological levels. As a result, logical ecology could be a key for solving logical problems since Zeno of Elea. Ecology of metaphors (Newell, Cousins, 2014) could be treated as a kind of language ecology with the similar problems of interaction between poetic language and poetic being. Last but not least, ecology of metaphors refers to creative environment of different levels.

As Fitzhugh (2001) shows, evolutionary ecology could be developed from two different perspectives. One of them is philosophy of science including the above mentioned questions of discovery and invention in certain social environment. Another one is physical geography, inseparable from the social perspectives. Evolutionary ecology refers to the dynamics of the systems and the agents within them. On the other hand, it refers to the principle of hard compete-

[4] According to Plato, evil is only a defect of the system, i.e. has no independent ontological base (*malum* as *privation*) See Plato (2013).

tion and fight for surviving. These principles characterize the creative environment better than, say, R. Florida's (2002) principle of tolerance. Every new creative idea should fight for its surviving in a hostile environment despite intolerance that makes the idea stronger. Finally, there arises the question: what is a creative or innovative idea (Adkins *et al.*, 2007) presupposed in certain social environment?

Since urban ecology (Newell, Cousins, 2014) deals not only with *green* environment in a city (1st level of ecology), but also with competition of the cities in global urban system, creativity has been treated as an advantage to survive (2nd level of ecology). As a result, we have a concept of creative city (Florida, 2005; Florida, Tinagli, 2004; Cetindamar, Gunsel, 2012; Gong, 2013), which is more attractive for both investors and the society. By the way, one of the indices of urban creative environment could be the number of the parks and other *green* places in a city. In this case, we have intersection of 1st and 2nd levels of urban ecology that is inseparable from political ecology.

Similarly, psychological ecology (Gibson, 1979) deals with two realities that are outside and inside us. The first one could be treated as the environment of the latter one. However, so called objective reality does emerge after a reflection in so called subjective reality. Consequently, we can speak about mental reality as an environment of the world. The task of psychological ecology would be to avoid these both extreme interpretations by appealing to cultural (creative) environment. On the one hand, we belong already to our cultural environment; on the other – we change it by creating our reality of desires, objectives, imaginations etc. As a result, we face here the creative niches between two extreme interpretations of the world, as well as between collective cultural tradition and individual creative aspirations. Not by accidence, creativity is one of the most important subjects of psychology (Torrance, 1966; Feist, 1998; Runco, 2004; Runco *et al*., 2005; Kornilova, Kornilov, 2012).

Ecology of visuality could be developed in twofold ways: in the frame of psychological discourse and by appealing to the creative industries or to the media, the most of which have the visual dimension. Speaking about the visual media, the same question of *rating thinking* has been raised from Plato (1988) to P. Bourdieu (1998). For example, an expansion of visuality in the TV channels means the orientation to bigger audience measured by the ratings. Ecology of visuality would refer to creativity deficit of such mass-production. By analysing the animal channels on TV, Cottle (2004) refers to different levels of ecology. On the one hand, animal channels show the nature *as it is* and the fight for surviving in the natural environment. However, the channels have been oriented to such *attractive* topics as violence, sex and death in order to survive in the environment of the media competition. According to P. Bourdieu (1998), we face similar content (deficit of creativity) of the TV channels under the conditions of severe competition in the media. As a result, creativity, to be precise, deficit of creativity, is the key problem in both – ecology of visuality and ecology in the media.

Conclusions

Classification of the ecological discourses exhibits the variety of scientific approaches often incommensurably concerning each other. Only area ecology deals with the nature and its protection. Since many other ecological discourses deal with cultural environment instead of natural one, they are more or less removed from this basic discourse and could be called meta-discourses. The different ecological discourses contain the common features as follows: 1) reference to certain environment; 2) suggested protection of a natural or cultural area, as well as the ways of sustainable development; 3) systematic approach; 4) the attitude that the parts of a system are fighting for their survival like the organisms in the nature; 5) dynamic approach towards both the system and its parts under the evolution; 6) conviction that the human activity should be regulated and limited.

Creative ecology could be treated both – as a branch in ecology of novelty and as a kind of meta-discourse, since every discourse requires creative thinking and creative niches for further development (more or less sustainable). For example, ontological ecology refers to the creative principles in an ontological or cosmological system. Even death could be treated as necessary moment in renewing a system. In ecology of education, the scholars speak about the creative niches while changing the roles between a teacher and a student. The recreating of education system is inseparable from the renewing of social environment. Ecology of language and its branch ecology of metaphors refer to the relationship between poetic language and creative being. Urban ecology deals with the concept of creative city by referring to the basic ecological discourse. Psychological ecology refers to the creative niches between two extreme interpretations of the world that is inseparable from human creative aspirations. Ecology of visuality, and such branches of it as ecology of the media and ecology of the creative industries, deals with creativity deficit in mass-production. Ecology of management inevitably faces the question – how to manage the creative workers. Ecology of politics raises the issue about the creative subjects (classes and the individuals) in certain social environment.

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The Impact of Sustainable Development on the Homeostasis of the Social Environment and the Matter of Survival

Wpływ zrównoważonego rozwoju na homeostazę środowiska przyrodniczego i sprawa przetrwania

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Abstract

The survival of social groups depends on internal factors (the size of a group, its socio-diversity, inner organization, coherence and synergy of actions for the common good), external factors, mostly on a safe natural and social environment, and on sustainable interactions with this environment. In addition, the survival and development of groups is determined by their stability, which in turn depends on the homeostatic mechanisms that maintain a state of balance within groups and in their environments. People have an influence on the stability of social systems; their actions may lead to strengthening or weakening of this homeostasis. The implementation of the concept of sustainable development serves, among others, to strengthen the homeostasis of social systems and consequently, to prolong the existence of mankind. However, paradoxically enough, the more the system tends to equilibrium, the less stable it becomes reducing its chance of survival. But still, striving to achieve a state of equilibrium has become an imperative nowadays in view of the concept of sustainable development. Moreover, since the beginning of the Anthropocene era, people's interference in the homeostasis of natural and social systems has been growing, helped by the progress of science and technology. However, only a handful of the world's population, the financial elite, benefit from this. Driven by economic interests and ignoring ecological criteria, they weaken this homeostasis carelessly and irresponsibly. Focused on their own benefits here and now, they do not care much about the fate of future generations.

Key words: social system, stability, survival, equilibrium, homeostasis, sustainable development

Streszczenie

Przetrwanie grup społecznych zależy od czynników wewnętrznych (liczebności, socjo-dywergencji, organizacji wewnętrznej, koherencji i synergii działań na rzecz dobra wspólnego), zewnętrznych – przede wszystkim od bezpiecznego środowiska przyrodniczego i społecznego oraz od zrównoważonych interakcji z otoczeniem. Oprócz tego o przetrwaniu i rozwoju decyduje ich stabilność, która zależy od mechanizmów homeostazy zachowujących równowagę w grupach i w środowisku, w jakim przebywają. O homeostazie systemów społecznych decydują ludzie. Ich działania mogą prowadzić do wzmacniania albo do osłabiania homeostazy. Wzmacnianiu homeostazy systemów społecznych, a w konsekwencji ekstensji czasu istnienia ludzkości, służy – między innymi – urzeczywistnianie idei rozwoju zrównoważonego. Tu jednak pojawia się paradoks: im bardziej system zmierza do równowagi, tym mniejszą osiąga stabilność i tym samym zmniejszą swoją szansę na przetrwanie. Nie zważając na to, dążenie do równowagi stało się nakazem chwili za sprawą koncepcji rozwoju zrównoważonego. Poza tym, od początku epoki antropocenu postępuje ingerencja ludzi w homeostazę systemów przyrodniczych i społecznych. A postęp wiedzy i techniki pomaga im w majsterkowaniu przy homeostazie. Korzysta z tego tylko garstka populacji świata – elity finansowe. Nie kierując się kryteriami ekologicznymi, lecz ekonomicznymi, beztrosko i nieodpowiedzialnie osłabiają homeostazę. Mają one na uwadze wyłącznie swoje korzyści osiągane teraz. Dlatego nie obchodzi ich, jaki los szykują wskutek tego przyszłym pokoleniom.

Słowa kluczowe: system społeczny, stabilność, przetrwanie, równowaga, homeostaza, rozwój zrównoważony

1. Equilibrium and survival

The survival of social groups and individuals depends on what they are, i.e. on endogenous factors, and on where they are, i.e. on their natural and social environment. Their survival is determined by the following internal factors:

- **Group size.** It is commonly believed that the bigger a group, the more likely it is to live longer or survive. This is explained in the first place by the fact that its power, that is the sum of powers of its individual components, guarantees a more effective defense compared to the power of a smaller group, and so bigger groups are more difficult to annihilate. However, this is not always the case because the power of a group is not a simple sum of the powers of its components, and the defensive capacity of a group is sometimes inversely proportional to its size. Besides, larger groups often experience problems connected with the stability and durability of their structure, with their internal organization, maintaining order, and implementing a common goal. On the other hand, a group which is too small is usually too weak to defend itself against various threats in the struggle for survival with larger groups, although even here there are some exceptions, because the power of a group depends not only on its size, but on many other factors. In order to determine the size of a group which ensures its survival and growth, we can use well known and appropriately modified laws of ecology formulated by Justus v. Liebieg, Ernest Shelford and Warder C. Allee:
  a) Liebig's law of the minimum: The scarcest factor has a destructive influence on the organism or on the whole population, i.e. on the individual or group.
  b) Shelford's law: Both deficiency and excess of various factors have a destructive influence on the individual or group. Maintaining the values of these factors in so called tolerance range, i.e. between the minimum and the maximum, is necessary for survival.
  c) Allee's law: The under-density as well as the over-density, i.e. exceeding the capacity of the environment in which some group exists, can have a destructive influence on this group. According to Allee, survival depends not only on the group size but also on its social abilities, i.e. ability to adapt to the existing social order.

  Hence it follows that:
  a) group size should be neither maximum nor minimum, but optimal, i.e. balanced;
  b) internal and external conditions in which a group lives determine its size;
  c) the optimum group size is not constant, but it varies depending on the respective internal and environmental factors.
- **Diversity.** When talking about diversity, ecologists usually mean biodiversity, especially species', racial and genetic biodiversity. Today no one doubts in the influence of diversity on the development and survival of living beings, and in particular on the survival of social groups. However, this survival is also and at least to the same extent determined by socio-diversity at ethnic, cultural, economic, professional, and other levels. Shelford's Law can be applied to human organisms and social groups just as it can be applied to populations of other living organisms. According to it, going to extremes and aiming at maximizing the group diversity is not desirable, but on the other hand, maximal group homogenization is also harmful, because as Pope Francis, among others, has rightly pointed out *(...) uniformity kills life* (Pope Francis, 2013). Uniformity and standardization inevitably lead to stagnation; they inhibit further development and consequently survival. Therefore, attempts at homogenizing society by striving for universal social equality or classlessness, as it is, for example, in socialist countries, have failed. Likewise, standardization, which is inextricably linked to globalisation, is doomed to fail. Objective evolutionary processes that take place in the social environment preserve its diversity. Only subjective factors, e.g. some leader, can intentionally or unintentionally destroy society by introducing homogenization. For this reason, the slogan of social equality is either an illusion or a real threat. Common sense, knowledge and historical experience impel us to strive for the golden mean in the form of some optimal or moderate social diversity, or in other words to keep a balance between diversity and uniformity. Diversity does not prevent integration; on the contrary, it is necessary for social integration, because in fact we can only integrate what is different. The importance of diversity was clearly emphasized in the UNESCO *Universal Declaration on Cultural Diversity*, which was adopted unanimously on 2 Nov, 2001 at the 31st session of the UNESCO General Conference in Paris. In the Declaration it is stated that cultural diversity is an important feature of humanity, it is the common heritage, it creates a rich and varied world and is the driving force of the sustainable development of communities, peoples and nations; therefore, it has to be respected, protected and preserved. Article 2 *From cultural diversity to cultural pluralism* emphasizes that *cultural diversity as a source of exchange, innovation and creativity is for mankind as necessary as biodiversity for nature* and in item 6 it is stated that *protection, promotion and maintenance of cultural diversity are essential and in-*
- *dispensable requirements for sustainable development for the benefit of present and future ge-*

nerations. In order to meet this requirement it is necessary to manage diversity in a proper way to maintain harmony and balance. As sociologist Michael Young, creator of the concept of meritocracy, declared *A society without inequality would be terrible* (Kieserling, 2015).

- **Efficient organization.** The term organization does not refer here to institutions, enterprises, administrative units, companies, offices, teams, groups, etc. (see Adamik, Matejun 2012), but rather it is organization in an attributive sense understood as a set of features of a complex system which serve to carry out various functions of this system, especially its target function (Tadeusz Kotarbiński calls it *organizing* (see Kotarbiński 1958). The term *system's organization* includes interactions (also links) between the elements of this system which make it possible for these elements to create one whole, become somehow ordered, and so act together, even synergistically, to implement some purpose. The relations which order the system's elements in a certain way, in some aspect and direction are important for its organization; such relations are reflexive, consistent, low-symmetric, and transitive (Kuratowski, Mostowski 1952, p.140). The organization of a system can be determined quantitatively by *the degree of its organization*, which is inversely proportional to the relative redundancy of the system. Hence, it can be concluded that the fewer superfluous elements (e.g. people) and relationships (e.g. interpersonal relations) a social group has, the more (better) organized it is, i.e. it is more integrated, functions better, realizes its goals more effectively and consequently, it is more stable and resistant to destructive external factors. Therefore, the sustainability of a group can be ensured by striving for the highest possible degree of its organization. At the same time, exceeding the critical level of this degree results in dysfunction and disintegration, because too strong organization reduces freedom, which is necessary for human activity. A group should be neither too weakly nor too strongly organized. In other words, a complete lack of organization, i.e. chaos as well as too low and too high degree of organization should be avoided.
- **Consistency.** This feature of a system is closely related to its structure. A structure is a multitude of dependencies, relations, connections and interactions between the system's components as well as the way these components are arranged, configured and organized. It imposes a spatial order on the system's elements and a social order in the case of social systems (groups). It limits the diversity of system's components and the relationships between them in such a way that their order is not disturbed. For this reason, consistence acts like a guardian of internal order, an order which is indispensable for the existence of social systems. The structure is a relatively invariant determinant of each system, which means that it can change, but only to the extent that does not violate the system's identity or does not lead to its disintegration. In a coherent structure, there are no internal contradictions. The durability of a system depends on the quality or nature of its structure: when its structure is thicker, more compact and coherent (i.e. the relationships between its elements are stronger, which in turn is connected with the strength of interactions between them), the system is more resistant to disturbing external factors, *ergo*, it is more stable. However, just as it is with size, diversity and organization, going to extremes when it comes to the consistency of a structure or durability of the system is not desirable. Durable as they are, stable systems cannot develop. Evolution is only possible in systems with limited, sustainable and optimal durability and consistence.
- **Solidarity and synergy of activities.** Social solidarity is understood here not only as identification with other people. It is a specific relationship between individuals or groups forming communities which is founded on emotional, intellectual, ideological, world-view, religious and political bonds as well as on empathy. It manifests itself in the mutual understanding, support and willingness to help each other in activities undertaken to achieve some common goal, as well as in implementing the common tasks. It results from individuals and groups being aware that they are not able to defend themselves, survive, develop or achieve anything on their own. Thus, a source of solidarity should be sought in obligation and compulsion rather than in good will dictated by religious or moral recommendations. The statement that *man is always in solidarity with somebody and for somebody* (Tischner 2005, p. 16) or that the development of solidarity (and solidarism) is owed to Christianity, which proclaims the principle of brotherly love, is false. The principle of brotherly love formulated in different ways and deriving from the principle of the golden mean was preached also in other pre-Christian religions. People show their solidarity only at certain times and in situations which force them to do so. The solidarity between the peoples of the socialist bloc (*Proletarians of all countries unite!*) imposed by the communist ideology is an example of forced solidarity, which turned out to be false and it disappeared just after the political transformation, giving way to mutual claims, conflicts and antagonisms, which in turn led to the breakdown of federal states (Czechoslovakia, the Federal Republic of Yugoslavia, and the USSR) and to the rebirth of old nation-states

and wars between them. However, solidarity that is forced or imposed from the outside may also be positive. After all, the principle of brotherly love has never been fully and widely respected by Christ's followers, and in modern times characterized by dominant hypocrisy, much fewer Christian believers live according to it. *There is something wrong when it comes to practicing this principle. It is held in contempt at every turn. There is a growing discrepancy between the declarations of brotherly love and the fact that this love, or just simple kindness is not shown in everyday life. There is abundant evidence for this. Empty religious declarations or creating more ethical codes will not help considering simple lack of good will, unwillingness to get rid of excessive egoism and unkindness in mutual relations between people, regardless of their beliefs, social position, wealth, origin and appearance* (Sztumski 2012). The prerequisite for solidarity is giving up one's selfishness, obviously not fully and under certain conditions, for the good of other group members and the group as a whole, i.e. for the common good. For this reason, solidarity is close to collectivism and altruism, and sometimes to selflessness. Solidarity bonds strengthen a group as the whole and each of its members individually. With more bonds, more structural ties and more solidary acts for a common good, a group usually becomes more stable. Another condition for solidarity is the appropriate size of a group, its consistency, diversity and degree of organization. In principle, in smaller and less diverse, but better organized and more integrated groups, we can expect more mutual understanding, empathy and commonality. Of course, there are exceptions to this rule, and even very small groups experience conflicts and discord and consequently they lack solidarity. Thanks to the solidarity that manifests itself in the mutual aid or in strengthening efforts to achieve common goals or group interests, in other words, in the realization of the target function of a group, its stability and *defensive potential* against external threats increases significantly, which gives it a better chance to survive and thrive.

2. Equilibrium and homeostasis

Maintaining the right proportions between the parameters that define the social environment, the structure of social systems, and in particular that of groups, is a prerequisite for preserving their stability and durability, and ensuring survival and development. The *right proportions* refer here to such proportions that ensure dynamic equilibrium within a given structure, a state which allows for changes of momentary equilibrium. The proportions may be slightly exceeded and violate the standards or deviate from the desired parameters, because such slight deviations are not able to disrupt the system's stable equilibrium and therefore are not dangerous for its functioning or existence. Homeostasis is a feature of open systems that enables them to self-regulate and to maintain the parameters and relations between their elements in optimal proportions, despite some changes in the systems themselves and in their environment. In the case of social groups, homeostasis balances the proportions relating to size, diversity and conflicts between individual and common interests, i.e. those parameters whose excess or deficiency threatens to distort order and in the worst case may lead to the destruction of the system. Equilibrium allows each member of the group some freedom within which they can act and deviate from the group (average) standards; each group member can realize their tasks, not disturbing others but rather supporting them. It facilitates the symbiosis of a group with its environment and it contributes to preserving order by alleviating inner contradictions and the tendency to disorganization. Therefore, homeostasis allows a group to preserve its structural and functional identity and relative autonomy (independence) in its *lifetime* and in the course of evolution. Equilibrium does not eliminate the hierarchical order in the group and does not make all its members equal in each respect. A balanced group works like a well-functioning organism or a mechanism equipped with self-regulatory systems (self-control and self-steering), which ensure homeostasis. In natural animate and inanimate systems (except for technical devices, created and programmed by humans), homeostasis is a product of nature and of natural evolution. It occurs automatically, spontaneously and involuntarily. On the other hand, in social systems (groups), homeostasis is a product of people and it is realized consciously, purposefully and in accordance with their desires. Although it is a product of people, people's awareness and activities are also determined by nature and its objective laws. Being a human product, it gets alienated, and starts to act like an objective factor – the *invisible hand* or some fate. Additionally, social systems are subject to objective statistical laws. Therefore, homeostasis is to some extent an objective attribute of social systems. Homeostasis maintains the internal parameters of the system at the steady level, even though they may oscillate around the average values depending on some random factors. This makes the system to some degree independent of external conditions. Spontaneous evolution of closed material systems, which is governed by chance, is accompanied by a steady growth in their entropy and dissipation of inner energy. Consequently, the tendency to maintain their dynamic equilibrium also grows. However, when the entropy and internal energy dissipation reach maximum values, and the system reaches a state of equilibrium (equilibrium is achieved with minimum energy and maximum entropy), no processes can occur in it

without some external factors. Simultaneously, with an increase of the system's entropy, its disorganization progresses according to the second law of thermodynamics, which is the universal law of nature. Consequently, such a system must be destroyed one day, as if in a natural way. The situation is different in the case of open systems, and social systems are open systems. In order for them to survive an increase of entropy must be stopped by being transformed into negative entropy. This is so because open systems can take more energy than they consume from their environment, so they are able to store surplus inner energy in the form of negative entropy. All spontaneous processes lead to the most probable of all situations or states, and states of higher entropy, i.e. states of equilibrium are the most probable. However, the higher the system's equilibrium is, the more disordered the system becomes. This follows from the law of increasing entropy known in physics as the second law of thermodynamics. This law states that in spontaneous processes, disorder increases because it is more probable than order. Thus, striving for maximum equilibrium leads to a perfect mess, which was proved in Ehrenfest's thought experiment. All this can be applied to social systems, which are getting increasingly complicated with the progress of civilization, and their development is getting out of people's control. For this reason, their development is more spontaneous than planned, and rather more chance-driven than controlled by the regularities.

3. Equilibrium and human interference in homeostasis

In the Anthropocene era, people interfere in the homeostasis of systems and intentionally and often irresponsibly tinker with it. They build dams and artificial lakes, which may be needed for the economy and tourism but are harmful to the environment; they reverse the course of rivers, cut down forests, expand cities, develop industry, create new breeds of animals, change genotypes and undertake other activities that alter the landscape, environment, fauna and flora. All this upsets the equilibrium, harmony, and eternal order of nature. Guided by the economic benefits and despite quite developed ecological awareness, people do it on an increasingly larger scale and proportionally to the scientific and technological progress. They disrupt, for example, homeostases of climate, species, ecosystems, the human organism (physiological, nervous and mental processes), the Earth and even of the planetary system – all the homeostases which are important for maintaining equilibrium in nature. They want to improve nature and shape it according to their wishes, but nature defends itself as much as it can and as if in reprisal, it *takes revenge*. Fortunately, people still do not have enough power and abilities to improve nature and despite victories won here and there, they are losing their battle with nature. On the other hand, they have been more successful in disturbing homeostasis in social systems. In the natural environment, there are different objective rules of prohibition and selection which must be taken into account and which limit people's interference in natural systems and manipulation with homeostasis. By contrast, in the social environment there are no effective restrictions of a social nature, apart from the limits imposed by technology. Such situation is caused by the relativization of ethical norms, lack of respect for cultural norms, and bypassing legal rules, which no longer restrain thoughtless or harmful destruction of homeostatic mechanisms in social systems. In any case, these norms and regulations are arbitrarily created by the elite (governments and owners of global corporations, trade organizations and banks which we cannot do without) that exercises despotic power over the world not so much for the benefit of mankind but rather to realize their own egoistic aims: multiply profits and wealth, and maintain power. These lords of the world create different models of social and economic regimes, management systems, legal codes, etc. which are best for them. As a result of their actions, social systems increasingly often transform from sustainable to unstable, from stationary to dissipative, from ordered to chaotic ones. Consequently, the autopoiesis of social systems, i.e. their ability to create, reproduce, and revive themselves is reduced. This not only weakens their chance of survival, further existence and development, but it can even lead to their collapse. In order to survive, a system should not only be open, flexible, and capable of adapting, but also capable of self-regulation thanks to homeostasis. The survival of social systems depends on how their institutions and organizations function, and also on the behavior of people, interactions and relationships among them. The systems in which the components (especially people) function in an established way thanks to the specific stabilizing factors that are part of homeostasis, survive longer. Those factors include sanction mechanisms imposed by various institutions and social organizations, the family, state, church, etc. Social institutions establish law and order, behavior norms and standards, everything that determines the sustainability of social systems. In addition, the homeostasis of social systems includes other stabilizing mechanisms that restrict free choices and stem from ethnic, cultural, and religious traditions. These mechanisms are communicated in the process of education, socialization, indoctrination and enculturation. Moreover, the stability and survival of social systems is influenced by conservative groups and ideologies, and by economic factors, for example redistribution of national income, salary structure, the proportion between supply and demand etc. Stabilization is not a process that aims at stagnation, but rather at continuous balancing of the disproportions, inequalities and disharmonies within the system; it is a necessary

though insufficient condition to preserve the identity and sustainability of a system. Under normal conditions, i.e. when the homeostasis of the social system is undisturbed and the values of the parameters defining it are within the referential limits, this system is always able to return to a state of equilibrium on its own. The larger the diapason of these limits is, the more stable the system is. As a rule, social systems are autopoietic, i.e. they have the ability of self-creation and self-reproduction, which enables them to survive, exist and thrive. Thus, in order to ensure the survival of the social system, it would seem purposeful to undertake activities which would contribute to increasing its stability, or at least to maintaining it in a constant state as long as possible. However, as a result of ill-considered and irresponsible behavior of the ruling elites, and also of various institutions and ordinary people, the stability of social systems, which is essential for the survival of humanity, is weakened all the time. Paradoxically, the autopoiezis of social systems disappears with their sustainable development. This is caused by the internal contradiction of this development between striving to maintain social ecosystems which make up our social environment as long as possible and destabilizing them. A social ecosystem is understood here as all the people inhabiting a defined territory and a network of interpersonal and inter-institutional relations.

There are many social ecosystems and areas of social life which are important for people and which get more and more destabilized. One of them, and probably the most important, is the economy.

For some time, two models of the economy have been competing with each other. Both were built on the dubious presupposition that the market economy is the best and the *only right*. This belief first appeared when the planned economy collapsed in the former socialist countries and then, after the political transformation in these countries, when strong connections between politicians, scientists and business made the economy *ancillae politicae* and no longer a wholly objective science. Some of these models were built on the basis of neoclassical conception while others on the ground of evolutionary economics, which emerged in the 20th century and was later developed in the eighties within neo-liberal economics. Evolutionary economics transferred the mechanisms of biological evolution onto the economy. The principle of natural selection in animate nature was substituted with the principle of natural replacement of a worse economy by a better one, a replacement which results from implementing innovations and competitive struggle. This competitive struggle is considered to be the driving force of economic development just as the struggle for existence in the world of living beings is the driving force of biological evolution. In addition, evolutionary economics takes into account the impact of exogenous factors (demographic, cultural, psychological and sociological) on the functioning of the economy (Leszkowska, 2013). Neoclassical models have a global reach and are based on the hypothesis that there are states of equilibrium in the economy. By contrast, neo-liberal evolutionary models take into account local conditions (for example, Anglo-Saxon, German, Japanese, and Scandinavian models can be distinguished, each of them having its pros and cons) and the fact that the economy can never achieve a state of equilibrium (for example, because of constant innovations); economic processes only strive to reach this state. Consequently, the economic analysis and prognosis are based on the study of transient states and on what occurs between the states of equilibrium as well as on the influence of random factors which disturb a state of equilibrium. In both models, economists *(...) view the economic reality as close to equilibrium or in equilibrium. Deviations from a state of equilibrium are only incidental and sooner or later market mechanisms and people's attitudes aiming at maximizing utility, bring about equilibrium in the economy* (Woś, 2001). Such models of the economy based on equilibrium and on laminar processes are inconsistent with the economic reality, which is full of chance events, turbulences, increasing risks and uncertainties. This is evidenced by increasingly frequent, unexpected and difficult to avoid and overcome economic crises and local and global collapses in finance, banking, supply and demand, employment, exports, etc. Dissipative models of the economy that irreversibly moves away from equilibrium, models which take into account chaotic and turbulent processes in the economy are better, especially as the homeostatic tendency of systems (not only the economic ones) to return to stable equilibrium is decreasing. Instead, there is a growing tendency to return to unstable equilibrium. This fact should be taken into account when developing economic models in the modern world. The concept of sustainable development corresponds with neoclassical and neoliberalist models of the economy. Therefore, the efforts to implement the idea of sustainable development, i.e. to achieve states of equilibrium – rather unstable than stable – in various sectors of the economy on a local and global scale inevitably weaken their homeostasis, leading to their instability and disorganization. Deregulation of the economy, unexpected economic crises and growing uncertainty about the financial situation (living conditions) make people's lives more difficult and have a negative influence on other spheres of social life. Practically speaking, all this results in the degradation of the whole social environment, in this way reducing its chance of survival.

The implementation of the concept of sustainable development, together with globalization processes aims at equalizing potentials in different social systems. It is not clear whether it is unintentional or planned. The rapid transfer of technology and labor force, mass transmigration and the spread of a global

network of banks and markets lead to disappearance of disproportions in technology, demography and the economy between continents and countries. Technological potentials are equalized (balanced) faster due to off-shoring (using cheap labor in underdeveloped countries) and outsourcing, which requires immediate transfer of modern technology to these countries. On the other hand, the equalization of economic potentials, especially of wages, purchasing power, and living standards of the masses, is much slower, because it is not in the interest of the corporation owners in rich countries. The rich are aware that they live at the expense of the poor and get rich thanks to them. They do not need to bridge this gap; it is better for them to maintain the existing discrepancies and relative poverty despite the ideas of globalization, sustainable development and the common good. However, such situation cannot last forever. Even now, the number of poor people in the world is significantly decreasing, the number of people earning average wages is growing, and the number of rich people is increasing only slightly[1].

It is possible that in the future, the steamroller of globalization and progressive economic growth will equalize the economic potentials of different countries and local economies will melt into a single truly sustainable global economy. With accelerated social processes, this may not take long. If this happens, we can expect economic stagnation in the best case scenario and a total collapse in the worst case. Both will have a negative impact on the fate of humanity.

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[1] From 2001 to 2011, nearly 700 million people got out of poverty, but most barely so. The number of the poor (living on less than $2 per day) fell by14%; now they constitute 15% of the world population. The number of the rich (having over $50 per day) increased by 1%; now they constitute 7% of the world population. The low-income population (living on from $2 to $10 per day) is the biggest group and increased by 6%, constituting 56% of the world population (Rakesh Kochhar, 2015)

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The Anthropocentric Sozology of Julian Aleksandrowicz

Juliana Aleksandrowicza antropocentryczna sozologia

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Abstract

The article presents original concepts of *ecological conscience* and *prevention for human health by protection of the natural and social environment* by Polish physician and scientist Julian Aleksandrowicz (1908-1988). Both of them in general contain threads of environmentalism, sozology, axiology with highlighted value of health and proposed *medicine of tomorrow*. In detailed considerations Polish researcher concentrates on issues of ecological conscience, diseases of civilization and social deformations – partly resulting from the degradation of nature, pacifism and standards for the physician of the future. In the article this matters are presented in three points: 1 Environmentalism; 2 Ecological Conscience; 3 Deformation of social and human health. Medicine of tomorrow. The text emphasizes the anthropocentrism in sozological aspect of Aleksandrowicz views. A proposal to recognize them in perspective sozophilosophy is also presented.

Key words: ecology, medicine of tomorrow, nature protection, sozology, sozophilosophy, ecological conscience, health

Streszczenie

Artykuł przedstawia oryginalne koncepcje polskiego lekarza i uczonego, Juliana Aleksandrowicza (1908-1988): *sumienia ekologicznego* oraz *profilaktyki zdrowia człowieka poprzez ochronę środowiska naturalnego i społecznego*. Są zawarte w nich na płaszczyźnie ogólnej wątki ekologizmu, sozologii, aksjologii z wyróżnioną wartością zdrowia i projektowanej *medycyny jutra*. Na obszarze konkretnym rozważania polskiego badacza dotyczą kwestii sumienia ekologicznego, chorób cywilizacyjnych, deformacji społecznych, po części będących skutkiem degradacji przyrody, pacyfizmu i wzorca lekarza przyszłości. Problematyka ta jest zawarta w trzech punktach: 1. Ekologizm; 2. Sumienie ekologiczne; 3. Deformacje społeczne a ludzkie zdrowie. Medycyna jutra. W tekście uwypuklony jest antropocentryzm sozologicznego aspektu poglądów Aleksandrowicza. Wyłożona jest też propozycja ujęcia ich w perspektywie sozofilozofii.

Słowa kluczowe: ekologia, medycyna jutra, ochrona przyrody, sozologia, sozofilozofia, sumienie ekologiczne, zdrowie

1. Introduction

Julian Aleksandrowicz[1], a professor of medicine, a world-class specialist in haematology and research on leukaemia, was one of the most eminent Polish scholars of the second half of the 20th century. He achieved recognition both at home and abroad mainly due to his research as well as organisational and popularizing work in the field of ecological prevention of diseases of affluence. His activity in

[1] Julian Aleksandrowicz was born in Cracow in 1908. It was also in Cracow that he attended secondary school and graduated from Jagiellonian University Medical College, where in 1934 he defended his doctoral thesis concerning research on bone marrow. In 1933-43 he worked in Cracow hospitals. During the subsequent years of German occupation he was involved in underground activities (assuming the pseudonym *Twardy/Hard*) working as a doctor for various groups of the Home Army. In 1947, he got

this area was based on his conviction about the fundamental unity of reality, manifesting itself in various correlated phenomena. The Polish scientist was especially interested in reflexive relations between the humans' social world and their natural environment. They constitute the starting point of Aleksandrowicz's reflection on the notion of nature conservation as well as on the protection of human health, which is put at risk by the increasing degradation of the natural environment and by the deformations of the social environment. His views in this respect, shaped from the 1960s and developed in the 1970s and 1980s, fit perfectly into the modern day sozology, so the science of environmental protection (Dołega, 2006, p. 1-23). Julian Aleksandrowicz's reflections concerning the ecological context of the health of the modern human (Jagiełłowicz, 2011) are presented on three levels, which together provide the interpretation of his specific *philosophy of health protection*. They concern, in turn: 1. Ecologism, 2. The ecological conscience and 3. The effect of the deformation of the social environment on the state of human health; at the same time, they create the internal structure of the presented text.

II. Ecologism

The fundamental assumption of Aleksandrowicz's reflection on the health dimension of the human existence is the ontological thesis which he termed *ecologism* (Aleksandrowicz, 1982, p. 12, 201). It proclaims the fundamental unity of the reality (monism), in which all its manifestations and phenomena are correlated and interdependent. This principle is best illustrated by the humans' place in the being, determined on the one hand by their inclusion in the social world (the world of culture), and in the world of nature on the other. The human, specified in this manner, evolves and is subject to historical processes, in which it is especially manifested that *(...) social development, conditioned by health, is the relationship between sociosphere, technosphere and various forms of life which constitute biosphere, subordinated to the increasingly sophisticated psychosphere* (Aleksandrowicz, Stawowy, 1992, p. 276-277). In his development of the abovementioned laconic ecological thesis, Aleksandrowicz stresses the more active role of sociosphere which remains in a relationship with biosphere. Sociosphere is the humans' psychosocial environment reflected in culture. It is on this level that humans come to understand their own limited nature in relation to biosphere (to which they partially belong and to which they are subjected, e.g. through the inevitable barrier of death or disease, which are a source of suffering); at the same time it is here that conditions are gradually created for their possibly best existence (through the development of science and technology – machines and the methods of using them, or technosphere). On this ground, psychosphere develops – or rationality, whose the most significant manifestation is the changing awareness of the human role in the world, determined by the following systems: human-human, human-the environment and human-the universe (Aleskandrowicz, Stawowy, 1992, p. 277). This whole system of correlations, which humans are subject to, is called by Aleksandrowicz *environmental determinism*.

The process of humans forging their place in the world consists mainly in exploiting the natural environment. Aleksandrowicz calls this environment biosphere. Humans are *immersed* in biosphere from birth till death, hence its significance for the human existence. Biosphere provides the link between humans and the sunlight; through air, water, soil and nourishment it is directly related to the human existence.

Aleksandrowicz treats sociosphere (together with technosphere) and biosphere, according to the primary thesis of ecology, as dynamic elements of a greater structure (a system – the whole of the life on Earth), which are always present in close relation to

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postdoctoral lecturing qualifications at Jagiellonian University based on his work concerning haematology. In 1951, he became an associate professor, and five years later a full professor at Cracow Medical University. From 1950, he was the director of the III University Hospital of Internal Diseases in Cracow, and from 1971 to his retirement in 1978 – the director of the University Hospital of Haematology (created as the result of the transformation of the III University Hospital). His scientific research concerned mainly the ecological prevention of leukaemias and diseases of affluence. As the president (from 1970) of the Committee on Public Health of the Polish Academy of Sciences and a member of numerous pro-health associations, commissions and organizations, he was the initiator of the socially far-reaching programme of ecological prevention of diseases of affluence. In this respect, he attached particular importance to counteracting the negative effects of the destroyed environment on human health. Therefore, he was active in working for noise reduction, against industrial water and air pollution, against depleting soil fertility. He propagated the idea of health foods and supplementing them with *bioelements* – substances indispensable for human health (e.g. dolomite, limestone, magnesium, selenium, lithium). This activity formed a basis for a specific *philosophy of the protection of human health* through increased nature conservation. Julian Aleksandrowicz is the author of over 500 scientific papers. In the context of the subject matter of the present article, the following of his books need to be mentioned: *Wiedza stwarza nadzieję* (1975); *Sumienie ekologiczne* (1979); *Kuchnia i medycyna,* co-authored with I. Gumowska (1979); *Nie ma nieuleczalnie chorych* (1982); *U progu medycyny jutra,* co-authored with H. Duda (1988); posthumously (memoirs edited by E. Stawowy) *Tyle wart człowiek...* (1992). He died in Cracow in 1988. More biographical and bibliographical data can be found in: Jagiełłowicz B.A., *Juliana Aleksandrowicza 'poszukiwania filozofii ochrony zdrowia',* Wrocław 2011; Rożnowska K., *Uleczyć świat. O Julianie Aleksandrowiczu,* Cracow 2012.

one another. Any change taking place in one of the subsystems results in changes in another subsystem, and such influences are usually of reflexive nature. Each of the greater subsystems contains a multiplicity of lower level subsystems (Cao, Piecuch, 2012).

In this systemic conceptualization, the Polish thinker states for example that the quality of biosphere depends mainly on the hydrogeochemical and biological composition of the natural environment, but above all he points out that it is conditioned by the human interference in this environment (Aleksandrowicz, Stawowy, 1992, p. 278). He stresses that with the civilizational development, it is especially the influence technosphere has on biosphere which is becoming greater. According to Aleksandrowicz, the process itself is not detrimental; it contributes to the improvement of human life as long as it proceeds in a rational way (Aleksandrowicz, 1979, p. 46-47). However, this is not the case, as he states with regret: *Humans introduce into biosphere, together with the smoke from chimneys and effluents from factories, contaminants in the form of chemical compounds which are foreign to living organisms. They have a harmful effect on health, giving rise to numerous diseases of affluence, both of somatic and psychological nature* (Aleskandrowicz, Stawowy, 1992, p. 278). Therefore, as a result of the scientific and technological development (or science-technology, as G. Picht terms it), especially since the 19th century scientific-technological revolution, a gradual and progressive degradation of biosphere has been taking place, altering the face of the Earth. At the same time this increasingly destroyed biosphere, in its various forms, affects sociosphere, having a negative influence on numerous aspects of social life, especially on the state of human health.

For Aleksandrowicz as a doctor, the abovementioned ecological perspective constitutes a starting point for developing a concept of the prevention of diseases of affluence. He starts from the proposition, based on empirical foundations, that a number of contemporary diseases, such as cardiovascular diseases, diseases of the respiratory system, cancers, infectious diseases or mental illnesses, are etiologically closely related to the environment in which a given person is; the environment which is largely shaped by the negative influence of technosphere. Contemporarily, the natural environment is not a welcoming home for humans, but a significant source of threats for their existence. According to Aleksandrowicz, the consequences of human interference in the world of nature which are the most dangerous for their life and health are: the pollution of the environment with by-products of heavy industry (mainly arms industry), energy industry (nuclear power plants) and chemical industry (polluting the air, soil and water with lead, mercury, cadmium or arsenic and their derivatives); the elimination of bioelements (especially microelements, such as magnesium, calcium, lithium, selenium, copper, manganese) from food in the currently employed food technologies (the result of which is highly processed food); the change in the chemical composition of the soil as a consequence of using chemical fertilisers, resulting in the low quality of agricultural food products; finally, the contamination of air and water with urban waste, e.g. exhaust fumes and sewage (Aleksandrowicz, 1979, p. 63-81). All these negative phenomena deplete and impoverish humans' natural environment, depriving it of elements which are important for their life and health. Such transformation of humans' own natural environment (often on a global scale; an example could be the greenhouse effect), brought about by their economic activity, forces them to adapt to the new worse conditions of existence. The process of this adaptation, according to Aleksandrowicz, is directly responsible for diseases of affluence. Such diseases are simply *an expression of the body's excessive adaptation reaction to the deficiency of vitamins and minerals indispensable for a healthy life. An excessive adaptation reaction causes premature damage of the structures and functions of the bodily organs, and therefore a disease often resulting in early death* (Aleksandrowicz, 1987, p. 119).

In such a situation, according to Aleksandrowicz, the methods of treatment widely employed in medicine, that is symptomatic and causative treatment (focusing on the measurable and partial causes of diseases), are definitely insufficient. The etiology of diseases of affluence is complex and multidimensional. When searching for their causes, one needs to refer to the most basic source – to the contaminated environment. The Polish scientist stresses therefore that *in the modern world, plagued by diseases with such extensive causes, an emphasis should not be placed on the treatment, but on prevention* (Aleksandrowicz, 1987, p. 281). From this perspective, the prevention of diseases of affluence is an activity aimed at eliminating the factors which negatively affect human health through *fixing* their natural environment. Concise phrasing of this project of protecting life from diseases of affluence is as follows: *Prevention is a higher form of treatment based on nature protection* (Rożnowska, 2012, p. 318).

Ecological prevention of diseases of affluence should above all be aimed at improving the environmental conditions of human life. In this respect Aleksandrowicz presents a few desiderata which need to be implemented: 1. Curbing the development of industry, especially of plants emitting gases and dust detrimental to humans; 2. Installing dust filters and filters neutralising the emission of toxic dust and gases in industrial plants; 3. Reducing the amount of exhaust fumes emitted by vehicles into the atmosphere; 4. Popularising electric vehicles (cars or trolleybuses); 5. Significantly increasing urban green areas; 6. Guaranteeing the supply of clean water, sufficiently saturated with bioelements; 7. Changing the diet so that it includes so-called health food, with the appropriate amount of vitamins and minerals (a prac-

tical expression of this suggestion is a cookbook written by Aleksandrowicz and I. Gumowska, *Kuchnia i medycyna – Cooking and medicine*); 8. Controlling food in terms of compounds detrimental to human health it contains, resulting from the excessive chemicalization of agricultural production and food industry, which should be limited (Aleksandrowicz, 1979, p. 104-109).

The suggestion to diagnose diseases of affluence in the ecological context is Aleksandrowicz's considerable achievement. In Poland, he was the precursor of combining medical practice with the analysis of threats to human health presented by the natural environment, which is becoming gradually more and more destroyed. His project of prevention as a higher form of medicine based on nature protection is a big step towards the new paradigm of medicine (Jagiełłowicz, 2011, p. 140-147).

III. The ecological conscience

The idea of ecological prevention of diseases of affluence is anchored in Aleksandrowicz's axiological reflection. Its nature is definitely anthropocentric, resulting from the conviction that *the whole reality needs to be considered from a human point of view* (Aleksandrowicz, 1992, p. 276). It is also demonstrated in the perspective of ecologism. Pointing out the interdependency, generally speaking, of biosphere and sociosphere, it highlights the necessity of introducing such a relationship between them that would ensure possibly the best conditions of human life.

The highest value for Aleksandrowicz is health: *health is the chief value of the human world* (Aleksandrowicz, 1992, p. 269). Being aware of the difficulties involved in providing a precise definition of health, he adopts a very broad formula describing it as a state of *balance in terms of the somatic and psychological structure of personality as well as the structure of a person* (Aleksandrowicz, 1987, p, 17). as a lack of disruption in homeostasis in the physical, psychological and social sphere of an individual human life. Such a broad perspective on health enables him to distance himself from modern medicine, interested, according to him, only in the biological aspect of human health (and disease). Health as well as human diseases need to be, as he claims, considered also from the psychological and social point of view. Such a holistic perspective and interdisciplinary medical examination shall be the characteristic features of the humanism of *the medicine of tomorrow* he advocates (Aleksandrowicz, 1979, p. 8-24).

From this point of view, the project of prevention based on nature protection concerns not only somatic diseases, but also psychological and social health. It is being damaged by a set of factors originating in the social environment, such as the stress-inducing character of the contemporary socio-political system, the phenomenon of wars or the moral crisis; at the same time it is dependent on the quality of food, which as a result of human impact on the environment is often full of poisonous toxins, *which damage not only biosphere, but above all the most evolved living matter – the human brain* (Aleksandrowicz, 1987, p. 102). Therefore, the prevention must include the protection of not only the biophysical environment, but also of the psychosocial one. *In this understanding, prevention amounts to forecasting future cultural patterns, which combining the biological knowledge of the environment with the knowledge of the relationships between people and nations provide the basis for the 'science of survival'* (Aleksandrowicz, 1987, p. 39).

Apart from the value of human health – the aim of prevention – the most significant category on Aleksandrowicz's axiological horizon is *the ecological conscience*, providing the foundation for the undertaken pro-health action through environmental protection. The Polish scholar did not define the notion of *the ecological conscience* anywhere in his writings; he used it intuitively, as a general term for the sensitivity to the condition of the natural environment[2]. At the same time, *the ecological conscience* plays the role of an *inner moral censor* of a person (Fiut, 2013) it is the voice of Socrates' *daimonion* forbidding one to undertake actions which increase human suffering resulting from the degradation of the broadly understood human environment, consisting in equal parts of nature and society.

When analysing the contents of the term *the ecological conscience*, it needs to be pointed out that *conscience* is a word signifying a system of internalized values, culturally and historically dependent, always constituting a specific moral compass for the actions one undertakes (when one is not faithful to these values, they feel remorse); the expression *ecological* points to the centre of this conscience, consisting of the conviction that there exist values the natural environment is entitled to. Jointly, *the ecological conscience* could be defined in A. Papuziński's words as *the moment in the human experience of freedom when they become aware of their responsibility for the life in all its forms: anthroposphere, zoosphere, biosphere and geosphere; for the whole genetic potential of the life on our planet; for maintaining the population size of all forms of life, at least enabling them to survive in their natural conditions; and for the unaltered balance of natural processes* (Papuzinski, 1997, p. 21-22)[3]. It needs to be stressed that the abovementioned proposition of understanding the term *ecological conscience* has a biocentric

[2] The category of *the ecological conscience* was introduced by Aldo Leopold in his essay *The Ecological Conscience,* in: *A Sand County Almanac* (1949).

[3] As a side note, it needs to be stressed that there is a close connection between *ecological conscience* and *ecological awareness*, the propagation of which is in the current

nature, which was not how Aleksandrowicz perceived it. According to him, the biological conscience is *activated* only in situations when a threat to human health form the socio-natural environment occurs. In relation to the natural environment, the ecological conscience is manifested through practical protective activities towards nature – not on account of nature itself, but exclusively in the context of ensuring human health, the highest value of the social world. In relation to the social world, ecological conscience is to blaze the trails of organising it in such a way that the threats to the psychosocial human health could be minimized as much as possible. Therefore, Aleksandrowicz's ecological conscience is definitely anthropocentric.

The value of human health and the ecological conscience are the bases for Aleksandrowicz's moral reflection. It is characterised, on the one hand, by its deep humanism; on the other, the quite unexpected connection it establishes between morality and the psychophysical quality (health) of human life as well as its socio-natural environment is striking. In this context, the Polish scholar writes openly that *morality cannot be separated from its bearer, that is, the human body and its physiology, as well as its correlation with the broadly understood environment* (Aleksandrowicz, 1992, p. 318). Subsequently, he supplements this conviction with a thesis that *A healthy person is good in the colloquial understanding of the word; they think and act morally* (Aleksandrowicz, 1987, p. 19). It means accepting the conclusion that the opposite of *health*, that is *disease*, perceived not only mechanically, as the *damage* to one of the organs of the human body, but as general improper functioning of a person also in the psychological and social sphere, is the source of evil. In this sense *what should be considered the antinomy of good are those human actions which add more suffering to existential suffering, cause the damage of structures and functions of bodily organs and lead to premature death* (Aleksandrowicz, 1987, p. 21), such as diseases of affluence. On the other hand, health and the good connected with it result in the sense of *self-esteem combined with the respect for others' dignity, that is with egalitarianism, with a sense of respect for life in any form. A healthy person (...), therefore equipped with a properly developed ecological conscience, is not cruel, but good; they think and act honestly, their deeds are characterised by horizontal and vertical responsibility* (Aleksandrowicz, 1979, p. 41). Horizontal responsibility concerns the relationships between people *hinc et nunc* on a micro-social (local, within a country) and macro-social (international) scale, while vertical responsibility relates to taking care of the older generation, of eliminating the inherited negative behaviour, propagating prosocial values for the future and concern for the future generations. In this understanding, responsibility amounts to sustaining the ecological balance of the environment of human life, ensuring humans with suitable conditions for maintaining their health.

Aleksandrowicz also employs the abovementioned bases of his moral reflection to formulate a few specific normative directives of human conduct (Aleksandrowicz, 1979, p, 42-43; Aleksandrowicz 1987, p. 19-20). They concern three areas: 1. Human personality; 2. Social coexistence and 3. Ecology.

Re. 1. In the first area, the guidelines concern the moral formation of human personality. The norms given here present an outline of a model of a good and healthy person:

- prohibition on consciously causing (through thinking and/or acting) suffering in others,
- prohibition on indifference to the phenomenon of hunger;
- prohibition on unjustified patronizing other people;
- prohibition on lying,
- an obligation to express gratitude for acts of kindness,
- an obligation to perform objective self-evaluation,
- an obligation to internally compensate (through spiritual development) physical or psychological defects,
- an obligation to be optimistic in life (and to reject pessimism at the same time),
- an obligation to attain spiritual self-fulfilment.

Re. 2. The second plane is where the norms describing the idea of *social health* and common good are located:

- prohibition on hating other people for reasons of racial, national or religious prejudice,
- prohibition on employing the law of *the justice of the stronger* in macro-social relations,
- an obligation to solve all social conflicts without harming other people,
- an obligation to *design* a better tomorrow according to the vision in which moral values prevail over material ones.

Re. 3. Finally, the third area refers to the principle of ecologism, which combines the social world of the people with the natural environment. The guidelines presented here define the core of the ecological conscience:

- an obligation to develop the awareness of the fact how detrimental it is for health to disturb the natural environment (Ale-

ecophilosophical reflection the necessary condition for salvation from an ecological disaster.

ksandrowicz calls a lack of such awareness a disease *caused by the deficiency of ecological conscience*),
- an obligation to prevent as much as possible the destruction of biosphere,
- an obligation to limit the purchase of consumer goods, which will result in reducing the exploitation of natural resources and, in turn, in increasing humanity's chances of survival,
- prohibition on wasting or destroying products essential for life, which is a crime against humanity and human sense of justice,
- an obligation to view the biosphere (including the human world) from the perspective of the rhythm of life, marked by birth, puberty, old age and death, in the face of which all beings are equal.

The moral norms ensuing from the value of health as well as from employing the ecological conscience in practice create the framework of an ethical system. Its specific characteristic is the identification of widely understood human health with moral good, and defining humans as beings which are most evolutionary advanced, but always closely related to their natural and social environment. The awareness of this fact and the concern for human health produce a sense of ecological conscience. Therefore, Aleksandrowicz's reflection in this area could be termed as *the ethics of the ecological conscience* (Fiut, 2013).

IV. Social deformations and human health. The medicine of tomorrow

Aleksandrowicz understands the deformations of social life as any anomalies occurring in human social life which negatively affect people's health.

Among such problems which have a harmful influence on the whole of the human life, he lists above all the ethical crisis, directly coupled with the ecological crisis. This crisis is a disease of *the atrophy of the ecological conscience*, the cause of which is the direction of the progress of human civilisation, with its excessively developed industrialisation and bloated, often gratuitous consumerism. The consequences of such direction of humanity's development are the gradual destruction and pollution of the natural environment, which have a definitely negative influence on the state of human health.

The second drastic deformation of social life is the phenomenon of war, irrational in itself, as well as the related arms industry. On the one hand, according to Aleksandrowicz, eliminating the phenomenon of war will undoubtedly end the suffering of war victims and their families. On the other, it is only through limiting it, and preferably through total disarmament of the world that it will not just become possible to eliminate genocide or terrorism, but also to allow for a radical *reduction in the pollution of the environment with by-products of industrial plants* (military factories – L.G.), *and the released funds can be used for the hierarchically most significant goal: the protection of health of the present and future generations* (Aleksandrowicz, 1987, p. 102). An expression of the Polish doctor's attitude of pacifism stated in such terms, especially close to him on account of his wartime fate, was his open letter entitled *Letter 2 concerning preservation of natural environment by war prophylaxis*, addressed to Secretary-General of the United Nations U Thant in 1970. Its main message is contained in the following words: *The prevention of the diseases of the modern civilization requires humans to protect their environment, that is nature. Its attribute is war prophylaxis, that is protection of peace* (Aleksandrowicz, 1992, p. 252-254).

The following feature of contemporaneity which Aleksandrowicz finds incomprehensible is hunger, which afflicts a large part of human population and whose influence on human health is indisputable. He finds its sources mainly in the definitely harmful current economic-political system, which, for example, orders that food be destroyed whenever there is a case of overproduction, so that profitable producer prices can be maintained. Hunger is also the result of conflicts, both military and political (e.g. through imposing an embargo or increasing the rates of duty on food products).

According to the Polish scientist, the present day is also characterised by an increase in the number of psychosocial anomalies. Among them, he includes depressive disorders, mental illnesses, drug addiction and alcoholism. He stresses that some of them are conditioned by cultural heredity (drinking alcohol), others – by inadequate social or health policy, but what he sees as a significant cause for their dissemination is insufficient presence of bioelements (e.g. lithium) in the diet of modern people, which has a destructive impact on the human brain. Their deficiency is mainly caused by robber economy (Aleksandrowicz, 1987, p. 187), resulting e.g. in depleting soil fertility.

Generalizing the remarks above, Aleksandrowicz writes that the sources of social deformations are to certain extent historically and culturally burdened, but they are also the result of human creativity: *the negative effects humans cause in their natural environment, expressed by three interconnected socio-cultural phenomena, that is war-hunger-disease, are not only the consequence of pedagogical errors, but also of the disorders in the structure and functions of the brain, which often fail to be detected clinically* (Aleksandrowicz, 1987, p. 40), this situation is profoundly influenced by human contamination of the natural environment. These social anomalies can be in great part eliminated by prevention based on nature protection.

It is in the context of the presented social deformations and the prevention in health protection that

Aleksandrowicz's idea of *the medicine of tomorrow* is situated. This project has its roots in the conviction that modern medicine adopts an inadequate approach to the patient. Above all, it loses sight of the inseparable psychophysical unity of the human; it fails to perceive a person's socio-cultural roots and to take these conditions into consideration in treatment. It treats an individual in need of medical intervention exclusively in categories of a separate medical case or disease entity. This trend is especially favoured by the development of unconnected medical specialities. Therefore, modern holistic medicine lacks a diagnostic perspective. The treatment technology, as a result of perceiving a person in a mechanistic way – which is the aftermath of the 19th century scientific and technical revolution (scientistic tendencies) – resembles a sort of *repairing a broken engine* (Aleksandrowicz, 1979, p. 15).

Aleksandrowicz claims that a change in modern medicine's approach to the patient is indispensable. He stresses that *disappointed with the scientific and technical revolution, we see our* (only – L.G.) *hope of saving mankind in scientific and humanistic revolution* (Aleksandrowicz, 1979, p. 52). For medicine, it means the necessity to be *deeply* [grounded] *in the issues of the humanities – philosophy, ethics, pedagogy, political and economic sciences, social sciences, as well as biological and exact sciences. The role of 'the medicine of tomorrow' would therefore consist in integrating the activities focused on culture, or sociosphere, with technosphere – the world of machines, in order to protect biosphere and its elements – humans – from damage, that is from disease* (Aleksandrowicz, 1979, p. 97). Hence, it would be true *environmental medicine*, broad in terms of the scope of research and practice. The foundation of such reorientation in medicine shall be philosophy (Jagiełłowicz, 2011, p. 215-216), especially Greek axiology as seen by Protagoras, Plato or Aristotle, who Aleksandrowicz referred to (e.g. Aleksandrowicz 1979, p. 38; 1987, p. 51; Wojtaszek, 2008, p. 38). It is to be based on the triad of the three most general values of good, beauty and truth.

In Aleksandrowicz's thought, the goals of the new medicine are to be set by the good of a holistically perceived human. They are formulated in most general terms on the normative grounds of the ethics of ecological conscience. Human physical and psychological health; the requirement of protecting the natural and social environment, related to the concern for human health; prevention of war; dissent at social deformations are priorities in this respect. The perspective of good understood in this manner demonstrates the need for taking immediate steps to put it into practice (e.g. through a suitable environmental, health and social policy), as a failure to act during an ecological crisis could result in an end to mankind. The medicine of the future plays a significant role in that regard in making people aware of the threats (by indicating the sources of e.g. diseases of affluence), implementing prevention (environmental protection, propagating a proper, healthy lifestyle) and employing a holistic approach in diagnosis and treatment.

The truth, as the objective of the human cognitive activity, is according to the Polish doctor to play an ancillary role to human good. Science, as an expression of truth, is considered by him mainly in the context of the human state of health. In this respect, he stresses the necessity for undertaking in the medicine of the future extensive interdisciplinary research on etiology and treatment of numerous diseases which were little known or treated as incurable for a long time (e.g. cancers). He believes that cooperation between specialists in different areas of science, especially those studying the environment (e.g. chemists, physicists, hydrologists, soil scientists, biologists) and those studying the human (doctors, representatives of social sciences and the humanities) has already revealed and will allow to reveal in the future many interconnections, at the moment imperceptible, between sociosphere and biosphere, which will enable people to understand the mechanisms of the emergence of diseases and of overcoming them. The second significant guideline for modern and future medicine is, according to Aleksandrowicz, the worldwide flow of scientific information concerning social and individual health, which would make it possible to successfully combat especially dangerous diseases (e.g. virus epidemics on a global scale). At the same time, it needs to be borne in mind that the contemporary situation of the international exchange of information about health has been radically changed since the times of Aleksandrowicz's writings as a result of using information technology, to a large extent meeting the Polish doctor's demand for close international scientific and medical cooperation. Finally, the third element of the new medicine is the process of training medical staff, related to education. In this point, the scientist specifies a few principles which are traditional for medical deontology and according to which future doctors should be shaped, e.g. alleviating suffering, making an effort to prolong a patient's life with no regard for the rules of procedure, e.g. he allows for alternative medicine treatments) or own profits (e.g. career, financial motivation (Aleksandrowicz, 1979, p. 14-22). However, the most important element of the *intellectual equipment* a doctor of *the medicine of tomorrow* should possess is, according to him, competence and humanistic, not technical in the spirit, pursuit of the profession. In this context, he writes: *I would entrust myself to the care of a doctor who would be as reflective as a sage, have knowledge and prudence whose source would not be just books, but also life experience* (Aleksandrowicz, 1979, p. 18-19). Furthermore: *I would like to see in my doctor-healer an eminent specialist in a particular branch of medicine (...), I would like them at the same time to be a person with the ability to perceive the world holistically* (Aleksandrowicz, 1979, p. 19). An ideal of *the med-*

icine of tomorrow is in this perspective a doctor-philosopher.

An important place in *the medicine of tomorrow* is occupied, according to Aleksandrowicz, by the value of beauty. In relation to this, he notes: *In what I call 'the hospital of tomorrow', aesthetic experiences should have its place; visual arts and music can play the role of elements stimulating the imagination not only of the patients, but also of the doctors* (Aleksandrowicz, 1979, p. 21). In turn, literature can support individual reflection which usually accompanies diseases, on the phenomena of suffering, death or on the purpose and sense of human existence. The alliance between art and medicine is to be, according to him, the basis of the one of the most significant therapeutic methods, especially in psychological rehabilitation (Aleksandrowicz, 1987).

Aleksandrowicz's remarks on *the medicine of tomorrow,* a project which has its roots in the acknowledgement of the abovementioned social deformations and the unsatisfactory state of modern medicine, clearly show the way beyond the concept of preventive healthcare through nature protection. This concept is absorbed by the idea of the new medicine, which, due to its suggested scope and line of reasoning, becomes an original idea of constructing a philosophy of medicine, or, more specifically – a philosophy of human health protection. According to the scientist's conviction that *Medicine has its roots in philosophy. If you cut a plant from its roots – it will die* (Rożnowska, 2012, p. 317), such construction is indispensable. It needs to be added that this project was only roughly outlined by Aleksandrowicz.

V. Conclusion

The title of the present article contains a thesis that Julian Aleksandrowicz's reflections on individual and social health in the context of environmental conditions are a specific type of sozologic thought. The ideas of ecologism and nature protection, which are in the foreground of his thought, as well as the related issue of diseases of affluence, are unambiguously situated within the area of sozology; they concern (partial, undertaken from a medical point of view) studies into the causes and consequences of the changes in the natural environment, occurring as a result of human social and economic activity; moreover, they tackle the problem of preventing the negative effects (diseases of affluence) of these changes for the human society.

The second thesis found in the title of the current text points to the specificity of the sozologic aspect of the Polish doctor's reflection. Namely, the pro-health activities through *environmental prevention* he highlights (as expressed in the maxim: *protection of health through the protection of the natural environment*, Aleksandrowicz, 1979, p. 55) have clearly anthropocentric qualities. In his perspective, the idea of environmental protection is not an autotelic value; it plays an ancillary role to the value of human life, and especially human health. The effort aimed at respecting the natural environment is made only on account of human good, both individual and social. The natural environment, therefore, represents only an instrumental value; it is not a goal in itself, but only a tool used to achieve human good that is health. Hence, Aleksandrowicz's concept should be included in the definitely anthropocentric version of the idea of environmental protection, in the humanistic concept of sozology (Dołęga, 2006, p. 13-14).[4]

Aleksandrowicz's multidimensionality and depth of thought, manifested for instance in his propositions of health prevention through nature protection, in undertaking systemic and interdisciplinary research on the intersection between natural sciences and the humanities, or in the project of *the medicine of tomorrow,* all justify terming it *the ethics of the ecological conscience*, *specific environmental bioethics* (Fiut, 2013) or *the philosophy of health protection* (Jagiełłowicz, 2011). These names reflect very clearly how it transcends *pure* medicine. Therefore, it is possible and partially justifiable to locate his reflection within the philosophy of medicine or sozology. However, the issue of protecting health in human life which Aleksandrowicz addresses most often springs from perceiving the environment of human life in its philosophical aspect. For this reason it seems that the most appropriate location of Aleksandrowicz's thought is within the framework of sozophilosophy.

Sozophilosophy is, as yet, a proposition of constructing a philosophy of environmental protection, analogously to the already existing ecophilosophy – the philosophy of ecology. The originator of the idea, Wiesław Sztumski, writes that: *The philosophy of sozology is more of a practical than theoretical philosophy, as it fits in with the strategy of actions aimed at protecting those elements of the environment which are essential for our life, which are worth protecting and can still be saved from destruction. (...) Its aim is to save from destruction these elements of the environment of life which have not yet been damaged as a result of the progress of civilization. (...) Just as it is in the case of ecophilosophy, sozophilosophy holds prospects of further development in view of the fact that it has a fundamental significance for human existence and functioning, like science and technology* (Sztumski, 2012, p. 73-74).

The whole of Aleksandrowicz's theoretical achievements and his actions for the protection of human health are contained within this framework. The issues he addresses and resolves – such as the idea of

[4] From a methodological point of view, considering the conspicuous *ecologism*, Aleksandrowicz's views should be located within systemic sozology.

the ecological unity of biosphere and anthroposphere; the idea of the environment of human life consisting of equal elements: nature and society; the anthropologic conception of the human homogeneous in psychological and physical terms; the system of values and their hierarchy in the human environment – are the philosophical basis for his practical actions for health protection. In his activities, he highlights the significance of the issue of human health and the necessity of providing protection to this area; protection which would be rational and would result from the concern for humankind's future and moral obligation towards people. In this sense, Aleksandrowicz anticipated one of the main directions of sozological reflection, focusing on the protection of spheres especially important for human existence.[5]

Aleksandrowicz's views perfectly fit in with the scope of valeology (from Latin, *valeo* – to be healthy), a modern interdisciplinary school of reflection combining medicine, psychology, sociology, sciences concerning physical culture; pedagogy or economy; it is taught in medical schools. Its subject matter is human health. In general terms, it prefers prevention and health promotion over treating diseases in its studies on human health. According to this area of science, activities focusing on maintaining health are more important than just the therapy (or at least equally important). Taking into consideration the significance Aleksandrowicz attached to the value of human health and to preventive healthcare achieved through nature protection, he can be undeniably considered as one of the initiators of valeology (Jagiełłowicz, 2011, p. 221-222; Bulicz, Murawow, 1997; Jaroń, 1998, p. 105-119).

Aleksandrowicz's medical activities, marked by the conviction that *there are no terminally ill people*, his social activity full of concern for improving individual and social health; scientific works indicating a broad intellectual perspective, requiring a reaction to the modern civilizational threats to human existence; finally, the fruits of his work in the form of, for example, a valuable diagnosis of diseases of affluence and the constructive ideas of *ecologism*, *the ecological conscience*, a higher degree of treatment through prevention consisting in the protection of the environment of human life, or *the medicine of tomorrow* – all these make Julian Aleksandrowicz – a doctor, scientist, academic teacher, humanist and philosopher – a prominent figure in Polish culture and science of the second half of the 20th century, especially distinguished in terms of raising ecological and sozological awareness.

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[5]According to Sztumski, sozophilosophy should be concerned with the philosophical justification of the protection, as well as with the protection itself, of areas especially essential for humans immersed in the natural and social environment, such as faith, knowledge, space, language, quiet, time, freedom, privacy or rationality; see Sztumski, 2012, p. 76-230. He did not mention the value of health.

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Tax Payment, Social Contribution for Pollution Prevention and Happiness

Płacenie podatków, społeczny wkład ograniczanie zanieczyszczeń i poczucie satysfakcji

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Abstract

Using data from the China part of the World Value Survey (WVS), this paper empirically studies the impact of air pollution on happiness, and further, the citizens' willingness to pay (WTP) for pollution prevention and its determinants. The result confirms that air pollution significantly worsens happiness. Regarding he WTP, it is differentiated in the form of tax and social contribution. Contrary to the expectation that the air pollution level affects the WTP, the concern on the environment plays a bigger role in increasing the WTP. Besides, the WTP are shown significantly influenced by tax compliance incentives, trust in the government or environmental organizations, attitudes toward environmental protection responsibilities and the family income, which sheds light on effective environmental policy making and implementation.

Key words: air pollution, happiness, willingness to pay, world value survey

Streszczenie

W artykule, wykorzystując dane odnoszące się do Chin w ramach bazy World Value Survey (WVS), omówiono badania empiryczne odnoszące się wpływu zanieczyszczeń powietrza na poczucie satysfakcji obywateli, a także ich gotowości do zapłaty za zanieczyszczenia powietrza i ich determinanty. Otrzymane rezultaty potwierdzają, że zanieczyszczenia powietrza znacząco pogarszają poczucie satysfakcji. Biorąc pod uwagę gotowość do zapłaty, odpowiedź jest uzależniona od formy podatku i społecznego zaangażowania. Przeciwnie do oczekiwań, że zanieczyszczenia powietrza wpływają bezpośrednio gotowość do zapłaty, okazało się, że ważniejsza jest troska o środowisko. Ponadto, na gotowość do zapłaty wpływają sensowne podatki, zaufanie do rządu, organizacji ekologicznych, świadomość odpowiedzialności za środowisko, a także osiągany dochód, co zarazem pozwala ocenić efektywność polityki środowiskowej i jej wdrażania.

Słowa kluczowe: zanieczyszczenia powietrza, pomyślność, gotowość do zapłaty, world value survey

1. Introduction

Pollutants come with economic activities. In 2013, China produces GDP amounted to 56885 billion yuan (9170 billion US dollars). At the same time, it emits 20 million tons of SO_2, 13 million tons of dust, 66936 billion square meter of industrial waste gas (Table 1). Moreover, in 2013, the fine particular pollution prevails in China, most cities are experiencing the haze problem more than 50 days of the whole year. In the report *Toward an Environmentally Sustainable Future: Country Environmental Analysis of the People's Republic of China* published by Asian Development Bank, among 500 big cities in China, only 1% can achieve the air quality standard recommended by the World Health Organization. The environmental degradation has become so serious that in the most polluted cities rank worldwide, Chinese cities occupy 7 of the top 10.

Table 1. Air pollution in China (2006-2013), data source：China Environment Yearbook

Pollution	2006	2007	2008	2009	2010	2011	2012	2013
SO_2 (in millions of tons)	25.9	24.7	23.2	22.1	21.8	22.2	21.2	20.4
Dust (in millions of tons)	10.9	9.9	9.0	8.5	8.5	12.8	12.3	12.8
Industrial waste gas (in billion square meter)	33099	38817	40387	43606	51917	67451	63552	66936

Despite the remarkable economic achievements realized, the pollution generates serious negative consequences. Evaluated by the World Bank (2007), the economic cost caused by the air pollution is estimated equivalent to 1.2% of GDP in China by the measure of illness, and as high as 3.8% by the measure of willingness to pay. Through health risks, the air pollution accounts for the fourth highest risk factor (after food security, high blood pressure and smoking) responsible for health hazards and the death rate. According to a report published on *The Lancet* in 2012, outdoor air pollution leads to the death of 1.2 million people in China.

In September of 2013, China releases the *Plan of Action for the Prevention of Air Pollution*, which emphasizes the significance and urgency of air pollution abatement, and establishes environmental targets, policy instruments and detailed strategies. No matter the action is to be carried out by the government or other agencies, the improvement of air quality requires a good deal of financial input, which is originated from the general public. Hence, studying the effect of air pollution on the personal welfare, the willingness to pay (WTP) for the pollution prevention, and economic social factors that affect the WTP, is essential for green taxation designs, public policy making, and environmental management.

In recent years, more and more research is conducted on personal subjective welfare, which is commonly measured by the response to *happiness* or *life satisfaction* (Frey and Stutzer, 2005; Dolan et al., 2008; MacKerron, 2012). Regarding the relationship between environmental quality and happiness, the existed literature explores the matter in various dimensions of air pollution, climate, noise and water quality as in Cuñado and Pérez Gracia (2013). As for the air pollution, Welsch (2006) discovers that air pollution significantly worsens personal welfare using data from 10 European countries. Rehdanz and Maddison (2008), Ferreira and Moro (2010), and Luechinger (2009, 2010) find similar results of negative correlation with focus on noise, PM_{10} and SO_2 with data from Germany, Ireland and European countries, respectively. Mackerron and Mourato (2009) match the subjects being interviewed in London and the air pollution concentration of their neighborhood using geography information system, and conclude that no matter measured or perceptive air pollution significantly reduces their life satisfaction. Such matching method is also employed in Levinson (2012) with data from the United States. Menz and Welsch (2012) study the preference and WTP of air quality involving age structures, with panel data of 25 OECD countries from 1990 to 2004, they demonstrate that people are willing to pay 100-188 dollars for exchange of a reduction of 1μg/m^3 of PM_{10}. Together with the acceleration of the aging problem, the WTP will double in 2030.

However, such research targeting China is scarce. Smyth et al. (2008) analyze data from 30 Chinese cities and find the more SO_2-polluted the area is, the lower the citizen's subjective satisfaction becomes. Yang and Yang (2011) take into consideration the effect of environmental satisfaction as well as job satisfaction and psychological elements such as extraversion, neuroticism, conscientiousness, etc. on personal well-being, and find, among others, environmental satisfaction is positively correlated with well-being.

Previous literature has revealed the negative relationship between pollution and happiness. Some estimates the value of pollution through the marginal substitution of pollution and personal income. It is evident that pollution results in loss of personal well-being, hence paying for pollution abatement, as long as the amount paid is smaller than the gain from pollution reduction, is a rational choice for enhancing the social welfare. Nevertheless, such common action encounters certain difficulties due to institutional reasons, transaction costs, free rider problems, etc. Hence, this paper aims to firstly test the welfare effect of air pollution, and further, to examine the WTP for environmental quality improvement and its determinants. Comparing to existed literature, our research is different in several ways. First, concerning WTP for pollution reduction, this paper involves a new dataset, innovatively separates and considers both tax payment and social contribution, hence provides evidence for effective and feasible environmental policy choices. Second, this paper emphasizes on the direct subjective WTP instead of indirect evaluation, through income for instance, which reflects a more practical value for promoting pollution abatement at both personal and community level. Lastly, current research on pollution control is more on the macro and policy dimension, this paper, basing on the micro data, provides micro foundation for public environmental policy making.

2. The data and model

2.1. The data description

The data is extracted from the Chinese part of the World Value Survey (WVS), which is a micro database based on a multi-national survey program, and widely used in sociology, political science, econom-

ics, etc. WVS conducted 5 surveys in China, because of the variable inconsistency and the aim of this paper, we adopt the data surveyed in 2007. The variables we use are explained in detail as follows.

Happiness and WTP for pollution prevention

Happiness, as one of the dependent variables, is introduced in the WVS with the question *would you say you are happy or not*. The value is defined for very happy, rather happy, not very happy, not at all happy as 1 to 4, and 77% of the respondents are self-evaluated as happy.

Regarding the WTP for environmental quality improvement, there are two questions in the WVS. One is *I would agree to an increase in taxes if the extra money were used to prevent environmental pollution,* and translates to the variable *taxfenvi*. The value 1 to 4 is given to answers of *strongly disagree, disagree, agree and strongly agree*, with higher values associated with higher willingness of tax payment. The other question asked is *I would give part of my income if I were certain that the money would be used to prevent environmental pollution*, corresponding to the variable *payfenvi* with values 1, 2, 3 and 4 representing *strongly disagree, disagree, agree and strongly agree* as before. The personal payment, as contrary to the official and compulsory payment with tax, reflects more of a social contribution. The two variables demonstrate different payment preferences for pollution control, with mean 2.88 and 3.01, respectively. Besides, 75% of respondents choose agree or strongly agree, while the percentage for giving up personal income is 83%. The general people have relatively high WTP. Besides, reflecting an obligatory and voluntary cost bearing for pollution prevention, the tax mechanism seems less favorable than the personal payment.

Air pollution

Air pollution index, as a key variable in this study of its effect on happiness and WTP, has two dimensions of measurement: objective pollution record, often represented in terms of the density of SO_2, NO_2, PM_{10} and $PM_{2.5}$, and subjective pollution perception of the person being interviewed. Since the objective pollution level is only recorded on the municipal and sometimes the county level, the air pollution density could differ greatly even in one city. Besides, the record demonstrates only the absolute value of pollution level, while the personal assessment involves both the objective air pollution and the relative satisfaction comparing to for instance the environmental quality in neighboring districts. Hence this paper employs personal perception on local air pollution, which is more comprehensive, influential and direct to individuals, as in Mackerron and Mourato (2009). In detail, the index is classified to *not serious at all, not very serious, somewhat serious, very serious* based on the personal valuation of the neighborhood, and is defined as 1, 2, 3 and 4. Among all respondents, 32% regards the air pollution as somewhat serious or very serious.

Other variables

The estimation also introduces various demographic variables, including gender, age, marital status, with child or not. Besides, the education is expressed with 0, 6, 9, 12, 16 and 19 years of schooling corresponding to *no formal education, primary school, secondary school, high school, university, master and above*. Regarding health status, two dummy variables of good health (healthg) and fair health (healthf) are set contrary to poor health. Income is represented by the family income, which is classified to 10 groups with integer value from the lowest 1 to highest 10.

The survey also includes other relevant variables concerning environment or tax attitude. *Looking after the environment is important* is defined as 1 in envimp variable, 0 otherwise. As *envimp* measures the concern on environment, another variable *govresp* represents the responsibility of environmental protection, corresponding to the reply of *the government should reduce environmental pollution but it should not cost me any money*. The value varies from 1 to 4, with different grades from disagree to agree. The attitude towards environmental organization and the government is also essential for different types of payment for pollution prevention, may be also expressed with emphasis on trust in the markets. Whether one trusts environmental organizations and whether one trusts the government are captured by *trustenv* and *trustgov*, with different trust degree from 1 to 4. Lastly, regarding the tax payment for environmental protection, the tax compliance attitude plays a role. We use *avoidtax* to measure incentives on tax evasion, with integer value 1 representing that cheating on tax is not justifiable and value 10 that cheating on tax if have a chance. Those variables reflect personal attitude, social trust, and sense of responsibility which influence the WTP in return.

2.2 The estimation model

The estimation aims to first test the effect of air pollution on personal happiness, represented in (1) as follows. Furthermore, the determinants of WTP are studied. Specifically, the WTP are in forms of tax and personal income, corresponding to equation (2) and (3), respectively.

$$happiness_i = c + \alpha_1 airp_i + \alpha_2 gender_i + \alpha_3 age_i + \alpha_4 age^2_i + \alpha_5 married_i + \alpha_6 child_i + \alpha_7 edu_i + \alpha_8 healthf_i + \alpha_9 healthg_i + \alpha_{10} income_i + \varepsilon_i \quad (1)$$

$$taxfenvi_i = \beta_1 gender_i + \beta_2 age_i + \beta_3 married_i + \beta_4 child_i + \beta_5 edu_i + \beta_6 income_i + \beta_7 healthf_i + \beta_8 healthg_i + \beta_9 airp_i + \beta_{10} envimp_i + \beta_{11} trustenvi_i + \beta_{12} avoidtax_i + \beta_{13} govresp_i + \varepsilon_i \quad (2)$$

$$payfenvi_i = \gamma_1 gender_i + \gamma_2 age_i + \gamma_3 married_i + \gamma_4 child_i + \gamma_5 edu_i + \gamma_6 income_i + \gamma_7 healthf_i + \gamma_8 healthg_i + \gamma_9 airp_i + \gamma_{10} envimp_i + \gamma_{11} trustgov_i + \gamma_{12} avoidtax_i + \gamma_{13} govresp_i + \varepsilon_i \quad (3)$$

In the model, α , β , γ are coefficients; c and ε represent the constant and the error term. Since the dependent variables are binary and ordinal variables, the estimation is processed with OLS, Probit and Order-probit model. The use of the model is justified in Ferreira and Moro (2010) where they find that the regression result is similar using OLS, Probit and Order-probit model if the dependent variables are ordinal. Besides, Maddison and Rehdanz (2008), Cuñado and Pérez Gracia (2013), and Ferreira et al. (2013) all study the matter with linear probability model and OLS estimation.

3. The regression result: pollution, happiness and WTP

3.1 Pollution and happiness

Table 2 demonstrates the regression results from model (1). The sign, coefficient and significance of both OLS and Probit estimation is consistent, showing that the air pollution does worsen the personal happiness significantly.

As for other variables, happiness represents a U-shape relationship with respect to age. Besides, conforming to common knowledge and previous literature, education, health and income all exhibit a positive effect on personal happiness. The variable gender turns out to be insignificant, consistent with Louis and Zhao (2002), Smyth et al. (2008), Cuñado and Pérez Gracia (2013), that female and male do not show evident differences in their happiness perceptions.

Table 2. The effect of air pollution on subjective happiness

	Dependent variable: happiness			
	OLS		Probit	
	coefficient	t	coefficient	z
airp	-0.0195**	-2.06	-0.0186*	-1.81
gender	-0.0214	-1.08	-0.0285	-1.32
age	-0.0101*	-1.82	-0.0096	-1.56
age^2	0.0001**	2.50	0.0001**	2.21
married	0.0772**	2.23	0.0830**	2.07
child	-0.0121	-0.27	-0.0140	-0.29
edu	0.0110***	5.24	0.0115***	5.10
healthf	0.2156***	6.62	0.1223***	4.68
healthg	0.4143***	13.50	0.3753***	11.39
income	0.0363***	6.73	0.0398***	6.58
c	0.3689***	3.18	-	-
R^2/Pseudo R^2	0.2225		0.2111	

*p<0.1,**p<0.05,***p<0.01

3.2. The willingness to pay tax for pollution prevention

Air pollution worsens subjective happiness as proven, thereby improving the environmental quality enhances personal and social welfare. Environmental protection requires financing, and the following regressions estimate the factors that influence the WTP for pollution reduction. Table 3 concentrates on the tax payment willingness, and the result is robust between OLS and Order-probit models.

The personal perception of air pollution does not show significance on the willingness to pay, in other words, who regards the air pollution is more severe will not necessarily pay more tax in order to reduce the pollution. Instead, variable envimp is significant at 1% level, that who cares more about the environment is willing to devote more in tax payment in exchange of a better environment. How much one would be willing to accept a raise in tax for pollution prevention, does not depend much on how polluted the air quality is, but hinges on the sense of environmental damage, the preference of clean air, thereby a higher demand for a greener environment.

Besides, the judgment on the responsibility of environmental protection (govresp) negatively affects the WTP, that is, a person tends to oppose a tax raise if he deems pollution abatement a government's obligation instead of a social action. Since the payment for pollution reduction is in the form of tax collection, whether the person trusts the government or not plays a role. Improving environmental quality is a public service that conforms to a general preference, and using tax is a common way to finance environmental management. In this process that the public exchanges the tax revenue for environmental service from the government, the faith that one holds towards whether and how efficiently the government will reduce the air pollution is pivotal in how much one is willing to pay. Therefore, building credibility of the government and gaining trust from the public are the basis for collecting tax and implementing the pollution abatement strategy. Concerning the tax payment, the variable avoidtax, representing the tendency that one evades the general tax and the lack of social responsibility, is negatively correlated with the willingness to pay tax for environmental protection in specific. Factors influencing the WTP also include the household income, where people with higher income are relatively less sensitive in money

Table 3. Determinants of the tax payment for pollution prevention

	Dependent variable: payfenvi			
	OLS		Order-probit	
	coefficient	t	coefficient	z
gender	0.0211	0.54	0.0411	0.59
age	0.0019	1.03	0.0033	1.03
married	0.0655	0.96	0.1218	1.00
child	-0.0633	-0.78	-0.1184	-0.82
edu	-0.0001	-0.02	-0.0001	-0.01
income	0.0398***	3.72	0.0716***	3.76
healthf	-0.0551	-0.80	-0.1020	-0.84
healthg	-0.0498	-0.77	-0.0913	-0.80
airp	-0.0102	-0.53	-0.0187	-0.55
envimp	0.2584***	5.89	0.4621***	5.89
trustgov	0.0968***	3.47	0.1763***	3.55
avoidtax	-0.0183*	-1.73	-0.0322*	-1.73
govresp	-0.1884***	-7.37	-0.3258***	-7.12
C	2.7221***	16.17		
R^2/Pseudo R^2	0.1118		0.0579	

*p<0.1,**p<0.05,***p<0.01

and more desirous of a pleasant environment, thereby more willing to pay for pollution abatement.

4. The social willingness to pay for pollution prevention

Different from previous estimation with willingness to pay tax for pollution prevention, the following part focuses on the determinants of WTP in the form of personal income, which we refer as a social contribution, contrasting to the obligatory taxation. The regression was run with OLS and Order-probit models, where the results do not differ much.

Similar with the regression result from Table 3, we find that the WTP is more related to the consciousness of environmental protection (envimp) instead of the air pollution level (aip). Hence, arousing the public concern on pollution prevention is an important step toward environmental governance. Besides, how one regards the pollution control as more of a social responsibility instead of government's job (govresp), more incentives of tax compliance (avoidtax) and family income (income), all encourage people to devote more in the finance of environmental protection. As we consider a social payment of WTP, whether one trusts environmental organization for their endeavors in environmental protection (trustenvi) should not be ignored. Environmental organizations, as a leading body working on environmental quality improvement other than the government, turn out to significantly affect the WTP (at 1% level) through how efficiently they use the donations and how satisfactory their environmental work is carried out.

Table 4. Determinants of the social payment for pollution prevention

	Dependent variable: payfenvi			
	OLS		Order-probit	
	coefficient	t	coefficient	z
gender	0.0228	0.60	0.0633	0.80
age	0.0010	0.56	0.0019	0.51
married	-0.0055	-0.08	-0.0089	-0.06
child	-0.0117	-0.15	-0.0275	-0.17
edu	-0.0053	-1.25	-0.0112	-1.27
income	0.0434***	4.21	0.0928***	4.30
healthf	-0.0300	-0.42	-0.0766	-0.52
healthg	-0.0549	-0.82	-0.1316	-0.94
airp	0.0155	0.84	0.0325	0.84
envimp	0.3053***	6.95	0.6290***	6.76
trustenvi	0.1396***	5.01	0.2905***	4.98
avoidtax	-0.0255***	-2.52	-0.0511**	-2.46
govresp	-0.1778***	-6.93	-0.3616***	-6.75
C	2.7197	16.23		
R^2/Pseudo R^2	0.1614		0.0945	

*p<0.1,**p<0.05,***p<0.01

5. Conclusion

The environmental problem has become a heated and tough issue in China. Curbing air pollution and protecting the environment needs a great deal of finances, which are directly or indirectly borne by the general public. Hence, understanding the impact of air pollution on personal welfare, the WTP for pollution prevention, and the social economic determinants of WTP, merits great value in environmental policy making. This paper analyzes the problem from a micro level using data from the WVS in China, and proves that air pollution significantly reduces personal happiness. Regarding the WTP, two dimensions are considered, the tax payment and the social contribution. The social payment is revealed slightly higher than the WTP in the form of tax, suggesting a preference of non-obligatory payment instead of a raise in tax to fund environmental services. Moreover, the factors influencing the WTP are similar, which include family income, trust in government or the environmental organization, tax compliance incentives, and the way regarding environmental protection responsibilities. However, the severity of air pollution level does not affect the WTP; instead, the concern on the environment plays a bigger role.

Given a high demand for pollution reduction and enhanced social welfare, the government, as well as environmental organizations, should take active measures. The policy implications for the government to gain support from the public and to effectively implement environmental policies involve a reasonable and transparent tax collection and usage, public consciousness of environmental protection, and improvement of social accountability. As people with higher income are more willing and capable to pay, the tax can be designed progressively. Besides, curbing pollution is not only the government's job. The finances used for environmental protection is gathered from the public, thereby the government should arouse the consensus of the environmental urgency and personal duty and social responsibility, hence lessen the free-rider problem and increase the WTP.

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Changes in Environmental Attitudes in Selected Countries of Central and Eastern Europe

Przemiany postaw wobec środowiska naturalnego w wybranych krajach Europy Środkowo-Wschodniej

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Abstract
The ISSP Environment data from 1993-2010 were used to show changes in environmental attitudes in four countries of Central and Eastern Europe: the Czech Republic, Slovenia, Bulgaria and Russia. Eight indicators were taken into account in the analysis. The Czech Republic and Slovenia displayed the most similar trends, whereas in Bulgaria and Russia these trends were slightly different. Generally, it can be concluded that pro-environmental attitudes strengthened, especially in the Czech Republic and Slovenia, or at least maintained the same level.

Key words: environmental attitudes, Central and Eastern Europe, Bulgaria, Czech Republic, Russia, Slovenia, International Social Survey Program

Streszczenie
Wykorzystując dane ISSP Environment z lat 1993-2010 ukazano przemiany postaw wobec środowiska naturalnego w czterech krajach Europy Środkowo-Wschodniej: Czechach, Słowenii, Bułgarii i Rosji. W analizach uwzględniono 8 wskaźników. W zakresie tendencji, krajami najbardziej podobnymi są Czechy i Słowenia. Bułgaria nieco różni się od tych dwóch krajów, podobnie Rosja. Jeżeli pominąć szczegóły, można dojść do wniosku, że w latach 1993-2010 postawy pro-środowiskowe uległy w tych krajach wzmocnieniu (zwłaszcza w Cechach i Słowenii) lub też przynajmniej utrzymały się na dotychczasowym poziomie.

Słowa kluczowe: postawy wobec ochrony środowiska, Europa Środkowo-Wschodnia, Bułgaria, Czechy, Rosja, Słowenia, International Social Survey Program

Introduction

The last quarter of a century saw important or even revolutionary changes in Central and Eastern Europe: the fall of communism, liberation from the Soviet Union's domination, economic transformation, and some new countries becoming members of NATO and the European Union.
The democratization process manifested itself also in the area of social research, including surveys of public opinion, which became more dynamic and independent from the political control. There is no doubt that opinion polls are a very important component of democracy. Like the independent media, they may be considered to be one of the pillars of democracy representing people's opinions rather than the views of politicians. The democratization of Central and Eastern Europe gave rise to the processes which enabled Central and Eastern European countries to participate more fully in different international research programs, including the International Social Survey Program (ISSP) Environment, which was one of the first thematic modules carried out in politically free Central and Eastern Europe.

Methodology

The ISSP (International Social Survey Program) is an international comparative research project con-

ducted annually in many countries all over the world. Its main aim is the regular measurement of variables which cover a broad scope of social life. A questionnaire method on random samples is employed in the project. The ISSP thematic modules are repeated every few years, which enables to observe changes in the selected modules. One of the modules is the ISSP Environment[1], which was implemented in 1993, 2000 and 2010 (the next research is planned for 2020). This affords an insight into changes in environmental attitudes over the period of 17 years, a long enough time for such changes to occur and be detected.

The article compares attitudes towards the natural environment in four countries: Bulgaria, the Czech Republic, Slovenia and Russia. These are the only Central and Eastern European countries that were included in all three editions of the ISSP Environment. So they were selected more out of necessity, but such choice turned out to be right in terms of its cognitive value. The countries analyzed differ significantly. On the one hand, there is the Czech Republic and Slovenia, which joined the EU in the first enlargement phase (2004), then Bulgaria, which became a member of the EU in the second enlargement phase (2007), and finally Russia, which is not the EU member. The countries also represent different levels of income. In this case, the best indicator is the GDP (Gross Domestic Product) *per capita*. According to the World Bank, between 2010 and 2014, it amounted to approximately $7,700 in Bulgaria, $19,600 in the Czech Republic, $24,000 in Slovenia, and $12,700 in Russia. Thus, the group analyzed includes: a relatively poor EU country (Bulgaria), noticeably richer country outside the EU (Russia) and much richer EU countries (the Czech Republic and Slovenia), where the GDP *per capita* was 83-84% of the average for the whole EU in 2014 (according to the Eurostat data). Moreover, the countries represent different geographical areas (center, south and east of Europe), and even different dominant religions (religious options): the Orthodox Church in Bulgaria and Russia, Catholicism in Slovenia and atheism in the Czech Republic.

The aim of the analysis is to answer the following research questions: (1) do and to what extent Bulgaria, the Czech Republic, Slovenia and Russia differ in terms of environmental attitudes? (2) what changes in environmental attitudes took place in these countries over the past decades?

The following indicators were selected from the set of the ISSP Environment 1993-2010 variables: (1) agree to pay much higher prices to protect environment, (2) agree to pay much higher taxes to protect environment, (3) agree to cut the standard of living to protect environment, (4) make effort – sort glass for recycling (5) signed a petition for environment protection in last 5 years, (6) given money for environment protection in last 5 years, (7) taken part in a protest demonstration for environment protection in last 5 years, (8) worry too much about future environment[2]. All these variables indicate different aspects of the attitude towards environment protection. The total sample consisted of 15,320 respondents, including 3,197 in Bulgaria, 3,677 in the Czech Republic, 5,255 in Russia, and 3,191 in Slovenia. In total, 6,717 men and 8,603 women took part in the study. The distribution of the respondents' mean age by country and by year is shown in Table 2. The sample included 5,149 respondents in 1993, 5,039 in 2000, and 5,132 in 2010. The ISSP Environment sample selection depends on the research program to which the module is attached. However, it is always some form of random selection.

The research tool employed in the ISSP Environment is a standardized survey questionnaire which respondents fill in on their own.

Table 1. Respondent's country and sex by year

Country			Year			Total
			1993	2000	2010	
Czech Republic		Male	479	502	684	1665
		Female	526	742	744	2012
	Total		1005	1244	1428	3677
Slovenia		Male	477	478	492	1447
		Female	555	599	590	1744
	Total		1032	1077	1082	3191
Bulgaria		Male	565	473	422	1460
		Female	616	540	581	1737
	Total		1181	1013	1003	3197
Russia		Male	809	777	559	2145
		Female	1122	928	1060	3110
	Total		1931	1705	1619	5255
Total		Male	2330	2230	2157	6717
		Female	2819	2809	2975	8603
	Total		5149	5039	5132	15320

Table 2 Respondent's mean age by country and year

Country	Year	Mean	N
Czech Republic	1993	44,84	1001
	2000	46,41	1244
	2010	47,59	1414
Slovenia	1993	42,80	1030
	2000	44,92	1077
	2010	48,64	1082
Bulgaria	1993	49,10	1175
	2000	46,96	1008
	2010	51,93	1003
Russia	1993	41,31	1931
	2000	44,66	1705
	2010	47,48	1619

[1] More information about the ISSP Environment can be found in P. Rydzewski, 2010, *Problemy Ekorozwoju/ Problems of Sustainable Development*, vol. 5, no 2, p. 51-60.

[2] Obviously, the variable *we worry too much about the future of the environment and not enough about prices and jobs today* must be interpreted *the other way round*, i.e. a negative response indicates pro-environmental attitude.

Results

One of the indicators used in the research were the answers to the question about willingness to pay much higher prices to protect the environment[3]. This is a very important issue in the context of sustainable development. In the Czech Republic, the frequency of pro-ecological attitudes measured by this indicator, increased from 38-39% between 1993 and 2000 to 53.6% in 2010. On the other hand, in Slovenia, the initially high percentage of pro-environmental attitudes that amounted to 69.1% in 1993 decreased to 59-61% in the following years. In Bulgaria, a still another trend was observed: the percentage of pro-environmental attitudes that was 53.1% in 1993 increased to 66.6% in 2000 to again decrease to 52.2% in 2010. By contrast, in Russia, there was a significant fall from 62.4% in 1993 to 49.4% in 2000, and then an increase to 54% in 2010. So four different trends can be observed in these countries: a quasi-linear increase in the Czech Republic, a quasi-linear decrease in Slovenia, the U-shaped relation in Russia and the inverted U-shaped relation in Bulgaria. In the last decade of the research (2000-2010), a significant increase of the indicator was observed in the Czech Republic; in Russia, this increase was much smaller, while in Slovenia and Bulgaria, a decrease was observed (slight and significant, respectively). In the final year of the research (2010), residents of Slovenia turned out to be the ones who were willing to accept price rises most often (60.9%) when compared with residents of the remaining countries (approx. 52-54%).

Another indicator of the environmental attitude was a variable that measured declarations of willingness to pay much higher taxes in order to protect the environment. In the Czech Republic, this indicator of pro-environmental attitude went up from 22.6% in 1993 to 41.6% in 2000, and to 60.1% in 2010. In Slovenia, the indicator stayed at a similar level of approx. 52-53% in 1993 and 2000, but in 2010 it increased to 64.9%. In Bulgaria, on the other hand, it

Table 3. Protect environment: pay much higher prices by year and country

Country			Year		
			1993	2000	2010
Czech Republic	Willing	n	263	346	556
		%	39,5%	38,8%	53,6%
	Unwilling	n	403	546	481
		%	60,5%	61,2%	46,4%
	Total	n	666	892	1037
		%	100,0 %	100,0 %	100,0 %
Slovenia	Willing	n	412	463	485
		%	69,1%	58,6%	60,9%
	Unwilling	n	184	327	312
		%	30,9%	41,4%	39,1%
	Total	n	596	790	797
		%	100,0 %	100,0 %	100,0 %
Bulgaria	Willing	n	499	451	409
		%	53,1%	66,6%	52,2%
	Unwilling	n	440	226	374
		%	46,9%	33,4%	47,8%
	Total	n	939	677	783
		%	100,0 %	100,0 %	100,0 %
Russia	Willing	n	827	613	563
		%	62,4%	49,4%	54,0%
	Unwilling	n	499	628	480
		%	37,6%	50,6%	46,0%
	Total	n	1326	1241	1043
		%	100,0 %	100,0 %	100,0 %
Total	Willing	n	2001	1873	2013
		%	56,7%	52,0%	55,0%
	Unwilling	n	1526	1727	1647
		%	43,3%	48,0%	45,0%
	Total	n	3527	3600	3660
		%	100,0 %	100,0 %	100,0 %

Chi-squared (Sig.): Czech Republic (<0,0005), Slovenia (<0,0005), Bulgaria (<0,0005), Russia (<0,0005).

Table 4. Protect environment: pay much higher taxes by year and country

Country			Year		
			1993	2000	2010
Czech Republic	Willing	n	160	442	603
		%	22,6%	41,6%	60,1%
	Unwilling	n	549	621	401
		%	77,4%	58,4%	39,9%
	Total	n	709	1063	1004
		%	100,0%	100,0%	100,0%
Slovenia	Willing	n	307	495	510
		%	52,8%	51,5%	64,9%
	Unwilling	n	274	467	276
		%	47,2%	48,5%	35,1%
	Total	n	581	962	786
		%	100,0%	100,0%	100,0%
Bulgaria	Willing	n	435	504	556
		%	46,0%	66,0%	80,2%
	Unwilling	n	511	260	137
		%	54,0%	34,0%	19,8%
	Total	n	946	764	693
		%	100,0%	100,0%	100,0%
Russia	Willing	n	806	375	813
		%	58,9%	28,4%	74,5%
	Unwilling	n	562	945	278
		%	41,1%	71,6%	25,5%
	Total	n	1368	1320	1091
		%	100,0%	100,0%	100,0%
Total	Willing	n	1708	1816	2482
		%	47,4%	44,2%	69,4%
	Unwilling	n	1896	2293	1092
		%	52,6%	55,8%	30,6%
	Total	n	3604	4109	3574
		%	100,0%	100,0%	100,0%

Chi-squared (Sig.): Czech Republic (<0,0005), Slovenia (<0,0005), Bulgaria (<0,0005), Russia (<0,0005).

3 The original set of responses (very willing, fairly willing, neither willing nor unwilling, fairly unwilling, very unwilling, can't choose) was reduced by combining *very willing* and *fairly willing* into one category of *willing* and also combining *fairly unwilling* and *very unwilling* into one category of *unwilling*. Answers *neither willing nor unwilling* and *can't choose* were not taken into consideration.

grew from 46.6% in 1993 to 66% in 2000 and to 80.2% in 2010. Finally, in Russia, it fell from 58.9% in 1993 to 28.4% in 2000 and then went up to 74.5% in 2010. So, a linear growth was observed in the Czech Republic and Bulgaria, a quasi-linear growth in Slovenia, and the U-shaped growth in Russia, but all the countries saw an increase of the indicator. In the last year of the research, the indicator reached the highest values in Bulgaria and Russia (approx. 80% and approx. 75% respectively), compared with approx. 60% and 65% in the Czech Republic and Slovenia respectively.

Table 5. Protect environment: cut standard of living by year and country

Country				Year		
				1993	2000	2010
Czech Republic		Willing	n	188	418	406
			%	25,6%	45,3%	41,0%
		Unwilling	n	545	505	584
			%	74,4%	54,7%	59,0%
	Total		n	733	923	990
			%	100,0%	100,0%	100,0%
Slovenia		Willing	n	281	291	369
			%	51,7%	32,9%	47,5%
		Unwilling	n	262	593	408
			%	48,3%	67,1%	52,5%
	Total		n	543	884	777
			%	100,0%	100,0%	100,0%
Bulgaria		Willing	n	370	270	559
			%	40,3%	42,2%	82,6%
		Unwilling	n	547	370	118
			%	59,7%	57,8%	17,4%
	Total		n	917	640	677
			%	100,0%	100,0%	100,0%
Russia		Willing	n	619	346	370
			%	47,5%	25,4%	39,5%
		Unwilling	n	685	1018	566
			%	52,5%	74,6%	60,5%
	Total		n	1304	1364	936
			%	100,0%	100,0%	100,0%
Total		Willing	n	1458	1325	1704
			%	41,7%	34,8%	50,4%
		Unwilling	n	2039	2486	1676
			%	58,3%	65,2%	49,6%
	Total		n	3497	3811	3380
			%	100,0%	100,0%	100,0%

Chi-squared (Sig.): Czech Republic (<0,0005), Slovenia (<0,0005), Bulgaria (<0,0005), Russia (<0,0005).

The willingness to lower the standard of living in order to protect the environment was yet another indicator of pro-environmental attitude. In the Czech Republic, this indicator grew from 25.6% in 1993 to about 41-45% between 2000 and 2010. Slovenia experienced a marked decline from 51.7% in 1993 to 32.9% in 2000, followed by a re-growth to 47.5% in 2010. A substantial increase from approx. 40-42% in 1993 and in 2000 to 82.6% in 2010 was noted in Bulgaria. In Russia, a decrease from 47.5% in 1993 to 25.4% in 2000 was only partly compensated by an increase to 39.5% in 2010. Looking for some patterns, it can be concluded that the Czech Republic and especially Bulgaria saw a quasi-linear increase of this indicator, Slovenia experienced the U-shaped fall, just like it was the case in Russia. However, if the research results from the last decade (2000-2010) are taken into consideration, increases in this indicator of pro-ecological attitudes can be observed in Slovenia, Russia, and most visibly in Bulgaria. A very slight decline is seen only in the Czech Republic. In the last year of the research, the indicator reached a very high level in Bulgaria (over 80%), was lower in Slovenia (approx. 48%) and significantly lower in the Czech Republic and Russia (approx. 40-41%).

The indicators of environmental attitudes described so far were all based on the respondents' opinions. Let us now turn to the indicators based on the respondents' behaviors.

One of them is the frequency of sorting waste (in this case, glass). In the Czech Republic, the percentage of people who always sorted glass for recycling grew from 12.5% in 1993 to 27.9% in 2000 and 41% in 2010. A similar upward trend was observed with respondents who often sorted glass (14.8%, 27.1%, 32.4% respectively). In Slovenia, this increase was even more noticeable. In 1993, 16.9% of the country's population always sorted glass for recycling, in 2000 their number grew to 19.5%, and in 2010 it amounted to 62.7%. The increase in this type of behavior concerned also individuals who often sorted glass (from approx. 19-20% between 1993 and 2000 to 25.1% in 2010). A slowly increasing trend in sorting glass was observable in Bulgaria (from approx. 3% in 1993 and 2000 to 12.7% in 2010 (sort always) and from 4-5% in 1993 and 2000 to 24.6% in 2010 (sort often). Likewise, in Russia, there was a growth, but from a very low level of 2-3% to an equally low value of approx. 6% (sort always) and from approx. 4% to 10% (sort often).

The surge in glass sorting between 2000 and 2010 was probably related to the availability of recycling. In all the countries analyzed in 2010, no respondent indicated lack of possibilities for sorting waste. However, the countries differ significantly in terms of using the recycling potential. In the last year of the study, as many as 97.8% Slovenians, 73.4% Czechs, 37.3% Bulgarians and only 15.8% Russians always or often sorted glass for recycling.

Other indicators of pro-ecological attitudes based on behavior included: signing a petition connected with environment protection, giving money for this purpose and participating in an environmental demonstration (in last 5 years). In 1993, the Czechs most often signed petitions (72.3%), in 2000 donated money (62.1%), while in 2010 participated in demonstrations (76.6%). A similar pattern was observed in Slovenia (59.7%, 61.5%, and 64.6% respectively). Bulgarians signed petitions most often (65.6%) in 1993, while in 2000 and 2010 participated in environmental demonstrations (80.1%, 58.2% respectively). In Bulgaria, giving money for environmental purposes was more common in the previous decades (approx. 27-29% compared to 10.6% in the last year of the research). In 1993, the

Table 6.
Effort: sort glass for recycling by country and year

Effort: sort glass for recycling			Year		
			1993	2000	2010
Czech Republic	Always	N	126	341	582
		%	12,5%	27,9%	41,0%
	Often	N	149	332	460
		%	14,8%	27,1%	32,4%
	Sometimes	N	181	339	293
		%	18,0%	27,7%	20,6%
	Never	N	86	98	86
		%	8,6%	8,0%	6,1%
	Recycling not available	N	462	113	0
		%	46,0%	9,2%	0,0%
	Summary	N	1004	1223	1421
		%	100,0%	100,0%	100,0%
Slovenia	Always	N	174	210	662
		%	16,9%	19,5%	62,7%
	Often	N	199	210	265
		%	19,3%	19,5%	25,1%
	Sometimes	N	247	231	105
		%	24,0%	21,4%	9,9%
	Never	N	87	62	24
		%	8,4%	5,8%	2,3%
	Recycling not available	N	323	364	0
		%	31,4%	33,8%	0,0%
	Summary	N	1030	1077	1056
		%	100,0%	100,0%	100,0%
Bulgaria	Always	N	31	32	83
		%	2,6%	3,2%	12,7%
	Often	N	63	38	161
		%	5,4%	3,8%	24,6%
	Sometimes	N	212	134	227
		%	18,0%	13,3%	34,7%
	Never	N	315	388	184
		%	26,8%	38,4%	28,1%
	Recycling not available	N	555	418	0
		%	47,2%	41,4%	0,0%
	Summary	N	1176	1010	655
		%	100,0%	100,0%	100,0%
Russia	Always	N	69	37	64
		%	3,6%	2,2%	5,8%
	Often	N	83	68	109
		%	4,3%	4,0%	10,0%
	Sometimes	N	253	163	251
		%	13,1%	9,6%	22,9%
	Never	N	537	621	671
		%	27,8%	36,7%	61,3%
	Recycling not available	N	989	803	0
		%	51,2%	47,5%	0,0%
	Summary	N	1931	1692	1095
		%	100,0%	100,0%	100,0%
	Always	N	400	620	1391
		%	7,8%	12,4%	32,9%
	Often	N	494	648	995
		%	9,6%	13,0%	23,5%
	Sometimes	N	893	867	876
		%	17,4%	17,3%	20,7%
	Never	N	1025	1169	965
		%	19,9%	23,4%	22,8%
	Recycling not available	N	2329	1698	0
		%	45,3%	33,9%	0,0%
	Summary	N	5141	5002	4227
		%	100,0%	100,0%	100,0%

Gamma (Sig.): Czech Republic (<0,0005), Slovenia (<0,0005), Bulgaria (<0,0005), Russia (<0,0005).

Table 7. Last five years: signed a petition, given money, protest demonstration by country and year[4]

Last five years			Year		
			1993	2000	2010
Czech Republic	Signed a petition	N	146	34	65
		%	72,3%	6,4%	25,8%
	Given money	N	59	330	44
		%	29,2%	62,1%	17,5%
	Protest demonstration	N	58	244	193
		%	28,7%	46,0%	76,6%
	Summary	N	202	531	252
Slovenia	Signed a petition	N	108	49	54
		%	59,7%	18,1%	29,8%
	Given money	N	80	166	39
		%	44,2%	61,5%	21,5%
	Protest demonstration	N	58	109	117
		%	32,0%	40,4%	64,6%
	Summary	N	181	270	181
Bulgaria	Signed a petition	N	103	35	63
		%	65,6%	7,0%	44,7%
	Given money	N	45	137	15
		%	28,7%	27,3%	10,6%
	Protest demonstration	N	71	402	82
		%	45,2%	80,1%	58,2%
	Summary	N	157	502	141
Russia	Signed a petition	N	205	22	152
		%	56,6%	2,3%	70,0%
	Given money	N	192	251	26
		%	53,0%	26,3%	12,0%
	Protest demonstration	N	75	819	73
		%	20,7%	85,8%	33,6%
	Summary	N	362	955	217

most common environmental behavior in Russia was signing petitions (56.6%) and giving money (53%), and in 2000 taking part in demonstrations (85.8%). In 2010, signing petitions was again the most common environmental behavior (70%).

Let us consider the research results from a different perspective. The frequency of signing petitions in the Czech Republic, Slovenia and Bulgaria fell significantly between 1993 and 2000 (usually from several dozen to a dozen or so or even several per cent) in order to rise between 2000 and 2010, though not to the level from 1993. In Russia, on the other hand, after a similar decline in the popularity of petitions in 2000, this form of action revived at a high level (70%). Giving money for environmental purposes in the Czech Republic and Slovenia took a reverse U-shaped trend, reaching the highest level in 2000 when approx. 62% people gave money for environmental purposes. Such generosity was not observed either earlier or later in the period covered in the research. In Bulgaria and Russia, a downward trend in giving money for environmental purposes was noted (in Russia it was linear, in Bulgaria – quasi-linear amounting to approx.11-12% in 2010). Taking part in demonstrations was on the linear increase in the Czech Republic and Slovenia and became the most common form of pro-environmental activity of the three analyzed here (approx. 65% in Slovenia and

[4] Multiple Response Table, dichotomy group tabulated at value 1 (*yes*), percentages and totals are based on respondents' answers. Statistical tests are not available.

Table 8. Worry too much about future environment by country and year

Worry too much about future environment				Year			Total
				1993	2000	2010	
Czech Republic		Strongly Agree	N	186	119	168	473
			%	19,0%	10,0%	11,8%	13,2%
		Agree	N	203	248	361	812
			%	20,8%	20,8%	25,4%	22,6%
		Neither Agree nor Disagree	N	156	257	523	936
			%	16,0%	21,5%	36,9%	26,1%
		Disagree	N	247	399	317	963
			%	25,3%	33,4%	22,3%	26,8%
		Strongly Disagree	N	185	172	50	407
			%	18,9%	14,4%	3,5%	11,3%
	Total		N	977	1195	1419	3591
			%	100,0%	100,0%	100,0%	100,0%
Slovenia		Strongly Agree	N	134	110	209	453
			%	13,6%	10,7%	19,6%	14,7%
		Agree	N	395	337	242	974
			%	40,2%	32,7%	22,7%	31,6%
		Neither Agree nor Disagree	N	148	152	399	699
			%	15,1%	14,7%	37,4%	22,7%
		Disagree	N	265	340	168	773
			%	27,0%	32,9%	15,7%	25,1%
		Strongly Disagree	N	40	93	49	182
			%	4,1%	9,0%	4,6%	5,9%
	Total		N	982	1032	1067	3081
			%	100,0%	100,0%	100,0%	100,0%
Bulgaria		Strongly Agree	N	256	93	299	648
			%	24,9%	11,9%	30,4%	23,2%
		Agree	N	207	269	315	791
			%	20,2%	34,4%	32,0%	28,3%
		Neither Agree nor Disagree	N	109	216	243	568
			%	10,6%	27,6%	24,7%	20,3%
		Disagree	N	162	122	86	370
			%	15,8%	15,6%	8,7%	13,2%
		Strongly Disagree	N	293	83	40	416
			%	28,5%	10,6%	4,1%	14,9%
	Total		N	1027	783	983	2793
			%	100,0%	100,0%	100,0%	100,0%
Russia		Strongly Agree	N	209	110	167	486
			%	12,0%	7,6%	10,6%	10,2%
		Agree	N	204	294	277	775
			%	11,8%	20,3%	17,5%	16,3%
		Neither Agree nor Disagree	N	433	269	628	1330
			%	24,9%	18,6%	39,7%	27,9%
		Disagree	N	381	505	322	1208
			%	21,9%	34,9%	20,4%	25,4%
		Strongly Disagree	N	509	269	188	966
			%	29,3%	18,6%	11,9%	20,3%
	Total		N	1736	1447	1582	4765
			%	100,0%	100,0%	100,0%	100,0%
Total		Strongly Agree	N	785	432	843	2060
			%	16,6%	9,7%	16,7%	14,5%
		Agree	N	1009	1148	1195	3352
			%	21,4%	25,8%	23,7%	23,6%
		Neither Agree nor Disagree	N	846	894	1793	3533
			%	17,9%	20,1%	35,5%	24,8%
		Disagree	N	1055	1366	893	3314
			%	22,3%	30,6%	17,7%	23,3%
		Strongly Disagree	N	1027	617	327	1971
			%	21,7%	13,8%	6,5%	13,9%
	Total		N	4722	4457	5051	14230
			%	100,0%	100,0%	100,0%	100,0%

Gamma (Sig.): Czech Republic (<0,0005), Slovenia (<0,0005), Bulgaria (<0,0005), Russia (<0,0005)

approx. 77% in the Czech Republic). By contrast, in Bulgaria and Russia, participation in demonstrations after reaching the peak level in 2000 with 80-86% of the country's population taking part in such demonstrations, became less popular (in Bulgaria it dwindled to about 58% and in Russia to 34%). In the last year of the research, participating in demonstrations was the most common pro-environmental activity in the Czech Republic, Slovenia and Bulgaria, while the Russians preferred signing petitions (an activity

which remained quite popular in Bulgaria as well). This may indicate radicalization of activities and moving from indirect action (perhaps perceived as less effective) to more direct and confrontational activities. By contrast, a reverse trend was observed in Russia, which might be resulting from a failure of direct actions there.

A slightly different picture emerges when another indicator is taken into account: concern about future environment, but in the context of today's problems (prices, the labor market). Positive replies indicate placing higher importance on the current problems than on environmental issues, while negative responses express concern about the environment despite current social problems.

In the Czech Republic, the indicator of pro-environmental attitudes between 1993 and 2000 remained at the level of approx. 44-48%, but in 2010 it decreased to approx. 26%.[5] There was a linear increase in the percentage of people that did not have strong opinions about the analyzed issue (neutral attitude) from 16% in 1993 to 21.5% in 2000 and up to 36.9% in 2010. The attitudes giving a higher priority to issues connected with economy and finances (such as prices and employment) were initially (in 1993) expressed often (39.8%), in 2000 they attracted less support (30.7%), but then once again became more often expressed (37.3% in 2010). To generalize these trends, it can be stated that pro-environmental attitudes in the Czech Republic lost slightly in popularity in favor of attitudes placing higher importance on economic issues, but above all in favor of neutral attitudes, which can be interpreted as indecisiveness.

A similar trend can be observed in Slovenia: a significant decrease in the frequency of pro-environmental attitudes to the level of 20.3% compared to 31.1% in 1993, and as much as 42% in 2010. Slovenia also experienced a significant increase in the frequency of neutral attitudes (from approx. 15% in 1993 and 2000 to 37.4% in 2010). In contrast to the Czech Republic, this was not accompanied by an increase in pro-economy attitudes, the frequency of which decreased from 53.9% in 1993 to approx. 42-43% between 2000 and 2010.

Similar, though much more pronounced trends occurred in Bulgaria. The frequency of environmental attitudes decreased almost four times (from 44.3% in 1993 to 26.2% in 2000 and 12.8% in 2010). At the same time, pro-economy attitudes increased in popularity from approx. 45%-46% between 1993 and 2000 to 62.5% in 2010. The frequency of neutral attitude increased from a low level of 10.6% in 1993 to 27.6% in 2000 and then slightly decreased to 24.7% in 2010.

The situation in Russia was specific with pro-environmental attitudes relatively more frequent and pro-economy attitudes relatively rarer than in the other three countries. However, the trend was similar especially to that in Slovenia and the Czech Republic: a fall in pro-environmental attitudes (from 51-54% between 1992 and 2000 to 32.2% in 2010), minor changes in pro-economy attitudes (from 23.8% in 1993 to approx. 28% between 2000 and 2010), and an increase in neutral attitudes (from 23.8% in 1993 and 18.6% in 2000 to 39.7% in 2010). Taking into account the last year of the research (2010), the four countries differ with regard to the frequency of environmental attitudes. Such attitudes were most frequent in Russia (32.2%), less frequent in the Czech Republic and Slovenia (25.9% and 20.3% respectively), and the most rare in Bulgaria (12.8%). By contrast, attitudes favoring economy over ecology were found most often in Bulgaria (62.5%), less often in Slovenia (42.3%) and the Czech Republic (37.3%), and were the most uncommon in Russia (28.1%).

Conclusions

Many important changes in the attitudes towards the environment took place in the Czech Republic, Slovenia, Bulgaria and Russia over the last few decades. Do these countries differ in terms of their residents' attitudes to environmental issues? The answer is *yes* and *no* and depends on the indicator which is used. Generally speaking, the Czech Republic and Slovenia demonstrate the most similar trends while Bulgaria and Russia are slightly different. In that case, is it possible to answer the question about trends that these countries display when it comes to concern for the environment? Is there one uniform trend? The general statement may be risked that between 1993 and 2010 pro-environmental attitudes in these countries strengthened (especially in the Czech Republic and Slovenia) or at least maintained the same level.

This conclusion can be drawn on the basis of most indicators used. It should be noted, however, that the analysis of the first indicator (worry too much about future environment), which is interpreted *the other way round* and takes into account the realities of everyday life, does not support the conclusion. Smaller or greater discrepancies in the interpretation of other indicators within individual countries are also visible. How can these discrepancies be explained? First of all, the wording of the questionnaire questions is very important. Questions, after all, give some context to a problem, e. g. we will get a different result when we ask about willingness to pay higher taxes to protect environment when it is not clear how high these taxes will be and whether they will more affect people with higher incomes than when we ask whether people worry too much about the future environment with so many other problems around, for example unemployment. In this example, we have

[5] In the description of the relationships between variables, positive responses (*strongly agree* and *agree*) were combined into one category, while negative responses (*disagree* and *strongly disagree*) into the other one; neutral responses (*neither agree nor disagree*) were left unchanged.

quite an indefinite future that is difficult to predict confronted with the realities of everyday life that is here and now and is often a source of very real concern. Perhaps the distribution of responses depends on how precisely we specify the sacrifices that must be made and how exactly we present competitive values. It may be stated that the more general and abstract the question is, the more *pro-ecological* responses it generates (after all, we all want to live in a healthy and unpolluted environment). On the other hand, making the respondent sacrifice something specific which in his mind translates into a measurable *loss* may result in getting a different answer. Another issue is how accurately behaviors can be measured; what does it mean that the respondent *often* or *rarely* sorts waste (e.g. glass)? The same frequency can be defined differently. If someone sorts glass for example twice a week, is it a frequent activity or not? The answers may vary.

If relying on indicators related to opinions can sometimes be problematic, wouldn't it be better to use indicators based on facts, such as sorting waste (glass), taking part in a demonstration, or signing a petition? One problem which has already been pointed out is the ambiguity of frequency scale which is so often used in behavior studies. Another problem is the *degree of involvement*. Can the behavior of someone who chose to go to the pro environment organization's office to sign a petition and someone who signed a petition when asked to do so in the street or clicked on the *sign* button on the social networking site asked by a friend, be interpreted in the same way? Similarly, if someone gave 1 euro (in 5 years) to support a shelter for homeless animals asked by some activist, he may consider himself as belonging to the group which *gave money for environmental protection*? And what about those who would be willing to sign a petition or take part in a demonstration, but this is not possible in the place where they live?

My aim is not to undermine the value of the research results, especially my own analysis. All I want to do (as a sociologist, methodologist and analyst) is to draw attention to some problems (probably familiar to many readers) that make it necessary to keep the research results in perspective. These problems are not anyone's fault; we just have no better measurement tools at our disposal and people usually react to questions included in questionnaires in this and not the other way.

It should also be noted that the research conducted fits in well with the concept of sustainable development, a concept which is not limited to ecological issues, but includes also economic and social ones. Pro-environmental attitude entails many consequences; for example, the willingness to pay higher taxes has direct economic consequences and the readiness to lower the standard of living in order to protect the natural environment is at the same time an important social issue. In fact, all these matters are interconnected, which makes them particularly challenging for further research of this type.

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Designing a Mixed Evaluating System for Green Manufacturing of Automotive Industry

Projektowanie mieszanego system oceny zielonej produkcji dla przemysłu samochodowego

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Abstract
The article proposed, from a sustainable development perspective, an index system based on Sustainability Balanced Scorecard (SBSC), including the main index of Financial, Internal process, Customer, Learning and growth, Social and the sub- index which comprised 28 indexes to evaluate the Green Manufacturing (GM) of automotive industry. Based on the index system, an evaluation model integrates by back-propagation artificial neural network (BPANN) and genetic algorithm (GA) was introduced. Using established model and indicators evaluated GM in four automotive companies; the key result of the evaluated show that: China's automotive manufacturing enterprises still have big room for improvement in respect of customer satisfaction, resource consumption, community service, low-carbon activities etc., so the strategy and management activities that put much pressure on these respect are necessary.

Key words: SBSC, GM, index system of automotive industry, GA, BPANN

Streszczenie
W artykule zaproponowano wykorzystanie systemu wskaźników opartych na Zrównoważonej Karcie Wyników (Sustainability Balanced Scorecard – SBSC). Zgodnie z koncepcją rozwoju zrównoważonego uwzględniono następujące główne wskaźniki: finansowy, procesów wewnętrznych, klienta, wzrostu i uczenia się, społeczny, a także 28 podwskaźników. Celem była ocena Zielonej Produkcji (Green Manufacturing – GM) w przemyśle motoryzacyjnym. Wprowadzono model oceny oparty na systemie wskaźników, łączący propagację wsteczną sztucznej sieci neuronowej (back-propagation artificial neural network – BPANN) oraz algorytm genetyczny (genetic algorithm – GA). Za pomocą wybranego modelu i wskaźników dokonano oceny Zielonej Produkcji w czterech firmach motoryzacyjnych. Wyniki wskazują, że chińskie przedsiębiorstwa motoryzacyjne mają jeszcze dużo do poprawy w kwestii satysfakcji klienta, zużycia zasobów, pracy społecznej, działań niskoemisyjnych, itp. Konieczne jest zatem obranie strategii oraz gospodarki, które kładą nacisk na wymienione kwestie.

Słowa kluczowe: SBSC, zielona produkcja, system wskaźników przemysłu motoryzacyjnego, GA, BPANN

Introduction

With the increasing awareness of sustainable development, organizations are obliged to take into account environmental practices and social responsibility to strengthen the green image of their own companies, alongside with the true intent of keeping the stable development (Yang et al., 2011; Tseng, 2011a; Tseng and Chiu, 2012; Lin, 2013). In this regard, companies, especially automotive companies, which is almost the biggest manufacturing industry in the world and now it can be considered to be unsustainable in many aspects, try to put more standards and obligations on activities, such as reducing

carbon emission, implementing sustainability concepts to prevent environmental deterioration and pollution, undertake more social responsibility etc., as an increasingly important issue for a business (Sarkis et al., 2011; Vachon and Klassen, 2008). GM can be regarded as an approach to the philosophy of sustainable development of automotive industry. GM refers to a novel manufacturing method which can reduce consumption and pollution, conserve energy, and provide more community service, it is a continuous application of an integrated environmental strategy to processes and services to increase efficiency and reduce risks to humans and the environment, and it is also an efficient method to pursue ecological benefits and social harmony (Despeisse et al., 2012; Lee and Chen, 2012; Oliver and Abhishek, 2013; Constantin and Antony, 2014). GM in automotive industry involves two primary purposes: (a) Promotes environmental compatibility during manufacturing processes and reduces the harm that the manufacturing process causes to humans and the environment; (b) Encourage companies to take more social responsibility, expanding the social impact, improve social performance, thereby improving the welfare of the stakeholder and achieve a harmonious society (Xiao, 2010; Sameer and Tobias, 2012; Cheng et al., 2013; Tseng et al., 2013; Wu and Olson, 2013).

Achieving GM in automotive industry to sustainable development means less resource waste and more social responsibility, it is very important for the environmentally conscious consumers and the sustainable society. But due to the limited understanding of GM and lack of criteria to evaluate manufacturing processes, there has not been a general framework to represent an organization's practical roadmap to management activities. The main objective of this paper is to propose comprehensive criteria to evaluate the GM in automotive industry using SBSC-BPANN. Besides, as it will be explored, there is no investigation of GM indicator in automotive industry using SBSC-BPANN, therefore, this is the first work attempting to use this technique to evaluate GM practices, the contribution of this paper is threefold: first, the validity and reliability of developed criteria for GM can be comprehended; Second, it proposes an integration of various criteria based on literature review, which allows us to have a clear and deep perception about the critical success factors influencing GM practices in automotive industry; third, in practice, these criteria can be used as benchmarking and improvement tools to ameliorate sustainable development practices.

The rest of this paper is structured as follows. In Section 2, an overview of GM and a comprehensive GM criteria system in automotive industry is proposed; In Section 3, research framework is put forward, and a BPANN method alongside with GA is presented; In Section 4, a real case study is elaborately explained; In Section 5, the finally section, conclusions and some managerial implications are drawn from the study.

2. Theoretical background

2.1. GM practices

Green Manufacturing is also known as sustainable manufacturing, clean manufacturing, environmentally conscious manufacturing and so on (Guo, 2014; Soubihia, 2015). Internationally, research on green manufacturing related content can be traced back to the 1980s, but the concept of green manufacturing system and the main content of the American Society of Manufacturing Engineers (SME) was published in 1996 on Green Manufacturing Blue Book *Green Manufacturing*. In 1998, SME published an online theme of green manufacturing report (*Trends of Green Manufacturing*), the importance and research issues related to green manufacturing has made a further introduction. In recent years, research on GM and related issues are very active, especially about the standards for the protection of the environment or which requires manufacturers to conform to.

Sarkis (2001) use LCA to built the evaluates criteria system of GM, evaluates the types and quantities of product inputs such as energy, raw materials and water, and of product outputs, such as atmospheric emissions, solid and waterborne wastes, and end-product. Zhu et al. (2007a) also think that LCA methodology is an objective tool to identify and evaluate opportunities to reduce the environmental impacts associated with specific process or activity. They suggested that the four basic interrelated components of an LCA include: Inventory Analysis (INVAN), that is identification and quantification of energy and resource use and the environmental effects to natural resources throughout a product's life; Impact Analysis (IMPAN), that is assessment of the consequences and risks that wastes have on the environment; Life-Cycle Costing (LCC), that identifies all costs for a product throughout its lifetime; Improvement Analysis (IMPVAN), that is environmental auditing. LCA does provide a comprehensive framework that has not be delineated elsewhere. Yet, there still some limitations framework, for example, other decision factors need to be incorporated, strategic elements such as cost, flexibility, quality issues need to be integrated to help determine the full impact of the alternatives (Wang, 2008; Tuzkaya et al., 2009; Awasthi et al., 2010; Yin, 2013; Shen et al., 2013; Zhu, 2014)

D.A. Garvin (1987) is the first one who use KPI to built the criteria system of GM, and this approach been adopt by Li (2004) and Gao (2006). They suggested that every manufacturing sector has some resource limits and use of KPI to built the criteria system of GM could imply on the operational level that if a company has different resource limits, the key criteria should be scheduled first and the remaining

Table1. Summary of the previous researches

Authors	Green practice evaluating criteria
Leo A. (1986)	resources consumed, the operator of occupational health, other environmental impacts
D.A.Garvin (1987)	quality of key performance indicators, time key performance indicators, key performance indicators and flexible cost key performance indicators
G.K.Leong (1990)	quality, delivery speed, delivery reliability, costs, flexible terms
G.Azzone (1991)	internal indicators, external indicators
Munoz A. (1995)	material consumption, energy consumption, tool consumption, cutting fluid consumption, and toxicity of cutting fluid, etc.
Neely (1997)	divided indicators into the external validity of the evaluation system and the system of internal evaluation process efficiency, the quality indicators, including performance, features, reliability, consistency, persistence technology, usability, aesthetic level, quality awareness, value; Time indicators including manufacturing time, product introduction rate, delivery time, punctual delivery time, delivery frequency; Key performance indicators include the cost of manufacturing costs, added value, the sale price, operating costs, service costs; Flexible key performance indicators, including quality of raw materials flexibility, flexible output quality, new product flexibility, delivery of flexible, hybrid production flexibility, production flexibility
Katsundo (1997)	energy, equipment efficiency, resource utilization, loss and recovery rates
Wang (1999)	subsystems sustainability indicators, productive resources sustainability indicators subsystem, technical and economic performance metrics child business management and corporate indicators subsystem system
Xiang (1999)	technical attributes indicators, economic indicators and green indicators
Liu (1999)	T (time), Q (quality), C (cost), E (environmental impact) and R (resource consumption)
Jiao (2001)	green and sustainable economic growth and operational strength index system; green and sustainable technological progress indicator systems; enterprise and coordination of social indicators system; green and sustainable resource intensive development of integrated subsystems; green and sustainable green development subsystem
Sarkis (2001); Zhu et al. (2007a)	Eco design, environmental certification, development of clean technologies, the use of environmentally friendly materials, return and reuse of packaging, the use of life cycle assessment (LCA) or waste management, reduction in environmental emissions
Dong (2002)	Resources Carrying Capacity, Environmental carrying capacity, Economic development, Social Development
Handfield et al. (2002)	ISO 14000 certified, Ozone depleting substances, recyclable content, volatile organic compounds content, on Environmental Protection Agency 17 hazardous material list, remanufacturing/reuse activity, returnable or reduced packaging, take back or reverse logistics, participation in voluntary Environmental Protection Agency (EPA) programs, public disclosure of environmental record
Liu (2003)	noise, Wastewater discharge, Solid Waste, Dust, concentration of harmful gas emissions
Li (2004)	circular economy, green effect, resources and energy properties, production process attributes, sale and consumption of property, the potential environmental effects
Li (2004); Gao (2006)	Air Pollution, Water pollution, Noise Pollution, Solid Waste pollution, Soil pollution, Material Resources, Equipment resources, Human Resources, Energy Type, proportion of renewable energy use, Energy efficiency, Total energy consumption, Cost of production, Social costs, Productivity, Product development cycle, Storage time
Zhang (2004)	environmental indicators, resource property indicators, energy property indicators and social indicators
Hao (2004)	environmental, economics, society and resources
Rao and Holt (2005)	Green purchasing, green manufacturing, green packaging, and reverse logistics
Hervani et al. (2005)	Re-use, remanufacturing, and recycling which are embedded in green design, green procurement practices, environmental management, environmentally friendly packaging, transportation and product end-of-life.
Wang (2005)	the degree of attention of senior leadership, environmental protection facilities, the proportion of investment funds, whether take sustainable development as an important development strategy
Shen (2006)	Including manpower, resources, economy, technology, management, environmental
Liu (2006)	economic, benefits, operators, resource and energy use
Vachon (2006, 2008)	Environmental collaboration with suppliers and customers
Jiang (2006)	the value of the main natural resources, depletion of environmental resources, the cost of the loss of environmental resources, environmental restoration cost, replacement cost and the opportunity cost of environmental resources, improve the income of environmental resources, environmental and ecological potential, etc.
Chen (2006)	corporate environmental disclosure, environmental performance leadership degree of attention, the government and the public's perception of the four-level indicators and business
Srivastava (2007); Walker et al. (2008)	Product design, material purchasing, manufacturing processes, final product delivery, disposal, and the product end-of-life management

Authors	Green practice evaluating criteria
Jiang (2007)	Time, cost, quality, resource utilization, logistics, environment, flexible
Zhen (2007)	Green Energy, includes three aspects: energy efficiency, natural energy (Solar, wind, hydro, etc.) use, Waste energy (waste heat, waste steam, etc.) Use; green production process, includes four aspects: green design, green technology, green packaging, green management; green products, in this will be summarized in two aspects, Green product certification and product performance upgrades (overall recycling); Product Recycling, means the product parts and reuse parts, cannot re-use part of the treatment should be harmless
Li (2008); ang Liang (2010)	Atmosphere, Water, Solid Waste, Material Resources, Equipment resources, Human Resources, Comprehensive utilization of energy, Renewable energy usage, Energy input-output ratio, Clean energy usage, Business costs, User costs, Social costs
Wang (2008)	Openness, Green degree, Virtual degrees, Harmony
Guo (2009)	Resource consumption, Energy consumption, Recycling, Intangible pollution, Emissions of pollutants
Tuzkaya et al. (2009)	Green process management, green product, green image, environment and legislative management, pollution control, environmental costs
Hsu and Hu (2009)	Requirement of green purchasing, green materials coding and recording, capability of green design, inventory of hazardous substances, management of hazardous substances, legal-compliance competency, environmental management system (EMA), hazardous substance management system
Yu (2009)	Technological innovation capability, Resource utilization capability, Management capacity, Capacity for environmental protection
Xiao (2010); Li (2011)	Profitability, Development capacity, Operating capacity, Solvency, Resource consumption, Environmental Impact, Environmental Governance, Product Liability, Business ethics, Labor and Employment, Social Impact
Awasthi et al. (2010)	Use of environmentally friendly technology, use of environmental friendly materials, green market share, partnership with green organizations, management commitment, adherence to environmental policies, green R&D projects, staff Training, lean process planning, design for environment, environmental certification, pollution control initiatives
Ninlawan et al. (2010)	Green supply chain management practices; green supply chain management performance; green supply chain management pressure (market regulatory competition).
He (2010); Wang (2013)	Resource consumption rate index, Resources recycling targets, Waste emission targets, Disposal pollution index, Economic indicators
Tseng (2011a)	Reliability of delivery, profitability of the supplier, relationship to the supplier, green technology capabilities, conformance quality, flexibility of the supplier, service quality, green purchasing capabilities, life cycle assessment, green design, green certifications, internal green production plans, management support, green production, the reduction of hazardous materials in the production process, environmental management system
Azevedo et al. (2011)	Environmental collaboration with suppliers, environmentally friendly purchasing practices, working with designers and suppliers to reduce and eliminate product environmental impact, minimization of waste, Decreased consumption of hazardous and toxic materials, ISO 14001 certification, reverse logistics, environmental collaboration with customers, environmentally friendly packaging, working with customers to change product specifications
Yin (2013)	Economic performance, environmental quality, social development, Sustainable economic development, Environmental capacity for sustainable development, Capacity for sustainable development of society, Economic conditions and the extent of coordination, The degree of social and environmental coordination, Social and economic level, Policy and management level
Wang (2013)	Industrial scale, Industrial productivity, Market competitiveness, Innovation capacity, The level of carbon
Shen et al. (2013)	Pollution production, resource consumption, eco-design, green image, EMS, commitment of GM from managers, use of environmentally friendly technology, use of environmentally friendly materials, staff environmental training
Zhu (2014)	Production data, Personnel actual, Equipment actual, Material produced, Material consumed, Consumable actual

factors should be assigned to the later. Hence, energy efficiency indicators are transferred into measures and actions Handfield et al. (2002) thought, although *energy efficiency* represents an important success factor for the business model of a company and serve as competitive factor, but customers ask not only for efficient products but also for efficient production processes, so we should certified the ISO 14000 as evaluating criteria; Rao and Holt (2005), Tuzkaya et al. (2009), Hsu and Hu (2009) take the manufacturing process as evaluating criteria directly, they certified evaluating criteria into: green purchasing, green manufacturing, green packaging, and reverse logistics. But Leo (1986), Vachon (2006,2008), Xiao (2010) thought GM(or sustainable manufacturing) not only need to consider the ecological performance, but also need to consider about the social and economic performance, therefore, indicators connected with social and economic should be taken into account too. The summary of

previous researches is shown in Table 1.
From Table 1 we can know that, notwithstanding researchers use various methods to build the criteria system, but there are still some research limitations according to the practice, one is no links between strategic goals to operational measures, changes in the direction of energy efficiency and social responsibility reach out to all levels of the decision making process; the other is that the manufacturing sector includes many types, key indicators in each type are different, the existing research does not distinguish these different.

2.2. Some specific aspects of automotive industry's GM

Automotive industry is a high input, high output and industrial cluster development. In terms of promote the development of related industry, absorb new technologies and new materials, expand industry scale and market size, create value and taxes and jobs, stimulating effect on the national economy, all of these, other industries are difficult to compare. In general, automotive industry is a pillar industry of the national economy because it accounts for about 8% of national economic output and accounting for 30% of machinery industrial output in most of countries (Peng, 2006), sometimes it is even strong enough to control the movements of the entire national economy. However, automobile manufacturing is huge manufacturing system, the manufacturing process is always accompanied by a large number of resource consumption and significant environmental impact. According to statistics, except consume water, electricity and gas, the automotive industry also consume a large amount of limited resources, for example, it consumes 50% of rubber production, 25% glass products, 15% of steel production and 34% gasoline in the world every year (Liu and Yin, 2008). During the manufacturing and using process, automobile also produces prodigious amounts of emissions, such as VOC, paint waste, waste, etc. Harmful emissions exhaust by a car is three times larger than its own weight in one year, vehicle exhaust emissions account for about 85% of atmospheric pollution (Yin, 2008), all these indicate automobile industry have a tremendous negative impact on the sustainability.
It is urgent for automobile manufacturing enterprises to implement GM strategy; this is an important measure to response the global energy conservation strategy, and also the fundamental way to solve the problem of automobile industry innovation and development. However there are still some barriers that are faced by automotive industry, for instance, the limited level of technological access, the perception for a low level of innovation, the lack of environmental training in human resources and the shortage of financial resources. So introduce an advanced evaluating indicator system to solve these barriers and meet the optimization of enterprises' profit and sustainable development is the important subject of all auto manufacturing enterprises.

2.3. Proposed criteria for GM of Automotive Industry

In the following we would like to use SBSC – to propose an approach to evaluate performance of automotive industry's GM. SBSC was built by some scholars in order to define sustainability or environmental targets (Epstein and Wisner, 2001; Hockerts, 2001; Figge et al.,2002; Sidiropoulos et al., 2004). To facilitate company to implement their sustainability strategy successfully, these scholars often were adding an extra perspective for sustainability issues, or incorporating such issues into four standard BSC perspectives (Schaltegger, 2005; Yong-vanich and Guthrie, 2006; Hubbard, 2009; Panayiotou et al., 2009). For example, Figge (2002) added an extra nonmarket sustainability perspective into the four conventional perspectives and building a separate scorecard to address sustainability aspects; while Epstein (2001) proposed an environment perspective that can be used to address potential environmental and social goals.Considering the specific aspects of automotive industry's GM, we would add another variation, which is social perspective, into the four conventional perspectives of BSC. Referring to the already existing variation of the BSC, the SBSC have five perspectives: Financial; Internal process; Customer; Learning and growth; Social. There are three benefits to integrate social perspective into the traditional BSC: the first benefit is it will help everyone within the company to recognize the importance of social and environmental issues and how they could contribute to the company's financial success; the second benefit is assist managers in planning and decision-making of sustainability issues; the third benefit is it may strengthen company's accountability and legitimize their operation.

2.3.1. Financial perspective (C_1)

Financial indicator is the level of economic production and the basis of organization's survival and the development of sustainable economy (Leo, 1986; Tuzkaya et al., 2009; Hsu and Hu, 2009; He, 2010; Xiao , 2010; Yin,2013). Financial perspective aims at efficient utilization of resources as required in the sustainable development and introduce the restrictive conditions of resources and the environment to the industrial competitiveness evaluation, in order to distinction the key and difficult point during the period of GM, but also provide the basis for the management to develop appropriate industrial policies and environmental regulations (Wang, 2013). The following sub-criteria were used in this research:
C_{11}. ROE (Katharina, 2010; Wang, 2005; Awasthi et al., 2010).
C_{12}. Rate of EVA (Xiao, 2010; Awasthi et al., 2010).
C_{13}. Cost margins (Garvin, 1987; Li, 2004; Gao, 2006; Katharina, 2010; Tuzkaya et al., 2009).

C_{14}. Capital maintenance sustainable growth rate (Xiao, 2010; Awasthi, 2010).
C_{15}. Asset-liability ratio (Li, 2011; Wang, 2013; Xiao, 2010).
C_{16}. The proportion of investment in technology (Li, 2003; Li, 2011; Wang , 2013; Wang, 2013).

2.3.2. Internal process perspective (C_2)
It is necessary to optimize internal structures and processes at the policy as well as the administrative level that influence the overall goal of GM (Seyed, 2011). Internal process perspective is based on production planning and manufacturing in response to the request. If the process according to the actual needs of the manufacturing request is subdivided into a plurality of manufacturing elements, then for manufacturing a single request may be one or more manufacturing response (Zhen, 2007; Zhu, 2014). In the manufacturing process, the transfer of social risks and increase of waste may be prohibited (Li, 2003; Seyed, 2011). The following sub-criteria were used in this research:
C_{21}. Cannot be reused in the cycle component (Katsundo, 1997; Zhu et al., 2007a; Wang, 2008).
C_{22}. Manufacturing process noise emission (Liu, 2003).
C_{23}. Manufacturing process solid waste disposal recycling rate (Liu, 2003; Zhen, 2007).
C_{24}. Manufacturing process wastewater volume (Liu, 2003; Tuzkaya, 2009).
C_{25}. The amount of manufacturing process waste (COD, VOC, phosphorus, organic solvent) (Tuzkaya, 2009; Tseng, 2011a).
C_{26}. The comprehensive utilization of energy (Leo, 1986; Shen, 2013).
C_{27}. 100 km emissions, main including: HC, CO, NOX and PM (Tuzkaya et al., 2009; Hsu and Hu, 2009).

2.3.3. Customer perspective (C_3)
In this article, we define customers include not only as external customers, but also as internal customers (employees). And customer response is a comprehensive index of the target layer, used to measure the level of development of the manufacturing system, and the development of continuing development of the coordination degree (Vachon, 2006; Srivastava, 2007; Walker et al., 2008). Customer response is needed to select the descriptive indicators and assessment indicators to reflect the overall development in the term of service and related interest (Azevedo et al., 2011; Tseng, 2011a). The following sub-criteria were used in this research:
C_{31}. Customer satisfaction (Leong, 1990; Neely, 1997; Li, 2004; Srivastava, 2007; Azevedo et al., 2011).
C_{32}. Customer complaint rate (Neely, 1997; Li, 2004; Jiang , 2007; Azevedo et al., 2011).
C_{33}. Employee training (Gao, 2006; Awasthi, 2010; Yin, 2013).
C_{34}. Wages and benefits (Gao, 2006).

2.3.4. Learning and growth perspective (C_4)
Learning and growth perspective indicators are a measure of the level of industrial development potential of the industry. Quickly growth and sustainable development automotive industries are mainly marked by the level of technological innovation and product quality certification (Neely, 1997; Sarkis, 2001; Zhu et al., 2007a; Yu, 2009; Tuzkaya et al., 2009; Awasthi et al., 2010; Li, 2011; Tseng, 2011a; Wang, 2013; Shen et al., 2013). The following subcriteria were used in this research:
C_{41}. New product development cycle (Neely, 1997; Tseng, 2011a; Wang, 2013; Shen et al., 2013).
C_{42}. Product quality certification (Handfield et al., 2002; Chen, 2006; Xiao, 2010; Azevedo et al., 2011; Wang , 2013).
C_{43}. Whether obtain the special subsidies for environmental protection (Chen, 2006).
C_{44}. The safety grade of automobile (Wang, 2008; Shen et al., 2013; You, 2014).

2.3.5. Social perspective (C_5)
The concepts of the BSC approach are widely applied to performance measurement, however, the traditional BSC technique ignores environmental and social aspects, so new social perspective was added for curing the problem. The SBSC combined with sustainable parameters helps to provide a meaningful instrument to the sustainability management (Chai, 2009). Therefore, the SBSC may not only help detect important strategic environmental and social objectives of the company but may also enhance the transparency of value-added potentials emerging from social and ecological aspects and prepare the implementation process of the strategy (Hsu, Hu, Chiou, Chen, 2011). The following subcriteria were used in this research:
C_{51}. The proportion of investment in environmental protection (Munoz, 1995; Li, 2004; Hervani et al., 2005; Chen, 2006; Tuzkaya et al., 2009; Hsu and Hu, 2009; He, 2010; Li, 2011; Wang, 2013).
C_{52}. Tax returns (Xiao, 2010).
C_{53}. Employment contribution (Dong, 2002; Gao, 2006; Xiao, 2010; Yin, 2013).
C_{54}. Community donations (Xiao, 2010; Yin, 2013).
C_{55}. Fulfillment of environmental laws and regulations (Tuzkaya et al., 2009; Wang, 2013).
C_{56}. Low-carbon activities (Munoz, 1995 ;Li, 2004; Xiao, 2010; Yin, 2013).
C_{57}. Community Service (Hervani et al., 2005; Tuzkaya et al., 2009).

2.4. Review on methodology
The multi-criteria decision making (MCDM) as an important evaluation methodology in science assumes that the GM is complex and with the help of a more rational, explicit and efficient methods the evaluation can be improved (Zavadskas and Turskis,

2010; Liou, 2013; Rostamzadeh, 2015). Based on the extensive literature review there are a limited number of studies that used fuzzy MCDM methods for evaluation of GM criteria. For example, Liu (2003) applied Rough Set Theory to the green degree evaluation of military parts manufacturing, and evaluated the noise emission, waste water, solid waste, dust, harmful gases concentrations five indicators in the manufacturing process. Hao (2004) suggested it is efficient to use fuzzy mathematics and expert advice combination methods to evaluate. Xing (2007) believes that the assessment methodology of GM should be considered from the angle of time dimension of product system, and according to this, proposed three evaluation method: (1) One-way analysis of production systems consider only affect a single direction; (2) Entrance-exit analysis method of considered comprehensive performance of system entrance and exit; (3) Full life-cycle approach of considered production system from design to complete. Tseng and Chiu (2012) integrated gray theory, entropy weight and the analytic network process (ANP) together to evaluate the green practices under uncertainty, the study results indicated that the proposed approach is reliable and reasonable, but the limitation is the ability of experts which may influence the results of the study. Kannan et al. (2014a) used fuzzy TOPSIS to select green suppliers for a Brazilian electronics company based on the GM criteria. They compared the results obtained from the geometric mean and the graded mean methods with FTOPSIS.

Recently, BPANN (back propagation artificial neural networks) method has been introduced as an applicable technique to be implemented within evaluation process. Feng (2015) structured BPANN method to optimize complex systems evaluating of tank bottom corrosion status based on online detection information are established to guide the assessment of tank bottom corrosion. Comparing with the result of acoustic emission online testing through the evaluation of test samples, BPANN model can evaluate tank bottom corrosion accurately and realize acoustic emission online testing intelligent evaluation of tank bottom. Zhen (2014) constructed a BPANN with a single hidden layer to evaluate the water quality in intensive shrimp tanks. Jia (2014) using BP neural network to construct an assessment model of drought at-risk populations under the circumstances of more parameters and unknown weights. BPANN has some advantages compared to other evaluation approaches: (1) powerful capability and functionality, BPANN have proven to provide an alternative approach for many complicated assessment problems that are difficult to solve by conventional approaches, such as function approximation and pattern recognition (Bishop, 1995; Luk et al., 2000; Jiang, 2001); (2) model both linear and nonlinear systems without the need to make any assumptions as are implicit in most traditional statistical approaches, so it can been widely used in various aspects of geographical and ecological sciences (Chang, 2007; Luk, 2000; Wang, 2011).

Because of its characteristics and capabilities, the application of BPANN method has been increased in recent years. This includes using BPANN in environmental quality evaluation (Zhu et al., 2009; Xie, 2013), assessment of drought at-risk populations (Kuo et al., 2007; Jia, 2014), evaluates competitive advantage (Luo, 2014), evaluates risk of logistics outsourcing (Liu, 2013) assessment of green technology innovation (Chen, 2013; Zhou, 2014), evaluates and predicts the water quality (Zhao et al., 2007; Yesilnacar et al., 2008; Dogan et al., 2009; Singh et al., 2009; Ranković et al., 2010; Jia, 2014; Zhen, 2014), Other applications can be considered in (Lopes, 2011; Irani, 2011; Liang, 2012; Ghasemi, 2012; Yang, 2012; Yang, 2012; Mo, 2013).

Literature review reveals that evaluation tools and criteria for GM are growing rapidly, but they still lack comprehensiveness and adequacy to assess fully the GM practices. These tools include methods such as rough set theory, fuzzy mathematics and expert advice combination methods, analytical hierarchy process (AHP), entrance-exit analysis method, fuzzy TOPSIS and life cycle analysis (Liu, 2003; Hao, 2004; Xing , 2007; Tseng and Chiu, 2012; Kannan et al., 2014a). Some of these tools have been or could be directly applied to various aspects of GM, but some does not have a massively parallel processing capabilities or non-objectivity with experience weight (Hao, 2004; Tseng and Chiu, 2012; Kannan et al., 2014a). This can be understood as a gap in the literature. In order to fill this gap and to support the theory and practice empirically and effectively, BPANN model is explored in this article. BPANN model has the ability of large scale parallel processing, good fault tolerance, self-organization and self-adaptive ability, and the association function, so it can avoid non objectivity of experience weight efficient. Calculation with the traditional BPANN model, fixed learning rate always leads to the slow convergence speed of network and long training time, and its convergence will been influenced by the choice of initial weights and need a lot of trial and error. In practical applications, several modified functions such as trainlm and genetic algorithms are used. Trainlm is a network training function that updates weight and bias values and fast computational speed, according to Levenberg Marquardt (Maier et al., 2010; Palani et al., 2008; Zhao et al., 2007); GA is a stochastic modeling procedure based on concepts from biological evolution; it is known to be (1) robust with respect to initial values, and (2) less likely to be *captured* by a local extremism. GA have been used in statistical modeling problems such as robust regression and experimental design (Burns et al., 1992; Neely et al., 1997; Routledge, 1999; Hamada et al., 2001; West and Linster, 2003; Meyer, 2003; Liu and Bozdogan, 2008; Howe and Bozdo-

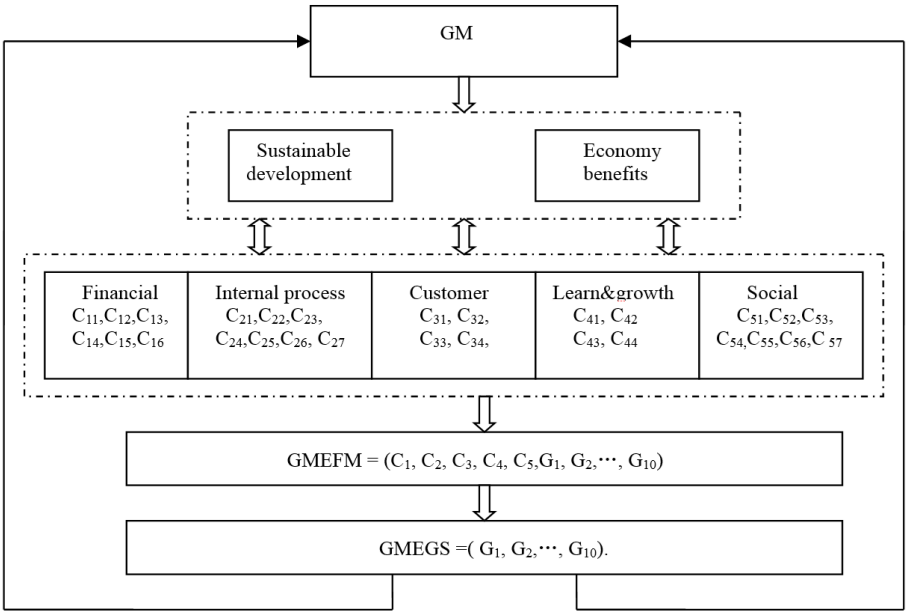

Figure 1. Evaluation Model of Green Manufacturing

gan, 2010). Because of network structure, learning efficiency coefficient and momentum factors of BPANN often require a lot of experience in setting or perform spreadsheet, so we will use GA to optimization the BPANN model in this study.

3. Research framework

3.1. Green Manufacturing Evaluation Model of Automotive Industry

Definition 1. Green Manufacturing evaluation factor set of automotive industry GMEFS= (Financial, Internal process, Customer, Learning and growth, Social) = (C_1, C_2, C_3, C_4, C_5)

In evaluation factors set, there are 5 factors and 28 sub-criteria, including: C_{11}; C_{12}; C_{13}; C_{14}; C_{15}; C_{16}; C_{21}; C_{22}; C_{23}; C_{24}; C_{25}; C_{26}; C_{27}; C_{31}; C_{32}; C_{33}; C_{34}; C_{41}; C_{42}; C_{43}; C_{44}; C_{51}; C_{52}; C_{53}; C_{54}; C_{55}; C_{56}; C_{57}.

Definition 2. Green Manufacturing rank set of automotive industry GMEGS = (G_1, G_2… G_{10}).

GMEGS green manufacturing rank set represents the state in which the car manufacturer's green manufacturing model belong to, such as: G_1 represents the international advanced level, G_4 represents the international advanced level, and G_6 represents the advanced level and so on.

Definition 3. Green Manufacturing evaluation fuzzy mappings of automotive industry GMEFM = (C_1, C_2, C_3, C_4, C_5, G_1, G_2… G_{10}).

GMEFM is a fuzzy mapping function of GMEFS and GMEGS, it establishes the nonlinear mapping relationship from GMEFS to GMEGS.GMEFM requires the mapping relations can overcome artificial weights, at the same time, have stronger robustness and adaptability.

Based on Definition1, Definition2 and Definition3, evaluation model of GM in automotive industry was built as Fig 1.

Figure 1 depicts the evaluation model of GM. The evaluation models of automobile manufacturers take GM and sustainable development as the ultimate goal, and divided this goal into social benefits and sustainable development two main evaluations. Primary evaluation factor set by the GM evaluation GMEFS = (Financial, Internal process, Customer, Learning and growth, Social) in the five factors reflect, and to decomposition of 28 sub-evaluation, then consisting of *2-5-2-8* evaluation index system. Through the evaluation index system and fuzzy mappings GMEFM, produce GM evaluation level: GMEGS=(G_1,G_2,…,G_{10}), the overall objective feedback as an important strategy to support the implementation of GM enterprises.

3.2. GA-BPANN model

Typically, the learning rate η and the momentum factor α of BPANN cannot be too large, otherwise they will affect the network strength and stability, but they cannot be too small either, too small they would affect the convergence speed of the network. Without the appropriate network, hidden layers and the number of nodes may lead to excessive training of BPANN. Optimization of network structure using genetic algorithms, can reduce the blindness of artificial selection of network structure, avoid network learning process *over training* phenomenon, enhance learning outcomes and predictive capability of the network. Thus, the GA-BPANN model can combine the ability of reflect complex nonlinear relationships and predict of BPANN with global optimiza-

tion features of genetic algorithms, and obtain a high value to deal with mathematical expressions without significant complications between variables and objective function value.

To facilitate the genetic operations, set up six DNAs, their relationship with the learning rate, momentum factor and the number of hidden layers shown in Figure 2.

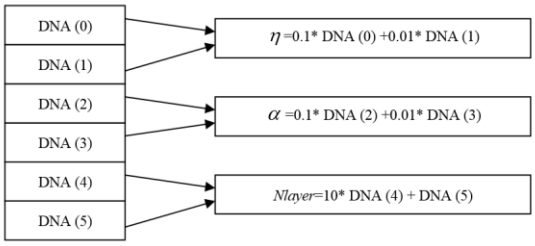

Figure 2.Genetic Algorithms DNA set

The following steps are the process of GA optimization BPANN:

Step 1. Generating a set of data randomly, using an encoding scheme to code each weight (or threshold) of the data, then construct a string (a string represents a kind of weight distribution of the network). In the premise of the network structure and learning rules have been given, the character string corresponds to neural networks which have a specific weight value or threshold value.

Step 2. Calculation of the error function of the neural network been generated in step1 in order to determine the fitness function value, the larger the error, the smaller the degree of adaptation.

Step 3. Select a number of fitness function value of the maximum of the individual, passed on to the next generation directly.

Step 4. Utilization of crossover and mutation genetic manipulation algorithms for processing the current generation groups, obtain the next population.

Step 5. Repeat Step 2, Step 3 and Step 4, so that a set of weights distribution which been determine at the initial phase could evolution constantly, until the training objectives are met.

By entering the characteristic number, evolution algebra, number of population, crossover and mutation probability, input learning sample statistically significant, we can get the final value of the improvement of the learning rate, momentum factor value and the number of hidden layers under constraints with the overall error, individual error and maximum number of iterations, then can determine the optimal network structure and parameter settings of BPANN; After this, input the training samples to BP artificial neural network, under set the maximum total error and individual errors, can determine the connection strength of the network and form a network weight matrix with constraints in a certain number of iterations; Thus completing the learning process of the network. Finally, substituted into the test sample and evaluate sample, detected and evaluated conclusions can be obtained. specific processes were shown in Figure 3.

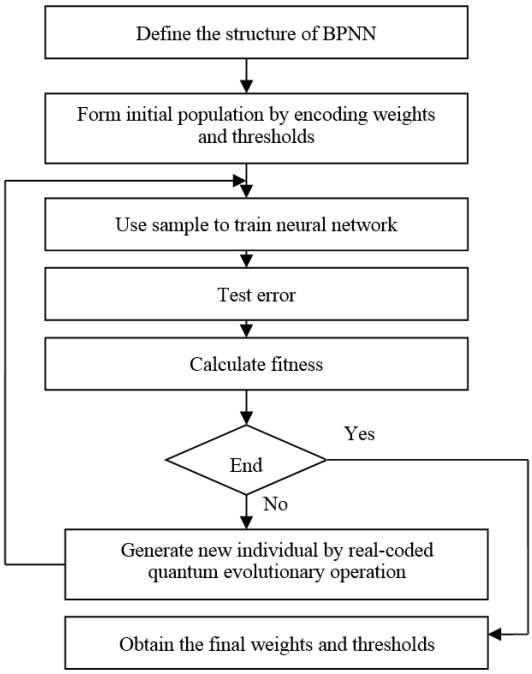

Figure 3. Flowchart of BPANN optimized by GA

3.3. Data acquisition, processing and evaluation

Financial (C_1) = (ROE, Rate of EVA, Cost margins, Capital maintenance sustainable growth rate, Asset-liability ratio, The proportion of investment in technology). ROE (C_{11}) = net profit /average shareholders' equity; Rate of EVA (C_{12}) = EVA/the total amount of capital, among them: EVA= NOPAT–TC*WACC (NOPAT represent net operating profit after tax; TC represent the total amount of capital; WACC represent the weighted average cost of capital); Cost margins, since the cost of automobile manufacturing enterprises difficult to measure, and even automobile manufacturing enterprise itself is difficult to provide accurate cost data, We use manufacturing cost efficiency coefficient (C_{13}) = (main business revenue–total profits) / total profit to reflect the cost of automobile manufacturers, this will not only ease to get the evaluate data, but also can reflects the company's manufacturing costs from the whole picture. Further, the reason for using the manufacturing cost efficiency factors, rather than simple cost, mainly taking into account the various car manufacturing companies may not be the same product mix; Capital maintenance sustainable growth rate (C_{14}) = the owner's equity at the end of the year/the owner's equity at the begin of the year, this is an important index to reflect the preservation and growth of investment, the higher the index, indicating the better state of the capital preservation, the faster growth of the owner's equity, the stronger their development potential; Asset-liability ratio (C_{15}) =total liabilities/total assets, this indicator reflects the degree of safety of the loans, low Asset-liability ratio indicate

the enterprise has a good solvency and debt management capacity. The proportion of investment in technology (C_{16}) = investment in technology/the output value of enterprises, this is one of the important factors of innovation capability of enterprises.

Internal process (C_2) = (Cannot be reused in the cycle component, Manufacturing process noise emission, Manufacturing process solid waste disposal recycling rate, Manufacturing process wastewater volume, The amount of Manufacturing process waste, The comprehensive utilization of energy, 100 km emissions), Manufacturing process noise emission (C_{22}) use factory noise indicators to describe; Manufacturing process wastewater volume (C_{24}) use wastewater volume in the key painting and assembly processes to describe; The comprehensive utilization of energy (C_{26}) use energy use in effective output/total energy use to describe; 100 km emissions (C_{27}), mainly include: HC, CO, NOX and PM, use auto emissions standards to describe, weighted average of different emission standard car in the enterprises.

Customer (C_3) = (Customer satisfaction, Customer complaint rate, Employee training, Wages and benefits), Customer satisfaction (C_{31}) use customer satisfaction rate to measure, customer satisfaction rate = the number of satisfied customers/the total number of customers involved in the investigation; Similarly, Customer complaint rate (C_{32}) = the number of complaint customers/the total number of customers involved in the investigation; Employee training (C_{33}) use training expense ratio to describe, training expense ratio = training expenses/main business income; Wages and benefits (C_{34}) use the growth rate of wages and benefits to measure, the growth rate of wages and benefits = (wages and benefits of this year-wages and benefits of last year)/wages and benefits of last year.

Learning and growth (C_4) = (New product development cycle, Product quality certification, Whether the special subsidies for environmental protection were obtained, The safety grade of automobile), New product development cycle (C_{41}) use month to measure; Product quality certification (C_{42}), use 1 to describe *passing* and 0 to describe *not passing*; Whether obtain the special subsidies for environmental protection (C_{43}), use 1 to describe *obtain* and 0 to describe *not obtain*; The safety grade of automobile (C_{44}), use weighted average of automobile production and test data volume by C-NCAP to describe.

Social (C_5) = (The proportion of investment in environmental protection, Tax returns, Employment contribution, Community donations, Fulfillment of environmental laws and regulations, Low-carbon activities, Community service), The proportion of investment in environmental protection (C_{51}) = investment in environmental protection/the output value of enterprises, this is an important index to measure the international ecological protection problem; Tax returns (C_{52}) use the annual tax/enterprise sales revenue to measure; Employment contribution (C_{53}) use employment rate to describe, employment rate = (the number of employees at the end of the year-the number of employees at the beginning of the year)/the number of employees at the beginning of the year; Community donations (C_{54}) use charitable donations/enterprise sales revenue to measure; Fulfillment of environmental laws and regulations (C_{55}) use the number of be notified of environmental violations or accidents to measure; Low-carbon activities (C_{56}) represent enterprise spent how many human resources and how much time on the low-carbon charity, as well as enterprise's environmental awareness and participation of other public service activities, this index is a qualitative indicators, to be assessed by the respondents judgment. Community service (C_{57}) including provide training and practice base for community residents, encourage community-based enterprises open some public resources to community residents, resolve the issue seriously which connect with community residents interest, protect public resources and green landscaping, create a pleasant communities, this index was evaluated by the community residents.

In order to evaluated accurately, we use 10 grade range to evaluated according to the current automobile manufacturers in these indicators data, such as manufacturing cost efficiency coefficient (C_{13}), we set greater than or equal to 0.30 as grade1, specific of classification as shown in Table 2.

Get the learning samples from 5 groups data which generated randomly between 10 ranges, then we rank binary coding: 1 for 0001; 2 for 0010; 3 for 0011; 4 for 0100; 5 for 0101; 6 for 0110; 7 for 0111; 8 for 1000; 9 for 1001; 10 for 1010; Set maximum evolution algebra as 100, the number of the population as 10, crossover probability as 0.3, mutation probability as 0.1, the maximum individual error is 0.001, the maximum total error as 0.01, the maximum number of iterations as 20,000. Perform optimization through GA-BPANN model. After the operation, we get: best hidden layer unit is 32, the best learning rate η is 0.53, and the best momentum factor α is 0.75.The result been substituted into the network (determined network connection strength matrix by studying sample) thereby fixing the evaluation network structure. Finally by detecting samples tested, all samples were found to correspond to the original level of the interval, indicate the evaluation method is more reliable at this time.

4. Case Study

We selected a national automotive manufacturing company, a Sino-German joint venture automotive manufacturing company, a Sino-US joint venture automotive manufacturing company and a Sino-Japanese joint venture automotive manufacturing company as the samples of case study, all the relevant data of four companies as shown in Table 3. Through

Table 2. Evaluation System of GM for Automotives Industry

Criteria	Indicator	Grade									
		1	2	3	4	5	6	7	8	9	10
Financial	C_{11} (%)	10	9	8	7.5	7.0	6.5	6.0	5.5	5.0	4.5
	C_{12} (%)	10	9	8	7.5	7.0	6.5	6.0	5.5	5.0	4.5
	C_{13} (%)	.30	.25	.20	.15	.10	.05	.04	.03	.02	.01
	C_{14} (%)	1.40	1.30	1.20	1.10	1.00	.90	.70	.50	.30	.10
	C_{15} (%)	.00	.10	.20	.30	.40	.50	.60	.70	.80	.90
	C_{16} (%)	.70	.60	.50	.40	.30	.25	.20	.15	.10	.05
Internal process	C_{21} (kg)	1	5	10	15	20	30	40	50	80	100
	C_{22} (db)	40	45	50	55	60	70	80	90	100	120
	C_{23} (%)	100	90	80	70	60	50	40	30	20	10
	C_{24} (m^3/m^2)	.05	.10	.15	.20	.30	.40	.50	.60	.80	1.00
	C_{25} (g/m^2)	30	35	40	45	50	70	90	100	200	300
	C_{26} (%)	90	80	70	60	50	40	30	20	10	5
	C_{27}	5.00	4.50	4.00	3.50	3.00	2.50	2.00	1.60	1.30	1.00
Customer	C_{31} (%)	95	90	85	80	70	60	50	45	40	30
	C_{32} (%)	5	10	15	20	25	30	40	50	60	70
	C_{33} (%)	5	4.5	4	3.5	3	2.5	2	1.5	1	0.5
	C_{34} (%)	.070	.060	.055	.050	.045	.040	.035	.030	.025	.020
Learning &growth	C_{41} month	18	24	30	36	42	48	60	72	84	96
	C_{42}	1									0
	C_{43}	1									0
	C_{44}	10	9	8	7	6	5	4	3	2	1
Social	C_{51} (%)	.050	.045	.040	.035	.030	.025	.020	.015	.010	.005
	C_{52} (%)	.070	.060	.050	.040	.030	.025	.020	.015	.010	.005
	C_{53} (%)	.300	.200	.100	.090	.070	.050	.040	.030	.020	.010
	C_{54} (%)	.0050	.0040	.0035	.0030	.0025	.0020	.0015	.0010	.0005	.0001
	C_{55}times	0	1	2	3	4	5	6	7	8	9
	C_{56}	10	9	8	7	6	5	4	3	2	1
	C_{57}	10	9	8	7	6	5	4	3	2	1

the optimized GA-BPANN model, that is, the number of hidden layer units is 32; learning rate is 0.53, the best momentum factor is 0.75, calculated with the data in Table 3, which were obtained from *China Automotive Industry Statistical Yearbook* and websites of various automobile manufacturers. The evaluation results was generate as show in the last row in Table 3. According to the previous level of encoding rules, we can determine the level of their GM which, namely: national automotive company to level 6, Sino-German joint venture automobile manufacturing enterprises to level 3, a Sino-US joint venture automobile manufacturing enterprises to level 4, Sino-Japanese joint venture automobile manufacturing enterprises to Level 5.

In respect of financial criteria, national automotive company lag lot was compared with the world famous automotive company in some indicators, such as ROE, rate of EVA and cost margins, but in indicators of Capital maintenance sustainable growth rate and Asset-liability ratio, national automotive company have a better performance, especially better than Sino-Japanese joint venture company. In respect of internal process criteria, national automotive company's performance is poor in almost every aspect except manufacturing process solid waste disposal recycling rate, this is probably because national automotive company manufacturing technology is still relatively backward, need to increase innovation investment. In respect of customer criteria, national automotive company have a better performance, especially in terms of employee training, this shows that national automotive company care about more employee development than other companies, and tries to make more contribution to improve employee's living standards. In respect of Learning & Growth criteria, although national automotive company obtains product quality certification, but still needs to be strengthened in terms of new product development and the safety grade of automobile, this indicate national automotive company need a strong scientific research strength to conduct development of innovative technology. In respect of social criteria, national automotive company has a good performance in employment contribution and community donations and low-carbon activities, all these also mean national automotive company pay more attention to the social impact and market reputation. From the perspective of the comprehensive performance, we can know if national automotive company want to catch up and achieve a good performance of green manufacturing, it is important to improve customer satisfaction and conduct more technology innovation, community service and low-carbon activities.

Table 3. The results of the GM evaluation for the four automotive manufacturers

Criteria	Indicator	national automotive company	Sino-German joint venture company	Sino- US joint venture company	Sino-Japanese joint venture company
Financial	C_{11} (%)	6.5	8	7	7.5
	C_{12} (%)	6.2	7.6	6.6	7.9
	C_{13} (%)	.169082	.298172	.201573	.258569
	C_{14} (%)	1.0348	1.0422	1.0203	0.9871
	C_{15} (%)	0.4596	0.6001	0.6269	0.6478
	C_{16} (%)	.4437	.6332	.4942	.3027
Internal process	C_{21} (kg)	38.25	2.23	2.47	4.75
	C_{22} (db)	57	50	55	52
	C_{23} (%)	100	100	100	100
	C_{24} (m^3/m^2)	.26	.18	.15	.22
	C_{25} (g/m^2)	47	39	38	45
	C_{26}(%)	73	87	80	77
	C_{27}	2.37	3.06	2.94	3.00
Customer	C_{31} (%)	69.5	90.3	89.2	79.4
	C_{32} (%)	20	15	30	35
	C_{33} (%)	2.56	1.82	1.11	1.60
	C_{34} (%)	.0415	.0635	.0453	.0386
Learning & growth	C_{41} (month)	33	14	24	18
	C_{42}	1	1	1	1
	C_{43}	1	1	1	1
	C_{44}	6.263	10.000	8.354	9.786
Social	C_{51} (%)	.0165	.0250	.0206	.0108
	C_{52} (%)	.0491	.0620	.0582	.0423
	C_{53} (%)	.1958	.0193	.0896	-0.0336
	C_{54} (%)	.0003	.0016	.0002	.0001
	C_{55}	3	1	1	2
	C_{56}	5	7	6	6
	C_{57}	2	3	3	4
Evaluation result		(0.00,0.99, 0.99,0.00)	(0.00, 0.00 0.99,0.99,)	(0.00, 0.99, 0.00,0.01)	(0.00,0.99, 0.01,0.99)

5. Conclusions and Implications for Automotive Industry

In the background of sustainable development, government and business promote GM vigorously, answering how to establish a reasonable evaluation index system of GM for the enterprise to carry out sustainable manufacturing, which has a positive meaning. This research using SBSC establishes a *2528* GM automobile manufacturing enterprise evaluation system, which includes: 2 main evaluation index (economy benefits and sustainable development); 5 criteria (Financial, Internal process, Customer, Learning and growth, Social), and 28 sub-criteria. By application of the SBSC, integrate energy efficiency to the strategic, the company's mission and vision can be developed out, moreover, it is feasible and simple for upper manager to control the whole process of GM.

Without the appropriate network hidden layers and the number of nodes it may lead to excessive training of BPANN. In order to reduce the blindness of artificial selection of network structure and avoid network learning process *over training* phenomenon, this research introduces genetic algorithms approach to optimization BPANN model, using genetic algorithms to determine the best hidden layer unit, the best learning rate η and the best momentum factor α, under the conditions of the identified parameter, realized automotive industry green manufacturing evaluation.

Through evaluate GM model of a national automotive manufacturing company, a Sino-German joint venture automotive manufacturing company, a Sino-US joint venture automotive manufacturing company and a Sino-Japanese joint venture automotive manufacturing company, the result shows that, compared with the world famous automotive company, China's automotive manufacturing enterprises have a good performance in the respect of employment contribution, employee training and wages and benefits, but there still have big room for improvement in community service, low-carbon activities, customer satisfaction, manufacturing cost efficiency and the proportion of investment in technology.

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Comparative Evaluation of Experience in Environmental Tax Reforms in Chosen EU States

Analiza porównawcza skutków reform systemów podatków środowiskowych w wybranych państwach Unii Europejskiej

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Abstract
The research presents the analysis and comparison of environmental tax reforms in the countries of the European Union, which are an effect of political decisions. The main focus in evaluation of environmental tax reforms is put on the results of improvement of environmental quality and maintenance of revenue neutrality that may be used to determine the appropriateness and benefit of the reform in the countries. The following countries which have implemented the environmental tax reforms have been chosen for the empirical study: Denmark, Germany, the Netherlands, Finland, Sweden, and the United Kingdom. Criteria of evaluation of environmental tax reforms have been determined, namely, the effect of environmental taxes on state revenue; economic-social effects of environmental taxes; the effect of environmental taxes on reduction of environmental pollution. The empirical quantitative and qualitative study has been conducted for analysis of the dynamics of the quantitative indicators by looking at their variation trends, determining the values of qualitative indicators and significance of quantitative and qualitative indicators, and applying the correlation analysis. The results of the study have suggested that the countries which have implemented the environmental tax reforms have achieved environmental, economic, and social aims. Environmental (energy intensity, GHG emissions productivity), economic-social (the share of environmental taxes in state revenue, labour productivity) indicators of the countries have improved during the analyzed period. The environmental tax reforms have not put any significant burden of taxation on the society, while some of the countries (the United Kingdom, the Netherlands) have even achieved the neutrality of state revenue.

Key words: Environmental taxes, environmental tax reform, the EU, comparative evaluation

Streszczenie
Problematyka zrównoważonego rozwoju, a zwłaszcza jej relacje prawno-ekonomiczne są ściśle związane z zagadnieniem ochrony środowiska. Zachowanie stanu środowiska naturalnego przy jednoczesnym rozwoju społeczno-gospodarczym wymaga dodatkowych nakładów finansowych. Z tego powodu powszechnie stosowanym rozwiązaniem jest nakładanie przez władze publiczne różnych obciążeń, w tym podatków i opłat środowiskowych. Zadaniem tych instrumentów fiskalnych jest pozyskiwanie środków na zabezpieczanie i odnawianie zasobów środowiska naturalnego. Jednocześnie też efektywność procesu wymaga oceny wpływu stosowanych rozwiązań na jakość środowiska naturalnego.
Kraje UE w różny sposób kształtują swoje systemy fiskalne, co determinuje zarówno wysokość i zasady naliczania podatków i opłat środowiskowych, jak i kształtuje efektywność tych systemów. Szczególne znaczenie mają w tym kontekście względy polityczne i konsekwencje prowadzonych reform. Z tego powodu niezbędne jest prowadzenie analiz i porównań ekologicznych reform podatkowych w wybranych krajach Unii Europejskiej.

Jednymi z zasadniczych kierunków oceny reform podatków środowiskowych są: poprawa jakości i utrzymanie zasobów środowiska. Są one szczególnie przydatne do ustalenia zasadności i korzyści z przeprowadzonych reform. Badaniami objęto następujące państwa: Danię, Niemcy, Holandię, Finlandię, Szwecję i Wielką Brytanię. Za główne kryteria oceny przyjęto wpływ podatków środowiskowych na dochody państwa, skutki ekonomiczno-społeczne oraz zmniejszanie zanieczyszczenia środowiska. Służyło to ustaleniu – na podstawie dynamiki wskaźników ilościowych oraz trendów zmienności – wartości wskaźników jakościowych. Efektem badań było wykazanie, że państwa, które wdrożyły reformy podatków środowiskowych osiągnęły założone cele środowiskowe, gospodarcze i społeczne. Oceniane reformy nie zwiększyły obciążeń podatkowych społeczeństwa, a w niektórych krajach, takich jak Wielka Brytania czy Holandia zaobserwowano nawet neutralność dochodów państwa. Dostosowanie podatków ekologicznych do zasad opodatkowania w najlepszy sposób przeprowadzono w Szwecji. W pozostałych państwach zidentyfikowano natomiast potrzebę usprawniania pro-środowiskowych systemów podatkowych.

Słowa kluczowe: podatki ekologiczne, reforma podatków ekologicznych, UE, ocena porównawcza

Introduction

As environmental pollution levels and the use of natural resources are rapidly growing throughout the world environmental protection has captured increasing attention. Environmental protection has been a topic for various discussions and research because economic and social progress depends on the preservation of the state of the environment, landscape and biodiversity and also on the rational use of natural resources. All the aspects of sustainable development are connected with legal documents. However, in no other case is this connection so strong as with reference to law-economy relations. In the free market, where everything is expressed in money, different economic tools play a significant part (Pawłowski, 2006). With a view to promoting national economic development and protecting the environment, in the world's practice it is common to impose environmental taxes (Graczyk, 2009) on the activities adversely affecting the environment, which also encourages investments in new environmentally sustainable technologies.

As maintained by scientists, a key measure of the fiscal policy is connected with green taxes regulating the interaction of economy and environment. Revenue from these taxes is used to promote a sustainable economy based on natural environment protection and more environmentally friendly production. Environmental taxes not only purposefully reduce pollution and promote sustainable national development but also lead to changes in the national tax structure, i.e. increase the tax base that does not distort the market (taxes on products and services having an adverse environmental impact) and reduce the tax base that distorts the market (corporate income tax, personal income tax, etc.).

Not a few countries of the world (Sweden, Germany, the Netherlands, Denmark and others) have implemented green tax reforms, i.e. for the purpose of sustainable development either introduced new eco-taxes into their tax systems or raised the existing ones and reduced taxes on labour/capital. Most scientists (Ekins, 2011; Parry, 2012; Conrad, Loschel, 2005; Albrecht, 2006; Fullerton, Leicester, Smith, 2010; Pedersen, 2005; Patuelli, Nijkamp, Pels, 2005) examined the possible benefit of environmental taxes for national economies and the outcomes of introducing these taxes. They maintain that encouragement to introduce these taxes is one of the best ways of minimising damage caused to the environment. In studies and discussions these taxes are commonly referred to as positive. It is maintained that depending on economic-social and political situations their introduction can adjust distortions in the tax system. However, there is no sufficient information about the actual influence of these taxes on the *greening* of economy, the national budget and social security improvement, also about the states in which green tax reforms have produced the best results for the economy, social sphere and environmental protection.

The aim of research is to analyse and compare environmental tax reforms in EU countries.

The object of research is environmental tax reforms.

Research tasks:

- To develop a methodology for the assessment of environmental tax reforms.
- To evaluate the results for the economy, social area and environmental protection achieved by individual countries having introduced environmental tax reforms.

To achieve the aim general **research methods** were employed: induction and deduction, comparative analysis, correlation and regression analysis, and graphical representation.

Research methods

Economy and nature (ecosystem) have always been interrelated and complementary systems. An ecosystem has a direct impact on economic growth as it is a provider of what is necessary for a full-fledged human life and society development. However, where only economic growth is pursued disregarding the impact of economy on the ecosystem, in the long-term this may have a feedback on the economy itself and at the same time on each member of the society in different aspects: increased pollution emissions, health problems, degradation of natural resources, etc. One of the instruments to address these problems – environmental taxes. Environmental taxes mean

taxes that are imposed on an adverse environmental impact and the use of environmental resources. Scientists and researchers (Musu, I., 2010, according to Brock and Taylor, 2005) point out the paramount factors behind the impact of economic activities on natural environment:

1) growth of the scale of the economic system (scale effect);
2) changes in the productive structure (composition effect);
3) impact of technological development (technique effect).

Recently, scientists and authorities worldwide have increasingly focused on environmental protection and measures for its implementation. On 4-5 November 2009, the European Economic and Social Committee shared Sweden's opinion on the subject *Towards an Eco-efficient Economy* that economic crisis presents both a threat and an opportunity for breaking the mould and adopting a win-win eco-efficiency fiscal strategy that will help to revive the economy, improve its competitiveness and create new jobs, at the same time transforming the energy base and reducing emissions substantially. One of the steps to achieve that is to promote and encourage green fiscal reforms.

United Nations Conference on Sustainable Development, Rio+20, held in Rio de Janeiro (Brazil) in 2012, acknowledged that the green economy was the main tool to achieve sustainable development. Environmental taxes make an inseparable part of the green economy.

Analysis of environmental tax reforms mainly focuses on determining whether or not these reforms are efficient and meet state's expectations. Works by many authors (Albrecht, 2006; Bosquet, 2000; Ciaschini, 2011; Fernandez, Perez, Ruiz, 2011; Fraser, Waschik, 2013; Fouquet, Johansson, 2003; Kosonen, Nicodeme, 2009; Fullerton, Leicester, Smith, 2007; Štreimikienė, Bubnienė, 2005; *et al.*) principally focus on results showing environmental quality improvement and national budget revenue neutrality maintenance which provide scientists with the basis for determining the suitability and utility of reforms in countries. On the basis of the aforementioned scientists' works the authors of the article have pointed out three criteria for assessing environmental fiscal reforms. Thus, the current economic, social and environmental dimensions are evaluated using these criteria:

- the impact of environmental taxes on state budget revenue;
- economic-social efficiency of environmental taxes;
- the impact of environmental taxes on environmental pollution reduction.

It is important to implement an environmental fiscal reform, on the basis of the general equilibrium concept, so that the state budget revenue equilibrium is not upset. In the fiscal policy it is desirable that the tax base should remain stable when taxes are introduced or increased. It is possible to achieve sustainable revenue through levying taxes on products/services that are inelastic in respect of consumer demand. Meanwhile, the objective of environmental protection is to reduce emissions or the use of products causing pollution, thus reducing the tax base, which would, in turn, reduce tax revenue. These are the most important criteria for environmental tax reform assessment which were used by OECD countries in adopting decisions on sustainable development.

Therefore, it is vital that environmental tax reforms are effective and yield not only economic benefits but also have an environmental effect. A survey of scientists' and researchers' works has shown the lack of comprehensive studies assessing the efficiency of green fiscal reforms because it is a difficult and complex process.

While surveying green fiscal reforms in the context of EU states the main outcomes of reforms are measured. The outcomes are evaluated using the comparative, and correlation and regression analyses. Applying such research method the authors of the article use the below ratios.

The analysis of environmental tax reforms in EU countries uses the environmental tax revenues/ GDP ratio (Speck, Jilkova, 2005):

$$\text{Ratio to GDP} = \frac{\text{Revenue from environmental taxes}}{\text{Gross domestic product}} \quad (1)$$

This ratio can show the share of environmental taxes in GDP. After adjusting the formula presented by Speck and Jilkova (2005), the share of environmental taxes in gross state tax revenue (GSTR) can be determined:

$$\text{Ratio to GDP} = \frac{\text{Revenue from environmental taxes}}{\text{Gross state tax revenue}} \quad (2)$$

Environmental taxes have a positive impact on tax revenue if this ratio has a growing tendency; however, if the ratio remains unchanged, it can be stated that introduction of environmental taxes has no importance to the state budget.

For the purpose of assessing the impact of environmental tax reform on state budget revenue, Miguel and Manzano (2011) suggest using the formula:

$$G_t = \tau_t^c c_t + \tau_t^h p^h eh_t + \tau_t^f p^f ef_t + \tau_t^w w_t n_t + \tau_t^k r_t k_t + T_t \quad (3)$$

where: G_t – government budget revenue; $\tau_t^c c_t$ – other state tax revenue; $\tau_t^h p^h eh_t$ – revenue derived from energy consumption by households; $\tau_t^f p^f ef_t$– revenue from energy used in production; $\tau_t^w w_t n_t$– revenue from labour taxation; $\tau_t^k r_t k_t$ – revenue from capital; T_t – transfers.

The suggested formula makes it possible to evaluate how environmental taxes impact gross national revenue and how the share of revenue from other collected taxes, particularly labour taxes being one of the main instruments of environmental tax reforms, changes.

The economic-social efficiency of environmental taxes is determined by analysing population employment in individual countries which is determined by social security contributions paid by employers. To determine efficiency the authors of the article use the formula suggested by Ekins (2011):

$$\text{Labour productivity} = \frac{\text{Gross domestic product}}{\text{Population employment}} \quad (4)$$

The ratio shows the value of social security contributions in a country. In order to measure economic-social efficiency resulting from environmental taxes when other factors are stable, the ratio of labour productivity has to be analysed together with population employment levels. Ekins (2011) analysed how that indicator changed over a certain period of time in a country having implemented environmental tax reforms. In the interests of higher employment levels, countries reduced social security contributions payable by employers and raised environmental taxes. It can be stated that when a level of employment, and at the same time the ratio of labour productivity, is growing and an increasing amount is collected in environmental taxes, the economic-social efficiency of environmental taxes is achieved.

The impact of environmental taxes on environmental pollution abatement was analysed using the following ratios (Bongaarts, 1992):

$$\text{Energy intensity} = \frac{\text{Amount of consumed energy}}{\text{Gross domestic product}} \quad (5)$$

Energy intensity shows the amount of energy consumed for the production of one relative unit of production. Energy intensity over a certain period is analysed when other factors are unvarying. The decrease of this ratio shows efficient energy consumption and sustainable development of a country and at the same shows that environmental taxes fulfil their function, i.e. promote the efficient use of natural resources. However, the efficient use of energy is in relation not only with reduced use of natural resources but also with the abatement of pollution emissions. Consequently, environmental taxes should encourage more efficient use of the sources of energy, and investments in environmentally sound equipment, technologies and vehicles for the purpose of cutting emission levels.

In implementing the energy policy in the area of renewable energy sources EU countries act in conformity with EU and national legislation and IRENA (International Renewable Energy Agency) directives (Renewable..., 2014). The EU Climate Change Package has set ambitious targets regarding climate change management until 2020:

- a 20 % (or 30 % in the event of agreement between countries) reduction in greenhouse emissions from 1990 levels;
- raising the share of energy consumption to 20 %;
- a 20 % share of consumed energy must be produced from renewable sources (including a 10 % share from biofuels).

In order to achieve a 20 % consumption of energy from renewable energy sources on EU scale until 2020 the states act in conformity with the EU Directive on the promotion of the use of energy from renewable sources. The Directive provides for the package of legal measures aimed at encouraging renewable energy development nationwide, and introduces the mechanisms of cooperation among EU states for achieving common goals in this area (Directive on the promotion..., 2009). This Directive regulates the guarantees of origin of energy and lays down sustainability criteria for biofuels used in the transport sector.

Thus, a change in the amount of greenhouse gas emissions in the environment is evaluated pursuant to international directives and provisions under which the states are obliged to abate environmental pollution:

$$\text{Greenhouse gas emission productivity} = \frac{\text{Gross domestic product}}{\text{Greenhouse gas emission amount}} \quad (6)$$

Using this ratio (Ekins 2011) the amount of GDP is determined when one greenhouse gas emission unit is released into the atmosphere, while other factors do not change. The increase of this indicator shows that national production and services have a less harmful effect on the environment, as the production of one GDP unit results in lower environmental pollution levels.

The EU countries selected for research on the basis the aforementioned ratios: Sweden, Denmark, Germany, Great Britain, the Netherlands, and Finland. The enumerated countries are among the first to implement environmental tax reforms as already before the start of reforms they paid major attention to the environment and ecology (e.g. Sweden) and are economically strong states of Northern Europe.

The period 2000-2011 has been selected for a comparative analysis of the results of environmental tax reforms. Such a selection was prompted by the fact that the aforementioned states launched green tax reforms in different years from 1990 (Sweden) to 1999 (Germany). Considering that the environmental tax reform provides performance results in terms of economy and eco-friendliness in the long-run only, it is expedient to evaluate the results that have already been achieved.

The comparative analysis of environmental tax reform was carried out using the method of correlation and regression analysis. First, the analysis covered the relationship between tax revenue productivity and these factors: the labour tax share in state expenditure, the corporate income tax share in state expenditure and the environmental tax share in state expenditure. The correlation analysis used data for 2000-2011 since environmental tax reforms were launched in 1990 and the last reform at issue was implemented only in 1999; therefore, a period that is the same for each country was selected for the analysis of taxation principles. Taxation principles, in this case the productivity of tax receipts, were ana-

lysed through the employment of *PASW Statistics* software using Spearman's rank correlation coefficient – r_s. A dependent variable – the productivity of tax receipts, and the aforementioned factors – independent variables were selected during analysis. Also, the correlation analysis was carried out in order to determine the dependence between state budget revenue (dependent variable) and certain taxes (independent variables), i.e. the analysis examined whether or not a strong relationship existed between environmental taxes and other taxes as well as state revenue.

To analyse economic-social and environmental indicators, linear regression equations were made and a different research period for each state depending on the start of reform implementation was selected. However, for the insufficiency of information on income from environmental taxes until 1995 it is important to take into account the fact that the years during which countries implemented reforms are not included in the period of analysis as the outcomes of reforms could be measured only after a year elapsed from their implementation. The analysis was performed on the assumption that other factors affecting the indicators at issue did not change. For this reason the analysis has selected income from environmental taxes as an independent variable (x) (EUR million) and labour productivity (y_1), energy intensity (y_2), greenhouse gas emission productivity (y_3) – dependent variables. Hence, the regression relationship is determined using the Excel function *Data Analysis* and composing a linear equation: $y = a + bx$. It has to be noted that the data of analysis are distorted by a financial-economic recession Europe slipped into several years ago. Therefore, until 2008 the data of analysis have one tendency of change, while change unsteadily in some countries in 2008-2011.

The EU's countries Sweden, Denmark, the Netherlands, Germany, Finland and Great Britain have been selected for research. The aim of environmental tax reforms in these countries was to levy taxes on energy consumption and CO_2 emissions by correcting the existing green taxes, reduce income taxes and social security contributions (Speck, Jilkova, 2010). Conditions were promoted for the business sector to receive support for investments in the efficiency of energy consumption. This enabled the comparison of results. The research used data presented in the EUROSTAT's database.

Research results

Environmental taxes are aimed at rearranging the tax system so that the economic-social and environmental factors responsible for sustainable development are promoted. Compliance by these taxes with taxation principles was determined according to taxation principles (fairness, the productivity and elasticity of tax receipts, and administrative simplicity), whereas environmental tax reforms were evaluated according to special criteria: the influence of environmental taxes on state budget revenue (the share of environmental taxes in GDP and state revenue), the economic-social efficiency of environmental taxes (labour productivity); the influence of environmental taxes on environmental pollution abatement (energy intensity, the productivity of greenhouse gases).

In order to determine whether or not environmental taxes distort the tax system the degree of compliance by environmental taxes with taxation principles is evaluated.

The fairness of taxation is analysed according to fair income taxation which is measured by the Gini coefficient (Table 1).

Table 1. Gini coefficient in percent, 2000-2011, source: own elaboration

Year	Denmark	Germany	Netherlands	Finland	Sweden	Great Britain
2000	22.0	25.0	29.0	24.0	24.3	32.0
2001	22.0	25.0	27.0	27.0	24.0	35.0
2002	23.5	25.5	27.0	26.0	23.0	35.0
2003	24.8	26.3	27.0	26.0	23.2	34.0
2004	23.9	26.0	27.0	25.5	23.0	33.0
2005	23.9	26.1	26.9	26.0	23.4	34.6
2006	23.7	26.8	26.4	25.9	24.0	32.5
2007	25.2	30.4	27.6	26.2	23.4	32.6
2008	25.1	30.2	27.6	26.3	24.0	33.9
2009	26.9	29.1	27.2	25.9	24.8	32.4
2010	26.9	29.3	25.5	25.4	24.1	32.9
2011	27.8	29.0	25.8	25.8	24.4	33.0
Relative change in percentage points (2011 against 2000)	26.36	16.0	-11.03	7.5	0.41	3.13

The research has found that the values of the Gini coefficient changed quite unevenly (Table 1). Sweden showed the smallest change in the inequality of after-tax income distribution which remained nearly stable, i.e. an increase of 0.41 percentage points in 2011 compared to 2000. In Denmark the Gini coefficient had an increasing tendency of 26.36 percentage points. In the Netherlands the inequality of income distribution had an inverse change tendency compared to other countries, i.e. income inequality dropped 11.03 percentage points. This leads to the conclusion that the inequality of after-tax income distribution among residents is gradually decreased seeking fairness of the tax system, meanwhile in Denmark the Gini coefficient was approaching a 30% limit. Consequently, the Netherlands best coordinated the introduction of environmental taxes with the reallocation of traditional taxes. Compared to other countries, Great Britain recorded the highest Gini indicator which was in excess of 30%. Considering the Gini coefficients of all the countries in question it was observed that they stood at around 30%, which shows that the tax systems were close to the limit of injustice. Evaluation of the Gini ratios in

Table 2. Tax receipts productivity indicator, 2000-2011, Source: own elaboration

	Year	Denmark	Germany	Netherlands	Finland	Sweden	Great Britain
Total taxes/ State expenditure	2000	0.89	0.52	0.54	0.72	0.70	0,81
	2007	0.94	0.53	0.54	0.65	0.74	0,67
	2011	0.81	0.51	0.47	0.56	0.72	0,60
Relative change in percent (2011 against 2000)		-8,99	-1.92	-12.96	-22.22	2.86	-25.95
Environmental taxes/ State expenditure	2000	0.088	0.053	0.085	0.065	0.051	0,081
	2007	0.091	0.051	0.081	0.058	0.052	0,056
	2011	0.070	0.050	0.075	0.057	0.049	0,055
Relative change in per cent (2011 against 2000)		-20,60	-6.81	-12.41	-12.54	-3.16	-32.94

Table 3. Correlation analysis of the shares of labour, profit and environmental taxes in state expenditure and the productivity of tax receipts in EU countries, source: own elaboration

Country	Spearman's rank correlation coefficient	Labour taxes	Profit taxes	Environmental taxes	Productivity of tax receipts
Denmark	Correlation coefficient	0.519	0.965	0.835	1
	p-value	0.042	0.000	0.000	
Germany	Correlation coefficient	0.181	0.640	-0.430	1
	p-value	0.287	0.013	0.082	
The Netherlands	Correlation coefficient	0.450	0.897	0.897	1
	p-value	0.071	0.000	0.000	
Finland	Correlation coefficient	0.931	0.896	0.756	1
	p-value	0.000	0.000	0.002	
Sweden	Correlation coefficient	-0.306	0.555	0.302	1
	p-value	0.167	0.030	0.170	
Great Britain	Correlation coefficient	0.991	0.832	0.864	1
	p-value	0.000	0.000	0.000	

the countries having introduced environmental fiscal reforms leads to the conclusion that the introduced environmental taxes weren't fully coordinated with traditional taxes and failed to ensure the neutrality of state budget revenue which was to be attained in nearly all states.

While evaluating the productivity and elasticity of tax receipts the importance of tax receipts for national budgets is determined. Following the principle of productivity of tax receipts it is necessary to ensure such revenue from taxes which would cover country's expenditure and ensure the exercise of its functions (Table 2).

As the results show, in the period 2000-2011 the productivity of tax receipts had a growing tendency in Denmark, Germany and Sweden until 2007, while from 2008 this indicator decreased. This resulted from the worsening of Europe's financial-economic situation from 2008: enterprises in bankruptcy, increased redundancies, declined investments and other negative factors which decreased state tax revenue and increased state expenditure in an attempt to cope with the exacerbating economic situation. Yet, the highest productivity of tax revenue as regards the share of total taxes and the share of environmental taxes covering state expenditure was maintained in Denmark, accounting for 87 % and 8.4 % of the total public expenditure, respectively. The smallest share of total tax receipts and environmental taxes in state expenditure was found in Germany representing, on the average, 48 % and 5.16 % of the total expenditure. Hence, despite decreased productivity indicators due to economic recession, Sweden is the only of all the countries in question that enjoyed an increase in productivity of nearly 3 %. Meanwhile, Denmark's tax system is the most productive, although it showed a small decreasing tendency in 2000-2011.

Introduction of environmental taxes had a diverse effect on the productivity of tax receipts due to improvements being made in the tax system by cutting some taxes. Assuming that other factors, except labour taxes, profit taxes and environmental taxes, do not vary, it is determined which taxes had a major impact on the productivity of tax receipts. Using the Spearman's rank correlation coefficient with a p-value = 0.05 it was determined that the productivity of tax receipts in Denmark, Finland and Great Britain was strongly dependent on all aforementioned taxes, as their $p<0.05$, and the coefficient of determination (R^2) ranged from 0.519 to 0.965 (Table 3). Equally, the relationship between the share of environmental taxes in state expenditure and productivity thereof was strong in the Netherlands. Countries' productivity indicators were most affected by the profit tax as the profit tax share in state expenditure in all the countries had a p-value <0.05 and a high R^2. A change in the productivity of tax receipts in Denmark can be explained by a 96.5% change in the share of the profit tax in state expenditure.

Table 4. Environmental tax elasticity indicator, 2000-2011, source: own elaboration

Year	Denmark	Germany	Netherlands	Finland	Sweden	Great Britain
2000	-0.50	2.81	0.86	-0.15	0.68	0.74
2001	0.94	3.05	0.50	-0.05	0.80	-2.22
2002	1.83	0.96	0.07	1.90	1.41	0.57
2003	-0.54	8.22	1.71	4.30	1.09	1.63
2004	1.69	-1.09	2.18	1.27	0.51	0.78
2005	1.07	-1.23	1.53	-0.40	1.50	-0.20
2006	0.70	0.27	1.50	0.53	0.38	0.38
2007	0.30	-0.60	-0.06	-0.15	0.41	1.44
2008	-2.08	0.33	1.54	0.37	-0.59	1.03
2009	2.35	-0.30	0.68	1.24	0.63	0.51
2010	1.20	-0.22	1.31	2.37	0.81	1.20
2011	1.46	1.44	-0.25	2.96	0.18	0.51
Average	0.70	1.14	0.96	1.18	0.65	0.53

Table 5. Administrative simplicity indicator, 2000-2011, source: own elaboration

Year	Denmark	Finland	Germany	Netherlands	Sweden	Great Britain
2000	0.79	0.73	1.10	1.70	0.52	1.02
2001	0.81	0.77	1.17	1.74	0.55	1.06
2002	0.73	0.82	0.98	1.76	0.56	1.11
2003	0.87	0.82	1.45	1.39	0.57	1.04
2004	0.83	0.80	1.38	1.30	0.59	0.97
2005	0.74	0.79	1.66	1.35	0.38	1.10
2006	0.63	0.78	1.55	1.15	0.39	1.12
2007	0.62	0.77	1.38	1.11	0.41	1.10
2008	0.64	0.80	1.36	0.99	0.39	1.12
2009	0.67	0.87	1.46	1.11	0.40	1.14
2010	0.76	0.84	1.50	1.02	0.41	0.98
2011	0.71	0.80	1.40	0.97	0.40	0.83
Relative change in percent (2011 against 2000)	-10.13	9.59	27.27	-42.94	-23.08	-18.63

However, measurement of the productivity of tax receipts alone is not enough as it is closely relating with the elasticity of the tax system showing how a country's tax receipts react to economic conditions.

In some years the environmental tax elasticity indicator had a negative value in all states, which shows a reverse changing direction of revenue from green taxes in respect of GDP, i.e. there was no linear dependence between these factors. This notwithstanding, the average elasticity indicator was the highest in Finland and Germany accounting for 1.18 and 1.14, respectively (Table 4). Evaluation of the general situation of these states suggests that the tax system was elastic during the years at issue. It is evident from the general situation of the tax system in 2000-2011 that Great Britain's elasticity indicator was the lowest (0.53, on the average). Hence, Great Britain's GDP changed more rapidly than revenue from environmental taxes, i.e. environmental taxes had no major effect on the increase of GDP.

The principle of administrative simplicity of taxation is measured in terms of the price of state tax collection. Based on OECD studies, the administrative complexity of all taxes was measured.

During the period analysed the price of tax administration showed a decreasing tendency in all countries except Finland and Germany (Table 5). In Germany the price of tax collection went up 27.27 %, although the price was decreasing in 2005-2011. The biggest fall in the price of tax collection was seen in the Netherlands (almost 43 %). In Germany, the Netherlands and Great Britain tax administration is quite expensive as the administrative simplicity indicator is above one. However, in Germany the process of tax administration is complicated. Thus, tax administration requires improvement. According to Vlassenko (2001), it is desirable that the administrative simplicity indicator should stand at 1 to 3 %, in which case the state tax system is evaluated positively. In this context only Sweden satisfies this indicator, i.e. the price of tax collection in this state is the lowest.

Evaluation of the tax systems according to taxation principles in the countries having implemented reforms suggests that Sweden's tax system best corresponds to the classical principles of taxation. Yet, it can be further improved according to the elasticity of tax receipts and the Gini coefficient. Indicators for the productivity of tax receipts and administrative simplicity during the period in question show an improving situation of the tax system. Tax systems in other states require yet greater improvement in order to have the effective and efficient fiscal policy.

Evaluation of environmental fiscal reforms according to the specified criteria is a complicated process for the existence of a number of side and additional

factors impeding measurement of the efficiency of reforms. Therefore, a correlation and regression analysis was carried out and a comparison was made of the selected economic, tax system and environmental indicators used to measure post-reform outcomes.

The evaluation of environmental tax reforms first analysed revenue derived from environmental damage taxation.

The aim environmental tax reforms is to collect the largest possible amount of revenue from these taxes and make it possible for the state to exercise its functions, i.e. to protect the natural environment against damage to it and encourage economic-social processes.

Although revenue from green taxes showed a growing tendency in all countries during the period in question, in 2011 compared to 2000 the share of this revenue in GDP decreased or remained stable (Finland, the Netherlands).

It has been determined that the share of environmental taxes in the total national budget revenue increased only in Sweden and Finland, up to 10.15 % and 15.99 %, respectively. The largest share of environmental tax revenue in the total collected tax revenue was in Finland. Environmental taxes in Finland are believed to have the biggest influence on the budget as in 2000-2011 environmental taxes grew more rapidly than gross state revenue. The smallest influence of environmental taxes on state budget revenue was determined in Great Britain where these taxes represented, on the average, around 6.1 %.

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The countries at issue have levied taxes on energy as the most important component of green taxes and have introduced a tax on pollution/natural resources, which represents a smaller share of environmental taxes compared to the energy tax. The impact of a tax is described by how it affects the prices of goods and what alternatives are available. Consequently, even a small tax on pollution can have a major impact on the natural resources used if it changes the relative price of a good. No taxes may be levied on petrol and coal throughout the world but they can be subsidised, which creates preconditions for different prices of fuel.

It is noteworthy that the structures of environmental taxes in Germany and Sweden slightly differ from those in other countries. Energy taxes in them amount to over 80 % of the total collected environmental taxes. Compared to the average of other countries, the share of these taxes in Germany and Sweden is 11 % larger. The total taxes on vehicles and pollution/natural resources, on the average, amount to 8 %. This shows that Germany and Sweden mainly focus on energy taxation and do not absolutely efficiently use the potential of taxes as an instrument of environmental pollution and transport taxation since the major share of taxation falls on energy disregarding other sources of pollution. In the meantime other countries (Finland, the Netherlands, Denmark) have distributed environmental taxes more evenly.

Yet, it is important to take into account not only how environmental taxes affect countries' GDP and budget revenues but also how the implemented environmental fiscal reforms affected the collection of other taxes (capital, labour). According to data given in Table 6, in most cases energy taxes (paid by enterprises) and profit taxes had no influence on increasing revenue. The strongest dependence was identified between national budget revenue and labour taxes and this dependence can be accepted because $p<0.05$. Change in labour taxes in EU states has a big impact on the change of budget revenue because $0.8<r_s<1$. Energy taxes paid by households also have a considerable impact on state budget revenue in all the countries excluding Great Britain. No dependence between taxes on energy and state budget revenue was found in Great Britain because $p>0.05$. The greatest impact on change in state budget revenue was made by profit taxes and labour taxes because $p<0.05$, and $R^2>0.8$.

In the opinion of Andersen and Ekins (2010), revenue from environmental taxes expressed as the share of total tax revenue or GDP is regularly used as an indicator illustrating the importance of the environmental tax policy in a country. Such information, however, should be interpreted with caution as it says nothing about the suitability of the entire fiscal policy or environmental policy for the country's environment. It is important to measure the impact of environmental taxes on economic-social factors, i.e. labour productivity in a country.

The aim of environmental fiscal reforms was to reduce environmental pollution and improve social and economic factors. Therefore, introduction of new environmental taxes was followed by the reduction of taxes on labour with the aim of creating more jobs, thus ameliorating society's social environment.

It has been determined that in 2000-2011 labour productivity was growing in all the countries. With population employment levels improving GDP was growing. However, with the onset of economic recession in 2008 labour productivity indicators worsened, because population employment levels lowered and countries no longer produced the pre-recession amount of GDP. With population employment levels growing the share of labour taxes in GDP, in-

Table 6. Correlation analysis of revenue and taxes of the state budget in EU countries, source: own elaboration

Country	Spearman's rank correlation coefficient	Energy taxes (household)	Energy taxes (enterprises)	Profit taxes	Labour taxes	Total revenue
Denmark	Correlation coefficient	0.797	0.376	0.847	0.947	1.000
	p-value	0.000	0.151	0.000	0.000	
Germany	Correlation coefficient	-0.685	0.587	0.755	0.790	1.000
	p-value	0.014	0.045	0.005	0.002	
Netherlands	Correlation coefficient	0.900	0.986	0.057	0.982	1.000
	p-value	0.000	0.000	0.840	0.000	
Finland	Correlation coefficient	0.767	0.758	-0.015	0.974	1.000
	p-value	0.001	0.002	0.958	0.000	
Sweden	Correlation coefficient	0.826	0.951	0.909	0.980	1.000
	p-value	0.000	0.000	0.000	0.000	
Great Britain	Correlation coefficient	0.479	0.114	0.811	0.993	1.000
	p-value	0.071	0.685	0.000	0.000	

Table 7. Regression correlation between labour productivity (EUR one thousand per person) and environmental tax revenue (EUR million), 1995-2011, source: own elaboration

	Denmark	Germany	Netherlands	Finland	Sweden	Great Britain
Type of equation	Linear	Linear	Linear	Linear	Linear	Linear
Coefficient of determination R^2	0.545	0.405	0.739	0.770	0.962	0.793
p-value	0.001	0.026	0.000	0.000	0.000	0.000
Coefficient a	37998.63	16880.95	36260.888	3302.959	2323.662	-14836.583
Coefficient b	4.175	0.812	1.427	13.121	7.900	1.662

Table 8. Regression relation between energy intensity (kg/EUR 1 000 GDP) and environmental tax revenue (EUR million), 1995-2011, source: own elaboration

	Denmark	Germany	Netherlands	Finland	Sweden	Great Britain
Type of equation	Linear	Linear	Linear	Linear	Linear	Linear
Coefficient of determination R^2	0.789	0.259	0.944	0.588	0.937	0.654
p-value	0.000	0.091	0.000	0.001	0.000	0.000
Coefficient a	256.580	332.466	294.561	435.072	445.31	350.981
Coefficient b	-0.017	-0.003	-0.007	-0.044	-0.033	-0.005

cluding social security contributions and personal income taxes, decreased. Although the Netherlands reduced the personal income tax and social security contributions payable by employers and taxed products causing damage to nature, the share of labour taxes in GDP grew – in 2011 compared to 2000 it grew 0.9 percentage points. The biggest decrease, 5 percentage points, was recorded in Sweden; however, yet this resulted in an increase in population employment of 1.7 percentage points being the highest among the countries analysed in 2000-2011. However, it is important to determine what impact in the states at issue environmental taxes had on these economic-social factors.

The strongest relation between a dependent variable – labour productivity and environmental taxes was identified in Sweden (Table 7). R^2 is 0.962, $p<0.05$, which shows a very strong correlation. In the case of linear dependence the coefficient of determination equals the square of the coefficient of correlation between variables *y* and *x*. Thus, a change of 96.2 % in Sweden's labour productivity can be explained by a change in environmental taxes. In this case the linear regression equation is composed: $y_1 = 2523.66 + 7.9x$, i.e. when environmental tax revenue grows by one unit (EUR one million) labour productivity grows by EUR 7.9 thousand per person. Although in 2000-2011 Germany's population employment levels had a growing tendency due to reduced social security contributions payable by employers and employees, a regression relation between revenue from environmental taxes and labour productivity is weak ($R^2 = 0.405$, while $p<0.05$). Generally, states achieve higher economic and social efficiency by either introducing or increasing environmental taxes since it is very important to retain the principle of *double dividends* which is the basis for environmental fiscal reforms in all countries. Hence, while protecting the environment against the impact of pollution, account is taken of energy consumption intensity, which is directly responsible for pollution processes and is important in the context of analysis of sustainable correlation between environment and economy.

Energy intensity shows energy consumption in the economy and the total energy efficiency. Total domestic energy costs are calculated as the sum of the five types of consumed energy: coal, electricity, oil, natural gas and renewable energy sources. Figure 1 shows that in 2000-2011 energy consumption had a decreasing tendency in the countries which used decreasing amounts of energy for the production of one unit of production. This resulted from improving

eco-friendly production technologies and taxes on energy.

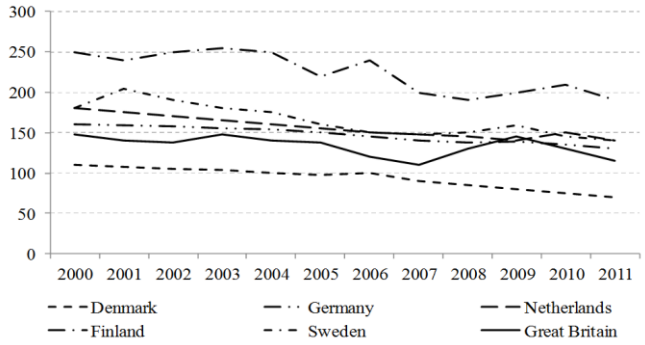

Figure 1. Change in energy intensity in EU countries (kg/EUR 1 000 GDP), 2000–2011, source: own study

In the years analysed the biggest fall in energy intensity was seen by Denmark, its change represented 31.5 %. In order to create EUR 1 000 GDP Denmark had to consume the smallest amount of energy (on the average, around 96.9 kg of oil equivalents), meanwhile Finland consumed the greatest energy amount which, on the average, was around 222.3 kg of oil equivalents/EUR 1 000 GDP. Nevertheless, in order to achieve the target of energy intensity reduction the states are encouraged to invest in research and development with the aim of finding new more efficient technologies and equipment based on a more efficient use of energy and resources.

The identified relation between environmental taxes and energy intensity is shown in Table 8.

Assuming that other factors do not affect the change of energy intensity, the dependence between energy intensity and environmental taxes exists in all the countries excluding Germany, because R^2 is relatively small, 0.259, while a p-value is above 0.05 (Table 8). Therefore, the model of linear regression equation is not suitable in the case of Germany. The strongest relation between energy intensity and environmental taxes was determined in the Netherlands where R^2 stands at 0.944, while $p<0.05$, which explains a 94.4 % change in energy intensity by the change of environmental taxes. In the case of the Netherlands, the linear regression equation is composed: $y_2 = 294.56 - 0.007x$. Thus, when environmental taxes increase by EUR one million energy intensity drops 0.007 kg/EUR 1 000 GDP.

We can observe that a decline in energy demand in the EU has been determined by greater costs resulting from higher energy taxes. Indeed, these costs can be interpreted as an increase in the tax burden which the states try to compensate by the changes of other taxes associated with a better quality of the public good of the environment (Bovenberg, Ploeg, 1998). Energy is one of the main sources of both pollution and tax revenue.

When oil tax rates are increased renewable energy (solar, wind, wave, hydro energy, biomass energy, geothermal energy) is encouraged because the price of petroleum products grows for industries and businesses as well as households. Its use can abate climate change and the consumption of products causing damage to the environment and preserve natural resources for the future generations.

Indicators in Figure 2 show that EU states implement the provisions of international agreements based on the promotion of renewable energy.

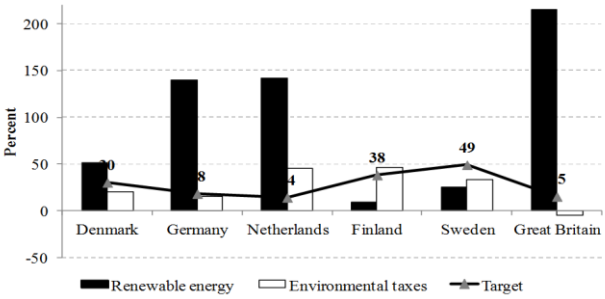

Figure 2. Relative changes in renewable energy consumption and environmental taxes in percent, 2011 against 2000, source: own study

The greatest progress in promoting renewable energy was achieved by Great Britain that raised the consumption of this type of energy from 1.2 % to 3.8 % which has resulted from the introduced tax on energy consumption for the business and industry.

The slowest renewable energy growth was seen by Finland where it upped 9 % and reached 31.8 %, meanwhile environmental taxes increased faster. Nonetheless, Finland has already exceeded the EU average rate to be achieved in 2020 and uses more renewable energy than envisaged in the Directive on the promotion of the use of energy from renewable sources. The highest consumption of renewable energy was determined in Sweden reaching 38.7 % and 46.8 % in 2004 and 2011, respectively. Environmental taxes also went up similarly the collection of which in Sweden contributed to the promotion of the use of energy from renewable sources. It is maintained that Sweden has already achieved its target share of 49 % of renewable energy consumption. Great Britain recorded the lowest consumption of renewable energy; however, of all the countries it enjoyed the biggest increase with environmental taxes therein going down insignificantly. This means that Great Britain seeks implement international commitments as regards the increase of consumption of this energy type disregarding the fact that the share of green taxes in the total revenue is the smallest.

Reduced use by industries and households of natural resources (coal, oil, natural gas, etc.) results in lower CO_2 emissions. This is important for reducing greenhouse gas emissions and implementing one of the key ideas of environmental taxes – to stop the process of climate warming. For this reason CO_2 emissions into the atmosphere dropped in all the countries in 2000-2011 (Figure 3).

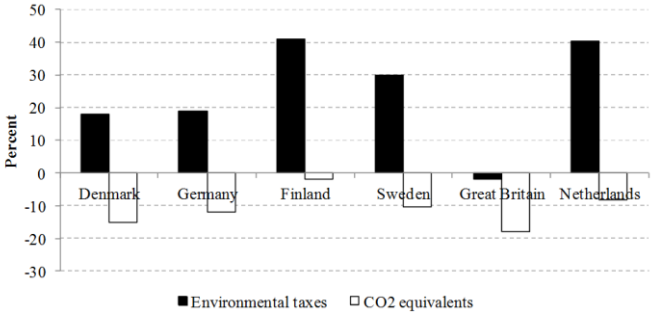

Figure 3. Relative percentage changes in CO_2 equivalents and environmental taxes, 2011 against 2000, source: own study.

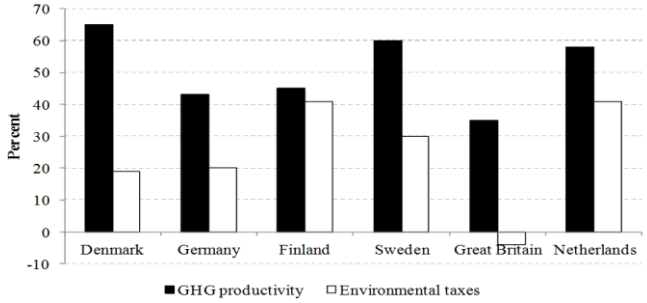

Figure 4. Relative changes in greenhouse gas emission productivity and environmental taxes in percent, 2011 against 2000, source: own study

The biggest drop in CO_2 emission levels was attained in Great Britain and Demark, 18 % and 17.6 %, respectively, whereas the smallest decrease in CO_2 emission, 3.3 %, was recorded in Finland. Consequently, the states honour their commitments to the European Community on the reduction of greenhouse gas emissions of the developed countries by at least 5 % over the period 2008-2012 compared with 1990 levels. (European Environment Agency, 2013). Information on CO_2 changes should be valued with caution as CO_2 taxes are generally levied on energy products. It is often difficult to identify CO_2 taxes separately because they are integrated into energy taxes, for example, through the differentiation of oil tax rates taking account of the coal amount in fuel. Furthermore, taxes on CO_2 are partially introduced as an energy tax substitute because revenue from these taxes is generally considerable compared to revenue collected from pollution taxes (Stamatova, Steurer, 2011). For instance, the introduction of a new CO_2 tax in Denmark and Sweden was accompanied by a decrease in existing energy taxes, in particular on industry (Barde, 2004). Based on the literature analysed, CO_2 taxes can be included in pollution taxes but not in energy taxes as this would impede the comparison of international information.

Greater consumption of renewable energy results in lower emissions of gases producing greenhouse gas emissions. Therefore, in implementing international agreements on air pollution abatement worldwide it is analysed how the productivity of greenhouse gas emissions changes after the introduction of green taxes. The aim is to achieve increasing enhancement of that productivity. In 2000-2011 the productivity of greenhouse gas emission rose due to a fall in countries' energy efficiency.

It has been determined that in 2011 compared to 2000, the average greenhouse gas emission productivity accounts for 53.28 % in the analysed states having introduced reforms. Nearly all the countries enjoyed a 50 % or greater increase in greenhouse gas emission productivity. The greenhouse gas emission productivity displayed a growing tendency because a particularly major focus is laid on the energy industry and the process occurring therein to make them more environmentally friendly. Hence, upon the start of environmental tax reforms the economic activities of the countries in question became more environmentally friendly, i.e. a CO_2 equivalent yielded a bigger GDP. Also, productivity indicators can be explained by increasing investment in low-emission equipment and vehicles (electric drive vehicles) and position with regard to technologies.

As the results show, the biggest impact of environmental taxes on a change in greenhouse gas emission productivity was felt in the Netherlands (Table 9). A 97.4 % change in greenhouse gas emission productivity in this country is explained by a change in environmental taxes. The dependence between these two variables is particularly strong. Based on data from the solved linear regression equation, the following equation is composed: $y_3 = -257.21 + 0.142x$. It is evident from the equation that when environmental taxes rise by one unit (EUR million) the productivity of greenhouse gas emission increases by 0.142 t/EUR 1 000 GDP. Meanwhile in respect of Germany the applied model is not suitable because R^2 is 0.249, while $p>0.05$.

In summary of the implemented environmental tax reforms, a positive impact of these reforms is observed not only on the environment but also on social and economic factors while preserving fiscal policy neutrality. Actually, some states expected a greater positive impact of environmental taxes on GDP than they have managed to achieve. Although reforms are relating with the shifting of part of the tax burden from labour to energy taxes, at the start of these reforms revenue from these changes was inconsiderable accounting for a mere 0.2 to 1.9 % of GDP. In Finland and Sweden as well as in Germany (over a certain period) the environmental tax reform achieved a general decrease in the tax burden and part of the reform compensated for certain deficits in national budgets. Other countries (Great Britain, the Netherlands) had the aim to achieve strict fiscal neutrality, i.e. the tax burden remained stable. During the process of reforms in Denmark too many subsidies were granted, which diminished environmental efficiency.

Table 9. Regression relation between greenhouse gas emission productivity (t/ EUR 1 000 GDP) and environmental tax revenue (EUR million), 1995-2011, source: own elaboration

	Denmark	Germany	Netherlands	Finland	Sweden	Great Britain
Type of equation	Linear	Linear	Linear	Linear	Linear	Linear
Coefficient of determination R^2	0.571	0.249	0.974	0.575	0.910	0.577
p-value	0.000	0.099	0.000	0.002	0.000	0.001
Coefficient a	3395.258	-1130.933	-257.208	-496.435	-2540.970	-1421.879
Coefficient b	-0.022	0.063	0.142	0.560	0.846	0.090

Conclusion

According to the assessment indicators of conformity by environmental taxes with taxation principles, the best results were achieved in Sweden, which already before the start of the reform paid major attention to the bettering of the environment and was the first to implement the reform.

The environmental tax systems of Finland, the Netherlands, Denmark, Germany and Great Britain require bigger improvements according to taxation principles in order to have an efficient and effective fiscal policy.

Environmental (energy intensity, greenhouse gas emission productivity) and social-economic (share of environmental taxes in state revenue, labour productivity) indicators of the countries improved over the analysed period. In Finland green taxes represented the largest share of the total taxes (around 16 %), whereas in Great Britain they accounted for about 7 % of state taxes. The strongest relation between labour productivity and environmental taxes was identified in Sweden because $R^2=0.962$, $p<0.05$ and therefore a 96.2 % change in Sweden's labour productivity can be explained by a change in environmental taxes. Denmark saw the sharpest decline in energy intensity of around 31.5 %, wherein the lowest energy consumption of around 96.9 kg of oil equivalents was required to create EUR 1 000 GDP. Therefore, a 79 % decrease in intensity is explained by higher environmental taxes. Finland enjoyed the highest energy consumption, which stood at 222.3 kg of oil equivalents/EUR 1 000 GDP. As regards CO_2 emission, its biggest drop was attained in Great Britain and Denmark representing 18 % and 17.6 %, respectively. All the countries took sufficient measures for air pollution abatement.

The analysed states that have implemented environmental fiscal reforms achieved environmental, economic and social objectives. Environmental tax reforms did not place a heavy tax burden on the society, while some states (Great Britain, the Netherlands) attained the neutrality of state budget revenue.

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Cultural Ecosystem Services – Framework, Theories and Practices

Usługi kulturowe pełnione przez ekosystemy – struktura, teoria i praktyka

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Abstract
The article above is an attempt to present main issues of conceptual background and research practices for cultural ecosystem services, seen as an important part of sustainable development, for its practical implementation. The author begins with conceptual background of ecosystems services as whole, then goes to cultural ecosystem services conceptual background and finally to cultural ecosystem services research practice. The last part of the article gives an overview of participant disciplines (their methodologies and perspectives), main research topics, national/ geographical background of authors, and finally – main weaknesses of contemporary researches and main challenges for the future ones.

Key words: ecosystem services, cultural ecosystem services, wellbeing

Streszczenie
Artykuł stanowi próbę przedstawienia głównych zagadnień odnoszących się do teoretycznego tła i praktyk badawczych odnoszących się do usług kulturowych pełnionych przez ekosystemy. Jest to ważna kwestia związana z wdrażaniem rozwoju zrównoważonego.
Autorka rozpoczyna od ogólnej analizy usług pełnionych przez ekosystemy, przechodząc następnie do uwarunkowań teoretycznych usług kulturowych, aby potem odnieść się także do praktyk badawczych. Ostatnia część artykułu to przegląd dyscyplin powiązanych (ich metodologii i perspektyw), głównych tematów badawczych, krajowego/geograficznego pochodzenia autorów, a także głównych słabości obecnie prowadzonych badań i zarysu wyzwań jakie staną przed nami w przyszłości.

Słowa kluczowe: usługi pełnione przez ekosystemy, kulturowe usługi pełnione przez ekosystemy, dobrobyt

Introduction

An important issue in sustainability is keeping balance between cultural, monetary and environmental needs, and the fair acting by all actors in wide range of situations. The three pillars of sustainability revolve around economy, social issues and the environment. For the economic, sustainability means: local prosperity, social equity, employment quality and economic viability. For social it is understood as local control, cultural richness and community wellbeing, and for the environment as a physical integrity, biological diversity, resource efficiency and environmental quality (UNEP & WTO, 2005).
The paradigms of sustainability, despite never criticized and formally accepted by decision makers and many stakeholders, remain quite often at the stage of rhetoric declaration. This lack of implementation was the main incentive to involve into play so called *ecosystem services*. The term has been created by ecologists and economists to explain the monetary value of ecosystems, giving decision makers a dollar value for fresh water, air, forests or coral reefs. Proving how much we can lose in a long-term perspective

if we don't respect the ecosystems enough (or – in other words – if we are not sustainable enough).
Ecosystem services revolve around same topic as sustainability but looking at it from different perspective, mostly very practical, monetary one. Thus, if the ecosystem services are not appropriate, sustainable development will not be possible. There is similar dependence with the term *wellbeing* revolving around most of principles of sustainable development (like respect for values, social equity etc.), but perceived from human-centred perspective. The researches about wellbeing look at what people are aware of (e.g. money, family, safety) and at what they are not, but remains very important (e.g. breathing fresh air, or having access to water). The second part is strongly related with environment. Again – if the resource efficiency and environmental purity are not respected, future generations wellbeing will not be possible. As A. Prescott (2001), the author of famous *Wellbeing of nations* stated *To sustain their own wellbeing people need to look after the wellbeing of the ecosystem: the system of land, water, air and living creatures that embraces and supports them. This dramatic change in the human conditions impels the growing concern for sustainable development. People still need ways of living that correspond to their views of the good life. But now this ways of life must also be equitable – both within and among societies and between present and future generations – and they must safeguard the diversity, productivity and resilience of the ecosystem* (Prescott, 2001, p. 1).
One of the main messages of the *Millennium Ecosystem Assessment*, related to cultural services, is that human cultures, heritages, religions, knowledge systems, social interactions and the linked amenity services always have been shaped or at least influenced by the environment (nature of the ecosystems and ecosystem conditions) in which each culture is based. At the same time, people have always shaped and influenced the environment to enhance the availability of certain services (MA, 2005; Tengberg et al., 2012, p. 14). A consensus of *Millennium Ecosystem Assessment* is to use the following framework for linking ecosystems to human wellbeing and sustainability (MA, 2005; De Groot et al., 2010).
In recent decades, the concept of ecosystem services has gained prevailing attention as an efficient approach for integrating into decision-making ecosystem-related values often heretofore dismissed as difficult to capture. As the supply of direct and indirect people's benefits coming from ecosystems, ecosystem services framework was seen as an approach to bridge the gap between ecology and economics, and thus this type of approach so far primarily represents these two perspectives (Daily, 1997; Chan et al., 2012, p. 8).
The article above is an attempt to present main issues of conceptual background and research practices for cultural ecosystem services, seen as an important part of sustainable development practical implementation. The author begins with conceptual background of ecosystems services as a whole, then goes to cultural ecosystem services conceptual background and finally to cultural ecosystem services research practice. The last part of the article gives an overview of participant disciplines (their methodologies and perspectives), main research topics, national/ geographical background of authors, and finally – main gaps of contemporary researches and main challenges for the future ones.

Conceptual background: how to value ecosystem services?

The concept of ecosystem services dates back at least to the 1970s (De Groot, 1992; Costanza et al., 1997; Daily, 1997). Especially, economic valuation techniques are implemented to determine a value to ecosystem components and functions. The economic valuation brought to ecologists the ability to express some of the values of ecosystems in metrics (dollars) that are better understood and have more powerful meaning to publics, policymakers and decision contexts. Ecosystem service approaches have than become a considerable basis for planning and management policies (Chan et al., 2012, p. 8). Major contribution was made to the understanding of both the monetary – costs-and-benefits – of ecosystem service delivery (Berkel, Verburg, 2014, p. 164).
In the scientific literature the idea of ecosystem services gained momentum in the 1990s (De Groot, 1992; Costanza et al., 1997; Daily, 1997). The concept was mainstreamed by the *Millennium Ecosystem Assessment* (MA, 2003, 2005) and since then, the number of publications about ecosystem and landscape functions and services increased rapidly (Fisher et al., 2009; De Groot et al., 2010). Also the efforts to put the concept into practice, since MA have increased strongly (Daily and Matson, 2008; Tallis et al., 2008). Landscape become an important concept in policy making, as decision makers always had to deal with an explicit and diversified demand for landscape services from a broad range of stakeholders (FAO, 1999; OECD, 2001; Hollander, 2004; Wilson, 2004; Bills and Gross, 2005; Hein et al., 2006, De Groot et al., 2010). Mapping ecosystem services have offered policymakers suggestions about best locations for service delivery (Egoh et al., 2008, Willemen et al., 2008).
The Millennium Ecosystem Assessment (2005) divided ecosystem services into: provisioning, regulating, cultural and supporting ones, but still there is much debate how to classify the services in order to make them quantifiable in a consistent manner (Wallace, 2007; Fisher et al., 2009). Also the distinction between ecosystem functions and services is still discussed. As De Groot et al. (2010) explained: *Ecosystem services are generated by ecosystem functions which in turn are underpinned by biophysical struc-*

tures and processes called 'supporting services' by the 'Millennium Ecosystem Assessment'. Ecosystem functions are thus intermediate between ecosystem processes and services and can be defined as the 'capacity of ecosystems to provide goods and services that satisfy human needs, directly and indirectly'. Actual use of a good or service provides benefits (nutrition, health, pleasure, etc.) which in turn can be valued in economic terms and monetary terms. Although the overall structure of this 'cascade' is generally accepted, the distinction between 'function', 'service' and 'benefit' is still debated." (De Groot et al., 2010, p. 261-262).

The discussion about defining and classifying ecosystem services is followed by approaches to quantify and value ecosystem services. Most of the research programs, however, are focussed at one or a few ecosystem services aspects. We still lack of coherent and integrated approach to practical application of ecosystem & landscape services, functions and planning (ICSU et al., 2008). Many issues still have to be resolved to fully integrate the concept of ecosystem services into regular landscape planning, management and decision-making (De Groot at al., 2010, p. 260). At the landscape level, the main challenge is how to decide on the best allocation and management of numerous and diversified land use options. However, ecosystem-landscape related services are still lacking in most policy support tools (Pinto-Correia et al., 2006; Vejre et al., 2007), and current landscape models mostly deal with either land cover patterns (Verburg et al., 2004) or are strongly sector-oriented (Heilig, 2003; Meyer and Grabaum, 2008, De Groot et al. 2010).

Another problem is that the quantitative relationship between biodiversity, ecosystem components, processes and services is still poorly understood. The specific nature of biotic communities and the functioning of ecosystems remains one of the most important unresolved questions even within ecology seen as one discipline (ICSU et al., 2008). Adequate indicators and criteria are needed to exhaustively describe the interactions between the ecological processes and components of ecosystems and their services (De Groot et al., 2010, p. 262).

The relationship between ecosystem processes and provision of ecosystem services is almost not researched and remains unknown (Carpenter et al., 2009). Thus, we don't know much about when to expect synergies or trade-offs between different services, we don't know the mechanisms that cause them, or how to minimize trade-offs and enhance synergies (Benett et al., 2009, p. 1395). This lack of knowledge has led to an increase in a few services and a decline in most other (MA, 2005). Sometimes, an overly-narrow focus on a selected set of ecosystem services has even led to regime shifts with unexpectedly sudden losses of other ecosystem services (Benett et al., 2009). Looking at the ecosystem services correlations, Benett et al., (2009, p. 1396) proposed a typology of relationship based on the two types of mechanisms causing them: (1) effects of drivers on multiple ecosystem services and (2) interactions among ecosystem services.

Integrating economic and ecological analysis has been an important platform for ecosystem services research (Turner and Daily, 2008). This integration has contributed to policies, primarily with payment for ecosystem services programs and researches (Eigenraam et al., 2007; Engel et al., 2008; Juniper, 2011; Muñoz-Piña et al., 2008; Turpie et al., 2008). But as Chan et al. (2012, p. 8) stated, *approaches of this kind cannot or have yet to encompass all dimensions of value, thus many important considerations remain marginalized within ecosystem services research and practice.* While this adaptation of economic metrics was likely fuelled by a desire to give monetary value to inherent, mostly intangible values of nature to better explain the policymakers their meaning (Satterfield and Kalof, 2005), one could argue that all efforts to include economics and ecologists result in adaptation or even acceptance of an essentially economic worldview only. In so doing, we *may have simultaneously closed the door to other social perspectives – those more fully representative of the vicissitudes of human behavior and the less tangible social and ethical concerns to be outlined more fully below* (Chan et al., 2012, p. 8).

Conceptual background: how to value cultural ecosystem services?

Ecosystem services have been defined in reference to their material or non-material values. The material values were considered in relation to provisioning, regulating, and supporting services, whereas non-material values have been associated with *cultural (ecosystem) services* (Chang et al., 2012, p. 9). Cultural ecosystem services have been included in many other typologies of ecosystem services and referred as: cultural services (Constanza et al.,1997), information functions (de Groot et al., 2002), life-fulfilling functions (Daily, 1999), amenities and fulfilment (Boyd and Banzhaf, 2007), cultural and amenity services (de Groot et al., 2010; Kumar 2010), or socio-cultural fulfilment (Wallace, 2007). They are often dependent on intermediate ecosystem services (Fisher et al., 2009; Johnston and Russell, 2011), and services combined with other forms of capital (Chan et al., 2011; Constanza et al., 2011; Milcu et al., 2013). Costanza et al. (1997) defined cultural values services as *aesthetic, artistic, educational, spiritual and/or scientific values of ecosystems* (p. 254). The *Millennium Ecosystem Assessment* (2005, p.894) expanded this definition to include the *non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience, including, e.g., knowledge systems, social relations, and aesthetic values*. Till now, The *Millennium Ecosystem Assess-*

ment still provides the most comprehensive overview and categorization of cultural ecosystem services, with the following categories suggested:

- *Cultural diversity* (in the sense that the diversity of ecosystems is one of factors contributing to the diversity of cultures);
- *Spiritual services* (recognising that many religions attach spiritual values to ecosystems or their components);
- *Knowledge systems* (recognising that ecosystems influence the traditional and formal knowledge systems developed by different cultures);
- *Educational values* (recognizing that ecosystems and their components provide the basis for formal and traditional education in many societies);
- *Inspiration* (in the sense that ecosystems provide a rich source of inspiration for art, folklore, national symbols, architecture, and advertising);
- *Aesthetic values* (recognizing that people find beauty in various aspects of ecosystems, as reflected in the support for forest, sea, parks, scenic drives, or choice for housing locations);
- *Social relations* (recognizing that ecosystems has an impact on types and character of social relations that are established in particular cultures);
- *Sense of place and identity* (ecosystems can be seen as a central pillar of the '*sense of place*' that is associated with recognised features of their environment);
- *Cultural heritage values* (understanding that many societies place high value on the maintenance of cultural landscape or culturally significant species);
- *Recreation and ecotourism* (recognising that people often choose where to spend their leisure time based on the characteristics of the natural or cultivated landscapes in a chosen area) (see also Kira, Burkhard, 2010, p. 350).

We also should add factors related to the observer, such a social and cultural personal experience, habits and belief systems, traditions of behaviour, style of living and judgement of other styles, coming into play when talking about given cultural ecosystem service. There is a wide range of factors that are related to the particular observer and indirectly at best to the ecosystem itself (Kumar and Kumar, 2008). E.g. a mountain slope can be seen as a great skiing opportunity but only for people used to skiing. For others it can have an aesthetic, or any kind of value. The benefits produced by cultural ecosystem services (physical, emotional, and mental ones) are often intuitive in nature (Kenter et al., 2011) and expressed through indirect manifestations. The value assigned to cultural ecosystem services is very personal depends therefore on personal cultural assessments of their contribution to someone's wellbeing (Charles and Dukes, 2007; Eicken et al., 2009; Scullion et al., 2011).

Yet, the definition of cultural ecosystem services, done by *Millennium Ecosystem Assessment* has been criticized (Boyd and Banzhaf, 2007; Wallace, 2007; Chan et al., 2012) because it does not clearly separate the welfare of human beneficiaries, between the above notions of services, benefits, and values (Milcu et al., 2013). De Groot et al., after Haines-Young and Potschin (2010, p. 264) proposed a framework for linking ecosystems to human wellbeing. Ecosystems & Biodiversity, first as a physical structure or process influences on functions (e.g. slow water passage biomass). The function impacts service (e.g. flood protection products). The service has an impact on human wellbeing, in socio-cultural context. First on benefits (contribution to health, safety) and from benefits to economic value (e.g. money for water protection or health services).

The discussions concerns also the understanding of *values*, *benefits* and their correlation. Costanza et al. (1997) define cultural ecosystem services as *values*, while the *Millennium Ecosystem Assessment* (2005) defines them as *benefits*. De Groot et al. (2005) talk about benefits, services, values, and activities. In the interest of conceptual clarity, Chang et al. (2012, p. 9) suggested distinguishing between these diverse things. They describe services as the production of benefits (where benefits may take the form of activities), which are of value to people. Accordingly, they defined cultural services inclusively as ecosystems contributions to the non-material benefits (e.g., capabilities and experiences) that arise from human-ecosystem relationships. (Chang et al., 2012, p. 9). Following Chang et al. (2012, p. 10) *Benefits are related to the level at which people can most easily relate ecosystems to themselves. Services, as the ecosystem processes underpinning benefits, are the level at which ecosystem properties and dynamics might be considered in planning and management. Values are the preferences, principles and virtues that we (up)hold as individuals or groups.* Values are seen as one way to understand and represent what matters to people, and not a set of entities that exist *out there*. Chang et al. (2012, p. 10-12) propose a distinction of values based on their dimensions for environmental decision – dividing them on eight platforms:

1. Preferences – vs. – Principles – vs. – Virtues;
2. Market-mediated vs. – Non-market-mediated;
3. Self-oriented vs. – Other-oriented;
4. Individual vs. – Holistic / group;
5. Experiential vs. – Metaphysical;
6. Supporting vs. – Final (instrumental vs. inherent);
7. Transformative vs. – Non-transformative;
8. Anthropocentric vs. – Biocentric.

De Groot et al. (2010, p. 263-264) proposed potential indicators for determining (sustainable) use of ecosystem service. They have distinguished 23 ecosys-

tem services, divided into: provisioning (e.g. food, water), regulating (e.g. climate regulations, waste treatment), habitat or supporting (nursery habitat, genepool protection), and cultural amenity ones (e.g. aesthetic, spiritual, cultural heritage and identity). To each ecosystem service they have indicated: first – ecological processes and/or component providing the service (or influencing it's availability) = functions, second – state indicator (how much the service is present) and third – performance indicator (how much can be used/ provided in a sustainable way). A proposed indicators give a wide range of classification of ecosystem services but also make an important step to linkages with sustainable development.

When talking about characteristic of cultural ecosystem services, there is a common agreement about their intangibility, that has been an explanation for their poor appraisal in the literature and policies (Sarukhán and Whyte, 2005; Adekola and Mitchell, 2011; Daw et al., 2011), but also as an argument for better consideration of them in the future research (Chiesura and de Groot, 2003; Chan et al., 2011).

Practical background – cultural ecosystem services in research and projects

Despite cultural ecosystem services and so called *non-use* values are included in all major typologies (Costanza et al., 1997; Daily et al., 1997; de Groot et al., 2002; MA, 2005), and present some of the most decisive reasons for conserving ecosystems, many barriers exist to their explicit characteristic. In practice they have received very limited attention in the growing body of empirical ecosystem services research and policies. They are seldom reflected by economic indicators (e.g., real estate prices) and are rarely marketable (Carpenter et al., 2009; Martín-López et al., 2009; Milcu et al., 2013). The exceptions are only cultural heritage & educational values (Kumar, 2010), and recreational & aesthetic ones (Chan and Ruckelshaus, 2010) quit widely described in the literature (Berkel, Verburg, 2014; Milcu et al., 2013). Still there is a wide research about cultural ecosystem services in regard to landscape recreational values (Tengberg et al., 2012; Plieninger et al., 2013; Berkel, Verburg, 2014) and role green areas in given cities (Bolund, Hunhammar, 1999). However, there have also been suggestions to remove cultural ecosystem services from the ecosystem services framework altogether (Fisher et al., 2009) and stop on simple recognition of them, with no going deeper into analysis (Tengberg et al., 2012, p. 15).

Insofar as cultural ecosystem services have been named, defined and quantified, they have generally been valued in purely economic terms (e.g. Chiesura and de Groot, 2003; Martín- López et al., 2009; Martín-López et al., 2007), which couldn't illustrate their full extent, and differences from other ecosystem services. Following Chan et al. (2012): *While these intangible values have been described elegantly through poetry and prose (…), these descriptions are neither expressions of how these values are produced (as in an ecological production function), nor are they commensurate with an ES framework* (p. 9).

Ecosystem services are mostly researched by English speaking authors. 99 % of papers on ecosystem services have been published in English (Schaich et al., 2010). One can say that English is widely used for all publication, thus high percent of English articles cannot serve as geographical indicator. However the same analysis shows that 69 % of all papers on ecosystem services is wrote by American, British, or Australian authors[1]. Cultural landscape papers are much more diverse in terms of geographic origin, with only 37 % of authors based in these countries. The results above were confirmed in *Tourism, Wellbeing and Ecosystem Services* COST action, which found out that within 30 participating countries only English speaking and Scandinavian have adequate vocabulary for ecosystem services and wellbeing. Thus only there adequate policies and researches were applied (www.tobewell.eu). Most of others have almost no linkages in researches and policies between tourism – wellbeing and ecosystem services[2]. Following UE advices participating countries must somehow value and map their ecosystems and ecosystem services, but as the term is subject to *artificial* translation, there is no common *feeling for it*. In consequence, except official government of UE payed analysis, almost no attention is attached to this topic by researchers. An important gap in most of those countries, is lack of linkages between cultural ecosystem services and wellbeing.

Publications dedicating more than half of their content to cultural ecosystem services were typically published after 2009. An overview of the current state of research in a frame of cultural ecosystem services was provided by Milcu et al. (2013), who have classified the diversity of research approaches by identifying clusters of publications that address cultural ecosystem services in similar ways, and highlighted some important challenges for the future research. The authors have reviewed 107 publications and extracted 20 attributes describing their type and content, including methods, scales, drivers of change, and trade-offs between services. Using a cluster analysis on a subset of attributes Milcu et al. (2013) identified five groups of publications: Group 1, conceptual focus, deals with theoretical issues; Group 2, descriptive reviews, consists mostly of

[1] The analysis was based on authors affiliation in American & British & Australian Universities, not on their nationality origins.

[2] The results of Tourism & Wellbeing and Ecosystem Services project, elaborated by working groups will be published in different articles.

desktop studies; Group 3, localized outcomes, deals with case studies coming from different disciplines; Group 4, social and participatory, deals mainly with assessing preferences and perceptions; and Group 5, economic assessments, provides economic valuations. The publications came from eight academic disciplines 72 contained case studies, 32 included strong conceptual elements, and 21 were reviews (p. 2).

Most publications named, as suppliers of cultural ecosystem services, specific types of ecosystems (n=54) such as coastal ecosystems or urban green areas, or specific geographical areas (n=25). The majority of the case studies were in English speaking countries (the USA n=12; the UK n=10; Australia n=4), others in Germany (n=8), Spain (n=8) and Finland (n=4), so all of them in western, *developed* part of the world.

Milcu et al. (2013) distinguished five clusters of articles. The first one (n=25) was called *conceptual focus*, and contained predominantly theoretical publications. Second was of *descriptive reviews* (=25), third, the largest one (n=32) was related to given locations, selected ecosystems, policies and managements, dealing with specific treats or conflict situations. Forth cluster (=13) – *social and participatory* emphasised social aspects of case studies. The fifth one (=12) named *economic assessment* was concentrated on present or future economic value of ecosystem services, giving factual, often monetary accounts of cultural ecosystem services. A surprising result of this analysis is that *social and participatory* cluster, that is supposed to be core topic for culture, is represented in such low (almost the lowest percentage) in the research of cultural ecosystem services.

Cultural ecosystem services research engages many disciplines that use a wide and different range of research approaches (p. 1). Looking at number of cultural ecosystem services publication done by authors of different disciplines the authors confirmed the dominance of biology and environment studies, and surprisingly low input of economics (tab. 1):

Table 1. Number of cultural ecosystem services publication related to author's discipline, after Milcu et al. (2013)

Biodiversity conservation and ecology	45
Environmental management and policy making	33
Others (geography, social sciences, engineering, chemistry)	10
Agriculture and forestry	9
Economics	7

An example of social sciences paper can be Kumar and Kumar (2008) one that builds upon insights from psychoanalytic psychology and environmental-psychology. *It outlines recent research findings from experimental psychology to redefine concepts such as ecological identity, self-other dichotomy, and the fostering of identification with nature, as issues that must be embraced in the valuation of ecosystem services* (p. 808).

As already told, most of studies evaluating cultural ecosystem services have been limited to the category of *recreation and ecotourism*, leaving out the intrinsic qualities that are interrelated with tourism in the cultural service category (Berkel, Verburg, 2014, p. 164). Still, a number of techniques have been developed for the localisation of different type of cultural services valued by stakeholders, through participatory mapping (Alessa et al., 2008; Brown and Raymond, 2007; Raymond et al., 2009; Sherrouse et al., 2011). The identification of best locations for service delivery has been helpful for understanding the spatial determinants of ecosystem and its associated value to given society (Berkel, Verburg; 2014, p. 164). However, as MA doesn't give detailed explanation about what exactly are cultural ecosystem services related to recreation, their identification is rather *free*. Plieninger et al. (2013, p. 120) e.g. have included: walking, dog walking, horse riding, swimming, gathering wild food, angling, hunting, other uses, whilst Berkel and Verburg (2014) involve: cycling, walking, swimming, tranquillity and rest, shopping, eat and drink, farm-based camping, unique landscape, family visits, region specific recreational activities, festival, other and – nothing. Respondents were required to pick the top three activities that attracted them to the region. The services selected by Plieninger et al. (2013) and Berkel and Verburg (2014) remain quit distant from services categories commonly applied in the tourism & recreation literature. Moreover, following the World Tourism Organization (WTO) definition of what tourism is, the authors were not allowed to use the term of *tourism* at all (as *tourism* means leaving the house for minimum 24 hours), but only – the term of *leisure* or *recreation.* Plieninger et al. (2013) and Berkel and Verburg (2014) article could be an example of detailed, well done analysis and mapping of services, but same time lack of linkages with mother discipline (in this case tourism & leisure).

Basing on current state of research in a frame of cultural ecosystem services, we could indicate three types of gaps and corresponding challenges for future work. First – lack of social & human perspective, second – lack of interdisciplinary cooperation, and third – lack of adequate approach to the discipline in which given service is done.

The first challenge (lack of social and human perspective) is widely discussed in the literature. It is underlined that for a holistic understanding of ecosystem services, social sciences are just as important as economy and ecology (Milcu et al., 2013). Cultural ecosystem services highlight powerful linkages with the social sciences, as by definition they are related to human perceptions, attitudes and beliefs (Wallace, 2007; Daily et al. 2009; Chan et al., 2012). The literature on ecosystem services shows such a

strong bias of studies carried out by researchers with the base in natural science. But an example of such bias is even the *Millennium Ecosystem Assessment* publication (2005), which devotes only 2 % of its total pages to cultural ecosystem services. Same with the assessment of The *Economics of Ecosystems and Biodiversity* (TEEB, 2010), which provides detailed economic analysis of ecosystem services, but no discussion of their intangible cultural values (Tengberg et al., 2012, p. 15). One reason for this could be that the MA was designed to respond to government requests for information received through the multilateral environmental agreements and conventions *(Convention on Biological Diversity, the United Nations Convention to Combat Desertification, the Ramsar Convention on Wetlands, and the Convention on Migratory Species)* which are generally perceived to be the responsibility of the environment sector alone (Tengberg, et al., 2012, p. 15). Second gap is widely discussed regarding methodology and perspective, as most of researches are very much within one discipline methodology narrowly focus. Despite four main ecosystem services (provisioning, regulating, cultural and supporting services) are interrelated in the MA concept, the literature shows clear tendencies of separating these categories in specialised research Fields. Third gap is somehow a consequence of first two. The cultural ecosystem services approaches are widening research fields, but without involving those *new* disciplines background. Such discipline-bound approaches that hold one component constant while varying (or not including) the others, can lead to incomplete or incorrect answers (Carpenter et al., 2012).

As long as cultural, non-use, and/ or intangible values are so poorly represented in the literature and project, rejected by ill-suited value metrics, an ecosystem services approach will continue to be criticized by many disciplines: ecologists and others perceiving higher values in nature (e.g., Ludwig, 2000; McCauley, 2006; Redford and Adams, 2009; Rees, 1998); philosophers and others concerned with inappropriate assumptions of substitutability and with diverse kinds of values (e.g. Norgaard, 2010; Norton and Noonan, 2007; Randall, 2002) and critical theorists concerned with the privatization and co modification of the environment (Robertson, 2004).

Some values do not fit within an ecosystems services approach, and it seems to be a kind of mission impossible to do such global inclusion. How one can value in monetary terms the social relations? Beliefs? Family tradition? Many questions still remains highly important and probably – rhetoric. However an ecosystem services approach that provides appropriate space for ill-fitting values such that important cultural and moral ones are not dismissed as hidden externalities, is more than needed.

Conclusions

The *Millennium Ecosystem Assessment* opened a new framework for social and ecological systems analysis having strong influence in both: the policy makers and scientific communities. As defined by MA, cultural ecosystem services are one of the four main ecosystem service categories, however they depend on provisioning, regulating and supporting services, thus their analysis and management must be done in wider perspective.

But still, despite contribution from numerous theories and methodologies, there is a common agreement that a sufficient level of understanding of many important issues and types of cultural ecosystem services has not been reached yet (de Groot et al., 2005; Beaumont et al., 2008; Gasparatos et al., 2011). Moreover, there are many signals that the framework for analysing cultural ecosystem services must be much wider and more precise than the one proposed by *Millennium Ecosystem Assessment*, but still adequate proposition for this are missing (Milcu et al., 2013, p. 2). There is a broad agreement that cultural ecosystem services analysis need insights from anthropology, psychology and behavioural studies with focus not only at the individual level (more typical for those disciplines) but also at the collective one (Chiesura and de Groot, 2003). We should agree with Carpenter (2009) that *The gaps in knowledge that exist today cannot be addressed through un coordinated studies of individual components by isolated traditional disciplines* and with Tengberg et al. (2012, p. 15) stating that to improve the understanding of cultural ecosystem services the interdisciplinary approaches are needed, so we should take into account the dynamic nature of human-environment interactions and possible synergies and trade-offs between cultural, supporting, provisioning and regulating ecosystem services.

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Joseph Kozielecki's Project of Temporal Transgression and the Philosophy of Sustainable Development

Projekt transgresji temporalnej Józefa Kozieleckiego w perspektywie filozofii zrównoważonego rozwoju

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Abstract

In this article the author reconstructs the concept of time as understood by Joseph Kozielecki, which is bound with the philosophy of sustainable development. In conclusion he points to the ambiguity of that concept. The first meaning presupposes the flow of time, which cannot kill a man-perpetrator, as he is able to build, create himself and – at the same time – transcend his own being. In the second meaning, time and the changes in it are the only reality, and the man as if undergoes destruction as a result of these changes.

Key words: time, globalization, sustainable development, education

Streszczenie

W artykule autor rekonstruuje pojęcie czasu w ujęciu Józefa Kozieleckiego, które wiąże z filozofią zrównoważonego rozwoju. W konkluzji wskazuje na niejednoznaczność tak sformułowanego pojęcia. Pierwsze znaczenie zakłada upływ czasu, który nie może unicestwić człowieka-sprawcy, skoro sam siebie może budować, tworzyć, a zarazem siebie przekraczać. W drugim z kolei czas i dokonujące się w nim przemiany stanowią jedyną rzeczywistość, a człowiek jakby ulegał unicestwieniu w wyniku tych przemian.
Słowa klucze: czas, globalizacja, zrównoważony rozwój, edukacja.

Słowa kluczowe: czas, globalizacja, rozwój zrównoważony, edukacja

Introduction

According to Kozielecki, the concept of temporal transgression can be seen as an important reflection on the mental and physical development of man. Therefore, one might ask: what is the time in the understanding of Kozielecki? What is its significance for human development? These questions are posed to show the close relationship between the transgression, which records the biopsychological properties of the dynamics of life, and the phenomenon of time. We will also indicate the possibility of its reinterpretation in the context of sustainable development.

The concept of time in Kozielecki's model mainly stems from its processual, historical and ontogenetic understanding. A man is – in a sense – *chained to time*, as Kozielecki says, and beyond time there is neither history nor the individual life biography. Both the ability to locate oneself in time and the ability to assess the passage of time appropriately play a very important role, not only in the process of adaptation to the world, but also in the development and creation of culture (Kozielecki, 1984, p. 74).

Thanks to its skillful use, people cross the borders of their actions, expand their control over nature, create new scientific theories, break literary conventions and make the attempts of self-creation (Tański, 2008, p. 3). In this model, the man-perpetrator wants to be *the master of time*, and not a tool to overcome its inevitable passage: he wants to go beyond what he possesses and what he is. Bearing the elapsing minutes, hours and days in his mind, he takes the actions going *beyond the material and the spiritual achievements*. As the possibility of extending the du-

ration of human nature is limited, *homo transgressivus* raises the fundamental question: *What will be after me?* Hence, he creates scientific, artistic, and technical works, mainly with the desire to leave a trace behind him. This is the human effort of a man-perpetrator to last in culture. He believes in the adage *non omnis moriar*, just as Horace did centuries ago.

Temporal transgression and time commercialization: towards a global society

Temporal transgression, i.e. time, as defined by Kozielecki, involves prolonging involves prolonging the biological life and going *beyond the statistical average*. A perpetrator takes a variety of actions, through which he tries to extend the duration of biological life (Orbik, 1996, p. 108). New forms of nutrition, a rational lifestyle, hygiene or the fight against heart disease and cancer are the way a human being lasts in nature (Kozielecki, 2002, p. 72). According to Kozielecki, time – in this case – is associated with protective actions, which would constitute a vector defining the aspirations of man from the beginning to the end of his life. It is an anticipation of his goals. These efforts are connected with an expansion, involving the extension of the biological life. The value of life is constituted by the time created by a man-perpetrator. Time understood this way does not define who a man is and what he should be, but rather what he can do, what he can achieve, and what he can serve. What counts, is his operational efficiency. The question how to develop and educate is linked with the disciplines that show the objective shape of reality, such as economics, politics, history or praxeology. The understanding of the development and education is shifting, in this case, to the one in terms of a narrow practicism.

Thus understood time is most often subject to commercialization and becomes a commodity. Therefore, it is treated as a means to the creation of wealth (Sztumski, 2008, p.15). Hence, the author of the concept of temporal transgression is aware of the threats that may be carried by the excessive efforts of a man-perpetrator to prolong his biological life. Particularly, he draws the attention to the dangers associated with the nature of the technocratic vision of civilization. The future reality, related to all phenomena of life, is reduced to the data corresponding to the rules of technology. Relatively autonomous natural and cultural realities will be eliminated in the future, and their interpretation will be monistic and materialistic. In the time created by a technocrat, technoelite and technopole (Kozielecki, 2004, p. 224, after Postmann, 1992; Postmann, 1985, p. 222), the borders between man and nature slowly disappear, including the opposition between man and society. Only one reality, which corresponds to the changes on the technocrat's clock face, will remain. This time seems to favor the possessive technocracy. All oppositions and autonomies in it are overcome; in such vision of the future there is no room for pluralism of realities or for different modes of existence of relatively autonomous worlds. Only one reality, heterogeneous in terms of physical organization, is going to exist – a universal techno-reality. As the author of *The Transgressive Society* notes, although it is subjected to the process of symbolization, eventually it is made shallower, countable, and measurable. This reduction of the divided realities having separate development laws, separate internal times and internal rhythms, has led to their consolidation and universalism. Furthermore, the reduction in technocrat's consciousness appears in different forms and to varying degrees, proving beyond any doubt the *exaltation of the future*, which in turn requires a great effort to cleanse it: first of all, to get rid of the *burden* of the past.

For a technocrat, time is like a reigning monarch and its category corresponds to the social collectivities, such as global society. It organizes and crystallizes the entire axiological space of this global community, with its technocratic ideology at the forefront (Kurczewska, 1987, p. 204-237). It determines its order, gives a value to each of its sequences, prioritizes them and participates in the establishment of norms and values defining the direction of the information in the world. The nature of this ideology and its materialistic product – a consumer good – requires that every action be clearly defined in time and subordinated to the development of electronic means that reduce everything to data. This produces communities, *spider-like* institutions which over time create a megasystem known as the network society (Kozielecki, 2004, p. 243). The process of globalization, which most often includes a hidden mechanism for manipulating people, is not only the result of the globalization of thinking and acting but also of the globalization of stupidity. It can be expressed by the process of growing chaos in the world, which leads to an increased risks of civilizational threats along with the progressive degradation of the human environment. An alarming phenomenon of *globalization of evil* appears, among other things, as a result of the world chaotization which often overcomes good and *as a consequence, the world becomes a great risk to life, multiplied by the networking processes based on the expansion of Internet technologies that cause hybrid connections between the virtual and real worlds* (Fiut, 2010, p.147).

Counteracting the process of world chaotization occurs through a return to human values, which were discovered and also shaped for centuries by a man-perpetrator. Hence, the normative postulate for human activities towards sustainable development (made a specific temporal transgression) assumes the absolute primacy of human values over the economy, technology, politics, and generally all the clever tools in the hands of a technocrat. Science, technology, politics leading to the well-being of a transgressive man assume the realization of values such as solidarity, honesty, truth, creativity, which

can be translated into the quality of life of a man-perpetrator. The quality of life having a specific past, present and future is the result of a significant reduction in consumption and exploitation of entire ecosystems, as well as the final values of the industrial production.

The project of temporal transgression is a part of the issues of sustainable development, which assumes coincidences of the ecological, economic and social reasons based on specific values. Were it not for these reasons, which were derived from certain systems of values (ecological, social, and economic), it would be difficult to talk about sustainable development, for it is impossible without the moral transformation of a man. As it is known, a man-perpetrator builds and shapes his own humanity based on the agatonic criterion (conscience), which forms goodness and becomes the source of responsibility. Man-perpetrator's responsibility is to counteract the disease of the century, which is the separation of the pursuit of effective activity from the moral principles (Kozielecki, 2001, p. 46). Therefore, the mental prowess of a man-perpetrator, as well as his moral dispositions, through which he is able to recognize the reality in the coincidence of goods and technical values with humanistic values become essential in the implementation of sustainable development in a particular temporal transgression (Sarzała, 2003, p. 93). The author of the transgressive concept used to say that the development of a transgressive man requires not only knowledge. but also the *hot values*, humanistic values based on the crossing of his own hubris (Kozielecki J., 1995).

Advantages and disadvantages of temporal transgression in the perspective of values preservation

According to the author of the transgressive concept, liberation from the legacy of the past took place through the deed of the *first* mythical parents – Adam and Eve. They ate the forbidden fruit of the *tree of knowledge of good and evil*, located in the middle of Eden, which helped them to get rid of the shackles of dependence and design their own time, as well as determine their own destiny more independently. In this case, we are probably dealing with a certain vision of the future. It is built in the perspective of cultivating the vital, utilitarian values which can be assumed both by a technocrat and also a *homo transgressivus*. The future conceived this way is seen as ideal, absolute and enables the realization of utilitarian values. Time is then treated as the source of values not only utilitarian but also symbolic and spiritual. It does not constitute a closed system, associated with the changes on a technocrat's clock face, but rather constitutes entire enclaves of indeterminacy and unpredictability (Bartoszewski, p. 39). This is simply a property of transgression, the objectives of which are often distant and last for a long time. *One could say that they colonize the unknown future* (Kozielecki, 2004, p. 47).

What gives a man-perpetrator satisfaction and pride is the activity determined by the linear time. In contrast to the protective actions associated with cyclical time, linear time is associated with the changes, the development not only of the man, but of all structures he is the creator and co-founder of. Experiencing this state of affairs can be a matter of concerns for a man-perpetrator. They arise from the pressure of time, which can lead to the feeling that time is running faster and faster. *It seems to a man that he is wasting time unnecessary activities, such as family, leisure or sport. Consequently, he changes the temporal budget, cuts it. He plays the game with time and finally loses it* (Kozielecki, 2004, p. 227-228). Afterwards, the temporal deviations may appear. One of them is the phenomenon of *temporal dissonance*, under which a man-perpetrator may feel like he is losing orientation in the course of events and processes. As a result, he no longer controls their course and becomes an enslaved tool of time. A man can also experience the future as if it was his presence here and now. Temporal deviations of this type are also a consequence of positive significance: they become delusions, which – as expressed by the psychologist – *allow one to live*. He stresses that the future anticipated state is thus made such a complete experience that only *objectively, it consists of something that does not exist*. This is a subjective, psychological experience of the moment, when they lack the systematic, empirical confirmation. In this context, Kozielecki mentions the hope of a cancer patient concerning the possibility of recovery, which does not need any external support of medical type and often leads to wishful thinking, actually overcoming, actually overcoming the disease or prolonging life (Kozielecki, 1984, p. 100).

The characterized temporal deviations most often arise from the far-reaching destruction of subjectively understood time, which I had previously mentioned in connection with the commercialization of time. A man-perpetrator may indeed be guided by economic, technological criteria of understanding it, thus upsetting the balance between the three pillars of sustainability (ecological, economic and social). The perpetrator begins to follow the economic time, becoming a slave to the *lack of time*. The domination of virtual over natural (real) time appears. This leads to certain consequences for the perpetrator for whom the experience of everyday life in the natural sense of time disappears, and at the same time takes its high density. From now on clock and economic time replace its natural rhythm, appropriate for human life. The rising monochromic culture, as defined by Wiesław Sztumski, based on the clock time leads to the fact that a perpetrator becomes a robot, while his life – automatic, because in practical activities he acts as an *extension of machines*. The sphere of ra-

tionality is governed by the instrumentation and technologization (Fiut, 2010, p. 146-147).

According to Kozielecki, temporal transgression seems to be (similarly to the concept of technocratic time) the time of civilizational revolts, violent transformation of consciousness saturated with utilitarian, vital values also including the symbolic and spiritual ones. However, its reduction to the time measured only by the achievements of civilization, especially the technical ones (transgressions *towards things*), turns out to be a big misunderstanding and shallowing of the essence of transgressive time, according to the author of *Psychotransgressionism*. At its source lies a major driving force of a man in the form of appreciating oneself (hubristic need), as well as the longing and desire for immortality. However, in the transgressive concept of a man he notes – quoting the views of Erich Fromm and Leszek Kolakowski – that transgression is determined by, inter alia, the temporal world of myths, illusions and delusions. Time is then associated with the inner experience of a man-perpetrator. Being encoded in the internal representation it is defined as a subjective or psychological time.

In the monograph *The Multidimensional Man,* Kozielecki assigns the multidimensional concept of time to the *prospective orientation*, which essentially becomes a kind of *creative adaptation*. The life of a man-perpetrator always expires in a particular present and future is immersed in the realm of expectations and sometimes in the space of planning. In this waiting new aspirations and needs appear and creative forces are born. These forces are concentrated around the prospectivity and foresight, which in turn tend to recognize the reality in the long time perspective (Hull, 2003, p. 19). In this case, the life of a man-perpetrator should assume the sustainable development, which would cause the coincidence of dynamic balance (homeostasis) with the processes of creating a new reality in both social and natural dimension. Thus understood time is the result of the Albert Schweitzer's *ethics of reverence for life*, according to which the greatest good is to maintain life, support it by giving it the highest values, whereas the evil is to destroy, harm, and push it aside. The new reality which appears this way becomes a basis for planning and design. The future determined by prospective orientation is not related to the continuation of what exists, but appears in new experiences and aspirations, in short – in creativity. However, as Kozielecki noted, the postulate of prospective orientation does not seem to be clear. The future recognized this way is unknown and uncertain, and human possibility of anticipation seems to be negligible as predictions formulated seem to be either vague or false. Therefore, great visions of forming the man-perpetrator, as well as the society as a whole, tend to be unspecified. Along with the criticism of the prevailing development models based on adaptation and conformism, the attitudes inducing aggression appear, distorting the essence of the prospective orientation. Then, how does one bind the postulate of prospective orientation with the adaptation to the world existing *here and now*? Kozielecki does not give a clear answer to this question, except for just paying attention to the nature of the complexity of the social structures within which one would achieve the objectives of innovative and creative thinking. Besides, the history continually proves that great ideas of social development require long periods of time. However, the author of the transgressive concept is aware that the development of a man-perpetrator oriented prospectively should offer such type of mind training in which he would be able to recognize the reality not only in terms of a fait accompli, but also in terms of the opportunities, in order to enhance the role of anticipation processes, significantly developing the strategy of divergent and probabilistic thinking. Then, the process of entering into the future can be revealed in this model of shaping the mind, because the converted mind will tighten the control over a man-perpetrator in each *here and now* situation.

In thus understood development, which was made in a specific temporal transgression, reasoning in terms of sustainable development philosophy, assuming the way of thinking about reality that respects interactions, relationships between a man-perpetrator, society and the biosphere, becomes crucial. However, does this way of thinking indeed lead to the integral (Hull, 2003, p. 18), global and universalistic thinking (Tyburski, 2008), if embedded in the contemporary culture and the proper time, could appear to some people as dogmatism which is distant from reality and puts the requirements of alternativity before the temporal transgression, i.e. the rejection of nationalism, extremism and political and economic particularism, thus moving away from dividing the world into independent parts. A man-perpetrator lives in the cultural conditions, in which some tensions, contradictions, as well as operating temporary differences within the conflicting environmental, social and economic values – associated with the idea of the problems and practice of sustainable development – seem to be quite natural. The assumed integral thinking does not sound convincing and gives rise to certain doubts, due to the fact that the risk of temporal transgression also seems to be perceived as an opportunity for better, more in-depth solutions that are the conditions for the new and better in terms of harmony versions of the world (Prigogine, Stengers, 1990).

Temporal transgression and the possibility of education for sustainable development

Among other things, the aporia between the education set by the adaptation of presentism and the education toward the world, found in the notion of time associated with a prospective orientation, is overcome. The former is based on the continuation, serv-

ing the finished world, seeking only the utilitarian values. The essence of the latter model of education is the attitude of rebellion against the existing patterns of education and self-education. In this concept of time, the integration of both models of education – which is important from the perspective of education for sustainable development – becomes possible. Within them, one must see the important, but also – in some cases – shallow areas of the world criticism, as well as the constructive or destructive visions of education towards a new future (Tomczyk, Wąsiński, 2014, p. 4-16). Just as one cannot break up with education of fidelity to the universal and permanent values rooted in European culture, which form a kind of barrier, defending a man from self-destruction, one cannot agree to any kind of vision for the future of education based on the relativism of moral values and norms.

The ability to find oneself in the time, determined by the prospective orientation (which is a kind of creative adaptation) means to integrate and demonstrate the convergence of these models of education that are based: 1) on the fidelity to the universal values prejudged by the control of conscience, a separate moral deliberation, 2) on the commitment to the emerging world by the existential method of trial and terror, not repealed by the adoption of the responsibility for the consequences of that engagement. Therefore, at the moment it seems reasonable to ask: was not the mission of education – which fosters the prospective orientation, emphasizing the time leaning towards the future – associated with the care and service for everything that comes from the conscience, respect for moral standards, as well as from mind, stimulating the self-motivation and skills? The prospective orientation associated with the future time is tantamount to the journey into the unknown deconstructs the existing arrangements forcing to project a new reality, and above all innovative behavior. These behaviors arise from the premises based on the philosophy of sustainable development (Tański, 2015, p. 61-62), respecting several interpretations of the same reality which is viewed from different angles and points. Thus, different actions assuming the coincidence of the order of reason (theory, description, explanation) and the order of heart (emotions, commitment, values), appear.

Conclusions: the ambiguity of the approach to the problem of temporal transgression

In summary, the concept of time according to the author of the transgressive concept does not seem to be unequivocal in the perspective of sustainable development. One can talk about its two main dimensions. In the first one, flow of time cannot kill a man since he can build, create and at the same time exceed himself, provided that he will not experience suffering or pleasure. Man is not a subject to destruction: he remains identical with himself. Time does not mean waiting for achieving a goal which is to be preceded by a conscious assessment of the situation, project or plan. Also, time does not appear to be an inner experience of man, although it becomes present in the hope of infinity, which has a metaphysical dimension. Thanks to this dimension, a man-perpetrator can transcend his biological limitations (Kozielecki, 2001, p. 19). While experiencing this time, a transgressive man may take responsible actions and identify himself with the force, the spirit that can surpass himself without submission to suffering or hedonism, able to shape himself. Undoubtedly, in this case the sustainable development – assuming the man-perpetrator's relationship with other people, as well as with nature not only in the realm of facts but also at the deontological level – would be made inside him (Lipiec, 2001, p. 44). In the second dimension, time and changes occurring in it are the only reality; in these changes the man, as it were, undergoes annihilation (Ingarden, 1975, p. 43). Time is subordinated to hubristic behaviors arising from the need to confirm one's own value. A transgressive man, escaping from changes on the clock face, creates the sense and values. Thereby, he suppresses the fear of the inevitability of passing time and wishes to find and confirm himself by creating immortal works. Therefore, time plays a significant role since it becomes the source of the ontological anxiety of a transgressive man.

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Title Sustainable Development in the World from the Aspect of Environmental Health and Human Development Index: Regional Variations and Patterns

Rozwój zrównoważony z perspektywy wskaźników Zdrowia (EH) i Rozwoju Społecznego (HDI): regionalne odmiany i wzorce

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Abstract
In this paper we consider the impact of Human Development Index and Environmental Health on sustainable development in 178 observed countries. We focus on the necessity of multidisciplinary approaches that estimate and predict how selected indicators such as (1) Improved sanitation facilities (% of population with access); (2) Life expectancy at birth, female (years); (3) Improved water source, rural areas (% of rural population with access); (4) Access to electricity (% of population), and (5) Health expenditure *per capita* (current USD) influence on sustainable development and environmental health in the World. The Environmental Health and Human Development Indicator allow countries to compare their social and environmental inequalities with other surrounding countries/regions. Any correlations between Environmental Health and Human Development Index as well as with five World Bank indicators were to be analyzed. The objective was also to explore the heterogeneity of observed countries according to their level of sustainable development based on Environmental Health and Human Development Index.

Key words: Environmental Health, Human Development Index, sustainable development, World Bank Indicators, scores and ranks, air and water quality

Streszczenie
W artykule przedstawiono wpływ wskaźników Rozwoju Społecznego (Human Development Index, HDI) i Zdrowia (Environmental Health, EH) na zrównoważony rozwój w 178 krajach. Szczególny nacisk położono na (1) Poprawę dostępu do urządzeń sanitarnych (% populacji z dostępem); (2) Oczekiwany czas życia od momentu urodzenia u kobiet (w latach); (3) Poprawa dostępu do wody na terenach rolniczych (% populacji z dostępem); (4) Dostęp do elektryczności (% populacji) oraz (5) Wpływ poziomu wydatków na zdrowie na osobę (w USD) na zrównoważony rozwój i kwestie zdrowotne w perspektywie światowej. Wskaźniki (w połączeniu z tym przygotowanymi przez Bank Światowy) te pozwalają na porównanie różnych krajów w zakresie ich społecznych i środowiskowych nierówności wobec siebie i innych krajów/regionów. Przeanalizowano wszelkie występujące korelacje pomiędzy wskaźnikami. Celem było także zbadanie poziomu heterogeniczności poszczególnych krajów z perspektywy poziomu wdrażanego rozwoju zrównoważonego z uwzględnieniem wskaźników Rozwoju Społecznego (HDI) i Zdrowia (EH).

Słowa kluczowe: Wskaźnik Zdrowia (EH), Wskaźniki Rozwoju Społecznego, rozwój zrównoważony, Wskaźniki Banku Światowego, punkty i rankingi, jakość powietrza i wody

Introduction

This study demonstrates that the Human Development Index (HDI) and Environmental Health (EH) in observed 178 countries can be predicted by the selected indicators such as (1) Improved sanitation facilities (% of population with access); (2) Life expectancy at birth, female (years); (3) Improved water source, rural areas (% of rural population with access); (4) Access to electricity (% of population), and (5) Health expenditure *per capita* (current USD). The practical aspects of sustainable development by composite indicators are also analyzed in this article. The main objectives of the study are as follows:

First, this study explores that the sustainable development in the World from the aspect of EH and HDI shows a spatial disparity in a development capacity. High-developed countries have remained absolute leaders as a human and environmental capital, as well as ranking among the top countries for long-term sustainable development.

Second, the EH and HDI allows countries to compare their social and environmental inequalities with other surrounding countries/regions in the World. The EH and HDI clearly demonstrate that the key to win the super competitive race in the sustainable environment is improvement and investment in the future: infrastructure (sanitation, water, and electricity facilities), healthcare, and education.

Third, we analyzed the relationship between each dependent variable (EH and HDI) in 178 observed countries worldwide. The EH and HDI were compared validation in terms of its relationship to World Bank (WB) indicators such as (1) Improved sanitation facilities (% of population with access); (2) Life expectancy at birth, female (years); (3) Improved water source, rural areas (% of rural population with access); (4) Access to electricity (% of population), and (5) Health expenditure per capita (current USD).

Most of the published studies dealing with spatial analysis of EH and HDI refer to the significant relationship between environmental and social indicators and sustainable development (Dahl, 2012; Moldan et al., 2012; Hak et al., 2012; Costantini et al., 2008; Boehringer et al., 2007; Blanc et al., 2008; Bassi et al., 2014; Hotez et al., 2015).

The relationship between environmental factors and sustainable development of a countries' is complicated considering that large sections of the country's population depend on natural resources for their livelihood. Weak environmental and socioeconomic conditions may have an unfavorable effect on sustainable development and their improvement measures. In additional, Bradshaw et al. (2009) consider that elevated degradation and loss of habitats and species are compromising ecosystem services that sustain the quality of life for billions of people worldwide. *Sustainability* is among the most sought after of all seafood products adjective (Volpe et al., 2013). EH is one of the principal determinants reducing environmental stress to health and increases the human quality of life. EH increases significantly when human development increases (Boutayeb, 2009).

Data and methodology

To be able to explore regional inequalities, the following variables were used to perform a multinational comparison (data provided by WB):

1. *Improved sanitation facilities (% of the population with access)* – refers to the percentage of the population using improved sanitation facilities.
2. *Life expectancy at birth, female (years)* – indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.
3. *Improved water source, rural areas (% of rural population with access)* – percentage of the population using an improved drinking water source.
4. *Access to electricity (% of the population)* – the percentage of the population with access to electricity.
5. *Health expenditure per capita* (*current USD)* – provided by World Health Organization and Global Health Expenditure Database.

As depended variables were used indicators such as EH and HDI. The EH is calculated comparing three indicators: health impacts, air quality, and water and sanitation. The EH builds on measure relevant to one primary objective that is reducing environmental stress to human health (Chandrasekharan et al., 2013). The HDI is a composite index measuring average achievement in 3 basic dimensions (4 indicators) of human development; long and healthy life (life expectancy at birth), education (mean and expected years of schooling), and decent standard of living (gross national income *per capita*). The index ranges from 0-1, with a higher score reflecting a higher degree of human development (Lou et al., 2014).

The series of indicators reveal in a clear and objective way the relative position of each of the countries. Therefore, factors were ranked according to the degree to which they are useful in determining the competitive position of those countries.

Our research based on following objectives:
H1: *We assumed that there is a high level of heterogeneity in terms of human development, environmental health and environmental performance among all observed countries.*
H2: *There is a strong correlation between the Human Development Index and the Environmental Health Index as well as selected environmental variables provided by World Bank database*
To describe the association between five WB indicators, EH, and HDI, two statistical methods were used – Pearson and Spearman correlation and linear regression analysis. The regression models were checked for collinearity. Analyzes were made using Statgraphics Centurion version XVI, SPSS version 22.0 and MapInfo version 11.0.

Results

Environmental and social indicators influencing on sustainable development
For the purpose of this study, social and environmental indicators were chosen from official statistics published by the Yale Center for the Environmental Law & Policy, Yale University and World Bank (Hsu et al., 2014), in collaboration with World Economic Forum in Geneva. The most meaningful results of our environmental health analysis of sustainable development had a focus on the spatial distribution of the selected indicators published by World Bank compared with the EH and HDI in the World. To describe the associations between EH and HDU we used WB indicators (Table 1).
The *Improved Sanitation Facilities* indicator provided by WB characterizes as a percentage of the population using improved sanitation facilities. The improved sanitation facilities include flush/pour flush (to piped sewer system, septic tank, and pit latrine), ventilated improved pit latrine, and composting toilet. The spatial distribution of development of the sanitation facilities indicator worldwide displays that there is a significant distinction between High-income countries located in Western Europe and Northern America on one side and Low and middle – income countries in central Africa and Southern Asia on the other side.
In equatorial Africa and South Asia, the majority of dwellers live in informal settlements served by inadequate sanitation facilities. These settlements present unique challenge to the provision of sustainable and hygienic sanitation, and there is insufficient information on access to improved facilities (Okurut et al., 2015). The highest rankings were reached in all Scandinavian countries, Benelux and Switzerland (Table 1, Figure 1, 5) as the countries with the best sanitation facilities in the world. These countries' sanitation facilities provide high health and social standards towards their inhabitants.
The lowest ranking was reported in Africa. Niger (9.0%), Somalia (9.8%) and Malawi (10.3%) gained the smallest percentage of population with access to sanitation facilities and are among the worst performers in affording the basic elements of improved sanitation facilities. However, depending on the variance values (Table 1), there is a significant increase in macro-regional inequalities in the sanitation facilities among the selected countries in the World. The difference between the minimum (9%) and maximum value (100 %) is 91%.
Life expectancy at birth, females is another indicator published by WB that is also considered as a significant driver of sustainable development and environmental health. Life expectancy at birth is considered as an important indicator of the mortality level of a population. Life expectancy at birth can be also influenced by components of the gender inequality. In the recent years, most countries worldwide experienced improved health outcomes as longevity increased steadily, and infant mortality rate decreased, along with a growth of the health expenditures (Jaba et al., 2014). It is calculated as a number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life. The range of the life expectancy females at birth in countries across the World reveals significant macro-regional disparities. Countries such as Japan (86.6 years), Spain (85.5), and France (85.4) have reached admirable overall life expectancy; as a result of outstanding conditions of healthcare as well as other factors including environmental health, socioeconomic conditions, etc (Figure 2, 5). The rest of high-income countries also have above-average values of life expectancy due to factors such as diet, public health, income and equal opportunities.
Poorly developed healthcare system, public social services and high level of inequality in society have significant impact on decreasing trends of life expectancy at birth in low-income countries such as Sierra Leone (45.8 years), Botswana (46.6), Swaziland (48.3), and Lesotho (49.5) and has an unfavorable impact on preventing diseases, prolonging life and promoting healthcare in a variety of ways. The difference between the marginal values is 40.8 years (minimum value 40.8 years, maximum value 86.6 years).
Access to an *improved water source in rural areas* refers to the percentage of the rural population using an improved drinking water source. Water source represents a compound of sustainable water infrastructure and environmental protection related indicators of sustainable development that provides reliable information about public taps or standpipes,

tube wells or boreholes, protected dug wells, protected springs, and rainwater collection.

Spatial distribution of sustainable water infrastructure indicators in rural areas across the World was rather varying with significant divergences across the macro-regions. The best outcomes, i. e. the highest values of the improved water source in rural areas indicator the evaluated countries were presented in Western European countries as well as in New Zealand, Australia, Japan and United Arab Emirates (100%). On opposite side, the lowest values for this indicator were reached in Somalia (10%), Democratic Republic of Congo (29%), Papua New Guinea (32.8%), and Angola (34.3%) among others. Information on quantity and quality of water resources in countries like Somalia, Niger, and Angola negatively affected the environmental protection and sustainable agricultural development because authorities of these countries cannot adequately afford water sources for sustainable development. The mean value of improved water source in rural areas was 81.6%; ranging from 10% to 100% (2012). Better management and protection of the water sources in rural areas, hygiene improvement, and domestic water treatment before consumption may be a possible solution to reduce health risks in low developed countries.

The next indicator within the selected WB indicators is of particular importance for a country's ability to provide *access to electricity*; while in most developed countries the proportion of households with access to electricity is almost 100%, in many developing countries the proportion may still be much smaller, depending on the level of urbanization and the level of development of the grid infrastructure.

About 1.5 billion people in developing countries lack access to electricity, and about three billion people rely on solid fuels – traditional biomass (2.6 billion) and coal (0.4 billion) – for cooking. Although energy access varies widely across developing countries, it is much lower in developing countries, placing poor countries at a huge disadvantage; it is also less in rural than in urban areas (Legros et al., 2011).

The indicator shows the percentage of the population with access to electricity. The spatial differentiation of the proportion of the population with secure access to electricity in the World is shown in Table 1; the countries with the highest proportion in the index (100%) covered all developed countries. Countries with 100% access to electricity of its population have the best households, factories as well as rural electrification networks that provide a measure of the overall level of regional sustainable development. The quartile with the lowest percentage of access to electricity (Q1) included the countries in central Africa. Chad (6.4%), Burundi (6.5%), and Liberia (9.8%) belonged to the countries with the lowest values in the access to electricity, due to low level of electrification especially in rural areas following by factors such as poverty, lack of resources, lack of political will, poor planning of sustainable development. The range of values in Access to electricity was from 6.4% to 100%; the variance is 950.2. It indicated that the access to electricity was inadequately spatially differentiated.

The last indicator within the analyzed WB indicators of EH is *Health expenditure per capita*. This indicator characterizes how the public and private health expenditure effects on quality of health services (preventative and curative), family planning activities, nutrition activities, and emergency aid designated for health in analyzed countries of this study. The highest values of the health expenditure per capita indicator were in Norway (9715 USD), Switzerland (9276 USD), and the United States of America (9146 USD). Norway and Switzerland are good examples of the phenomenon how efficiently utilize public and private healthcare funds for providing care that is respectful and responsive to individual patient preferences as well as supporting services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit (avoiding underuse and overuse).

The spatial differentiation of Health expenditure per capita in the World is illustrated in Table 1. According to the reported values of indicator, countries belong in four quartiles. One quartile represents all countries mostly low-income economies in Africa and Asia such as Somalia (4 USD), Central African Rep. (13 USD), Myanmar (14 USD), Dem. Rep. Congo (16 USD), and Eritrea (17 USD) among others. These countries belong to low-income economies; governments cannot provide qualitative standards related to access to proper healthcare services. The results of health expenditure *per capita* indicate that substantial proportions of residents in low-income economies face catastrophic health expenditure and would likely forgo health care they need but cannot afford. According to Buigut et al. (2015) immediately implementation mechanisms and international action programs that pool risk and cost (insurance) are needed to protect the poorest residents from catastrophic health expenditure and improve equality in health care access and payment.

Worldwide, there are tremendous inequalities in preventive services and access to care. The range of values between the highest and lowest countries in health expenditure per capita was from 4 to 9715 USD in 2013. It implies that the health expenditure per capita in World is strongly spatially differentiated (Table 1, Figure 5). The next two indicators – *Environmental Health and Human Development index* were used as sustainable indicators potentially influencing on the selected WB indicators (Table 1, Figure 3, 4, 5).

Table 1. Primary data on environmental and social indicators in the World, source: author's research

Indicators	Mean	Median	Q1	Q3	Range	Variance	Std. Deviation
1. Improved Sanitation Facilities - WB	72.5	87.8	46.8	98.2	91.0	920.1	30.3
2. Life Expectancy at Birth, Female - WB	72.7	76.2	65.3	80.0	40.8	97.4	9.9
3. Improved Water Source, Rural A. - WB	81.6	88.7	68.5	99.0	90.0	408.3	20.2
4. Access to Electricity – WB	77.5	97.7	55.2	100.0	93.6	950.2	30.8
5. Health Expenditure per Capita - WB	1071	343	93.8	1005.5	9711	3430165	1852.1
EH1 Health Impacts	66.6	72.0	43.8	92.0	90.3	761.6	27.6
EH2 Air Quality	79.6	80.1	69.7	95.8	86.2	283.6	16.8
EH3 Water and Sanitation	49.7	46.2	20.9	77.3	98.7	1050.4	32.4
EH 1-3 Environmental Health Index	65.3	69.3	42.7	85.4	75.5	492.7	22.2
Human Development Index (HDI) 2013	0.680	0.717	0.552	0.813	0.89	0.027	0.165

Table 2. Correlations between HDI 2013, EH 2014, and selected environmental and social indicators provided by World Bank (Pearson and Spearman Correlations), source: author's research

	INDICATORS								
	1.	2.	3.	4.	5.	EH1	EH2	EH3	*(HDI 2013*
Pearson Correlation									
1. Improved Sanitation Facilities - WB									.881**
2. Life Expectancy at Birth, Female - WB	.837**								.883**
3. Improved Water Source, Rural A. - WB	.803**	.750**							.801**
4. Access to Electricity – WB	.877**	.828**	.743**						.846**
5. Health Expenditure per Capita - WB	.450**	.512**	.432**	.377**					.614**
EH1 Health Impacts	.868**	.927**	.818**	.828**	.544**				.927**
EH2 Air Quality	.461**	.370**	.270**	.382**	.282**	.383**			.471**
EH3 Water and Sanitation	.863**	.805**	.823**	.759**	.652**	.870**	.391**		.885**
EH 1-3 Environmental Health Index	.896**	.870**	.808**	.809**	.614**	.934**	.602**	.946**	.934**
Spearman Correlation									
1. Improved Sanitation Facilities - WB									.913**
2. Life Expectancy at Birth, Female - WB	.850**								.915**
3. Improved Water Source, Rural A. - WB	.824**	.805**							.834**
4. Access to Electricity – WB	.826**	.793**	.720**						.822**
5. Health Expenditure per Capita - WB	.841**	.837**	.769**	.742**					.936**
EH1 Health Impacts	.879**	.931**	.854**	.811**	.846**				.936**
EH2 Air Quality	.473**	.469**	.365**	.439**	.608**	.447**			.539**
EH3 Water and Sanitation	.946**	.863**	.918**	.817**	.861**	.896**	.472**		.919**
EH 1-3 Environmental Health Index	.922**	.902**	.871**	.804**	.906**	.939**	.620**	.957**	.948**

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

Table 3. Linear regression between HDI, EH and selected environmental and social indicators provided by World Bank, source: author's research

	Environmental Health (2014)			Human Development Index (2013)		
	B	Std. Error	Sig.	B	Std. Error	Sig.
(Constant)	-19.505	6.314	.002	.028	.047	.555
Improved Sanitation Facilities (2012)	.346	.045	.000**	.001	.000	.000**
Life Expectancy at Birth, Female (20012)	.617	.118	.000**	.005	.001	.000**
Improved Water Source, Rural A. (2012)	.165	.048	.001**	.001	.000	.002**
Access to Electricity (2012)	-.015	.041	.711	.001	.000	.001**
Health Expenditure per Capita (2013)	.002	.000	.000**	1.915E-5	.000	.000**
R2		.892			.893	

Dependent Variables: Human Development Index (2013) and Environmental Health (2014), **Correlation is significant at the 0.01 level (two-tailed)

All indicators were computed for each country. The EH is based on indicators such as child mortality, household air quality, air pollution, access to drinkable water, and access to sanitation. The HDI is composing of life expectancy, education, and per capita income indicators, which is used to rank countries into four tiers of human development.

Environmental protection is critical attribute to maintain ecosystem services essential for human well-being. It is important to be able to rank countries by their environmental impact so that poor performers, as well as policy *models*, can be identified (Bradshaw et al., 2010). Environmental Health, using the percentage of the aggregate index calculated from following indica-

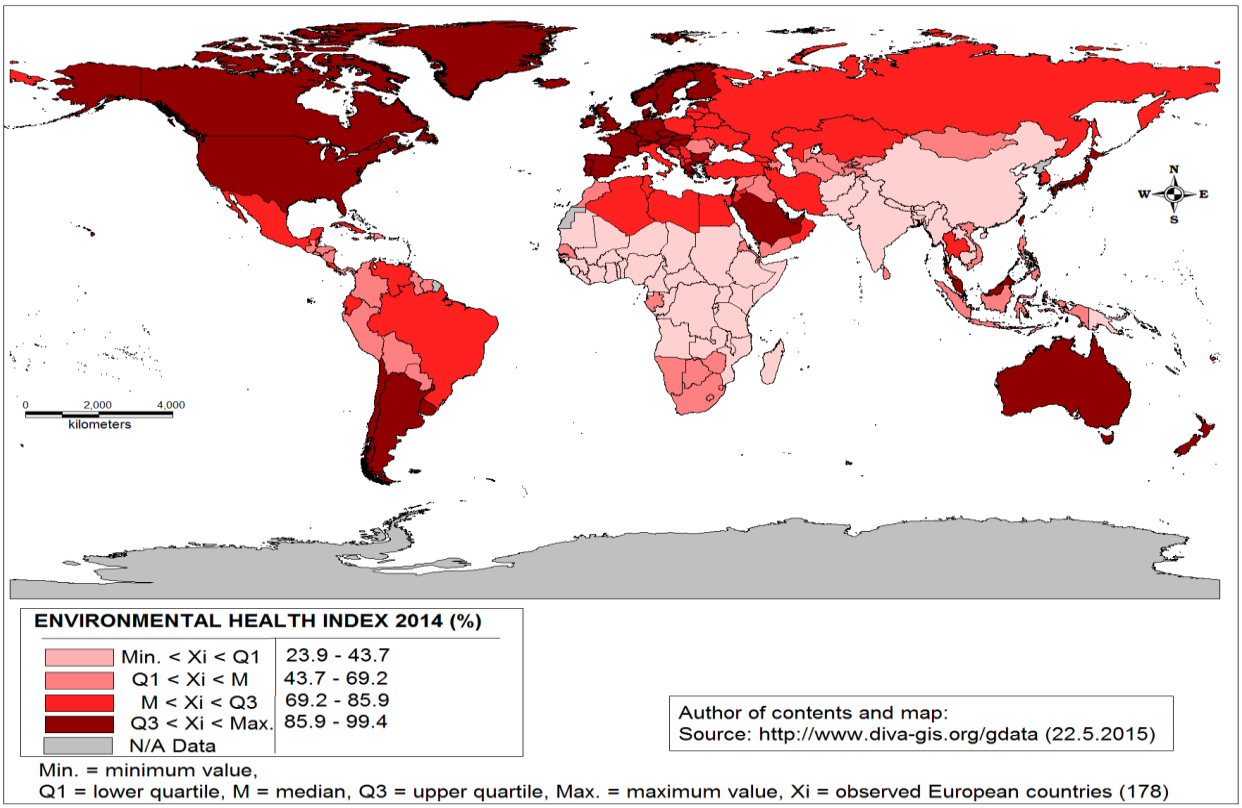

Figure 1. Environmental Health Index (%) in the World (2014)

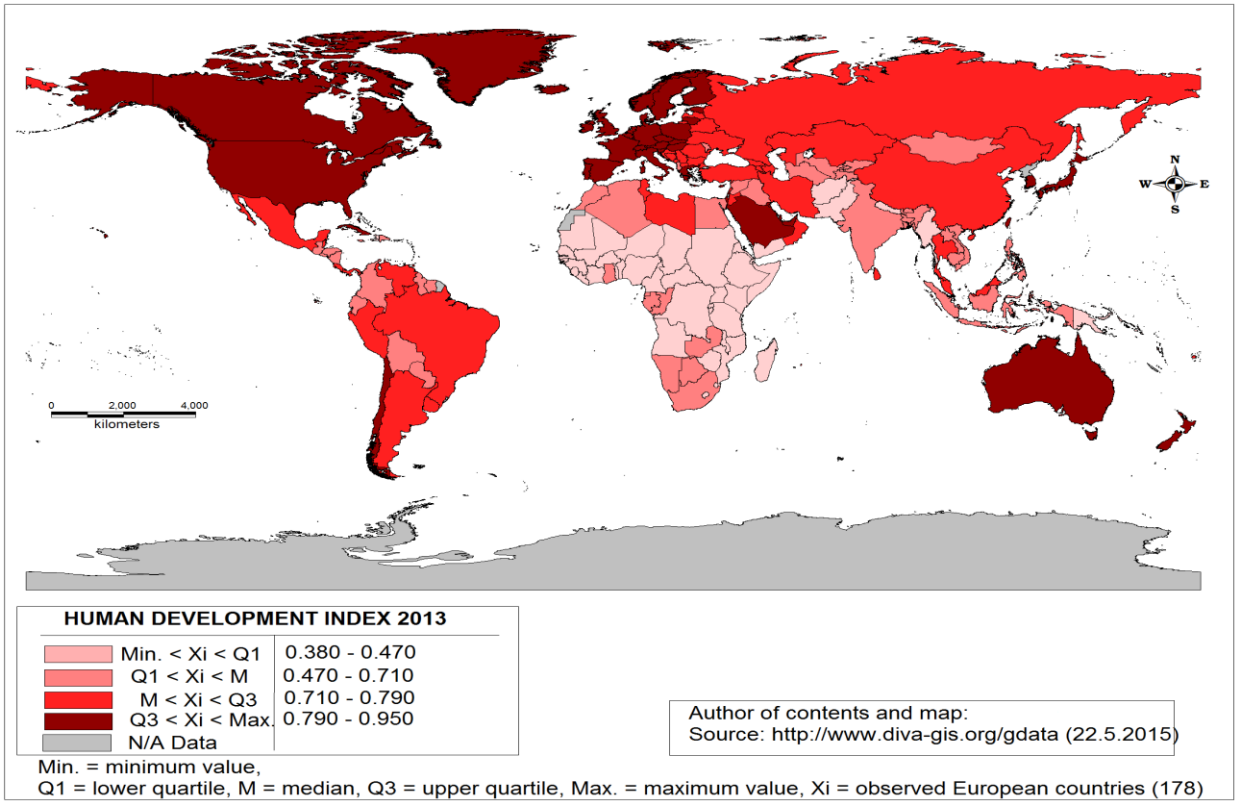

Figure 2. Human Development Index in the World (2013)

tors: (EH1) health impacts, (EH2) air quality, and (EH3) water and sanitation. It was based on the 2014 survey published by the Yale Center for the Environmental Law & Policy, Yale University and the Center for International Earth Science Information Network, Columbia University, in collaboration with World Economic Forum in Geneva. The mean proportion in the World was 65.3% (ranging from 23.9% in Dem. Rep. Congo to 99.44% in Norway).

Human Development Index rankings have provided a referenced measure for people to choose a country in which to travel or live (Wu et al., 2014). HDI (includes level of social and economic development based on four criteria: Life expectancy at birth, mean years of schooling, expected years of schooling and gross national income per capita) was based on data 2013 survey; provided by the United Nations. The mean HDI in the countries was 0.680 in the year 2013; ranging from 0.050 for Somalia to 0.944 for Norway.

Correlations and linear regression of indicators influencing on sustainable development

There was evidence of high correlation and concordance among the different composite indicators compared. The results of Pearson and Spearman correlations are provided in Table 2, which pointed out the correlation between the selected WB indicators such as Improved sanitation facilities, Life expectancy at birth – female, Improved water source in rural areas, Access to electricity, Health expenditure per capita, and two aggregated indexes – EH and HDI. EH and HDI were positively correlated (Pearson's r = 0.934; Spearman's r = 0.948, P <0.01). For EH, in 2014 the Pearson and Spearman correlation between all five selected indicators provided by WB was significant at 0.01 levels (2-tailed). There was strong positive relationship between EH and Improved sanitation facilities (Pearson's r = 0.896; Spearman's r = 0.922), Life expectancy at birth – female (Pearson's r = 0.870; Spearman's r = 0.902), Improved water sources in rural areas (Pearson's r = 0.808; Spearman's r = 0.871) and Access to electricity (Pearson's r = 0.809; Spearman's r = 0.804). The same positively correlation were demonstrated between Improved sanitation facilities (Pearson's r = 0.881; Spearman's r = 0.913), Life expectancy at birth – female (Pearson's r = 0.883; Spearman's r = 0.915), Improved water sources in rural areas (Pearson's r = 0.801; Spearman's r = 0.834), Access to electricity (Pearson's r = 0.846; Spearman's r = 0.822), Health expenditure per capita ((Pearson's r = 0.927; Spearman's r = 0.936), and HDI.

The table 3 presence of the linear regression of the EH, HDI in 178 countries and the separate WB indicators in 2012. In the presented model, the variables were calculated successively to examine the effects independently. The dependent variables are the EH rate and HDI for 178 observed countries. Table 3 illustrates, that the Improved sanitation facilities, Life expectancy at birth – females, Improved water resources in rural areas, and Health expenditure per capita were significantly associated with the EH and Access to electricity did not contribute to the prediction of the EH index. All selected WB indicators were significantly associated with the HDI. The model also explained 89.2% of the variance in EH among the countries in 2013 and 89.3% of the variance in HDI in the year 2014.

Conclusions

The results of the research conducted in this paper indicate which variables determine EH. To be precise, the results suggest that environmental development, measured by WB indicators, and human development measured by the Human Development aggregated index, a significant influence on sustainable development. Developing a national statistic comparison of sustainable development for each country is a real effort to construct a tool to support its development.

Sustainable development of the 178 countries in World is placed on different levels, which confirms their various positions on the sustainability world list as measured by the EH and HDI. By analyzing the countries according to EH score in 2014 the order of the top 5 positions is as follows: Norway (99.44), Australia (99.44), Singapore (99.44), Finland (99.44), and Sweden (99.04). The resulting maps of selected WB indicators as well as EH and HDI show that the low developed countries mostly in central Africa and South Asia have less potential for social and environmental development and accomplish progress in sustainable development of its environment and human habitat. It should be mentioned, however, that these different conditions among the countries are generally caused by considerable differences in their spatial distribution of development of the sanitation facilities; factors such as diet, public health, income and equal opportunities; sustainable water infrastructure and environmental protection; the level of urbanization and the level of development of the grid infrastructure and reducing environmental stress to human health. Mentioned statement confirmed the first hypothesis of this research that there is a high level of heterogeneity in terms of HDI, EH and environmental performance among all observed countries. The strong correlation between the EH and HDI suggest that the analyzed countries should innovate social, economic and environmental strategies to increase the overall sustainable development. It is important to show that incensement of the HDI significantly con-

tributes to the EH. In other words, the incensement of the HDI and EH of the countries enables increase net of its overall sustainable development competitiveness. Mentioned facts were also confirmed by using linear regression analysis to determinate the influence of HDI on the EH, as well as the in influence variables chosen by the WB statistics. Hence, the second hypothesis of this research is confirmed.

Limitation of our research based on published datasets from different sources such as World Bank, United Nations Development Program as well as Yale Center for the Environmental Law & Policy. Consequently, we were limited to mentioned data and the available relevant sources thus this may be frustrating not to give a complete panorama of this interesting subject of research.

Another limitation of this analysis is heterogeneity of the countries within the selected World Bank indicators and short period of observations as well as not including other indicators that represents sustainable development in the model, due to lack of available and comparable data.

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Rebuilding the Pillars of Sustainable Society Index: a Multivariate Post Hoc I-distance Approach

Kształtowanie wskaźnika Zrównoważonego Społeczeństwa: analiza wielowariantowa I-distance

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Abstract

Sustainable Society Index (SSI) is a composite indicator constructed to measure and describe societal progress along all three dimensions of sustainable development: human, environmental and economic. In this paper, we explore possibilities to evaluate and enhance SSI ranking calculation methodology based on the use of an iterative multivariate post hoc I-distance approach. Based on the assessment on how each indicator contributes to the final position of different countries and identification of the most influential indicators, we examine possibilities of reduction of a number of indicators. The goal is to improve the stability of the ranking results and overall quality of the model, focusing on the analysis of the relative contribution of the indicators in an iterative assessment process. By this, we provide in-depth analysis and more comprehensive understanding of specific factors that determines one country ranking position. Thus proposed approach can support policymakers to identify key indicators and focus the priority areas where investment in improvement measures and programs would have the most efficient impact on the overall positioning of the country.

Key words: sustainable development; Sustainable Society Index; composite indicators; I-distance; relative contributions

Streszczenie

Indeks Zrównoważonego Społeczeństwa (Sustainable Society Index, SSI) jest zagregowanym wskaźnikiem stworzonym w celu pomiaru i opisu postępu społecznego w trzech wymiarach rozwoju zrównoważonego: publicznym, środowiskowym i ekonomicznym. W artykule przeanalizowano możliwości oszacowania i rozszerzenia metodologii SSI w oparciu o wielokrotną analizę wielowariantową I-distance. W oparciu o ocenę, jak każdy wskaźnik przyczynia się do ostatecznego wyniku osiąganego przez różne kraje i identyfikację wskaźników o największym znaczeniu, zbadamy możliwość zmniejszenia ilości branych pod uwagę wskaźników. Celem jest poprawa wiarygodności otrzymywanych wyników i ogólnej jakości modelu, z podkreśleniem znaczenia analizy względnych udziałów wskaźników w wielokrotnym procesie oceny. Umożliwi to przeprowadzenie szczegółowych badań i bardziej wszechstronne podejście do poszczególnych czynników które wpływają na miejsce, które dany kraj zajmuje w rankingu. Proponowane narzędzie może pomóc decydentom w zidentyfikowaniu kluczowych wskaźników i wskazać obszary priorytetowe, w ramach których inwestycje i programy modernizacyjne będą miały największy wpływ na pozycjonowanie danego kraju.

Słowa kluczowe: rozwój zrównoważony wskaźnik Społeczeństwa Zrównoważonego, wskaźniki zagregowane, analiza wielowariantowa, względny udział

1. Introduction

The roots of sustainability concept could be found in different sources from the sciences of religion, philosophy and economics from many centuries ago (Mebratu, 1998). However, the most common definition of sustainable development was published in The Brundtland Report (WCED, 1987), where sus-

tainable development was defined as development that satisfies the needs of the existing, without jeopardizing possibilities of the future generations to satisfy their needs. Sustainable development includes various environmental, economic and social factors, which are stated as the three pillars of the sustainability which do not exclude each other, but even can accent each other (UN, 2005). Rising interest for sustainable development is a result of the perception of current worrying conditions of the global human environment. It calls and demands urgent reaction of all members of society, focused on long-term environment protection and overall sustainable development of the humanity (Petrovic, 2012).

Sustainable development is a critical and popular concept that is open to different approaches and interpretations. Naturally a large number of researchers, organizations, institutions and international agencies developed and offered many various methodologies and concepts for measuring sustainability. Conceptual approaches to measuring sustainable development could be grouped into two general categories: (1) set of indicators and (2) composite indicators. Unlike the sets of indicators, composite indicators have the ability to summarize complex and sometimes elusive processes into a single figure to benchmark a country's performance in policy consumption (Giovannini et al., 2008). Numerous sustainability composite indicators were developed and proposed in recent decades. The following approaches are mostly present and discussed: Index for Sustainable Economic Welfare ISEW (Daly and Cobb, 1989), Genuine Progress Indicator GPI (Cobb et al., 1995), Genuine Savings/Adjusted Net Savings GS/ANS (Hamilton et al., 1997), Environmental Sustainability Index ESI (Esty et al, 2005), Environmental Performance Index EPI (Esty et al, 2006), Ecological Footprint EF (Ewing et al., 2010), Human Development Index HDI (UNDP, 2014) and Sustainable Society Index SSI (van de Kerk and Manuel, 2014). Among all of them, only SSI approach is tending to consider all three dimensions of sustainable development integrally.

The Sustainable Society Index (SSI) has been developed since 2006 with the aim to be a comprehensive quantitative method for measurement of the health of coupled human-environmental systems and to describe societal progress across human, environmental and economic dimensions (Saisana and Philippas, 2012). SSI tends to overcome the main noted shortcomings of previously developed metrics: a limited definition of sustainability, a deficit of transparency and an absence of regular updates (van de Kerk and Manuel, 2008). SSI is calculated for 151 countries accounting for 99% of the world population, with regular two-year updates that demonstrate developments over time and available underlying data that allow in-depth analysis of the differences between countries. SSI methodology has been refined several times to improve conceptual coherence and statistical soundness, with the support of Joint Research Centre (JRC) (Saisana and Philippas, 2012). In latest fifth edition, the new SSI-2014 framework has been presented, consisting of 21 indicators, grouped into seven categories and three dimensions (Table 1).

Table 1. The SSI-2014 conceptual framework

Category	Dimension	Indicator	Code
Human Wellbeing	Basic Needs	1. Sufficient Food	var1
		2. Sufficient to Drink	var2
		3. Safe Sanitation	var3
	Health	4. Education	var4
		5. Healthy Life	var5
		6. Gender Equality	var6
	Personal & Social Development	7. Income Distribution	var7
		8. Population Growth	var8
		9. Good Governance	var9
Environmental Wellbeing	Natural Resources	10. Biodiversity	var10
		11. Renewable Water Resources	var11
		12. Consumption	var12
	Climate & Energy	13. Energy Use	var13
		14. Energy Savings	var14
		15. Greenhouse Gases	var15
		16. Renewable Energy	var16
Economic Wellbeing	Economy	17. Organic Farming	var17
		18. Genuine Savings	var18
	Transition	19. Gross Domestic Product	var19
		20. Employment	var20
		21. Public Debt	var21

Because of *lack of a scientific basis for the attribution of different weights to the indicators, every indicator has received the same weight for the aggregation into dimensions* (SSI, 2014). In the last edition, dimensions are not aggregated into a single value for the overall composite, in view of the negative correlation between Human and Environmental Wellbeing (SSI, 2014). Composite indicators like SSI are designed to measure a multi-criteria performance, where is important to avoid composite indicators to represent unstable assessments, as their stability ensures the amount of validity of the observed system (Dobrota et al., 2015b). The usefulness of multivariate analysis for the aggregation of individual indicators to a composite indicator is often emphasized (Saltelli et al., 2008). As weights are essentially value judgments (Giovannini et al., 2008), results and values of composite indicators are significantly influenced by

the indicator weights and often are the subject of controversy and debate (Saltelli, 2007). Equal weighting of indicators implies that all variables are *worth* the same in the composite indicator. However, the decision to apply equal weighting could be the consequence of the absence of a statistical or an empirical basis or a lack of consensus on the alternative (Giovannini et al., 2008). Paruolo et al. (2013) noted that *in many cases the declared importance of single indicators and their main effect are very different, and that the data correlation structure often prevents developers from obtaining the stated importance*.

In order to reduce subjectivity, improve stability and overall quality of the SSI ranking model, we apply I-distance methodology on the SSI-2014 values (SSI, 2014). One task is to provide clear understanding of how each indicator contributes to the final position of different countries, as well as to identify the most influential indicators and assess their relative influence on the overall results. The second goal is to use analysis of the relative contribution of the indicators as a tool to examine possibilities for reduction of a number of indicators in iterative assessment process focused on gradual improvement of the statistical quality of the model. By this, we provide in-depth analysis and more comprehensive understanding of specific factors that determines one country ranking position. It could represent useful signals for policymakers in which priority areas they should focus relevant measures and programs to have the most efficient impact on the overall positioning of the country.

The paper is structured as follows. Section 2 focuses on the post hoc I-distance methodology. The results of the analysis are discussed in Section 3. The last section provides a summary of the conclusions, including policy implications.

2. Methodology

The often problem with a different composite indicator based ranking and rating methods is that normative and subjective model assumptions significantly affect the results of measurements. This problem can be overcome by the use of the statistical I-distance method, which was originally developed by Ivanovic (1973, 1977) and which has been recently significantly advanced (Jeremic et al., 2012; Maricic et al, 2014; Dobrota et al., 2015a,b; Isljamovic et al., 2015). The I-distance measurement is based on calculating the mutual distances between the entities, where I-distance is a metric distance in an n-dimensional space. Any entity with real or fictive minimal, maximal or average values of all its variables' values can be considered as the referent entity. The ranking of assessed entities in the set is based on the calculated distance from the referent entity. For a designated set of variables $XT = (X1, X2, \ldots Xk)$ that characterize the entities under assessment, the I-distance between the two entities $er = (x1r, x2r, \ldots xkr)$ and $es = (x1s, x2s, \ldots xks)$ is given as

$$D(r,s) = \sum_{i=1}^{k} \frac{|d_i(r,s)|}{\sigma_i} \prod_{j=1}^{i-1} \left(1 - r_{ji.12\ldots j-1}\right)$$

where *di(r,s)* represent the distance between the values of variable *Xi* for *er* and *es*, e.g. the discriminate effect,

$$di(r,s) = xir - xis \;,\; i \in \{1, \ldots, k\}$$

σi the standard deviation of *Xia* and *rji.12...j-1* is a partial coefficient of the correlation between *Xi* and *Xj, (j<i)*.

The measure of the square I-distance represents a solution to the problem of the negative coefficient of partial correlation, which can occur in cases where is not possible to achieve the same direction of all variables in all sets. The square I-distance is defined as:

$$D^2(r,s) = \sum_{i=1}^{k} \frac{d_i^2(r,s)}{\sigma_i^2} \prod_{j=1}^{i-1} \left(1 - r_{ji.12\ldots j-1}^2\right)$$

Based on CIDI approach (Dobrota et al., 2015a), I-distance could be used to determine indicator weights based on the empirical Pearson correlations, where values of correlations are divided by the sum of correlations:

$$w_i = \frac{r_i}{\sum_{r=1}^{j} r_j}$$

where *ri* (*i = 1, . . . k*) is a Pearson correlation between *i*-th input variable and I-distance value and the final sum of all weights equals 1 (same applies using coefficient of determination, as used in our case study).

3. Results

Our analysis has been performed in several consecutive I-distance iterations, starting with the first I-distance iteration that includes all of the indicators listed in Table 1, together with calculated coefficients of determination. For the following I-distance iterations, a variable with the smallest coefficient of determination in the previous iteration has been excluded from the further analysis. The analysis of the relative contribution of the indicators to the score of some country has been used to determine the final number of iterations. This statistical method could provide information if some indicators dominate over the total scores and what is the level of that influence (Saisana and d'Hombres, 2008). The relative contributions have been calculated as a proportion of an indicator score multiplied by the appropriate weight (calculated by the CIDI approach) with regard to the overall score for each indicator and country. Average relative contributions and standard deviations have been calculated in next step, where is important to note that higher standard deviation leads to higher level of rank oscillation. Focus is to

Table 2. Average relative contributions (Me) and related standard deviations (SD) for all variables (Var) comprehended in 14th and 15th iterations

14th iteration	Var	var19	var5	var9	var4	var13	var15	var3	var2	Total
	Me	0.1432	0.1201	0.1428	0.1481	0.0949	0.1212	0.1162	0.1135	1.0
	SD	0.0158	0.0442	0.0189	0.0186	0.0269	0.0664	0.0701	0.0619	0.3228
15th iteration	Var	var19	var9	var5	var4	var13	var15	var3		Total
	Me	0.1295	0.1674	0.1715	0.1156	0.1457	0.1358	0.1344		1.0
	SD	0.0487	0.0232	0.0226	0.0329	0.0787	0.0808	0.0741		0.3609

Table 3. List of comprehended variables with their coefficient of determination (r^2) and average r^2 for initial and final iterations

1st iteration	r^2	2nd iteration	r^2	…	13th iteration	r^2	14th iteration	r^2
var9	0.7310	var9	0.7396	…	var19	0.8911	var19	0.9025
var19	0.6115	var19	0.6448	…	var5	0.8082	var5	0.8154
var5	0.5700	var5	0.5929	…	var4	0.7039	var9	0.7709
var4	0.5155	var4	0.5655	…	var9	0.7022	var4	0.7174
var13	0.4942	var13	0.5027	…	var3	0.6889	var13	0.6708
var6	0.4638	var17	0.4998	…	var15	0.6773	var15	0.6529
var17	0.4597	var6	0.4651	…	var13	0.6773	var3	0.6480
var2	0.4290	var2	0.4529	…	var2	0.6529	var2	0.6209
var15	0.4134	var15	0.4316	…	var1	0.6384		
…	…	…	…	…				
var11	0.0317	var11	0.0259					
var20	0.0066							
Average r^2	0.3316		0.3665			0.7156		0.7248

Table 4. Changes in rank, median rank and IQR for selected countries

Country	Iterations														Delta	Me	IQR
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th			
Norway	1	1	1	1	1	2	2	2	2	3	2	6	1	1	0	2	1
Australia	21	24	24	29	27	24	12	13	13	13	12	8	2	2	-19	13	19
Netherlands	12	15	15	11	11	9	10	10	10	10	9	10	3	3	-9	10	7
Denmark	10	10	9	9	10	11	5	5	5	5	5	5	4	4	-6	5	4
Finland	4	4	4	3	4	4	1	1	1	1	1	3	5	5	1	4	3
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Lebanon	137	132	129	123	116	115	100	82	82	76	77	52	51	53	-84	91	57
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Sudan	151	151	151	151	151	151	150	150	150	149	149	149	149	147	-4	150	6
Congo DR	147	148	149	149	149	148	149	149	149	151	151	151	151	148	1	149	3
Niger	100	103	110	114	112	121	131	144	145	136	135	131	130	149	49	131	26
Sierra Leone	126	136	137	138	140	143	136	145	146	145	145	143	143	150	24	143	11
Chad	148	147	148	150	150	150	151	151	151	150	150	150	150	151	3	150	0

identify the iteration with the lowest cumulative standard deviation of the average relative contributions of each variable. This iteration should be the final one because following iterations would increase fluctuations of the countries ranks, which would decrease the quality of the model.

In our case, calculated values of cumulative standard deviation have been continuously lower compared to

the previous one for all iterations until the 15th iteration, which have had higher value then in 14th iteration (Table 2). Therefore, the 14th iteration, which comprehends eight statistically most important indicators, has been defined as the final one.

The in-depth analysis focused on the consistency in the rank and general structure of the performance can reveal the sensitivity of the rank of countries in relation to each indicator included in the analysis. Table 3 provides a review of comprehended variables, their coefficient of determination and appropriate average coefficient of determination calculated for initial and final iterations. The table with full results for all iterations is available with authors on request.

The average coefficient of determination continuously rises through all iterations, confirming the increase of the quality of the model (Markovic et al., 2015). The results of the final 14th iteration are pointing out the significant importance of eight indicators out of initially considered 21 indicators, which represent essential elements for utilization of the I-distance framework in an evaluation of SSI results and methodology. These most important variables are: Gross *Domestic Product* (var19), *Healthy Life* (var5), *Good Governance* (var9), *Education* (var4), *Energy Use* (var13), *Greenhouse Gases* (var15), *Safe Sanitation* (var3) and *Sufficient to Drink* (var2). It can be noted that indicators from all three dimensions are present in the final set, with the highest share of indicators of human wellbeing (5 indicators) compared to environmental (2 indicators) and economic wellbeing (1 indicator).

First ranked *Gross Domestic Product* is calculated on GDP *per capita* PPP basis. GDP has been qualified as a poor indicator of economic well-being (Pissourios, 2013) which cannot be used alone to describe the broader quality of life (Caminada et al., 2010). However, the results of our analysis confirm that GDP *remains a very important indicator for measuring the economic performance of countries, which is a fundamental driver of well-being* (Borini, 2012).

Health-adjusted life expectancy (HALE) at birth represent a basis for the calculation of *Healthy Life* variable. It represents a number of years that a newborn is expected to live, reduced by the number of years spent in poor health. WHO introduced this metric with the goal to take into account not only the average life expectancy of people but also their health (Mathers et al., 2010).

Good Governance variable represents the average of values of the six World Bank's Governance Indicators: Voice and Accountability, Political Stability, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption (WGI, 2015). It is founded on the rationale that good governance represents *condition for the development of all people in freedom and harmony, within the framework of rules and laws* (van de Kerk and Manuel, 2014).

Education indicator is calculated based on the UNESCO metric of combined gross enrollment ratio (UNESCO, 2015). This ratio expresses the count of students enrolled in primary, secondary and tertiary levels of education, irrespective of their age and expressed as a percentage of the population of official school age for the all three levels. Outputs of our study are in alignment with the opinions that education plays *crucial role in adaptation towards sustainable development* (Svanstrom et al., 2008) and that it is essential for *the change in social attitudes that will be needed to protect the welfare of future generations* (Chalkley et al., 2013).

"*Energy Use* is calculated based on IEA measure of energy consumption in tons oil equivalents (toe) per person, where energy use higher than 5 toe per capita is penalized with a zero value of the *Energy Use* indicator (SSI, 2014). Energy is not only a key requirement for economic progress, but also it causes significant pressures on the environment, both by depletion of the resources and by the creation of the pollution. Results of our analysis confirm relevance and importance of the ability of this variable to reflect the energy-use patterns and aggregate energy intensity of a society (IAEA, 2005).

Calculation formula for *Greenhouse Gases* as a measure of main human contribution to climate change is based on IEA metric of CO_2 emissions per capita per year, with zero-score penalization of the emissions higher than 10 (SSI, 2014). As the latest carbon dioxide emissions continue to track the top end of emission scenarios (Piters et al., 2013), the main focus in climate change battle is moving towards economy-wide emission reduction targets (Olivier et al., 2013).

Safe Sanitation variable is related to WHO estimation of the share of total population with sustainable access to improved sanitation, considering connection to facilities like public sewer, septic tank, pour-flush latrine, etc. (WHO, 2015). Accessibility to adequate sanitation facilities is fundamental to decrease the risk and the frequency of associated diseases.

Sufficient to Drink variable is based on another WHO measure of the number of people as share of the total population with sustainable access to an improved water source like household connections, public standpipes, protected wells, springs, rainwater collection, etc. (WHO, 2015). The ability of the latest two variables to describe general hygiene and quality of life and their easy association with other socioeconomic characteristics (like education and income) make them useful indicators of human development (UNDESA, 2007).

Table 4 provides changes in ranks of countries between the first and the final iteration (Delta), together with related median ranking position (Me)

and interquartile range (IQR) values, for the selected countries. The full list of values for all countries is available with authors on request. The interquartile range is a robust measure of statistical dispersion that represents the middle 50 percent of the distribution of an ordered range of data. Being equal to the difference between the upper and lower quartiles, IQR is not affected by extreme values. Median presents the average value that falls in a middle of the set of an ordered range of data.

In total, there are nine countries with a change of rank for 50 or more places, which implies that these countries are the most sensitive to excluding variables through iterations. The largest change in rank occurs with Lebanon for 84 places. On the other hand, small changes of the rank (max. 5 places) are noted for 40 countries, including four of them (Norway, New Zealand, Kenya, Guinea) without any change.

Figure 1 shows the oscillation in the ranks of the five top-ranked countries. Obviously, all of them are democracies with the highly developed economies. Interestingly, Norway does not change its first position between initial and last iteration, which can be explained with very good scores in terms of the elaborated most significant indicators: *Safe Sanitation*, *Sufficient to Drink* (all 10/10), *GDP* (9.89/10), *Education* (9.81/10), *Healthy life* (8.99/10) and *Good Governance* (8.56/10).

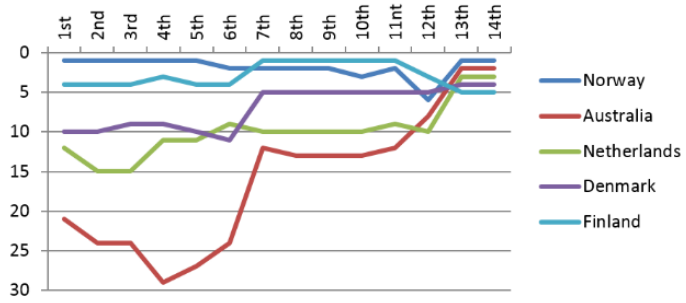

Figure 1. Overview of the fluctuations in the ranks of the five top-ranked countries

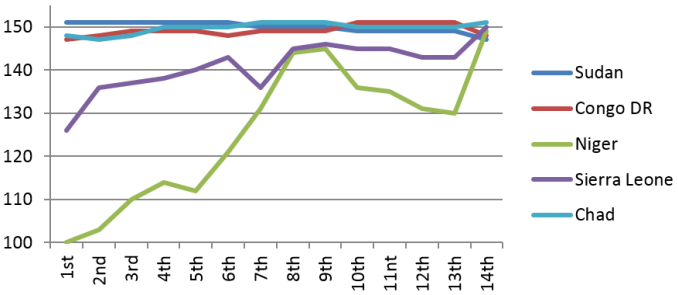

Figure 2. Overview of the fluctuations in the ranks of the five bottom-ranked countries

Indeed, being one of the most developed countries with very stable and prosperous mixed economy, with both large state sector and a vibrant private sector (NEP, 2014), Norway has very high value of GDP *per capita* PPP of $65.640 (WB, 2015). In addition to the best performance in area of sanitation and drinking water, Norway have impressive combined gross enrolment ratio of 98.1% and life expectancy at birth equal to 74 years of healthy life years (SSI, 2014). Although health care expenditure participates in GDP with 9.4%, due to Norway's very high value of GDP *per capita*, its average health expenditure is among the highest on a global level (Ringard et al., 2013). Finally, the traditions and institutions by which authority in a Norway is exercised are perceived as among the best on global level, which is illustrated by very high values of the six Worldwide Governance Indicators (WGI, 2015). At the same time, Norway has good performances in many other variables that have been gradually excluded, which explains the low level of rank oscillations through iterations indicated by IQR value equal to 1.

Dispersion of the rank measured by IQR for the most of these top-ranked countries is reasonably low, except for Australia (IQR=19). Australia is the only one with a significant change of the rank by improving its position for 19 places, mainly in the 7th iteration, where variable *Biodiversity* has been excluded. There are almost 3000 threatened ecosystems and ecological communities in Australia while 94% of the bioregions have at least one or more threatened ecosystems (Randall, 2008). At the same time, the imposingly negative trend in forest area noticed for an extended period (Bradshaw, 2012). All together it could explain Australia's poor SSI score (4.9) and a very low 112th ranking position for *Biodiversity* variable. On the other hand, Australia has quite good scores in terms of *Education*, *Safe Sanitation*, *Sufficient to Drink* (all 10), *GDP* (9.61), *Healthy Life* (9.12) and *Good Governance* (8.21). It implies that good performances of Australia in previously elaborated most significant indicators have been shadowed by the influence of less significant indicators where Australia do not have impressing results. Thus, reduction of the number of indicators provided more transparent insight and enabled Australia to improve its rank significantly through proposed iterative procedure to the remarkable second overall position.

The fluctuations in the ranks of the five bottom-ranked countries are illustrated in Figure 2. Chad is a country in the last 151st position with a very small change in rank (3 places) compared to the initial iteration, mainly due to its quite poor scores for the majority of the most significant indicators: *Safe Sanitation* (1.19), *GDP* (1.73), *Good Governance* (2.44) and *Healthy Life* (3.65).

Indeed, Chad is a poor country with weak institutional and policy capacity, limited progress in poverty reduction, fragile economy facing a trend decline in oil revenues and vulnerable to oil price and regional security shocks (IMF, 2014). Chad was ranked in 184th place out of 187 countries on the UN's 2014 HDI list (UNDP, 2014). Being one of the poorest and most corrupted countries, it is noted that

Chad failed to utilize recently emerged oil export revenues to boost development and reduce poverty due to three major factors: institutional capacity constraints, socio-political incompatibilities and subversive interactions with external factors (Kojucharov, 2007).

On the other hand closely positioned Niger has noticed one of the biggest increases in rank, which has significantly worsened its position through iterations for 49 places. With the negative shift of 19 places and high level of dispersion of the ranking results confirmed by IQR value equal to 26, the last iteration appeared to be the most influential one, in which variable *Sufficient Food* has been excluded from the analysis. Obviously, Niger has good results in this variable (9.36), and when its effect has been neutralized, the final rank has been swiftly adjusted in accordance with generally poor achievement in the most of remaining variables. Niger is least-developed, low-income country with desert counting for two-thirds of its land and dominantly agricultural population that is doubling every 18 years, which all together represent a real challenge for food security, healthcare, family planning, social protection, education and employment growth (AEO, 2015).

The biggest change of rank for 84 places occurs with Lebanon, causing improvement of its rank from 137th to 53rd position, and with the highest level of dispersion of the result (IQR=57) measured in our research. Its economy was hard-hit by the 15-years civil war (1975–1990) and still occasionally suffers from economic downturns caused by local and regional political instabilities. At the same time, the Lebanese real GDP has grown at a faster pace than the regional real GDP since 2007 (Dagher and Yacoubian, 2012). It can be noted that effects of generally solid performances in the final set of significant variables, which all have been better or close to average values, have been extenuated with relatively lower results in many of the other variables. Among them following ones have had the biggest negative impact: *Biodiversity* (score 3.85 compared to average per country 6.18; excluded in 7th iteration), *Genuine Savings* (score 3.66 compared to average per country 6.57; excluded in 8th iteration) and *Gender Equality* score 6.03 compared to average per country 6.8; excluded in 12th iteration).

4. Conclusion

The rising popularity and importance of the sustainable development concept induced development of numerous measurement approach and methodologies in the related area. Among them, the Sustainable Society Index is currently the only one that attempts to comprehend all three dimensions of sustainable development integrally. This composite indicator is constructed to be able to measure progress along all three dimensions of sustainable development: human, environmental and economic.

In this paper, we explore possibilities to evaluate and enhance SSI ranking calculation methodology based on the use of an iterative multivariate post hoc I-distance approach. The I-distance method can synthesize many different indicators into a single numerical value that represents the basis for ranking observed entities. The proposed approach could provide not only more comprehensive and detailed understanding of differences between countries but also a deeper insight into the relative statistical importance of selected indicators. This post hoc approach can be a solid ground not only for gradual exclusion of the less significant existing indicators but also for inclusion of additional new variables in a process of evaluation and improvement of the considered measurement framework. The main idea behind proposed approach is to improve the stability of the ranking results and overall quality of the model, focusing on the analysis of the relative contribution of the indicators in an iterative assessment process. By this, we provide in-depth analysis and more comprehensive understanding of specific factors that determines one country ranking position.

As sustainability metrics are used as quantitative information base and foundation for creation of appropriate sustainable development policies, this proposal has important policy implications related to improvement of objectiveness of sustainability metrics used in processes of sustainable development policy making on all levels. Improved reliability and accuracy of the sustainability metrics combined with an analytical framework for exhaustive understanding of the most significant factors influencing one's country positioning is of the highest importance for sustainability policy making processes.

It is noted that statistical analysis of composite indicators is *essential to prevent media and stakeholders taking them at face value possibly leading to questionable policy choices* (Paruolo et al., 2013). More transparent and robust underpinning statistical framework of composite indicators would reduce perceived disproportion between strong communicative power and reliability of sustainability indexes (Luzzati and Gucciardi, 2015). It would simplify communication tasks of policymakers and make sustainable development policies more credible.

The proposed post hoc I-distance approach is able to reveal specific priority areas for each country so that policymakers could focus their attention on the areas where relevant policies, programs and action plans would have the most significant impact on the overall relative position of the country. It could be used to assess sustainable development in one country by the specific statistically-determined importance level. Clear identification and focus on those priority areas can represent a solid background in planning and regular monitoring of progress towards the strategic objectives of sustainable development. It can provide significant inputs for policy

adjustment processes to identify and propose the most efficient programs and measures. Policymakers could use it to benchmark policies and to evaluate consequence and influence of the alternative scenarios on the country's position relative to others.

There are many factors that explain reasons for the current situation in one country, but obviously their importance and significance cannot be equal. In our approach, I-distance method is used to assess the relative contribution of the indicators in an iterative process, resulting in eight SSI indicators that are identified as the most significant. First ranked country is Norway, similar to its first position on the UN's 2014 HDI list (UNDP, 2014). It has superb performances in the most of variables and dimensions, coupled with the very low level of rank oscillations through iterations. Although Norway does not have the best scores noted for all variables, clearly it has a better balance of the performances over a set of those most crucial indicators compared to all other countries.

Obviously, it is important for policymakers to know and understand their country's relative position in terms of the achieved level of sustainable development per dimensions and overall. However, even more important for them is to know in which areas improvements are possible, how these improvements would impact their positioning and in which areas those improvements would provide the most efficient effects on the sustainability ranking. The proposed approach can improve capabilities of policymakers to understand the implications of selected sustainability-related policies and their impacts on the shaping and making development sustainable. As in reality trade-offs are inevitable, there is an imminent need for well-based and balanced choices to be made during policy creation and adjustment, where this approach could provide important insight of relative importance and contribution of alternative actions and measures in different areas.

Further potential study could be directed towards assessment of each SSI dimension separately based on CIDI approach, in order to better understand relative importance of variables within corresponding dimension and to exceed limitations of the originally applied equal weighting scheme. Moreover, our approach could be the foundation for the development of a more general framework for evaluation and improvement of some other composite indicators concepts and approaches, not necessarily in the area of sustainable development.

The main contribution of the paper is the application of the I-distance methodology in an iterative process focused on assessment of the relative contribution of individual indicators to the final position of the countries and appropriate stepwise reduction of number of indicators. By this, we not only improve stability and overall quality of the model but also provide in-depth analysis and more comprehensive understanding of specific factors that determines one country ranking position. This is of crucial importance policymakers to identify key indicators and focus the priority areas where appropriate policies, programs and measures would have the most efficient impact on the overall positioning of the country in terms of sustainable development.

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Agricultural Biodiversity for Sustainable Development

Bioróżnorodność rolna dla zrównoważonego rozwoju

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Abstract

Agricultural biodiversity should be considered as a key resource and the most important human heritage. Biodiversity of farm animals and plants gives the foundation to food production that ensures the existence and future of contemporary civilizations. Rapid economic development, unfortunately, does not facilitate the preservation of biodiversity and organisms characterised by many desirable properties and features are perishing. Economic progress forces humans to abandon traditional, safe and more varied species, and to switch to monocultures and those non-native to specific habitats, but which are more productive. In this way mankind had lost forever a large part of this *living deposit of the past times*, and this process continues. Probably, in some cases, this results simply from the pure ignorance of local keepers concerning traditional varieties and breeds. Therefore, it is worth promoting and encouraging the efforts of both individuals and institutions in terms of a better understanding of this subject, and to seek support in the interests of present and future mankind.

Key words: agricultural biodiversity, genetic erosion, ecological agriculture

Streszczenie

Bioróżnorodność rolną należy traktować jako podstawowy zasób i najważniejsze dziedzictwo ludzkości. Na zróżnicowaniu biologicznym hodowanych zwierząt i roślin opiera się produkcja żywności zapewniająca byt i przyszłość współczesnym cywilizacjom. Gwałtowny rozwój gospodarczy niestety nie sprzyja utrzymywaniu bogactwa form. Znikają zatem organizmy kryjące w sobie wiele pożądanych właściwości i cech. Progres ekonomiczny zmusza do porzucania tradycyjnych, bezpiecznych i bardziej zróżnicowanych gatunków na rzecz ujednoliconych i obcych danemu miejscu, ale bardziej wydajnych. W ten sposób bezpowrotnie ludzkość utraciła już sporą część tego *żywego depozytu przeszłości* i wyzbywa się go nadal. Prawdopodobnie, w niektórych wypadkach, wynika to po prostu ze zwykłej niewiedzy depozytariuszy lokalnych i tradycyjnych odmian czy ras. Warto zatem propagować i promować wysiłki zarówno ludzi jak i instytucji zmierzające do pogłębienia wiedzy na ten temat oraz szukania wsparcia w interesie dzisiejszego i przyszłego człowieka.

Słowa kluczowe: bioróżnorodność rolna, erozja genetyczna, rolnictwo ekologiczne

Introduction

Biodiversity is a term commonly known and used today to define the diversity of the living world[1]. Typically, it is used with reference to the abundance of different forms of animate nature. Its scope includes the diversity of ecosystems, species and genes. A full understanding of the importance of biodiversity and its assessment is not easy – if at all possible. The term biodiversity became popular in science, politics and society in the 1990s. This coincided with the documented, alarmingly rapid extinction of species. However, from the epistemological point of view, biodiversity is a new paradigm, because it combines various areas of knowledge, both of the human sciences and natural sciences.

[1] The biodiversity of agricultural ecosystems includes agrobiodiversity, and hence the diversity of crop plant species and varieties, along with the multitude of farm animal species and breeds, and the biodiversity of wild fauna and flora accompanying domesticated plants and animals on land used for agricultural purposes.

The value of biodiversity is particularly appreciated in agriculture (Tyburski, Kostrzewska, 2013, p. 11). For centuries, to achieve stable access to diverse food, people have learned to breed many animal species and to grow even more plant varieties. Contemporary agriculture is focused on the same goal, but additionally seeks to develop new production systems with the lowest possible environmental impact. The increase in the global human population forces us to look again at species that were once domesticated but over time have been forgotten and are now almost extinct. One of the aims of this paper is to support the justification to develop conservation measures and to restore economically marginalised and/or declining traditional and local varieties and breeds (Badora et al., 2014), which, being better adapted to the place of their origin, may provide food where more popular but feeble alien species are no longer able to do so. Besides, many wild species contain genes that can improve the resistance of crops to diseases and pests without resorting to chemical plant protection, or to provide active ingredients to treat numerous human diseases.

The decline of biodiversity, and anthropogenic pressure

Genetic diversity within the population is the basis of evolutionary processes resulting from environmental interaction with the biological mechanisms at the molecular level. Organisms that, due to their genetic potential, are able to make better use of adaptive traits survive, reproduce and pass on a part of their genetic material to offspring, contributing in this way to the evolutionary improvement of the species. The more diversified the populations and individuals of the species, the greater the genetic diversity of the species. Thus, the diversity largely depends on environmental pressure, and in the case of crops or livestock, also on human activity. On the other hand, genetic erosion, i.e. the loss of valuable and painstakingly achieved genetic diversity, progressing at the same time due as human activity, is a serious signal of a hazard which, when left without an adequate response, may bring grave consequences. The diversity within and between species is therefore a specific guarantee for the functioning of adaptation mechanisms, the continued existence of the species, and life in general.

Living organisms forming ecosystems are closely dependent on each other, and are in dynamic equilibrium oriented at evolution and differentiation. Therefore, if one species disappears or enters into a new relationship with another, the established balance is upset, the ecosystem looks for new solutions. However, when more than one species disappears (or, for example, the dominant one), the formed ecosystem may collapse, and even perish. But ecosystems do not exist as separate units; they always interact with each other through constant energy flow, circulation of matter, or the migration of individuals and species. Gradual exploration of these relationships between biotic and abiotic components has led to the creation of the concept of ecology at the macro level. For this reason, since the 1970s the Earth has been considered as a single large ecosystem. Therefore, it is logical to make conclusions about the global consequences of the extinction of even local species.

The most pernicious factors, besides natural ones, responsible for the decline of species generally include habitat destruction, fragmentation of ecosystems, invasions of alien species, deforestation and land drainage, urbanization and industrialization, which are all a part of multidirectional destructive economic and non-economic unsustainable human activity. Another factor is global climate change (considered, however, as both the cause and effect), the intensity of which depends, to varying degrees, on all of these causes[2].

Thus, we can say without much error that humans, through more or less intensified transformations, introduce the most undesirable changes in their environment, exposing in this way themselves and their environment to additional hazards. Through science and technology humankind, convinced of its emancipation from being biologically dependent on its environment, is in fact working to its own disadvantage. Agriculture is considered the last redoubt of the former relatively harmonious cooperation with nature, as it still perceives human dependency on *the friendly attitude* of the environment (Sobczyk, 2014). Nevertheless, centuries of agricultural activity brought both remarkable damages and successes. Paradoxically, agriculture itself, and more precisely the need for increased food and feed production, contributed to the loss of biodiversity in breeds and varieties that once had been purposefully created. It can be said that at some point the focus on economic profitability replaced common sense. The current situation can also be justified by the lack of relevant studies before the problem emerged. Over the years only selective species conservation has been promoted, while the direct relationship of the conserved species and its habitat and their mutual influence has been ignored. Spatial forms of conservation for rural areas have not been taken into account at all, while in fact they, by gathering valuable wild and domesticated species (unless the use of means increasing productivity led to advanced degradation), are characterized by a unique richness of life forms not found elsewhere. Fallow lands, field margins, wastelands, brushwoods and woodlots among fields, microhabitats, ponds, ditches, etc. are real incubators of biodiversity (Tyburski 2013, 279-291). The same can be

[2] Too rapidly progressing (again due to human activity) climate change and succession of plant species may, for example, contribute to increase or decrease of biodiversity up to certain limits.

applied to, e.g. traditionally used grasslands. Regular mowing of meadows and grazing pastures prevents natural but harmful succession from the point of view of protecting biodiversity.

Varying degrees of complexity and constant changes in the species composition of individual environments significantly complicate research on the actual status and nature-related and non-nature values of agricultural ecosystems, which additionally strongly rely on sophisticated technologies and chemicals. Hence, the direct and indirect causes of biodiversity loss are usually attributed to human activity. Biodiversity indices play an important role in understanding the dynamics of this process. Two other factors are also considered, although they do not always, and not directly, lead to the right conclusions. These are genetic erosion, namely the decline in biodiversity within species, and the decline in the number of species characteristic for a given ecosystem. The use of appropriate bioindicators makes it easy to monitor multiple environmental parameters indirectly, demonstrating the state of the environment and the level of biodiversity on the world[3].

The situation in Europe, as well as all over the world, is not optimistic. According to the report of the European Environment Agency (EEA), the number of endangered species is continuously rising. In many countries, particularly in the north-western and the central part of the continent, over 70% of habitats have been destroyed or seriously damaged and approximately 60% of the species living there (including 50% vertebrates) have been in danger of extinction. This situation is mainly caused by changes in exploitation of ecosystems mostly for agricultural purposes, expansion of transport and industrial infrastructure, water use and water pollution, steppe formation and desertification. However, population growth is noticed in species connected with the presence of humans and their activities, chiefly plants which tolerate acidification and increased level of nutrients. It also refers to some birds, terrestrial and aquatic invasive species.

The Southern Europe is particularly affected by the loss of waterlogged areas. Similar process occurs to a minor extent in the western and central part of the continent. Attempts of bringing back the previous state of some rivers, lakes, swamps, peat-bogs, small field and forest reservoirs do not compensate for the losses suffered as a consequence of urbanization and intensification of agricultural production. Paradoxically also afforestation conducted with a view to increasing production of wood leads to impoverishing of biotopes and disappearing of extensively harnessed agricultural half-natural ecosystems distinguished by great biodiversity.

In the Eastern Europe agricultural use of land has been decreased since 1990s. An area of sowing is also reduced. Land use pattern of cross-border areas has been changing and there have appeared set-aside, abandoned, shrubby vegetation and forest areas. Many anthropophilic species have increased their amount. There has been a drastic decrease of the number of wild plants and animals which are concomitant of extensive agricultural economy or simplified use of meadows, pastures, sometimes strictly dependent on the presence of field wasteland and balks. Stopping erosion and sustaining existing in this region natural and agricultural biological diversity seems to be possible, although it requires serious financial, organizational and legal investments.

In the Western Europe tendency towards developing intensive and specialised agriculture has not been decreased. In spite of serious subventions – based on the need of stopping the process of genetic erosion and human habitat degradation – the cases of reafforestation or reintroduction of wild species or even restoring the degraded place into the primeval state are incidental and they are regarded as a considerable success. They have rather media than ecologic dimension (Tyburski, 2013).

Agriculture, agricultural biodiversity and food production

The beginnings of agriculture can be traced back to 10,000 years ago. Presumably, this practice was neither a discovery nor an invention, but a simple consequence of the need to supplement food deficits by people involved on a daily basis in hunting and gathering. It spontaneously appeared in many regions of the world and developed with various pace depending on the local biotic and abiotic conditions.

Thus, the will and need to secure a steady source of food was the first reason that pushed humans towards innovative solutions for cyclic storage and the use of some seeds for replanting, the selection of preferred plants and improving growth conditions in order to obtain the greatest possible benefits. This process, repeated again and again, with time led to the enhancement of quantitative and qualitative traits in species, preferred from the point of view of human needs.

However, regardless of its later successes, the origins of agriculture were associated with the domestication of preferred or randomly chosen species. Phenotypes and genotypes of species were selected

[3] Some plants, for example, accumulate heavy metals or sulfur compounds in their tissues, thereby signalling, in advance, processes and changes that lead to the decline of more sensitive species. Hence, the search for plants that are able to serve this purpose is very urgent. Indicators of biodiversity are all those species whose changes in occurrence and abundance are correlated with similar changes in other species, for example, economically important ones. Advanced technologies that use molecular indicators make it possible to spot the *shrinkage* of the species within the population, even before changes are revealed on the phenotypic level.

more or less consciously, with the main focus on their suitability for consumption, often at the expense of weaker adaptive traits. Plants altered in this process moved from place to place, and have spread along with human populations. Through selective pressure, human interference in the natural evolution of plants was so effective that in a relatively short period of time it led to a loss of genetic diversity obvious in the populations of wild ancestors. The exceptional productivity of species with impoverished genetic diversity replaced effective mechanisms of adaptation stemming from this diversity.

The situation in the agricultural sector, of course, has not always looked the same. A significant development took place along with great inventions and increased economic activity. The popularisation and spread of new species was stimulated by human curiosity, increased demand for previously unknown commodities, and the development of maritime trade. The opening of new markets coincided with an increase in food productivity and changes in land use. This fact, in the 18th and 19th centuries, enabled the shifting of surplus labour from the countryside to the cities, and its use in transforming small-scale craftsmanship into large-scale industrial production. The second agricultural revolution took place in the 19th century. This time, traditional agriculture gained the characteristics of agricultural production by using modern machinery and fertilizers. The scale of the revolution, however, was limited, as it mostly affected western countries, where agriculture was supported by the developed machine and chemical industries.

The second half of the 20th century brought more changes. Advances in biological sciences with the development of the industrial sector have led to the Green Revolution. The production of basic cereals doubled, and new and high-yielding varieties of rice, wheat, corn and other crops were created. But these spectacular successes had their price. Negative transformations of agricultural environments stimulated the need for a closer look at innovations in this sector of production. A belief emerged that changes need to be continued, but this time with a focus on sustainable agriculture.

Today, the commercial attractiveness of crops mainly depends on their productivity and morphological characteristics, while nutritional and organoleptic values only began to gain importance. For this reason, the use of some almost forgotten and/or abandoned species, grown only occasionally or on a small-scale, despite their outstanding nutritional parameters, is still limited to local communities and markets. However, these plants have great potential. First and foremost, they are characterized by significant genetic diversity, and if grown on a large scale could diversify product range, increase food security, and improve the economic status of producers and the health of people suffering from nutritional deficiencies. Some of these plants also have medicinal properties. They do not require large inputs (fertilizers, plant protection measures), and are generally well adapted even to extreme local climatic conditions, so they perfectly fit into the modern trends of sustainable agriculture. And because science has never before given them proper attention, information from people cherishing knowledge about their properties and methods of cultivation is now proving to be very valuable, and is part of cultural diversity. Modern agriculture relies primarily on modern biotechnology focused on the genetic improvement of utility organisms, the selection of individuals resistant to adverse environmental factors, cross-breeding varieties and genetic engineering. To reduce the negative impact on the environment, and to improve the water-air relations and soil physico-chemical parameters, farmers are trying to use catch crops and innovative *ecocompatible* farming practices (they are usually associated with proecological or integrated agriculture), and to establish seed banks or landscape parks.

Since agricultural activity is based on the skilful exploitation of the potential of the natural environment, emphasis should be put on thoughtful interference, and changes that are integrated with, or at least minimally colliding with, the environmental changes resulting from the need to improve food and feed production. By expanding agricultural production humankind has already very seriously transformed natural ecosystems into agroecosystems, with varying degrees of impact on them. Negative consequences of this process – beyond those regarding the natural environment – can be found in the strained social, political and economic situations in many countries. Agriculture can therefore be defined as general activity aimed at obtaining products of the land necessary to feed people and animals, and materials for further processing (e.g. fibre, medicines) or energy resources. Agriculture can be regarded as the primordial form of biotechnology – knowledge shaping the cultural decision-making models aimed at improving the quality and quantity of products obtained from plants and animals. This very feature distinguishes agriculture from a simple spontaneous gathering of fruit produced by land, which humans neither influence nor support. It must therefore take a very long period of accumulated experience, including organoleptic and aesthetic, to go beyond gathering and to take up new activities, this time related to domestication. In areas where land and climate conditions were favourable, satisfactory production yields were obtained by growing plants which for some reason drew the attention of their first-time breeders. The first ancient centres of biodiversity then developed in different geographic locations: The Fertile Crescent, China, Central America, and the Mediterranean Basin.

Biodiversity and sustainable agriculture

Agriculture, in addition to hunting, forestry, fishery, aquaculture, mining and quarrying, is today a part of the primary sector of the economy. It differs depending on the era and region, and even today, traditional, or even extensive, agriculture exists alongside very advanced, almost industrial production practices. Extensive agriculture is a term used to define low-productivity systems which require relatively little effort and resources. Conversely, agriculture aimed at maximum profit requires high workload and financial resources. It is characterized by the widespread use of high-performance machines, farming and breeding practices.

Conventional agriculture is a way of farming aimed at maximizing the profit obtained thanks to the high performance of plants and animals in specialized farms, using technologies based on the high consumption of means of production, mainly agrochemicals. As a result, there has been a considerable increase in the occurrence of weeds and diseases, and the use of pesticides led to an increase in expenditure. Disturbed crop structure and the need for supplementary feeding of high-yielding crop varieties forced the increasing use of fertilizers. Thus, a number of negative consequences for agriculture, the environment and consumers have been recorded, manifested by:

- reduced ability of self-regulation in ecosystem and reduced populations of some groups of organisms due to the use of pesticides This led to the selection of resistant pathogens and harmful organisms, and reduced the number of their natural enemies;
- decrease in soil fertility caused by the lack of organic fertilization increased erosion, the use of heavy machinery, and adverse changes in agricultural ecosystems;
- contamination of groundwater and eutrophication of surface water by the excess of unassimilated nitrogen and phosphorus;
- accumulation of harmful substances and their presence in food chains;
- reduced nutritional value of plant-derived food and feed due to the imbalance of minerals or pesticide residues.

Ecocompatible agriculture departs from the use of chemical plant protection and fertilization, and is aimed at producing healthy, low-processed food and environmental protection.

Intensified conservation activities in agriculture are mainly driven by progressive genetic erosion, i.e. the rapid loss of species, animal breeds and crop varieties. The most important reasons rightly pointed out include the disappearance and fragmentation of sustainable agricultural habitats and ecosystems caused by natural (e.g. climate change) and anthropogenic factors, popularization of monocultures and high-yielding crop varieties, environmental pollution and the extinction of the most vulnerable species, the expansion of alien species, and economic factors forcing maximized productivity[4]. Awareness of these facts obviously leads to remedial organizational and legislative initiatives. Centres of usable and natural biodiversity are created, collections of crop plants in their original places of occurrence (*in situ*) and banks of seeds and propagating material stored outside the place of their natural occurrence (i.e. *ex situ*) are being established. All this has a legal framework of international[5] conventions and national regulations aimed at the protection of the environment, but also the rights of the communities associated with them. Hence, besides clear environmental targets, i.e. creating sites to protect the ancestor and original species of those currently grown which are important for food and feed production, activities are carried out to maintain local cultural diversity, through the work of farmers using, preserving and keeping for the future generations plants they tend, and together with them the assets of practical knowledge and experience[6].

Biodiversity and sustainable development

Life on Earth forms a single self-sustaining ecosystem in dynamic equilibrium. Human life depends on its normal functioning. Accumulating difficulties with maintaining the status of the natural environment force the need for deeper insight into the essence of problems that threaten contemporary man. One of them is the conservation of existing resources, which includes everything that is obtained from the environment to meet human needs. Most of these resources, unfortunately, are not present everywhere in the same amount or enough to cover the demand, and only some of them are renewable. Sustainable development should support efforts to satisfy at least the basic needs of humankind. By definition, sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Biodiversity plays a key role in this strategy. The state of the human living environment depends

[4] Modern highly productive agriculture rejects old varieties, mainly due to their low productivity and lack of adaptation to the new mechanized production technologies.

[5] Art. 8, 9 of the Convention on Biological Diversity; Art. 5, 15 of the International Treaty on Plant Genetic Resources for Food and Agriculture.

[6] Biodiversity is strongly linked with culture as a whole characteristic of a particular group or nation, knowledge, tradition, processes and technical procedures, practices systematically shared and used.
Food is one of the emanations of biodiversity and cultural diversity. Some dishes prepared according to specific recipes are linked with the celebration of holidays, religions, traditions and customs.
This link, of varying strength, is present in every civilisation and culture.

on the diversity of other living organisms. The destruction of this diversity leads to ecological, economic and cultural losses. Thus, for several decades, people have aimed at revising the established approach of humans to the nature surrounding them. An important achievement in this area is, for example, awareness of cross-border environmental interactions, also taking into account the ethical, cultural, political, scientific, technical and institutional interests of countries.

Huge progress in agricultural production, especially in the yield of the major crops in the second half of the 20th century, was achieved through genetic improvements in specific varieties, with the strong support of fertilizers and plant protection measures. Varieties were created that satisfied expectations, but only under optimum conditions for them; any changes – in water or nutrient supply, weather conditions, or the presence of pathogens against which the vast majority of farmers in the world are not able to protect crops (for financial constraints or other reasons), always result in decreased yield. Moreover, modern varieties are not adapted to biotic and abiotic stresses and local conditions, which are usually very varied. Despite that, they supplanted, often permanently, a substantial number of primary varieties grown locally and characterized by much lower productivity, but having better nutritive values. The latter features have re-awakened local markets, as the food security policy tends to prefer qualitative to quantitative issues. The chemicals and heavy machinery necessary for the production of high-yielding varieties disturb soil structure, water and air transport, contribute to soil erosion, increase salinity, impoverish flora and fauna in the soil, reduce natural fertility and resistance, and increase the risk of the spreading new diseases and pests. And since most land suitable for food production is already in use, all possible efforts should be made to sustain its long-term productivity. In this aspect plants used as food are still the main substrate. Because of that, their genetic improvement is important to maintain biodiversity, but also to obtain new varieties more suited to the expectations of producers and consumers. For this reason, all projects – either aimed at the conservation or utilization of genetic resources – are interdependent and important for future.

For sustainable agriculture, a specific *qualifying test* is the ecology of the land which is intended for the production of safer foods and feeds. And the purpose of this sustainability is – as far as possible – the transformation of industrial agriculture from destructing to supporting activity. It is therefore not only about the quantity but also the quality of products, and the place of its origin, because only sustainable production gives a chance to achieve the quality of life which we all expect. Agricultural production itself was somehow assigned a new strategic goal – to build a sense of long-lasting public safety by ensuring ecological and food security. The goal is both ambitious and complicated, and therefore must be implemented in many areas in parallel, according to the rules relevant to local conditions and needs. These include, for example, wider use of the natural processes of binding elements in order to reduce the use of fertilizers, reduction in the use of pesticides that interfere with biological cycles and replacing them with, for example, ecological methods of pest control; diversification of production systems through the use of the biological and genetic potential of native and local species; restoration of crop rotations to maintain soil fertility; increase in the absorption capacity of the soil and wetlands; preferential market mechanisms promoting small-scale farmers; development of biotechnology and genetic engineering to explore and create an effective system of protection and safe use of the survived potential of agricultural biodiversity.

Conclusions

The last of these goals seems to be the most important, because biodiversity opens a way to sustainable agriculture, can improve production without unnecessary damage to the environment, compensate for losses in the yields of high-performance but risky monocultures, stabilize fluctuations in yield volumes, respond in a positive way to climate change, and give greater guarantees of food security. These and other goals can be achieved only by maintaining the greatest possible level of biodiversity, which allows organisms to evolve and adapt to changing environmental conditions. Thanks to biodiversity, humans can everyday use various ecological products and services. It is therefore worth making an effort to rescue the prematurely lost crops and farm animals because, although only 20 species cover 90% of energy demand, there are tens of thousands of plants of economic importance (sometimes only very limited or local). However, all of them are of great importance in food production, shaping the local economy, and are usually closely connected with the local cuisine, culture and tradition. Following this direction, and with a consistent policy aimed at supporting, and where necessary restoring sustainable methods of food production, requires *biological facilities*. The major component of this is the diversity of organisms, plants and animals used in agriculture, whose pool is dangerously depleting. Various legal, financial and organizational measures undertaken for that purpose should certainly be considered as promising and necessary investments.

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Factory Farming Versus Environment and Society. The Analysis of Selected Problems

Przemysłowa hodowla zwierząt a środowisko i społeczeństwo. Analiza wybranych problemów

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Abstract

The thesis examined in the article is the argumentation against a popular belief that industrialised agricultural systems and intensive agriculture are beneficial. Objective facts, reports and commonly available data confirm such argumentation. Intensification in animal farming – in a long-term and multi-faceted approach – turns out to be a practice which not only abuses ecosystems and livestock, but also our health. When we consider all moral, medical and ecological controversies, it seems is meaningful and necessary to express doubts regarding the economic value of factory farming.

Key words: factory farming, intensive agriculture, monocultures, fishmeal industry

Streszczenie

Treścią niniejszej pracy jest argumentacja przeciwko popularnemu przekonaniu o dobroczynnym skutku przemysłowych upraw i chowu zwierząt. Wskazują na to obserwowane fakty, sprawozdania oraz powszechnie dostępne informacje. Polityka rolna zalecająca intensyfikację chowu – w ujęciu długoterminowym i wieloaspektowym – okazuje się praktykami nie tylko skrajnie eksploatującymi naturalne ekosystemy oraz żywy inwentarz, ale również działaniami szkodliwymi dla naszego zdrowia. Biorąc pod uwagę wszystkie moralne, medyczne, ekonomiczne i ekologiczne kontrowersje, wyrażanie wątpliwości odnośnie gospodarczej wartości przemysłowej hodowli zwierząt wydaje się być istotne i konieczne.

Słowa kluczowe: hodowla przemysłowa, intensywna agrokultura, uprawy monokulturowe, przetwórstwo rybne

Introduction

According to Hans Jonas, technology used to be tantamount to looking after Nature and caring about it, so an inherent value within Nature had been recognized, and thus respected. Nowadays, Nature is only seen instrumentally as a means to satisfy our needs and habits, including the culinary ones. Sustainable usage of natural riches has been superseded by extreme exploitation, which involves using advanced technology that is centered around the rule of *maximizing profits with minimum time and effort*. Jonas formulates a thesis on a changing nature of human action, and this change evokes a serious ecological crisis in the natural environment and economic crisis in the social environment. However, first and foremost, the change of our action brings about an ethical and even a medical crisis. *The source of the crisis is the increase of human power, which enables such a deep interference in the nature (...) that it can cause – if it had not caused them already – irreversible changes leading to the erasure of human existence both in physical, and specific sense* (Ciążela, 2006, p. 108). Without doubt, mechanized interference in the natural environment in the form of factory farming is an example of such change of human action,

which may serve as the evidence of the increasing human technological power.

There is a common opinion that factory megafarms are reportedly the only profitable form of dairy and meat production, and battery farming is the most effective method of feeding the constantly rising population of people. This belief exploits a naive way of thinking that *more means better*, and on a model of corporate social irresponsibility. In the history of factory farming the first serious mistake was made with the creation of the theory of farm automation. Prior to its introduction, no tests which could enable risk management, forecasting of threats, avoiding them and to performing effective forms of counteraction against unwelcome results (water, air and soil pollution; disease epidemics etc.) were performed. The existence of megafarms in a global and long-term perspective – with regard to ecology, economics or medicine – has not been considered either. The aftermath of these mistakes is seen today, in the form of significant influence of intensive agriculture on natural environment, the health of all consumers and people all around the world. The fact that the method of food production influences its quality is disregarded. The knowledge that the used means and the method of production determine the final value of a product – as the author of *The Poverty of Philosophy* taught us – has been forgotten.

Critical analysis of factory farming is the subject which should be constantly brought up, because *the way that meat, eggs and milk are produced is surrounded by one of our great silences, in which most people collaborate, it's time to wean ourselves off the fairytale version of farming* (Monbiot, 2015).

In the present article we are going to demonstrate that the idea of positive results derived from mass monoculture and farm animal industry is false. Tangible facts, everyday observations and publically available data provide certain pieces of evidence. Agri-politics, which promotes intensive farming, is a harmful practice for people and animals from the point of view of *corporate community and environment involvement*[1]. Taking into account all doubts, the criticism of factory farming indeed becomes a moral necessity. What is also necessary, is continuing the discussions about the future of megafarms and undermining the thoughtless trust of consumers regarding their imagining of animal husbandry. In the article we have intentionally omitted the problem of the unfathomable suffering of animals in factory farming. Such decision is dictated by the fact that a lot of data regarding farm animals cruelty is readily available, whereas there is insufficient information about some other negative aspects characteristic of factory farming[2].

The main thesis of the present investigation is the statement, that factory farming leads to the extinction of entire species of animals, pollution of soil, air and water pollution (Panagiotis, 2004), epidemics of lifestyle diseases, as well as food wastage. The aim of the article is to question a contemporary myth that factory farming is the best way of feeding the constantly rising human population number of people in the world. Another purpose is the attempt to answer the questions of how to avert the ecological disaster; how to avoid the food wastage; how we can – and should – protect ecosystems, and finally: how to ensure the welfare of farm animals.

First, we must explain that such terms as *factory farming, animal raising and breeding, monoculture and monocropping* or *megafarms* are the central catchwords of industrial revolution, which has encroached upon rustic areas, bringing numerous dangers and real losses. The core of factory farming is gaining the maximum quantity of meat by means of the least outlay of money, work and time. This situation concerns poultry, cattle, aqua-farming and dairy farming. It can be done by concentrating a great number of animals in a disproportionately small space (battery, boxes), where entire meat or dairy production (fattening, milking) aims for the full automation of some processes at the expense of natural activity and functions of animal organisms. Maximized dairy production consists in a radical diet with antibiotics and growth hormones in order to force upon cows and hens a drastic exceeding of their natural limits in milk and eggs production. The hallmark of factory farming is a massive disappearance of poultry, swine and cattle from grasslands and pastures. The natural way of animal nutrition consisting in unhampered grazing is time-absorbing, and thereby unprofitable for agribusiness. Hence the reaction of livestock farmers, which can be described as a commodification of farm animals, i.e. moving animal husbandry into halls, cages and pools, where animals become utterly objectified, and their physiology is under mechanical control. Therefore, the second distinctive feature of factory farming is the horribly low level of farm animals welfare. Monocultures and monocroppings – specialized in growing and supplying only one single plant or crop species in large amounts – which are closely related to megafarms will be discussed in the further part of the text.

Selected facts concerning factory farming

Food wastage is the issue which we seldom think about as we buy *grade 3* eggs or chicken in a supermarket. In their publication, Isabel Oakeshott and

[1] The point is about the consequences of so-called *ecological imperialism*, an idea formulated by Alfred W. Crosby (2004). We write about this concept more broadly– see: I.S. Fiut (2003, p. 185-200).

[2] Such organisations, as *Animal Equality* http://www. animalequality.net/, *The Nonhuman Rights Project* http:// www.nonhumanrightsproject.org/ are concerned with regular reporting about the suffering and inhumane treatment of farm animals.

Philip Lymbery report that 70 billion of animals in the world are slaughtered every year in order to be consumed; within this number as many as 11.6 million chickens, 270 million pigs and 59 million cows are wasted. *At the same time billion of people starves, and farming seizes more and more area of forest to produce even more food* (Lymbery, 2015, p. 325). Moreover, according to *Food and Agriculture Organization*, as many as 30% of world's crops of grain are allocated for farm animal fodder regularly, which seems to be squandering of work and money. If these crops were allocated directly to social consumption as food, it would be possible to feed about 3.5 billion people, especially in the Third and Fourth World (FAO, 2011). 28% of world's farmlands serve to produce wasted food, which costs about 750 billion of USD, and outstrips GDP of Switzerland in 2014 – almost 40 billion of dollars. On the other hand, industrially mass-produced meat contains plenty of fat and some quantity of steroids, preservatives and antibiotics, which farm animal had to eat while being nourished.

In public media there is an opinion that factory farming is the good way to fight with farmers' poverty. Certain rules of economics state that the best way to maintain profits when the farm gets into trouble because of increasing expenses of production is to increase the amount of caged animals, and to keep low price of produced meat for the liquidity of sale. The situation resembles a vicious circle – *tragedy of the commons* – for three things increase at the same time: the farm operation charges, the amount of production waste and the amount of damage done in the ecosystem (spent water, polluted air and ground). Factory farming is the symbol of initiative, but simultaneously it requires a huge outlay of money and permanent exploitation of natural environment. The Western European model of intensive farming is willingly copied by the Far and Near East. Meanwhile, the promotion of factory farming in developing countries is irrational and immoral insofar as it exploits the naivety of farmers, who do not have any experience in applying strong chemicals, and particularly – they do not have the required capital for successive investments. Thus, it often leads to even bigger debts of the poorest, ending up with *insolvency*, and even suicide contagion (Jędrysik, 2011).

Regarding megafarms as job places for local dwellers – as Lymbery reports – both intensive animal farming in the USA and Asia, as well as intensive crop farming in Latin America not only *did nothing for inhabitants*, but additionally it *ruined roads*, natural environment and the health of inhabitants by intense air polluting, *destroying water sources and polluting ground waters* with toxic chemicals and animal excreta (Lymbery, 2015, p. 295).

The next fact that is worth noticing is the issue of pollution. Global factory farming produces 14.5% of greenhouse gas emitted by human activity – more than by all cars, planes and trains altogether (*ibidem*, p. 266). On the other hand, mass overuse of pesticides and fertilizers, in connection with factory farming, constitute the most lethal factor for the consumers health, local dwellers and for local environment. Farming seems to be one of the biggest emitters of chemical substances, which penetrate into food, soil, air, waters, flora, fauna, as well as farmed and consumed animals. Dairy megafarms, together with battery caged poultry, generate large amounts of soil, water and air pollution, which wreak havoc in local wildlife. As far as soil is concerned, in California alone *there are 1.75 million dairy cattle farmed* which yield *milk worth around 6 billion of dollars every year and produce as much dung and urine, as 90 million people* (*ibidem*, p. 25). Toxic dung produced by one cow is several dozen times bigger than human faeces, which ought to be multiplied by about 10 000 cows found in a farm of an optimal size. These excrements are collected in underground tanks, which – for the mentioned quantity of cows – are around 50 metres long and 25 metres wide, where *preventing the leak of faeces is impossible* (*ibidem*, p. 35). Similar problems are connected with poultry faeces, which – in large amount – contain lethal doses of phosphorus and nitrogen. This brings about chemical contamination of the region and it is a serious pathogenic factor, contributing to diseases among the local residents.

Another problem consists in the air being polluted by stench and smog. It is a combination of the *reek of excrements* connected with toxic fumes of manure, herbicides, insecticides and fumigants. The abovementioned chemicals are used in order to produce fodder faster and more efficiently for an enormous quantity of concentrated animals. Obviously, such amount of toxins poisons not only local air, but it infiltrates through soil, ending up in ground waters and local watercourses – rivers, streams, brooks and other surface waters. It should be kept in mind that dairy farms, alongside with the whole production of pollution, are often placed nearby factories producing cheese and other dairy goods, which are afterwards consumed by us.

This is how the tangible reality of factory farming methods looks like, where – by means of machines and computers – vegetable fodder is turned into animal meat and dairy, as Ruth Harrison wrote in her book *Animal Machines* (Harison, 1964).

Factory farming in ecological perspective

As it can be drawn from observations, the arrival of the industrial revolution in farming caused irreversible devastation of ecosystems. In the mild version it involves the destruction of meadows and pastures for huge, sterile monoculture plantation of, for instance, cereal, soya or corn. In the extreme version, it involves expanding lands of infertile soil – which are already vast enough – by pouring out huge amounts of dung there. Previous experience shows that

crowding animals in one closed place quickly causes the problem with storing large amounts of animal faeces. Although, dung is valuable manure, far too much of it is produced in factory farming – the surplus of dung is a serious ecological danger for natural watery areas, watercourses and ground waters surrounding farms. Lethal quantities of ammonia, potassium, hydrogen sulfide or other damaging chemical substances penetrate to ground waters and rivers with rain, thus poisoning them. Additionally, farm faeces include certain quantities of pesticides, hormones and antibiotics (administered to living animals), which makes a toxic combination after infiltrating both into natural environment, and into human body. As one can read in the 4th chapter of the book *Livestock's long shadow* (Steinfeld, 2006, p. 136): *Livestock excreta contain a considerable amount of nutrients (nitrogen, phosphorous, potassium), drug residues, heavy metals and pathogens. If these get into the water or accumulate in the soil, they can pose serious threats to the environment*. In the same book, there is a statistical analysis which concludes that pig's dung poisons water several times stronger than domestic sewage. It should be considered that faeces left on barren vegetation exude poisonous fumes when there is no rain for a long time. All local inhabitants of nearby barren fields are endangered by chronic diseases of the airways and cardiac rhythm abnormalities due to the inhalation of ammonia and hydrogen sulfide.

Chris Mead, who died in 2003, warned about the tragic results of intensive farming (Mead, 2000). As an ornithologist, he observed that using enormous amounts of chemicals (phosphates and nitrates) – for such purpose as soil fertilization and vermin extermination – spreads wastes in natural ecosystems. The direct effect of an excessive usage of, for example, insecticides is not only the eradication of all invertebrates in the biotope, but also death of birds, which feed on some insects. In other words, the destructive outcome of farming, which conforms to the intensification plan, is the critical decline of population number of such birds, as grey partridge, house sparrow, yellowhammer, common reed bunting or corn bunting. Rural areas, natural habitats of the above-mentioned species, become too sterile and impoverished, deprived of cereal grains, weeds or insects. Chemical fertilizers strengthen the acidification of ground which kills oligochaeta, a certain species of earthworms that are natural prey for birds. While looking for grains or invertebrates on arable lands, birds die of starvation or due to the inhalation of high concentrations of chemicals found in the air. According to Leake, *populations of seed-eating bird species have fallen 70% below their natural levels. Modern farming has simply become too efficient: it leaves almost nothing for birds to eat* (Leake, 2012). A report by Lymbery can also be mentioned here. According to his observation, the air and soil in the western part of the USA are so polluted, due to chemical spraying, that not even a centimetre of grass grows over the area of thousands acres and not one animal – including insects – lives there. Nothing can be found there apart from genetically immuned soya, corn and wheat, growing in perfectly arranged lines.

The reason of mass extinction of invertebrates, birds or fish is poisoning the wildlife by unbelievable amounts of pesticides that are used by modern farming. The problem of biocoenosis disappearance, as a result of intensive usage of chemicals and leaks from factory farming objects, is well known since about 1960. We owe the publicity of the problem to some publications by the pioneers of contemporary ecology – Rachel Carson and Conor Mark Jameson, and in Poland – Antonina Leńkowa (Leńkowa, 1961). Despite almost a half of century went by, the problem still increases – as it is shown in some reports, for example the one by John Krebs, an ornithologist from Oxford University (Krebs *et al*., 1999, s. 611-612), who indicates industrial intensification of farming as the main cause of danger of extinction of 20% species from all European birds. Furthermore, *Birdlife International* alerts: *Europe-wide monitoring schemes highlight declines in widespread farmland birds* (Birdlife, 2013). The conclusion is clear – intensification of modern farming and transformation of grasslands into agricultural areas have caused aterrifying decline of birds number in the USA and Europe: *the European farmland bird index declined by 52% covering the period 1980–2010, representing a loss of 300 million birds, with decline rates greatest in the late 1970s and early 1980s* (PECBMS, 2012). A comparison of new and old EU Member States shows that although farmland birds were performing better in new EU countries, their trends appear to be worsening in recent years, now mimicking the trends in old EU countries PECBMS, 2012).

As far as invertebrates from rural areas are concerned, the natural population of wild honeybees and butterflies decreases too as a result of farming industrialization. This phenomenon is so dangerous and advanced that a special term was coined – *Colony Collapse Disorder*. Such massive dying out of bees generates huge economical loss, because the abundance of vegetable, fruit and food plant harvests depend on pollination done by bees. The reproduction of wild plants also relies on the pollination, therefore the extinction of bees is highly dangerous from ecological perspective. Monocultures, from orange groves to rose and cotton-plant fields, are based on large amounts of chemicals that destroy the organisms of bees and butterflies. Plants become lethally toxic for all insects, and *weather conditions make pesticides move to nearby areas, influencing the bees work* (Lymbery, 2015, p. 81). Researches published in 2012 in *Science* prove that pesticides destroy bees' ability of navigation, which makes it impossible to return to a hive (Whitehorn *et al*., 2012, p. 351-352).

According to Bernhard Warner, *For food science researchers, finding the culprit for bee colony collapse disorder has become the equivalent of discovering a cure for cancer. (...) The use of certain pesticides by farmers, the agricultural industry, and gardeners has also long been suspected of possibly killing bees, or at the very least fouling up their foraging instincts, confusing them to a point at which they cannot be relied upon to pollinate acres of almond groves or cherry orchards* (Warner, 2013). Additional reason of the dying out of insects is decreasing the area of land covered by forests and meadows in order to extend the agricultural areas and build large megafarms. Wood cover is necessary for birds and insects to survive, eat vermin or pollinate. For butterflies, trees are the natural protection against changing weather conditions like heat or gales. Dying out of the natural biodiversity, which consists of insects and birds, is the direct symbol of the fatal state of natural environment. And the condition of Nature reflects the way we manage this biodiversity. Because the condition of ecosystems and the whole biodiversity is dramatically bad, the conclusion regarding human activity is one: it leads to the destruction of Nature.

As for overdosing of pesticides, the agrichemical industry often sponsors research, which constitutes the basis for norms and legal regulations on the safe usage of chemicals. Such sponsoring makes to be statistics rounded up or down slightly to the advantage of farming, but with deadly effect for natural environment, including insects and birds. The certification system of the farm *welfare* looks similar. Agricultural business defends factory farming while referring to the standards which are established by hired experts. However, these publications do not have any value – they are used to lull consumers' moral sense by getting another certificate, for they describe standards just a little bit above the legal minimum. The actual situation of animals and environment does not improve (Monbiot, 2015). Furthermore, the production of pesticides and synthetic fertilizers requires lots of petroleum, and *some amount of petroleum that is absorbed by the crop treatment is overshadowed by the amount of petroleum needed to product meat from factory farming* (Lymbery, 2015, p. 245). Though traditional farming is based on physical work, the intensive farming is based on fossil fuels – petroleum and gas. The involvement of petroleum companies in modern agribusiness is so deep, that Albert Bertlett expressed it using a metaphor of transformation of not only crops into meat, but *petroleum into food*: *modern agriculture is based on petroleum-powered machinery and on petroleum-based fertilizers. This is reflected in a definition of modern agriculture: 'Modern agriculture is the use of land to convert petroleum into food'* (Bartlett, 2015).

The wildlife devastation by factory farming runs through the fishing industry in the form of indoor, underwater fish farms. Intensive aquaculture bases on the use of toxic chemicals, which pollutes the natural environment, contributes to the spread of disease and parasite epidemics and also to the pollution of coral reef. Outdoor and indoor fish farms not only poison the environment, but they also lead to the extermination of small species of wild fish – which serve as food for bigger farm fish. Unfortunately, feeding the bigger species leads to intensive fishing of small species, thus seriously disturbing the balance of a marine ecosystem. *Large negative effects of fish farms on wild salmon indicate that as the industry continues to grow, aquaculture management practices must be improved to reduce impacts on wild salmon*, it is the quotation from research report *Lenfest Ocean Program* (2008). However, it cannot be denied, though, that fish farms exploit the limited fish stocks of seas and oceans. In order to feed a ton of farm fish, one must fish out few tons of wild, small species – it indicates, that fish farms exploit stocks of wild water organisms, which are unable to regenerate in such short period of time and in such huge amounts, as they are caught. About 20% of fish from the entire world's fishing industry is not meant for people to be eaten, but they are given to other fish species as fodder or – in triturated form (fishmeal) – added to hen's and pig's fodder in factory farming. *Food and Agriculture Organization* informs, that excessive exploitation of oceans and seas drove to extinction of anchoa and Alaska pollock population in Pacific and herrings in Atlantic (FAO, 2014).

Likewise, Mark John Costello, a professor of aquaculture and water science proved – taking outdoor salmon farm as an example (Costello, 2009, p. 115-118) – that parasite epidemic, like sea lice, seriously disturbs economical profitability of fish farms. Fish farming, as a breeding ground for some highly infectious fish diseases, becomes a severe danger for wild species. Parasites get out of farms to natural environment, change the host and decimate marine stock of wild fish. Due to disease epidemics, the sources of which are often factory farms, wild salmons, cods and halibuts became endangered species (Rosenberg, 2008, p. 23-24). Furthermore, ill farm fish undergo intense chemical bath, which kills parasites, but also is infiltrate into the fish organism, and is subsequently eaten by us. Infected fish from aquafarms are not the sole danger in natural biotopes. Interbreeding of farm and wild salmons gives genetically weaker offspring, which has lower adaptability in natural environment. In short, the offspring of farming and wild fish dies more often as a result of fading instinctual behaviour.

Thus, fish farming is a real threat for the equivalent species living in the wild. As if this wasn't bad enough, fish farming poses yet another risk for fauna: marine farms allure birds, seals and otters. These predators are shot by farm owners just like foxes are shot while they are poaching hens. Killing an otter or a seal is a cheaper and faster solution than

buying and setting up some security measures against predators, such as fence. In this way, according to Lymbery's calculation (Lymbery, 2015, p. 107) several thousand seals die annually by farm owners' hands. In other words – by eating a trout or a salmon from the fish farm, a consumer supports indirectly the process of seal killing. Every purchase of fish from the farm means the money will partly be spent for the ammunition, which is going to be used to shoot sea mammals.

Fishmeal is used to feed farm fish, poultry, cattle and swine. It consists of ground and compressed tons of small species of fish, with some of the oil and water removed from the meat. Dry fodder prepared in such way is exported from Latin America to factory farms in Europe and Asia. The problem is that producing fishmeal constitutes a real ecological disaster, for it relies on regular fishing of huge amounts of small fish species – like anchovy – from seas and oceans. In this way, the wild fish, birds and sea mammals are deprived of their natural food, and predators die of starvation. The population of cormorants, gannets or pelicans by the shore of South America diminishes dramatically, because these wild species, normally eaten by birds, are fished too intensely. *In the middle of 20th century 40 millions of marine birds used to live on 28 islands by the shore of Peru. Now, only 1.8 million remains. This decline of amount is connected with the increase of fishmeal production* (*ibidem*, p. 112). Feeding farm animals with fishmeal contributes directly to the decline of the amount of wild water animals living in the opposite part of the world. Pelicans or cormorants are trophically far from hens and pigs, but due to factory farming they all are tragically connected by the shared source of food.

Unfortunately, this is only the first half of entire ecological disaster. The other half is a large number of fat wastes, which are generated during fishmeal production. These wastes pollute seashore waters creating vast dead zones, and also poison the air around fishmeal industry factories. Lymbery reports – as an eyewitness – that during fishmeal production he observed the production companies discharge all sewage straight to seashore water creating strands of toxic slime. The slime consists of different chemical substances (such as caustic soda) mixed with discarded parts of fish: blood, fat, bowels and scales. This greasy and caustic ooze, is pumped back into a gulf of the sea or ocean. In effect, so-called dead zones, completely devoided of life, expand. One could say, that the life of terraqueous wildlife is destroyed to satisfy a need of farming *macdonaldisation*. The general conclusion is one: factory farming drastically disturbs ecological sustainability.

Forage and fodder industry

Genetically modified, high-protein fodder used to speed up the fattening of animals is a central, very profitable element of factory farming. Simultaneously, it seems to be the element that is often overlooked in discussions concerning factory farming. Speaking more precisely, factory farming in Europe and Asia requires proper amount of fodder for animals. For this reason crops are imported from – often transgenic – monocultural cultivations and plantations placed in some poorer parts of South America and Africa, because importing from the distant continent is still cost-effective. Such cultivations provoke a number of questions and doubts.

Physical establishment of the plantation is connected with the reclamation of large forest areas and exploitation of local natural resources (soil, wood, water). Not only woodlands disappear, but also potential croplands, where individual farmers could sow for their own and regional use. Meanwhile, it often happens that local authorities of the Third World countries forcefully deprive poor owners of grounds, and then sell these grounds to some wealthy investors to grow soya monocultures, for example. *These poorest and the most powerless people in the world are pushed on the margins of society, to constantly provide people who live thousands kilometers away with cheap and poor quality chickens, pork and beef. For this reason the soybean meal is produced: to serve as the fodder for factory farmed animals* (*ibidem*, p. 218).

Such phenomenon can be described as *colonialism* of farmlands. This paradox consists in associating the intensification of farming with saving the usable area, which is normally used by grazing animals. However, intensive farming requires much greater area of land than free range raising in an open space. As Thomas K. Rudel with his team demonstrated (Rudel *et al*., 2009), the intensification of animal farming goes hand in hand with profits from fodder factories, and enormous areas of ground are used for intensive growing monocultural crops. If crops from these grounds were not manufactured, the whole area could be used, for example, for vegetable growing. As Lymbery wrote, *In reality, if all meat chickens in the UK had the free-range access, they would cover the area of approximately 1/3 of Isles of Wight surface – so it is not a ridiculous idea after all. The entire world's population of meat chickens – about 55 billion – would fit in the area of Hawaii Islands (…). The farmlands used for growing fodder for farm animals are so extensive that they would occupy the area of whole UE or a half of the USA (…). Every year the area of woodland equal to a half of the UK is being cut down, mainly for farm animal fodder monocultures* (Lymbery, 2015, p. 213). Factory farming rapidly extends the area of land used for the GMO intensive growing, destroying the balance of ecosystems, devastating forests, meadows and pastures. Transgenic soya is the perfect food for human regarding nutritional values, but nevertheless it is intended for fodder production. If it was possible to allocate crops directly for consumption – instead of

fodder, which is going to be turned into meat in megafarms and subsequently end up in shops – then it would also be possible to feed much more people by lower costs and lesser ecosystem devastation. Unfortunately, quite the opposite happens because of the substantial financial gains from the factory farming – going against logic, ecology and economics. Rajendra Pachauri elaborates on the problem in his lecture (2015).

The whole situation is even more dramatic, for the greatest damage of wildlife related to monocultural growing happens in Africa and South America – the countries which are poorest financially, but richest in respect to the number of nature reserves, bioreserves or species biodiversity.

In the article *Land grab in Africa* Marta Messa presents example of Ethiopia – *government offered three million hectares of virgin land to foreign corporations. At a first glimpse, this could sound like good news: large investments, improvement in infrastructures, technology transfers, higher food supplies, improvement in food security. (...)* [But] *the contracts, behind land deals, are often short, unspecific and grant long-term rights to extensive areas, with no guarantee of local investments and jobs. They do not regulate access to water or even ground priority rights over its use. What is grown by foreign companies are cash crops (e.g. cotton, sugar cane, rice) and biofuels to be exported. These deals are in fact land grabs driven by increasing demand for cheap food drops* (Messa, 2012). Usually, minors are employed in private plantations, exploitation thrives, and local dwellers themselves admit that they have no control of the soil, which once belonged to their families, nor their own destiny. Similar situation concerns, among others, Ghana, Sudan, Zambia Mali, Magadascar, Botswana, Malawi, Mozambique, Kenya, Tanzania, and also parts of Brazil, Argentina or India. What is more, some methods of growing transgenic soya are highly dangerous for the health of local inhabitants. Huge factories of soybean meal pollute local rivers with sewage from mills to such degree that the rivers turn into lifeless, chemical bogs. Even more dangerous are the soybean farmlands, which are sprayed with enormous amounts of carcinogenic chemicals. And the irony is that weeds get more and more resistant to herbicides which are used in increasing amounts. Quoting Paul Brown, environment correspondent for *The Guardian – a report in New Scientist magazine says that because of problems with the crops, farmers are now using twice as much herbicide as in conventional systems. (...) The control of soya has led to a number of disasters for neighbouring small farmers who have lost their own crops and livestock to the drift of herbicide spray* (Brown, 2004). Horrifying statistics regarding Argentina is delivered by. Medardo A. Vazquez and Carlos Nota. The *Report from the 1st National Meeting of Physicians in the Crop-Sprayed Towns* published in 2010 in Faculty of Medical Sciences in National University of Cordoba informs: *It is crucial to acknowledge the fact that, together with the increase in cancer and birth defect cases in the mentioned areas, the use of pesticides also increased exponentially since the introduction of transgenic crops. This type of crop requires the use of more and more pesticides. In 1990, 35 million liters were used during the crop year. In 1996, the introduction of transgenic biotechnology accelerated the use of pesticides to the extent that 98 million liters were used, and in 2000, it increased to 145 million liters. Last year 292 million liters were used, and this year we will be spraying the fields with over 300 million liters of herbicides, insecticides, acaricides, defoliants and other poisonous substances* (Vazquez, Nota, 2010, p. 14-15). Chemical sprays reach houses, schools, parks, workplaces or drinking water resources easy; thus, the risk of miscarriage, hypothyroidism, allergy and cancer of stomach, testicles, liver, pancreas and lungs increase seriously. Inhabitants of such polluted areas are incapable of standing up successfully to the subjects responsible for this tragic state of health and environment devastation, and by *subjects* we mean international concerns like Monsanto (p. 16). It seems really obvious that this situation does not concern Argentina only, but thousands of contaminated regions found all over the world.

It is not difficult to predict that the prevalent stereotype of eating meat, as the indicator of luxury, will still be increasing the global hunger for meat. It implicates permanent need to have more and more farmlands to produce cheap meat and fodder. The sad consequences of such a need are reported in the *Science* magazine by Virginia Morell – our diet, rich in meat from factory farming, is bad for our health and for Earth's biodiversity. It is the matter of human carnivory impact on land use and how terribly it affects the environment. *You eat a steak, you kill a lemur in Madagascar. You eat a chicken, you kill an Amazonian parrot. That's because species-rich habitats are being converted to pasture and feed crops as the human appetite for meat grows* says Gidon Eshel, a geophysicist at Bard College in New York (Morell, 2015). The conclusion which can be drawn, is: craving for meat connected with lust for financial profit leads to the marginalization of the interests of poor people and natural environment, off the public debate. The consequence of the need for cheap meat and high-protein fodder is the destruction of local biotopes, rich biodiversity and health of local inhabitants.

Factory farming as a danger for society

Diseases

Factory farms base their activity on using huge amounts of pesticides, synthetic fertilizers and antibiotics, which threatens the health of workers and dwellers from the areas surrounding a farm, as well as the health of consumers, because it is one of the

main sources of oncological diseases, circulatory system diseases, diabetes and obesity. The outbreaks of these diseases occur especially in the countries of *core states*, more seldom in the countries of *semi-peripheral areas* – using the terms of Immanuel Wallerstein. As we can read in the American Report of the Pew Commission on Industrial Farm Animal Production, *one of the most serious unintended consequences of industrial food animal production is the growing public health threat (...) Industrial food animal production facilities can be harmful to workers, neighbors, and even those living far from the facilities through air and water pollution, and via the spread of disease* (A Report…, 2008).

Farms and barns housing thousands of animals crowded in a closed area are often the habitat of serious diseases, which leads to the administration of irrational, preventive amounts of antibiotics, which are to stave off a disease, not to heal animals. Farmers *discovered, that adding a small amount of antibiotics to fodder for pigs significantly affects the tempo of their growth* (Lymbery, 2015, p. 148). As a result pigs are fed with huge doses of penicillin – which may lead to the progression of new type of bacteria resistant to this drug. In some indefinite point of future, the tuberculosis infection, pneumonia, typhoid or sexually transmitted disease can cause an epidemic on the scale of the 14th century extermination, which was triggered by the bacteria of bubonic plague. All the worse, the afore-mentioned plague bacteria became immune to newer antibiotics in last twenty years (see: Welch *et al*., 2007), while salmonella bacteria constantly immunizes against remedies, posing a lethal danger for people. Although megafarms are the place of disease incubation, and *preventive larding of farm animals all over the world with antibiotics implicates fatal effects for the public health, (…) factory farming supports pharmaceutical industry, for which more pigs mean more earned money* (Lymbery, 2015, p. 306).

Keeping uncountable amount of hens in battery caged farms results in the outbreaks of newer and newer mutations of avian flu. On the other hand, estrogen and xenoestrogen are used for poultry fatting, increasing the bulk of chicken meat by accumulating in their breasts. Later, these juicy chicken breasts are served in millions restaurants and sold in shops all over the world. The problem is that estrogen brings about men's infertility. *The consequence of increasing estrogen concentration to the suprapsychological level can be changing functions of many systems, including the male reproductive system* (Czupryńska, 2007, p. 323). The author goes on: *Reportedly, certain pharmaceuticals with estrogen or testosterone are still being used during beef cattle growing in the United States, and the percentage of big farms, which use hormones to boost the gain of muscle mass of animals, is described as 99%. Part of hormones, which was not metabolized in tissues, get through the soil along with the faeces, and then to rivers as well, inducing hormonal changes among living organisms, especially fish. Xenoestrogens found in meat are also connected with farming. (…) Meat contains estrogen esters of fatty acids, which are metabolites of estrogens and can be the source of hormonally active substances, especially after oral administration* (Czupryńska, 2007, p. 325). Owners of megafarms in China discovered a similar way to quickly increase the pig size and keeping the meat lean. This method involves the use of a body-building steroid klenbuterol; however, when it is consumed with pork, it causes serious cardiological side effects. Thus, eating meat which was bought in a supermarket or fast-food restaurant carries a high level of risk that we consume either meat infected by viruses and immunized bacteria, or meat laden with chemicals at the level which is detrimental for health.

The clear example of danger resulting from the consumption of factory farmed meat from are previous epidemics of bovine spongiform encephalopathy (BSE) and the attacks of *super-resistant* bacteria MRSA in pig farms. The neurodegenerative cattle disease BSE appears in the situation, when plant-eating cows are fed with meat and bone meal (MBM) containing prion proteins. Unfortunately, bovine spongiform encephalopathy is contagious among different species – beef consumers constantly risk infection, for lethal prions are not destroyed during cooking or heat treating the beef. MRSA bacteria, which are extremely dangerous and invulnerable to most of the known antibiotics, are now found outside hospitals – a situation different from the one several years ago. The *Soil Association* report shows certain unknown strains of this bacteria have been found in factory pig farms over a decade ago (and also in cow, sheep, hen and horse meat), though pigs are administered with the biggest amounts of antibiotics (Nunan, Young, 2007). We know factory megafarming is the basic, extramural source of MRSA proliferation in Western Europe and North America, but we do not still have the full knowledge of health dangers, which are carried by MRSA bacteria and its new mutations. Although it seems that the concentration of animals in closed rooms should theoretically protect poultry and pigs against diseases, in practice the closed space, together with enormous amount of excrements and chemicals create a suitable environment for the development of new, aggressive strains of bacteria and viruses. *The full scale of the threat to human health from MRSA on farms is clearly not yet known (...) for the general population there remains uncertainty about the scale of the danger, although Dutch scientists, including Government scientists, have said that pig-MRSA can also be transmitted between humans* (Nunan, Young, 2007, p. 47). Even more fearful, although fully realistic vision, is the possibility of emergence of new virus strains resulting from the combination of bird, pig and human viruses. As Aysha Akhtar rightly pointed

out, *We don't need a terrorist to wreak havoc. By confining billions of animals on factory farms, we have created a worldwide natural laboratory for the rapid development of a deadly and highly infectious form of the virus* (Aysha, 2012). Lethal epidemics remain a serious threat for us as long as factory farming exists.

To sum up, husbandry employing different methods of intensifying farming is the breeding ground for viral and bacterial diseases, which can be contracted by a man quickly and easily. By consuming meat from factory farming, we risk a contagion of drug-resistant germs, which results in longer hospitalization and a higher mortality rate of sick people.

Pollution

The development of bacteria and viruses is connected with air and water pollution by poisonous fumes and faeces from farms. Pig, poultry and dairy megafarms generate amazing amounts of faeces, which permanently pollute air, fresh and ground water available in wells. This pollution leads to serious diseases of the respiratory system, like asthma and pneumonia; diseases of cardiovascular system and equally serious diseases of digestive system connected with polluted water consumption. As *Socially Responsible Agricultural Project* informs, the main factor that makes drinking well water impossible (which is dredged in proximity of megafarms) is a high risk of *Escherichia coli* bacteria presence and huge amount of nitrates in water (Socially Responsible…, 2007). As Lymbery reports, *average life expectancy of people, who live close to factory farms, is shorter by as much as ten years* (Lymbery, 2015, p. 36). Children, pregnant women and elderly people belong to the group are particularly exposed to diseases and poisonings caused by the contact with toxic fumes and faeces. While writing about the occurrence *E. coli* bacteria in fresh water near dairy megafarms, poultry farms should be mentioned as well. According to the warnings of the British *Department for Environment, Food and Rural Affairs* – poultry farms generate not only huge amounts of faeces and ammonia, but such farms are also regularly attacked by avian flu. In the case of indoor fish farming and fishmeal industry, large amounts of sewage – which poisons not only the coastal water, but also air in the surroundings – are produced. Kilometres of toxic slime accumulated on the beaches of Latin America emit fumes, inhaled by the inhabitants living in the vicinity. *The production of fish meal is the cause of serious infections of respiratory system, asthma*, as well as *skin lesions* (Lymbery, 2015, p. 120).

Poor quality of food

The feature that distinguishes cheap food provided by factory farming, is the poor nutritional quality. The cause of poor quality of meat provided from factory farming is the horrible model of animal feeding connected with almost total immobilization of these animals. Intensive feeding of cows with grains, which are not part of their natural diet, increase the amount of noxious fats in meat, and at the same time reduce the amount of nutrients and vitamins. As William H. Dietz wrote, industrial raising of animals is rather industrial raising of damaging saturated fatty acids with negligible amount of nourishing polyunsaturated fatty acids, like ω-3 fatty acids (Dietz, 2011). Easy access to cheap and harmful fat, of which most of supermarket and fast-food customers are unaware, is the source of global pandemic of obesity and cardiovascular system diseases. Beef made of grass-fed cows contains much higher concentration of healthy fatty acids. The content of fat in meat delivered from factory farming always depends on the methods of animal nutrition. The explicit confirmation of this fact is scientific research conducted by Cynthia A. Daley and her team, published in *Nutrition Journal* in 2010. There, we can read for example that: *The amount of total lipid (fat) found in a serving of meat is highly dependent upon the feeding regimen, (...) the effect of feeding regimen is a very powerful determinant of fatty acid composition* (Daley, 2010, p. 7).

Meat, eggs or milk of the highest quality come only from animals, which look for natural – for their diet – food in an unhampered way and diversify this food with different species of grass, bush or tree bark. Therefore, the highest quality food is delivered from farms with high welfare of animal raising. All the nutritional benefits of animal products, that come from conditions of high welfare, were analysed by Heather Pickett in her report (Pickett, 2012), published for the organization *Compassion in World Farming*. Eggs from poultry farms can contain even half as much of vitamin E and three times less of beta-carotene in comparison with eggs from ecofarms. Similar differences are seen in nutrition facts of pork and cow milk. The meat of chickens which are raised in battery cages contains about 40% more harmful fat than protein needed especially by sportsmen. In report's recapitulation we may read: *Higher-welfare animal products were shown to have a number of nutritional benefits over intensively-reared animal products. Excessive fat consumption can contribute to weight gain and associated health problems. Higher-welfare animal products are often significantly lower in fat than equivalent products from intensively-reared animals. This is true of pasture-reared beef, free-range and organic chicken and chicken of slower-growing breeds and wild salmon and trout* (Pickett, 2012, p. 33).

Fish farming, besides the corruption of wild fish gene pools and the increase of fish mortality, poses one more serious danger.

Meat from factory farmed fish does not contain equally high nutritional values, as the meat of fish living in the wild. According to some reports, that were published by American *National Nutrient Da-*

tabase, the meat of indoor-raisedtrouts and salmons contains several times more fat, than wild fish meat and, what is worse – meat of indoor-raised fish additionally contains very high concentration of toxic chemical compounds, which are subsequently consumed by us. These chemicals found in fish organism are the remains of chemical baths connected either (1) with the elimination of diseases and parasites, which often decimate indoor-raised populations, or (2) with using chemicals to give fish body a pretty, *healthy* colour. The general conclusion arises that megafarms – regardless whether of cattle, poultry or fish – are the source of not only animal suffering, but also the suffering of social environment, and meat consumers because of the real danger of serious somatic disease emergence.

Recommendations and predictions

When we observe the activity of proecological organisations and scientific authorities, who proclaim and coax us into realizing the sustainable development idea, what strikes us quite firmly is the fatal independence among the work of theoreticians and raising practices. The lack of knowledge flow among theoreticians and practitioners seems to be the waste of a big intellectual capability. Thus, the first recommendation is the call for more direct complementarity of actions. It would consist in a close cooperation; exchange of experience, reflections and ideas among activists, theoreticians and groups – often hermetic – connected with industrial livestock producers. The efficiency of this recommendation can be testified by the cooperation of Polish Ethical Society and social initiatives, like Gaia Club or Viva! Organization – it results in wide-scale popularization of activities connected with animal welfare and environmental protection, where practice is supported by prominent scientists. Promotion of knowledge about the state of natural environment and animals takes such different forms, as: preparing manifestations and protests; taking part in conferences and congresses; frequent coverage in mass media; education of future staff; independent expert opinions; modernization of law; pushing forward necessary regulations. Cooperation of theoreticians and practitioners definitely intensifies the impact on public opinion and shapes the awareness of consumers. Raising the consumers' awareness concerning shopping decisions appears to be justified action, for it can significantly impact the awareness of implementing the idea of sustainable development. If a recommendation may be formulated regarding what should be done, then it would certainly involve the process of increasing the aware consumption in the society. The knowledge about the influence of factory farming on the condition of our health and natural environment should have a direct translation into the kind of products we prefer and buy. Hence, publicizing facts about factory farming becomes necessary, which is easier in our contemporary time of mass multimedia.

Simultaneously, there is the consumers' need to open the access to cheaper, healthy, organic and sustainable food as the proecological alternative for the meat from industrial farms. It would be the action compatible with assumption that looking (at facts) evokes comprehending seeing (of dangers, devastation, suffering). The adherent of such attitude was, among others, Jacques Derrida, a French philosopher who claimed, in the conversation with Élisabeth Roudinesco, that *visiblity* of a situation makes it to be known and understood a lot better (Derrida, 2015, p. 40).

Considering the European tradition of consuming meat in large amounts – which nowadays has often got a very low nutritional value – the next recommendation is striving for the modification of culinary habits. What we mean is the promotion of a diet deprived of damaging saturated fatty acids (found in overwhelming amounts in the meat from megafarms), which requires an easy access to diversified, ecological food. This is a very tall order, because ecological food is an expensive and – to a certain extent – luxurious product. Additionally, there is a lingering stereotype that regular meat consumption is the indicator of a high social status. Yet, lowering the meat-eating norm would be profitable both for consumers (lower risk of carcinoma and heart diseases, less overweight risk), for natural environment and animals themselves. The results of studies conducted by Willem Brandenburg and Rene Wijffels constitute solid evidence in favor of this theory. In their opinion, the ideal alternatives for meat are sea algae – easily digested, healthy, and – in respect of the protein contents – much more nutritious than meat. Regarding possibilities of growing seaweeds on the sea farms, this solution would relieve exploited soil and save fresh water. Theoretically, the idea seems to be brilliant in its simplicity. All we gain is health, environment and animal welfare and the price to pay is the change of anachronistic customs and cultural stereotypes. The problem lies in the issue of taste and our cultural habits. However, if the change of beliefs and customs exceeds the current possibilities of consumers, there is still a new hope in the *in vitro* meat production. Unfortunately, the conventional meat production influences not only the global climate changes, water pollution and oncological diseases, but also the profits in pharmaceutical, petrochemical or technological business, which is well known by stakeholders and shareholders and they are not going to abandon their financial customs.

Another recommendation, supported by economic facts and financial statistics, is the proposal of modernization of animal husbandry model and food production model. What is *de facto* meant is the contemporary return to the old type of agriculture – the reanimation of traditional mixed farming. In practice such model means:

1. Free range farming, keeping animals outdoors, out of cages, with full access to grass and natural food. By saying *traditional mixed farming* we understand the mixing arable farming with the raising of at least two species of domesticated animals, ranging from bees and hens to cattle and sheep. Such return causes *animal liberation* both literally and figuratively – the liberation happens on our mental level, for we liberate ourselves from post-Cartesian paradigm of perceiving animals as *machines*, which provide us with milk, eggs, meat, fur and leather. Giving up factory farming is the only one natural, but also traditional way of soil regeneration which does not necessitate using ridiculous amounts of synthetic, chemical fertilizers. One could say that sustaining the rustic tradition of respect for nature, we liberate ourselves from the Cartesian shackles of tradition to reify and objectify this nature.
2. Giving up intensive, monocultural crop farming, which means weakening the demand for soya bean and cereal intended for animals. The reduction of demand would require using smaller areas of the most fertile soils, where food for farms is being grown. *Currently, 1/3 of cereals and 90% of world soybean crops serve as the feed for intensive animal farming (…). If the whole grain, that currently serves as fodder for factory farmed animals, was consumed directly by people, and not after converting into meat, it would be able to feed an astonishing number of people – as much as 3 billion. For sure, it would be much more productive use of resources, considering, how much plant protein is needed to raise a chicken, a pig or a cow* (Lymbery, 2015, p. 257-258). *In order to produce one kilogram of meat that is really fit for consumption by industrial methods, as much as 20 kilograms of fodder is required* (*ibidem*, p. 259).
3. The traditional mixed farming model also leads to the limitation of pesticide use, and generally – the limitation of intensive farming which requires huge amounts of fuel and water. What can we gain thanks to this solution?
   a) The number of breeding habitats of water wildlife, mammals and birds increases. In American *The State of the Birds Report 2014* we can find some hints which enable us to save thousands of birds in the USA each year, for example by: *Limiting the broadcast spraying of pesticides and insecticides and introducing integrated pest management practices (which reduce or eliminate chemical applications) in agricultural areas* (Rosenberg, 2014, p. 6).
   b) The necessity of using limited reserves of petroleum decreases. According to *Oil Depletion Analysis Centre*, we have already exploited about 50% of natural oil reserves reaching the maximal level of oil output, what augurs the so-called *peak oil crisis* (higher petrol prices in the face of decreasing reserves). In the meantime, leading animals out of farms onto pasture implicates a decline of the fossil fuels exploitation. Similarly, the traditional growing of cereal, vegetables and corn or traditional animal raising is more energy-efficient than intensive meat and dairy production. Giving up feeding farm animals with imported soybean meal or fishmeal, and allowing free range grazing of animals, enables us to save energy. Economic calculation is simple: megafarms use up energy, health and resources in the form of pesticides, fertilizers, machines and fuel, in inadequately high amounts in comparison to the financial profits. Subsequently, organic cultivations together with traditional animal farming generate not only material profits and savings, but also compensate for the environmental losses successfully.
   c) The amount of used drinking water that is a scarce resource today, declines. Giving water to animals and clearing farms requires enormous amount of fresh water and particularly lots of it is wasted during the industrial meat and dairy production[3]. In addition, factory farming, from fish to beef, together with intensive crop farming, severely pollute every watercourse and ground waters. Moreover, using water from underground resources lowers the ground water level. *World Economic Forum* described watering of large monocultivated fields and intensive animal farming as the main source of water waste in agriculture (World Economic Forum, 2009). We may also read in formerly cited *Livestock's Long Shadow* that the agriculture itself, especially intensive and industrial, uses 70% of world's drinking water resources. Hence, debates regarding saving drinking water have to consider the future shape of global agriculture. Here the calculation is also simple: the bigger the megafarm, the bigger the pollution and waste of water. As Peter Cullen from Australian *National Water Commission* claims: *the amount of money*

[3] In 1961 Antonina Leńkowa warned us already, that *more and more emphasis is placed on the agricultural intensification, and the greater need of water is joined integrally with it. Only presently (!) the husbandry uses as much as 50-70 thousands of water cubic metres more per square kilometre, than formerly (…). We want larger harvests, so where can we get enough water from*? (Leńkowa, 1961, p. 165).

farms make for every million litres of water they use varies dramatically between states, from roughly $300 in New South Wales to $600 in Victoria and $1,000 in South Australia. (...) In the long run, the irrigation of pasture for livestock, which currently consumes about half of the basin's agricultural water, will not make sense (Mouth, 2007). Increasing the demand for meat and dairy products from farms seriously depletes – though indirectly – global shortage of drinking water.

All the above-mentioned facts indicate that water, soil and all biosphere would be used better – in a sustainable way – if we returned to natural grazing, farming and traditional cultivation, which is smaller, and operates on a local scale. These recommendations seem to be difficult to implement, for factory farming is the area of very strong financial relations, which generate high incomes for different stakeholders and shareholders. These include not only farm owners, but also producers, transporters, and distributors of fodder, pharmaceutical and petrochemical concerns, producers of agricultural gear and outfit, and even scientific institutions doing authorized evaluations and researches in order to provide evidences that legalize business *socially involved* and *environmentally responsible*. However, the main stakeholders that particularly care about the existence of factory farming, due to enormous incomes, are international chains of hypermarkets and fast food restaurants. Global chain of units selling huge amounts of cheap meat develops and thrives on industrial agriculture and carnage of animals.

The last recommendation, probably the hardest to implement, is the propagation of esteem for nature, animals and people. Unfortunately, not the esteem, but the fear of pathogenic food from megafarms, delivered via fast-foods and supermarkets, can make consumers demand healthy, slow food coming from ecological farms more often. Such propagation may impact on the current situation in a twofold way:

1. International corporations, like McDonald's or Burger King, will recognize healthy, ecological food as a profitable source, and vegetarian/vegan dishes or dishes based on humanitarian slaughter will become overwhelming content of the menu. It is impossible to stop global giants by request or threats, but their activities can be modified by reaching a compromise. Approaching the problem, not from an idealistic perspective but pragmatic one, the cooperation with fast food restaurants is the real chance for reforms in the entire eco-agri-food field, from choosing the types of growing crops and raising animals to the consumption in a bar. *If these giants make a decision to implement a change, for example to sell the milk only from free-range cows or eggs only from free-range hens, they can do it much faster and more definitely, than governments* (Lymbery, 2015, p. 317; Cao, Piecuch, 2012). Therefore, this is the tactics of increasing the demand and consumers' pressure connected with the work over diversifying our eating habits. The power of consumer boycotts and pressure is limited mainly by being uninformed, by staying unaware and by the lack of social sensitivity. That is why the exposure of problems, or even *the strategy of rumour* (*buzz anti-marketing*), are presently deemed to be rational recommendation in the media society.
2. Aware consumers directly influence the conditions, and also the health, of animals intended for consumption. Paraphrasing Lymbery, *unhappy pig, hen or cow is an unhealthy animal, and unhealthy animals give us unhealthy food* (*ibidem*, p. 308). We should remember that a real change in megafarm functioning is possible in the situation of consumer grassroots movements with, at the same time, the top-down decisions, taken at the highest level of Government, and in the end – at the Members of Parliament level.

Concluding remarks

We already know, what links the situation of cows from dairy megafarms, fish from indoor fishfarms with wild butterflies and bees: all these animals, as the whole ecosystems, are the real victims of industrialization of rural areas. Birds feeding with vertebrates and pollinating insects are the natural systems that prop up the husbandry. This is how ecologically sustainable agriculture looks like, which can actually implement the idea of sustainable development. Meantime, killing some elements of biocoenosis, which help out to hold on such sustainability, is a clear evidence that industrial intensification of farming may flaw the agriculture in a long-term perspective. In the long-term approach it is profitable for the whole society to resign from radical industrialization, but it needs to transcend our egocentricity and take a collective and long-range perspective, where the profit will be deferred for much further in the future. The idea that methods of intensive farming are the key to social prosperity and wealth is clearly false.

The result of sustainable development of food industry is the protection of farm animals and promotion of animal welfare all over the world. Farm animal welfare can arise:

1) from the modification of law, which regulates the raising conditions of poultry, pigs and cattle and
2) from the modification of eating habits and patterns among consumers of meat and dairy products.

The second reason of welfare seems much more meaningful, because it would be caused not by ex-

ternal constraints and the fear of penalty, but by internal beliefs based on the aware and free choice and acceptance of our own hierarchy of values.

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Urbanization, Food Insecurity and Agriculture – Challenges for Social Sustainable Development

Urbanizacja oraz zagrożenia bezpieczeństwa żywieniowego – wyzwania dla społecznej płaszczyzny rozwoju zrównoważonego

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Abstract

Sustainability essentially involves maintaining level of *per capita* well-being over time. With coming of the concept of sustainability the line of distinction existing between Human and society got vanished and there was a paradigm shift to understanding the various dimension of human society and their inter linkages along with the challenges we face. This paper reviews contemporary thinking and outlines the challenges with regard to the three very important dimensions, namely: urbanization, food insecurity and agriculture. Among the various reasons for growing food insecurity the key one has been Urbanization and its consequential increase in population. Through this paper we are presenting the ideas and practices of agricultural sustainability dealing with the following problems: Agro-environmental Sources, Inputs System, Socio-Economic system and the various Farming Systems. Also in this paper outline for ideas of urban sustainability incorporating the concept of urban social sustainability, understanding the position of urban ecology have been studied. Concept of urban farming is also important, since it helps to reduce problems in urban food supply by ensuring urban food security.

Key words: food security, sustainability, education, ecology

Streszczenie

Zrównoważony rozwój w istocie polega na stałym utrzymywaniu odpowiedniego poziomu życia ludzi. Wraz z rozwojem koncepcji rozwoju zrównoważonego linia podziału pomiędzy jednostką a społeczeństwem zanika, a jednocześnie następuje zmiana paradygmatu w kierunku poznania różnych wymiarów życia społecznego i ich powiązań z wyzwaniami, przed którymi stoimy. Niniejszy artykuł stanowi refleksję odnoszącą się do wyzwań związanych z trzema ważnymi wymiarami: urbanizacją, zagrożeniami bezpieczeństwa żywieniowego i rolnictwem. Wśród różnych uwarunkowań rosnącego zagrożenia bezpieczeństwa żywieniowego kluczową rolę odgrywa urbanizacja i jej konsekwencje. Przedstawiamy idee i zagadnienia praktyczne związane ze zrównoważonością w rolnictwie zwracając uwagę na: aspekty agro-środowiskowe, system wejść, system społeczno-ekonomiczny i różne systemy uprawiania roli. Próbujemy także przybliżyć koncepcję miejskiej zrównoważoności, zawierającej w sobie zagadnienia związane z miejską zrównoważonością społeczną, rolą, którą powinna odegrać ekologia miasta, a także możliwościami rozwoju miejskiego rolnictwa, jako sposobu na zmniejszenie niedostatków dostaw żywności i poprzez to zapewnienie miejskiego bezpieczeństwa żywieniowego.

Słowa kluczowe: bezpieczeństwo żywieniowe, zrównoważoność, edukacja, ekologia

Introduction

Food is the essential for human well-being and human development. Sustainability is when People, at all times, have access to required food for a normal and healthy life. Food Security is determined by food stability, food availability, utilization, food access and linked to livelihood security. Food security assessments include indicators of food availability, access and nutritional status. Increased food production is the cornerstone for alleviating global food insecurity (Corvalan, Hales and Mcmichael, 2005). Despite the agricultural production being more adjusted to the demand, still in some areas there is acute malnourishment. The key reasons connected with pressure on food security are: atmospheric conditions change, urbanisation, worldwide integration, population increase, diseases, as well as various other factors responsible for changing patterns of food consumption. In developing countries these factors are concentrated. Together they impede people's access to sufficient, nutritious food; mainly through affecting livelihoods, income and food prices.

An Asian Perspective on Food Security

The strategic approach for sustainability, adopted by Asian governments, includes:

a) Growth element of macroeconomics: The period up to 1997 saw high rates of savings and investment along with sustained level of capital productivity and with high investment in human capital. This was the growth that reached the poor termed pro-poor growth (Agarwala, 1983).
b) Stabilization of food prices: this ensured that the economic environmental problems, or the short run fluctuation, does not reduce the access to food to the poor.

The above strategies address the macro dimension of food security (not the micro dimension which works within the household and individual level). These include rural education, nutrition education, etc. Asian perspective on food security can be best understood by presenting economic and political background of differences connected with rice cultivation trends, that may be manifested in three ways:

(a) First, daily access to rice is essential for survival (Timmer, 2005), substantial part of farming involves rice cultivation.

(b) Second, knowledge acquired by rice growers, as well as skill of cultivation during favourable market condition.

(c) Third, stock buffering in Asian markets is needed to immunize the consumers from fluctuating prices. This requires that government actively controls the flow of rice.

Removing the special status of rice cultivation will help to make it more as an economic commodity and reduce the political influence. Greater investment is being done, with the coordinated international efforts, to open free trade in rice market, so as to stabilize the price. This will ensure more prosperous future for Asia by providing greater food security.

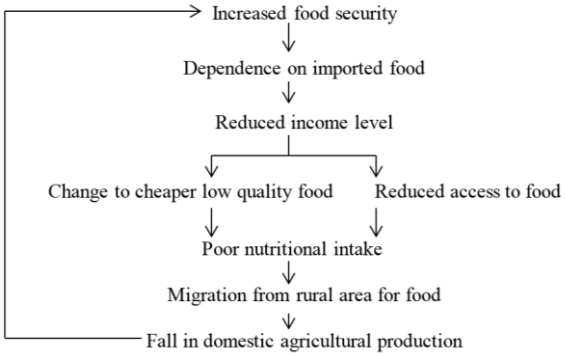

Figure 1. Graphical representation of Food Insecurity cycle

Figure 1 is an incorrect cycle, where each part is strengthening the other. The very first stage, i.e. increased food security, is supplemented by various factors. Key reasons for mounting pressure on food security are: climate change, urbanization, globalization, population boom, diseases, other changes in food consumption pattern, etc. With greater food insecurity subsequently the domestic food supply is already affected; there will be increased dependence on imported food. Since the imports increase consequently, the individual household gets affected because of the same level of income. This would effect in change in livelihood activities. When there will be increased dependence on imported food this would result in reduced income level (effect to livelihood: reduced expenditure on non-essential items what lead to sale of non-productive assets).

Reduced income level will have two effects. Firstly, shift to cheaper/low quality food, because of reduced buying power. Secondly, reduced access to food (effect to livelihood: increased number of poor people) and use of low quality food will consequently result in poor nutrient intake, because the daily nutritional requirement will not be met. All the above will contribute to increased migration from rural areas in search of availability of food (effect to people: there will be increase in rate of school dropouts in the case of children accompanying their migrating parents). Migration from rural areas will lead to fall in agricultural production, this in turn would lead to even greater increase in food insecurity and the cycle would continue.

Figure 2. is a cyclical representation of individual as an element of food security chain. This cycle considers both the growth aspect as well as the developmental aspect of society. At society level both physical and economic factors are contributing assets. The first box is the assets table including physical, social and economic contributing factors (for example: person's physical attributes contribute to the

farmland production). With more food production the purchasing power increases, hence the earning increases, so also does the saving and investment. Certain livelihood strategies (including production, investment, saving etc.) provide basic services and infrastructure. This subsequently leads to food availability in the market, the outcome of which is better food access, better health care practice and better hygienic conditions. As a consequence, the food intake increases and improves the health status of individual, which supplements the body nutrient stores and increases immunity, thereby decreasing mortality.

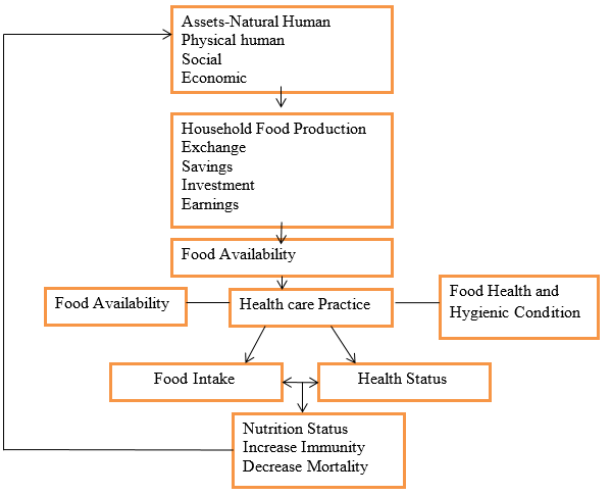

Figure 2. Food Security and Individual's Socio-Economic Status

Urbanization and Food Security

As regard to the urban food supply, the rural and international imports represents majority of food supply. One important aspect is that it is highly vulnerable to climate variations and international trade policy. The urban and peri-urban production (high value commodity) also contributes to the urban supply chain and these may include fresh vegetables, fish, meat, dairy, etc. Processing, packaging and transport in urban area is a challenge to food security and is contributing to carbon footprint (hence it becomes a challenge to the sustainability). The consequences are connected with increasing number of infectious diseases and water borne illnesses in urban areas of developing world. Moreover, with imports of high value commodity from rural areas, limited cash incomes makes urban area population more vulnerable to price shocks.

Agriculture

Agriculture provides the bulk of various goods, required by the non-agricultural sector, as well as numerous raw materials for industry. The direct and indirect share of agricultural products in exports is quite high. Sustainable food production, protection of ecosystem and climate policy is only achievable through effective agriculture. Poverty is also known

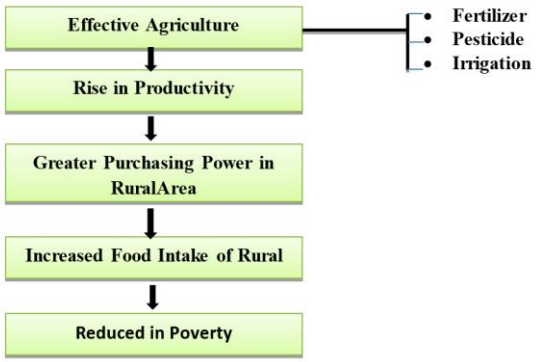

Figure 3. Agricultural Sustainability

to be impacted by agriculture. The forest land, when changed to agriculture land, leads to i.e. soil erosion, which leads to substantial disturbance in coastal ecosystems. This happens because of clearance of forest land for agricultural purposes, which means a consequential elimination of the natural carbon sink. The damage is then mitigated to other components of biosphere including the coastal ecosystem. So there is a need for saving the nature from degradation and to elevate poverty. The Asian 1960's criterion was based on Figure 3. At that time there was a rise in the productivity of rice. The increased productivity of rice led to an increased purchasing power in rural areas. It also improved the food intake of rural households (hence rural economy helps to reduce poverty quickly by inducing higher real wages). All the components which were used in 1960's showed gains in agriculture productivity, but it also raised the concern about sustainability. The excessive use of pesticides, insecticides, herbicides and chemical fertilizers has bad impact on soil fertility. No doubt production was increased manifolds, but it was at the cost of environment.

Sustainable Agriculture

The 1990's era saw a growing movement that questioned the role of the agricultural establishment, especially with reference to Green Revolution, in promoting practices that contribute to a variety of socio-economic and other problems. Within the mainstream agriculture this movement has found huge support. Sustainable agriculture addresses environmental and social concerns, and it offers innovative and economically viable opportunities for farmers, consumers, policy makers and many others in the entire food production system. It really is important to identify the basic ideas, practices and policies that constitute the concept of sustainable agriculture, since it will remain evolving in the coming years (FAO, 1989). This will be essential in setting the priorities. In Asian countries sustainable agricultural productivity has to be thought in terms of raising yield levels until population stabilizes and malnutrition is alleviated. Under these circumstances sustained production level, which is not harming the

ecosystem, is considered as sustainable productivity. According to the FAO, agriculture is sustainable when it is ecologically sound, economically viable, socially just, culturally appropriate and is based on a holistic scientific approach. Reijntjes, Haverkort and Water (1992), define Sustainable Agriculture as: ***Low External Inputs and Sustainable Agriculture (LEISA) –* [so] *the agriculture which makes optimal use of locally available natural and human resources such as soil, water, vegetation, local plants and animals, human labour, knowledge and skills and which is economically feasible, ecologically comprehensive, culturally amended and socially fair.*** Sustainable agriculture in loose sense defines a range of strategies to address problems like:

a) Loss of productivity due to soil erosion,
b) Mismanagement in use of agro-chemicals, particularly pesticides and fertilizers,
c) Pollution of surface and ground water due to agricultural practices and inputs,
d) Diminishing supply of non-renewable energy sources, and
e) Decreased farm income due too low commodity prices and high production costs.

Urban Sustainability

Urban cities have become the centres of world economy, since substantial part of population live there. It has rightly been said, that humanity has entered the *Urban Age* (more than half of the worldwide population is already urban). Objectives of sustainable development in urban areas involves not only achieving sustainability in development and planning of urban settlements, but also the general guiding principles of sustainability. Urban sustainability provides safe and healthy environment, which means healthy living environment, proper drainage and sanitation, waste disposal, adequate economic base for society and other important social and cultural goals. Due to several associated risks that urbanization has specifically on the human health, it brings several challenges to urban sustainability. A widespread rural relocation to urban areas causes risk to human health, due to certain dietary and social changes. The reason for this is that the societies in rural areas have entirely different social culture and habits compared to those in urban areas. With the migration from rural areas to urban areas it leads to heterogeneous population, which results in emergence of new culture or a new form of human behaviour (Wirth, 1938).

In urban areas the effort to raise living standard resulted in exhaustion of the ecological background. Ecology is the realm of natural sciences, since it is understood as study of relationship between the living and the external world. Whereas urbanization is associated with social sciences, since the centre of urbanization is connected with changes in human society. Ecological factors in urban areas has definitely been affected by the prosperity of the human society and the consumptive actions of human nature.

The rapid pace at which the growing population is exploiting the locally available resources is a threat to ecological factors. Ecosystem is created through self-building processes and man is its very essential part. Human behaviour in one area can affect the health and well-being of people not only in the same place, but also in other regions (Nan, 2000). For urban sustainability a healthy and protected urban environment is a precondition. Understanding this human spatial relationship with the ecosphere, i.e. the nature, is essential.

Urban Farming

The main aim of urban farming is to promote and inspire the urban farmers to grow food more sustainably. Irrespective of the size of the farm land, the most important element of urban farming is efficiency. Urban farming contributes to social economic improvement in the urban areas of developing world because firstly, it supplements the income and food production and secondly, because in some communities it acts as sort of recreation and relaxation. Urban farming relieves the rural agricultural production for export oriented purposes by attaining substantial self-sufficiency. Since urban areas are prone to food supply problems, hence farming in urban areas contribute to food availability to urban population.

More importantly, it increases resilience to adverse shocks by maintaining food production. Urban agriculture is in fact a response to increasing urban poor population crisis (Wackernagel, 1994), hence becomes very essential for community building. Sustainability in urban farming is achieved though recognition of environmental degradation of cities. Emphasis is on relocation of resources to better serve the population by various schemes of sustainable agriculture.

Local Climate Governance

Whether the contemporary political and administrative systems can handle the challenges emerging from climate change is the question.

Local governance is restricted in various fronts on formulating and implementing the action plan. The climate protection strategy, based on the common good, is often objected for the adverse consequences and lack of scientific certainty it holds, hence there is a tendency to delay the action. But most importantly, these findings have implications on urban sustainability (Jagers and Stripple, 2003). Hence the existing governmental systems/institutes are not adapting to the environmental flux and thereby are not going beyond the traditional governance structures. Climate governance essentially means the

modes by which the stakeholders implement policies to mitigate the impact on climate and furthermore adapting to the effect of such climate change. Amongst all the stakeholders much emphasis is on local government as a major stakeholder. For easy understanding of modes of local governance, modes of local climate governance were identified (Bulkeley and Kern 2006):

Firstly, mode of self-governance, where the applicability is on the government itself, e.g. going beyond the national building standards and regulating energy use by municipal buildings, purchasing green energy. This also involves self-assessment and certain amount of accountability and transparency.

Secondly, through enabling and supporting the other stakeholders. This framework involves an element of decentralization of planning structure and is also effective due to the participation, recognition and inclusion of local stakeholders. Example – access and management of resources for low income groups, advice for energy efficiency, campaigns on green transport, dedicated funding of environment programmes, providing green jobs, etc.

Thirdly, the local government act as service provider, i.e. provides basic environmental services like waste collection, safe water supply, public transport and deals with environmental disaster, etc.

Finally, governance by authority, e.g. identifying and analyzing environmental issues, selecting program focus, defining institutional structure and planning, incentives and regulations, laying down efficiency and emission standards, providing proper city planning, etc. Effective governance of urban cities is a challenge to the economic productivity and human well-being. Local level of governance does not have full access to the key areas of decision making. Moreover, since there is a need for larger research effort for adaptive framework, hence the local government tend to overlook this aspect. Urban sustainability is the most neglected domain and up to what extent the local governance can address the challenges of sustainability is the most important question. Shaping cities towards a healthy future could help also to achieve goals of sustainability.

There is a need for setting and planning agenda to encourage leadership and gain stakeholders support.

Conclusion

The concept of sustainable agriculture will remain ever evolving in the years to come. For the society it is really important to identify the basic ideas, practices and policies that constitute the concept of sustainable agriculture. Urbanization has had a big impact on fundamental changes taking place in our contemporary food system. The rapid unsustainable growth of cities is adversely affecting the basic Urban Support Service system, which hampers the basic health of individuals. This, along with migration from rural area, adds to growing number of urban slum dwellers further worsening of food security.

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Ecological Entrepreneurship and Sustainable Development

Przedsiębiorczość ekologiczna a rozwój zrównoważony

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Abstract

The issue of sustainable development applies to all spheres of social life. Current activities in this field endeavour to create comprehensive solutions at all levels, ranging from local to global. Their planning should take into account the coexistence and interaction of the three capitals: economic, social and environmental. This article presents the essence of sustainable development, which seeks to harmonise these capitals. The proposal is to consider them in accordance with the principles of the system approach. It will show that the implementation of this idea requires entrepreneurial activities aimed at rationalising and modernising the economic, social, and ecological subsystems, as well as their integration to achieve synergy. Particular attention is paid to environmental entrepreneurship as a factor in regional development.
Key words: sustainable development, ecological entrepreneurship, system approach

Streszczenie

Problematyka koncepcji zrównoważonego rozwoju dotyczy wszystkich sfer życia społecznego. Obecne działania w tym zakresie zmierzają do tworzenia kompleksowych rozwiązań na wszystkich szczeblach – od lokalnego do globalnego. Powinno się je planować uwzględniając współistnienie i wzajemne oddziaływanie trzech kapitałów: ekonomicznego, społecznego i ekologicznego. W artykule przedstawiono istotę zrównoważonego rozwoju, który dąży do harmonizacji tych kapitałów, zaproponowano rozpatrywanie ich zgodne z zasadami podejścia systemowego. Pokazano, że wdrożenie tej idei wymaga działań przedsiębiorczych skierowanych na usprawnienie i unowocześnienie podsystemów ekonomicznego, społecznego, ekologicznego, a także na ich zintegrowanie i uzyskanie efektu synergii. Szczególną uwagę zwrócono na przedsiębiorczość ekologiczną jako czynnik rozwoju regionalnego.

Słowa kluczowe: rozwój zrównoważony, przedsiębiorczość ekologiczna, podejście systemowe

Introduction

The issue of sustainable development is increasingly becoming the subject of theoretical and practical research. It is actively discussed in scientific and popular literature, on various forums as well as during national and global conferences. Many scientific works are devoted to the development of theoretical and methodological basics of the various sustainable development aspects including political, environmental, organisational, financial, and economic. Politicians, philosophers, economists, lawyers, environmentalists, sociologists, physicists and biologists from around the world are involved in discussions on this subject. Each discipline perceives sustainable development through the filter of its own concepts and methods. From the management point of view the main objective should be to equip people with the right tools so that they can responsibly plan for social and economic development of the communities to which they belong, by wisely exploiting natural resources (Cao Y., Piecuch I., 2012; Olkiewicz et al., 2015). A simplified discrete analysis of the economic, environmental and social systems should be replaced by an integrated approach. Here, man plays the main role shaping reality around him through his

actions. There is even the opinion that *the management of natural resources is really the management of people*, but the importance of the social aspects of resource management is not widely recognised (Berkes, Folke, Colding, 1998).

For a better understanding of the inter-relationship between the economic, social and environmental components, which form the basis of sustainable development, a systems approach should be used. This will give the opportunity to take into account many points of view and to take advantage of the available knowledge and experience of all stakeholders (local authorities, representatives from local communities, non-governmental organisations, scientists from various disciplines, businesses).

Sustainable development of each system (organisation, society, natural environment) is impossible without commercial activities. Free enterprise is widely regarded as a major factor in a country's socio-economic development and rise in its economic competitiveness. It is usually only associated with economic activity. The evolution of sustainable development is accompanied by a process which shapes the main instrument of this concept – a multidimensional enterprise. Innovative, creative actions are needed to rationalise and modernise all economic, social and ecological systems, to integrate them and achieve synergy. One can talk about the three dimensions of free enterprise:

- free enterprise in the economic dimension involves the creation of new businesses, introducing new products, services and production inputs, developing new organisational and management methods, etc. Mariusz Bratnicki points to three main aspects: carrying out a business activity, creation of new enterprises and the creation and taking advantage of opportunities, which incorporate a strategic renewal of existing organisations (Bratnicki, 2008),
- free enterprise in the social dimension includes the behaviour of entire communities, comprising of different groups of people. Andrzej Klasik stresses that *free enterprise can be characterised as a socially conditioned process of generating opportunities for wealth creation, as well as their imaginative use through the exploitation of financial, material, as well as human and social capital in an innovative way* (Klasik, 2006),
- free enterprise in the ecological dimension, i.e. commercial activities undertaken and implemented for the benefit of the natural environment, while simultaneously respecting the legal regulations, take into account the pro-ecological impact on the market and the ecological values of the consumers. The state of the environment and a sense of responsibility for the exploitation of its resources may affect the business model. More and more frequently it takes on an eco-friendly character, based on environmental competencies, creating a value chain, which takes into account ecological requirements, eco-innovation arising out of ecological awareness (Chodyński, 2009, p. 34; *Ekologiczna strategia sukcesu*, 2008).

Businesses perceive opportunities of conducting their commerce within the concept of sustainable development on a global scale across national borders, without political turmoil, with financial stability, in a favourable investment climate, support from national and regional institutions which protect human rights and ensure security for citizens and organisations.

Sustainable development in economics and management

The concept of *sustainable development* was defined in 1987 in a report titled *Our Common Future* (Brundtland Report) published by the World Commission on Environment and Development. The definition in the report is *Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs* (WCED, 1987). Achieving this goal requires diversified, integrated worldwide activities in three key areas: responsible, long-term economic growth of all nations and communities, as well as uniform distribution of benefits, protection of the environment and natural resources, social development. Only such an approach helps to plan long-term ventures taking into account the following:

a) their economic facet (satisfying needs and attaining profits),
b) rational use of natural resources (which naturally limit the possibilities of satisfying needs),
c) ethics and responsibility both on a local and global scale (satisfying the needs of all people in a similar way).

The main objective of sustainable development is to satisfy the most important needs for living for all people and to ensure everyone has equal opportunities to realise their aspirations for a better life (Кувшинов, 2011). However, one must remember about the existence of restrictions constrained by growth of knowledge, techniques and technologies that affect the natural environment's ability to meet humanity's present and future needs (Miksch, 2015; Siepak, 2015).

The current approach to the concept of sustainability was shaped over many decades. It was presented for the first time by the Club of Rome, in the report *Limits to Growth* published in 1972, which analysed humanity's future with respect to the growth of Earth's population and the exhaustion of natural resources (Meadows, Meadows, Randers, Behrens, 1973).

Members of this international organisation, consisting of scientists, politicians and businessmen, discussed the concepts of dynamic growth, organic

growth and dynamic progress (Peccei, 1977; Pestel, 1989; Гизатуллин, Троицкий, 1998) which had one common element – a comparison of the global economic system with that of a living organism. In the evolution of living organisms quantitative growth does not play a significant role, vitality and the ability to survive are the most important improving quality as well as adapting to the environment. Likewise, a society that has attained sustainable development will be able to respond to changing external and internal circumstances and achieve an internal state of equilibrium as well as in the environment where it operates. In management this organisational characteristic is called dynamic equilibrium, or homeostasis.

It could be argued that contemporary ecological problems which inspired the concept of sustainable development, to a certain extent, have been due to the delay of the economic school of thought. From the time of Adam Smith, neither classical theories, nor subsequent economic schools paid any attention to environmental constraints in economic development. It was only in the 1970s, when worldwide environmental problems strongly intensified, did a need to understand and explain economic developmental trends arise in addition to the development of new concepts. To deal with the long-term, extensive and complex challenges of sustainable development, according to Robert Costanza and Carl Folke, it is necessary to solve three interrelated problems (Costanza, Folke, 1994):

1) maintain a stable economic size, which corresponds to the ecological life support system,
2) achieve a fair distribution of resources and opportunities within the current generation, between the current and future generations as well as between humans and other biological species,
3) ensure an efficient allocation of resources while taking into account natural capital.

According to traditional economic thought, the second problem should be resolved by using political rather than economic means. In turn, the third problem was not even considered to be important because the possibility of replacing or finding new resources was taken into account through the achievements of scientific and technical progress. However, due to intensive development of management science within the field of economics with its systems approach, attention was also drawn to these two problems. The systems approach treats an organisation as a unified, purposeful, open system, composed of interrelated parts which form a certain whole which differentiates itself in the environment (Figure 1).

From the definition of an organisation as *a group of people who work together in an orderly and coordinated manner to achieve a set of goals* (Griffin, 2010, p. 35), it follows that individual economies, societies and countries can be examined and analysed in a similar way. They are also complete systems which form part of the external environment. The creators of the systems approach believed that the only non-negotiable and explicit objective of an organisation (and thus the remainder of the listed systems) is survival and development. Consistency and strength of the system influences the prospects of its implementation, its position in the environment, and its ability to be maintained and strengthened (Katz, Kahn, 1979; Yuchtman, Seashore, 1983; Leavitt, Bass, 1964).

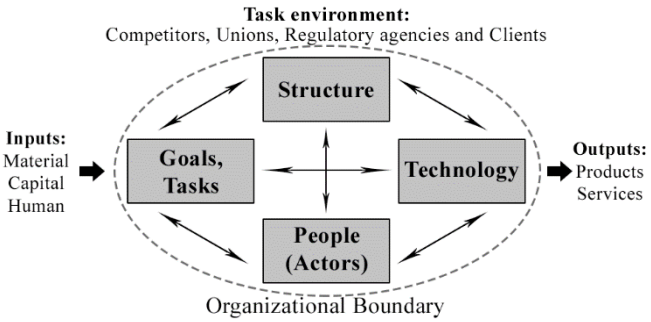

Figure 1. A model of an organisation by Harold Jack Leavitt – a systems approach, based on Leavitt, 1965, p. 1144.

This form of thinking fully reflects the essence of sustainable development. It is worth emphasising the difference between economic growth and development. Economic growth is a quantitative change. It depends on increasing the production of goods and the number of services provided in a short time. It is not accompanied by changes in the structure of the economy in a given country. Economic development is the transformation of both quantity and quality. The increase in production of goods and the number of services is observed over a long term. It causes changes in the structure of the economy.

The concept of sustainable development would not have become widely accepted if there were no suitable justifications within the traditional economic sciences and societies. Three basic processes need to be mentioned here: rationalisation, globalisation and economic development based on knowledge and information. Up to the middle of the 20th century, economic growth was based mainly on rationalisation, i.e. the search for any methods and techniques which allow obtaining the best possible results at the lowest possible cost (time, energy, raw materials, manpower, etc.). Later globalisation intensified and the global economy was established. It turned out that the business must take into account the global and not the local point of view. The globalisation process refutes all constraints (economic, financial, and cultural) and leads to a gradual disappearance of barriers to the movement of capital, goods, services and people. It was only in the 1990s that it gained a strong momentum after the collapse of the socialist system and the breakup of the Soviet Union. Borders were opened not only to goods, services and investment, but also to technology, information and ideas (Godlewska, 2001).

Globalisation has helped to accelerate the development of the modern world economy, raise living standards, quicken the pace of technological progress, and open up access to learning and education. It has led to the emergence of an economy based on knowledge and information at the turn of the 21st century. Its essence is effective creation, assimilation, sharing and exploitation of knowledge with the economy being the basis for doing business. Its characteristics include the growing importance of knowledge, the rapid pace of technological change, the development of information and communication technologies, the growing demand for knowledge creation etc. (Świadek, 2011). Thus the traditional principles of economic efficiency of the 1970s were somewhat changed by the need to solve social problems in developing countries. Increased poverty in those countries required specific actions on a global scale related to allocating part of the profits to social objectives. In the beginning of the 1980s it was proven that the degradation of the natural environmental is a serious obstacle to economic development. Neglecting ecological problems cannot be explained by the need to pursue economic goals. Combining these three points of view (economic, social, ecological) led to the creation of the concept of sustainable development.

Remigiusz Rosicki believes that the inspiration for solving complex problems of sustainable development should be sought, among others, in (Rosicki, 2010):

- systematic research methods,
- new management concepts,
- performance research,
- technological development,
- development forecasts presented at scientific and journalistic circles,
- economic analyses of international economic relations,
- analyses of the so-called third world countries, both developing and developed,
- research into climate change,
- the generation of new man-environment ideas.

The systems approach is certainly suitable for sustainable development. Environmental protection, economic growth and social justice are closely related. This is shown in Figure 2.

The results from one sphere are the input for the remaining two spheres relating to life and social activities. The natural environment, its condition and quality, is necessary for business as production indicators and for society as essential living conditions. Results from the economic sphere (goods, services, income) satisfy human needs while simultaneously affecting the environment. The process and method of satisfying social needs, including natural resources, also have certain effects which impact on the environment and on the possibility of obtaining resources for the business. Moreover, one can notice not only that these spheres are interlinked but also a conflict of interest; the more the interests are taken into account and objectives are met in one sphere the more the interests of the remaining two are in conflict. It is therefore a very complex task to reconcile these interests and devise specific projects. The interaction between the social and economic spheres generates such tasks as the pursuit of justice in the distribution of income and help for the poorer classes in society. The interaction between the economic and environmental spheres requires tackling the problems associated with implementing eco-friendly, efficient technologies. Linking the environmental and social spheres requires the resolution of such dilemmas as intra-generational and inter-generational equality, taking into account the rights of future generations and the development of an eco-friendly mind-set (ТО КЕН СИК, 2010).

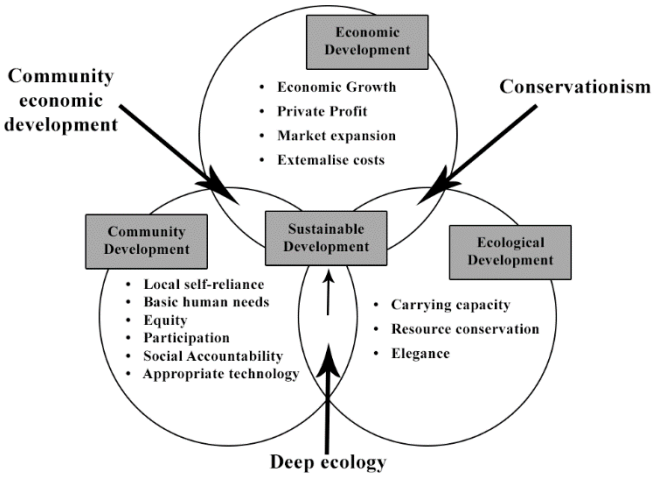

Figure 2. The sustainable development model, source: http://lewishistoricalsociety.com/wiki2011/tiki-read_article.php?articleId=110 (17.05.2015).

Understanding these interdependencies and devising appropriate ways for organisations and societies to function under such complex conditions requires creative and innovative thinking and enterprising actions.

Ecological entrepreneurship

There is general agreement that entrepreneurship has contributed to the civilised development of the modern world and not just economic progress. Social prosperity grows when innovative processes are implemented, the economy is knowledge-based, and the principles of sustainable development are implemented. Entrepreneurship is a broad and multi-faceted concept which is difficult to define clearly. Robert Hisrich and Michael Peters define it in a fairly universal way as the process of *creating something different with value by devoting the necessary time and effort, assuming the accompanying financial, psychological and social risks and receiving the resulting rewards of monetary and personal satisfaction* (Hisrich, Peters, 1992). For the development of

entrepreneurship, not only are economic and political factors important, but so too are cultural, i.e. a system of values and beliefs, traditions, trust, family ties, a social climate (Kraśnicka, 2002). It is also strongly linked to local development, which is based on harmonised and systematic communal actions, aimed at satisfying its needs and contributing to its overall progress. It should be extended to cover increased environmental awareness, based on respecting values for the natural environment, careful creation of spatial order, reduction in pollution, and use of eco-friendly technologies.

The aim of eco-entrepreneurship is the initiation and realisation of projects related to environmental protection, dissemination of *clean technologies*, recycling and deepening society's knowledge and awareness, striving to create a *green*, more eco-friendly economy. It is widely accepted that eco-entrepreneurship plays an important role in minimising the negative impact of organisations and people on the environment. It includes actions in the development and implementation of (Wzorce…, 2011; Huczek, 2010):

- environmental technologies, generating less pollution than hitherto, which use natural resources sparingly. They relate to: acquiring resources, conservation of soil, waters, and air, preventing global climate change, sustainable production, consumption, logistics,
- clean production technologies, namely various technical measures adopted to conserve resources and reduce or even eliminate *at source* any arduousness, pollution and waste. They focus on conserving raw materials and energy, eliminating toxic raw materials and reducing the quantity and toxicity of all emissions and waste, and determining interactions throughout the product life cycle, from extraction of raw materials to their final disposal,
- non-technological innovations such as new products and services, new business practices with a reduced adverse impact on the environment or allow for the optimal use of resources,
- ecological awareness programs, to improve environmental education. These are complex processes, run differently, depending on the moral norms, and the degree of knowledge about the ecological consequences of actions undertaken in relation to the environment. The necessary change in awareness combined with the development of new civilisation models. A new world vision requires environmental education, which would change the way of understanding nature.

Three main groups of factors favour the development of eco-entrepreneurship. The first group includes the tightening of international and EU environmental standards, improvement of legal regulations at national and international level, simplifying administrative procedures and financial incentives for promoting environmental aspects. In 2012 TNS Political & Social Research carried out research among businesses operating in the EU in the 27 EU Member States and in 11 other countries for the Flash Eurobarometer 342 survey *SMEs, Resource Efficiency and Green Markets*. It turns out that 51% of businesses believe that tax credits, grants and loans are the best measures to encourage investments in energy efficiency. Almost half (49%) of companies which already offer eco-products and eco-services, declared that financial incentives would be most helpful to increase the range of products or services and to develop the products. 31% of those who currently do not offer green products believe that financial incentives would help them to start such activities. Technical advice and simplification of administration were recognised as a very effective means to assist in the implementation of ecological issues (Flash Eurobarometer…, 2012).

The second group of factors is the rapid growth of markets in eco-goods and eco-services. The EU market for ecological products has quadrupled in the last 10 years. For the sector to continue expanding and responding to market challenges, the European Commission has undertaken a number of actions related to improving quality and promoting organic food, strengthening consumer confidence in organic products and the removal of barriers to the development of organic farming. They focus on three main objectives: maintaining consumer confidence, maintaining producer confidence and helping farmers in their transition to organic production (Ekologia modna, 2014). In 2013 worldwide organic production was estimated to be €55bn, with the United States (€24.3bn), Germany (€7.6bn), France (€4.4bn) and China (€2.4bn). The market value of organic products in the EU was €22.2bn. Figure 3 shows each country's share of organic sales.

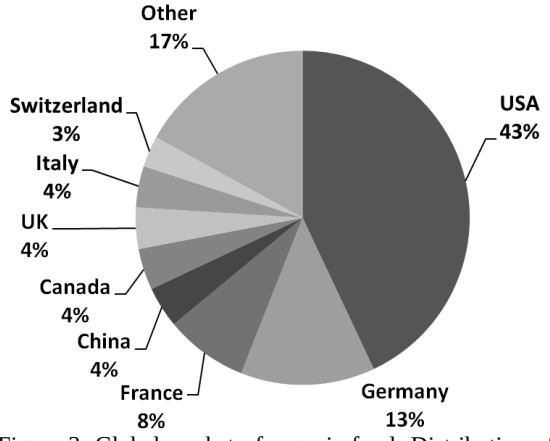

Figure 3. Global market of organic food: Distribution of retail sales by country 2013, source*: The World of Organic Agriculture. Statistics and Emerging Trends*, 2015, http://www.organic-world.net/yearbook-2015.html (01.07.2015).

The highest consumption per capita was recorded in Switzerland (€210), Denmark (€163) and Luxembourg (€157). The largest market share was achieved

Table 1. Factors in the development of the region, source: own work based on Brandenburg, 2011; Gralak, 2006; Makieła, 2008.

	Sphere	*Factors*
Endogenous factors	economic	economic base and structure of the region, scale and structure of local and regional markets, investments, entrepreneurship, ability to innovate, labour market, demand, personal and business incomes
	infrastructure	transport infrastructure, institutional infrastructure, potential for infrastructure development, investment in infrastructure and affluence of communities, counties and the region
	social	population structure, demographics, human capital, social capital, living conditions, values, institutions and social services
	spatial	the availability of space, condition and structure of the settlement, spatial structure (composition), spatial order, the value of space
	ecological	environmental components and resources, level of pollution and environmental devastation, quality of the natural environment, the development potential of the ecological infrastructure, residents' environmental awareness
Exogenous factors	political	globalisation, European integration, domestic policy, interregional policy, sectoral policy, constitutional changes, global political map, historical conditions
	socio-economic	macroeconomics, external investments, regional competitiveness, public welfare, external demand for the region's products and services, economic situation, human migration

in Denmark (8%), Switzerland (6.9%) and Austria (6.5%). Organic farming is practiced in 170 countries with approximately two million farmers growing produce organically on over more than 43 million hectares of agricultural land (The World of Organic Agriculture, 2015).

The third group of factors is increasing consumer interest in purchasing organic products thereby increasing the producers' production. As mentioned previously, the survey showed that 37% of SMEs in the EU has at least one full-time or part-time employee working in green jobs. For SMEs, 1 in 8 employees (almost 13% of all jobs) work in green jobs, while in large companies this figure is only 1 in 33 (3% of all jobs). 61% of all surveyed EU companies have offered green products or services for more than three years. In the US this figure is 52%.

The main reasons for the growth in sales of green products and services are: customer demand (48%), the company's core value (32%) and its image (30%). The most common actions are concentrated on the following: resource efficiency (93% of companies), energy saving (64%), minimizing waste (62%), and recycling (61%) (Flash Eurobarometer 342, 2012).

Creating a *green* image and the introduction of eco-friendly solutions has become in recent years an important element of an organisation's strategy throughout the world. Knowingly investing in ecological initiatives allows for the caring of the environment, which is consistent with the organisation's concept of social responsibility and its duty, but usually turns out to be cost effective in terms of business and helps build a positive image of the organisation. The concept of ecological investment means committing capital to so-called *green* economic sectors, such as *clean* energy, water management, and recycling. The additional capital raised from investors allows such organisations for a wider dissemination of their technologies and solutions, and thus faster development. The development and marketing of innovative *green* solutions is also a way to stand out from competition. Offering a unique solution, the organisation increases its competitiveness resulting in higher returns. Such projects may be funded by the European Union under the Entrepreneurship and Innovation Programme (EIP).

Ecological entrepreneurship – ecology or economics?

Every country or region needs as one of the most important factors of economic development and employment growth a strong and competitive industrial base, both in terms of production as well as investment. Endogenous and exogenous factors have a decisive influence on this economic development. See the table below. Endogenous factors include all resources within a region, are located within its area, have a specific character pertinent only to that region and created by that region. Exogenous factors are factors external to that region and include changes in its macro-environment.

Over the last few decades in order to achieve economic growth in specific regions through the use of various instruments has resulted in profound damage to the natural environment. This includes climate change, global warming, air and water pollution, soil degradation, decrease in biodiversity, etc. Due to the fact that the environmental components are inextricably linked, a regional polluted environment has an impact on a national, international and even global scale. An example is China, whose rapidly growing economy is based on outdated technologies. They are frequently half as efficient and consume twice the energy than those currently used in developed countries. These outdated technologies have at times been banned in the developed countries due to their

destructive impact on the environment (Diamond, 2005). The *migration* of these low-cost technologies to countries which remain at a lower level of development can also pose a danger.

This raises the question, if it is possible to reconcile economics with ecology. On the one hand, it is known that initiatives to protect the environment are very expensive, while on the other hand, environmental problems create many opportunities for businesses. It should be taken into account that the European Union supports a number of business initiatives aimed at reducing environmental damage. These include building sewage treatment works and installing filters to extract harmful substances from being emitted into the atmosphere. More and more frequently there is a departure from heavy industry. Organisations appear which deal with environmental education, to increase ecological awareness and knowledge. Actions are also undertaken to increase a company's resource efficiency, one of the main factors of competitiveness. On average, for European businesses, raw materials constitute 40% of their costs and if expenditure on energy and water is included these costs can be as high as 50%. For comparison, labour costs account for 20% of the total production costs. Furthermore, 60% of all waste in the EU is not re-used or is not currently subject to being recycled or composted, which causes the loss of large amounts of valuable resources (Guide to resource efficiency…, 2012). Significant business opportunities arise from this situation, particularly for small businesses which could produce and sell green products, services and solutions. Business opportunities can also be created by implementing more business models, based on a closed loop and green technologies, to the activities of existing and new businesses.

Organic farming may be a development potential for certain regions. It combines best environmental practices, a high degree of biodiversity, protection of natural resources and high production standards using natural substances and processes. In view of society's growing environmental awareness, organic farming is beginning to play an important role. It is based on local resources, is environmentally friendly, and produces food products characterised by high quality. It is therefore more labour-intensive than conventional farming. Nevertheless, business development in this sector is characterised by significant dynamism, especially in recent years. The growth in organic agriculture is conducive to increasing the residents' business potential (Strategia Doliny…, 2015):

- eco-agriculture is more labour-intensive; the products are more expensive than in conventional farming. Although this involves more work, more revenue is ensured,
- eco-agricultural development entails the expansion of processing and sales networks for organic products, thereby increasing employment, and creating demand for other organic products (cosmetics, cleaning products, clothing, furniture) and services (agro-tourism, herbal medicines, natural medicine),
- increased tourist and commercial attractiveness for the region creates prospects for setting up a private business in the countryside, including opportunities for the educated youth,
- greater availability of EU funding is an encouragement to conducting an eco-business.

Under favourable circumstances, an eco-business can become a resource and a value not only for those directly involved in the production of organic food. It can also influence the development of the community and the place where it is located. Its positive impact is felt primarily on local employment. Well-run associations and affiliations of producers of organic goods in many European, American, Asian and African countries have practically eliminated local unemployment problems. Eco-farmers are most frequently well-educated people, perfectly capable of coping with management even under very difficult agricultural conditions. They are open to innovation, collaboration and are involved in the local community. However, it is necessary to involve the local authorities and scientific institutions in the development of eco-businesses, creation of a good climate, and support for the promotion, research, and realisation of investments.

Conclusions

The effectiveness of the sustainable development strategy depends largely on the participation of all groups and social structures including the government in its implementation. Its ecological initiative is one of the key elements which is dependent on active, innovative actions in an eco-market aimed at obtaining income through satisfying social needs in ecologically friendly living conditions. The priorities of an eco-business at all levels (individual, organisational, regional) are not only financial benefits, but above all environmental care and people's health. Taking up the challenge to implement ecological solutions in the organisation, one must remember that *green* business can bring tangible benefits only if it is long-term and consistent with its development strategy. Taking care of the natural environment must become one of it values which will be realised, with consequences, by all employees starting from senior management down. This is important, because by all indications, in future, ecology will be an organisation's business card. Eco-innovations can become the main development direction of not only a single organisation, but also the region. An enterprising region is one that is characterised by innovation; a high degree of investment, both public and private, in research and development; has a high number of high-tech companies; has a high level of individual entrepreneurship; and has an aspiration

for sustainable development. Thus appropriate investment and innovation policies need to be established which will stimulate eco-friendly business ventures as well as the development of the eco-goods and eco-services market. The policies should be based on a strategic partnership between users of natural resources, local authorities, residents and eco-business. The words of the Greek philosopher Aristotle are worth calling to mind: *The time has come to understand that nature will exist without man, but not man without nature* (CPE, 2015).

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PROBLEMY EKOROZWOJU – PROBLEMS OF SUSTAINABLE DEVELOPMENT
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Sustainable Mitigation of Greenhouse Gases Emissions

Zrównoważone przeciwdziałanie efektowi cieplarnianemu

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Abstract

The emission and absorption fluxes of CO_2 and CH_4 in the environment have been characterized. It has been pointed out that the anthropogenic emission of CO_2 amounts only to 3% of emissions from the natural sources. It has been also noted that increasing CO_2 absorption of terrestrial ecosystems by 3% could inhibit the increase of CO_2 concentration in the atmosphere. This means that mitigation of global warming by intensifying natural processes is a more sustainable solution than performing expensive changes in energy policy. Lowering the emission of methane, on the other hand, can be accomplished by utilizing fodder additives for ruminants and the process of microbiological methane oxidation in covering soil layers or biofilters.

Key words: greenhouse gases, CO_2 emissions, sustainable development

Streszczenie

W artykule scharakteryzowano strumień emisji i absorpcji gazów cieplarnianych CO_2 i CH_4 w środowisku. Zwrócono uwagę, że antropogeniczna emisja CO_2 wynosi zaledwie 3% poziomu emisji ze źródeł naturalnych. Ponadto zauważono, że intensyfikacja absorpcji CO_2 przez ekosystemy lądowe o 3% mogłaby zahamować wzrost stężenia CO_2 w atmosferze. Oznacza to, że bardziej zrównoważone jest przeciwdziałanie efektowi cieplarnianemu poprzez intensyfikację procesów naturalnych od kosztownych zmian w polityce energetycznej. Natomiast ograniczanie emisji innego gazu cieplarnianego – metanu – można osiągnąć poprzez stosowanie dodatków do paszy dla zwierząt przeżuwających oraz wykorzystanie procesu mikrobiologicznego utleniania metanu w nakładach glebowych i biofiltrach.

Słowa kluczowe: gazy cieplarniane, emisja CO_2, zrównoważony rozwój

1. Introduction

The problems connected with the emission of greenhouse gases are directly associated with the issue of sustainable development. According to reports (IPCC, 2013, 2014), excessive emission of greenhouse gases leads to the degradation of environment, and thus violates the intergenerational equity paradigm of sustainability which requires taking the actions that preserve the non-degraded environment for the future generations.

In the ongoing discussion about greenhouse effect mitigation, costly solutions – which may seriously hinder the inhabitants of less developed countries in the process of going out of poverty – are being recommended. This, in turn, violates the second important paradigm of sustainable development, which requires taking the actions that strive for ensuing equal life standards for all people.

Hence, it is important to seek such methods of inhibiting climate changes which would conform to the paradigms of sustainable development (Cholewa, Pawłowski, 2008; Pawłowski 2019, 2013).

2. Characteristics of the emission of the main greenhouse gases: CO_2 and CH_4

The policy of counteracting the greenhouse effect focuses mainly on mitigating the CO_2 emission from combustion processes. Meanwhile, according to the

data published by Intergovernmental Panel on Climate Change (IPCC 2007), the emission of CO_2 from fossil fuels combustion and cement production equals 7.6±0.6 GT/year, which is a relatively small amount in comparison to the natural fluxes. The emission of CO_2 resulting from the respiration of organisms and plants amounts to 118.7 GT/year, whereas the emission from the surface of oceans equals 78.4 GT/year. This is further supplemented by the emission of CO_2 from volcanic eruptions, approximating 0.1 GT/year and the emission from inland waterways, amounting to 1 GT/year. Changes in land use, which mainly include deforestation, increase the CO_2 emissions by 1.1±0.8 GT/year. Thus, the total CO_2 emission from natural processes equals 198.2 GT/year, while the emissions from anthropogenic sources – 8.7±1.4 GT/year (Falkowski et al., 2000).

Simultaneously, absorption of CO_2 from the atmosphere takes place. Plants absorb 123 GT/year during photosynthesis, 80 GT/year is absorbed by oceans, and 0.3 GT/year is absorbed through the erosion of rocks. According to the above-mentioned data, out of the anthropogenic emissions amounting to 8.7±1.4 GT CO_2/year, 5.0 GT CO_2/year is absorbed in natural processes. The remaining 3.7 GT CO_2/year contributes to the increase of CO_2 concentration in the atmosphere. Therefore, if the absorption of CO_2 in natural processes was enhanced by 3.7 GT CO_2/year, the increase of CO_2 in the atmosphere would be inhibited. In such context, the approach of J. Szyszko, Polish Minister of Environment, deserves attention. Instead of costly changes in energy policy, he proposes to take an interest in the sequestration of CO_2 by forests.

Methane is another important greenhouse gas. According to the data published by IPCC (IPCC, 2013), 87-94 MT of methane us emitted by animal husbandry, 33-40 MT/year is emitted from rice cultivation, 85-105 MT/year from fossil fuel extraction and processing, 67-90 MT/year from landfills, and 32-39 MT/year from biomass combustion, which in total amounts to 304-368 MT/year (Uliasz-Bocheńczyk, Mokrzycki, 2015).

Moreover, the emission of CH_4 in natural processes comprises: 2-9 MT/year from hydrates, 177-284 MT/year from swamps, 8-73 MT/year from surface waters, 2-22 MT/year by termites, and 33-75 MT/year from geological reservoirs, which amounts to 222-463 MT/year when combined. The total annual emission of methane from both anthropological and natural sources amounts to 676-1080 MT/year.

Natural processes of methane removal occur in the atmosphere: 16-84 MT/year of methane is oxidized by OH^- radicals in the stratosphere, whereas in the troposphere – the oxidized amount ranges 454-617 MT/year. Moreover, microorganisms in soil annually remove 9-47 MT of CH_4 through oxidation.

Hence, the methane content in the atmosphere increases by 184-305 MT/year.

3. Sustainable mitigation of CO_2 and CH_4 emissions

Vast majority of efforts aimed at mitigating the greenhouse effect focuses on limiting the CO_2 emissions, mainly by eliminating usable energy from fossil fuels, with coal in particular. Such approach, as pointed out by Lindzen (2010) leads to a substantial increase in the cost of energy. Additionally, there are concerns whether alternative energy carriers exist in sufficient amounts to ensure smooth functioning of the human civilization (Pawłowski, 2009). It seems that the role of natural processes occurring in the environment remains underappreciated.

According to the CO_2 balance given in the introduction, out of 8.7±1.4 GT/year produced through anthropogenic emission, 5.0 GT/year is absorbed in natural processes, mainly in photosynthesis and by dissolving in oceans, and only 3.7 GT/year is emitted to the atmosphere, contributing to the increasing CO_2 concentration in the atmosphere.

The CO_2 absorption capacity of seas and oceans is limited, as the symptoms of acidification are already becoming apparent, leading to a reduced CO_2 solubility in water. Attempts are being made to increase the CO_2 absorption capacity in sea water through artificial intensification of algal growth, carried out by means of fertilization with ferric ions (IPCC, 2007; Boyd et al., 2000; Coale et al., 1996; Aumont and Bopp, 2006). However, this method raises certain concerns (Allsopp et al., 2007). On the other hand, absorption of CO_2 by terrestrial ecosystems remains underappreciated. While comparing the annual CO_2 emission from the anthropogenic sources – which equal 3.7 GT/year – with the level of CO_2 absorption occurring in terrestrial ecosystems through photosynthesis, it is becomes obvious that raising the photosynthesis intensity merely by 3.0% could completely inhibit the increase of CO_2 concentration in the atmosphere. This could be achieved, e.g. by a proper silviculture (Oren et al., 2001; Garbulski et al., 2008; Gorte, 2009; Uliasz-Bocheńczyk, Mokrzycki, 2005; Olejnik et al., 2011; Gaj, 2012; Dubey et al., 2015).

Polish Minister of Environment noticed this possibility, showing that CO_2 sequestration by forest ecosystems is very beneficial and profitable. Sequestrating 1 MT of CO_2 would cost approximately €4 (Szyszko, 1015). Silviculture in Poland occupies 9.5 million ha. The absorption of CO_2 by forests ranges from 9 to 21 MT of CO_2/ha per year. Thus, it is easy to calculate that Polish forests absorb 86.5-199.5 MT of CO_2 annually. In 1990, 387.3 MT of CO_2 was emitted in Poland, whereas in 2014 – 316.8 MT of CO_2, i.e. the emission was cut by 18.1% (B.P, 2015). According to the above-mentioned data, Polish forests remove 27.3-63.3% of CO_2 emitted by the Polish industry. Therefore, proper silviculture is the most sustainable method of reducing CO_2 emissions, and not only in Poland.

As methane is a useful fuel, the most advantageous solution is to recover it for energy production. If the concentration of methane is sufficiently high, it can be used as a fuel. However, lower concentrations are problematic. In the case of air obtained from bituminous coal mine shafts ventilation, attempts have been made to combust it in a reactor equipped with a catalytic converter (Gosiewski et al., 2010).
Regulating natural processes in the case of methane is significantly more difficult. The highest amounts of methane are emitted by ruminants. The studies performed (Boadi et al., 2004) have shown that the addition of ionophores probioties, acetogens, bacteriocins, archaeal viruses and organic acids can reduce generation of enteric methane.
Utilizing natural processes of microbial oxidation of methane allows to reduce the emission of methane. One of the simplest methods is the oxidation of methane in covering soil layers or biofiltres (Stępniewski, Pawłowska, 1996; Bogner, 2003; Streese, Stegmann, 2003; Pawłowska, 2008; Scheutz et al., 2009; Montusiewicz at al., 2008; Staszewska, Pawłowska, 2011; Zdeb, 2015).

Conclusions

To sum up, effective employment of CO_2 absorption by terrestrial ecosystems consisting in the intensification of photosynthesis – which additionally increases the production of biomass – constitutes an example of implementing sustainable development principles in the mitigation of greenhouse effect.
Mitigation of methane emissions is possible by utilizing fodder additives for ruminants and employing a microbiological methane oxidation process in specially formed covering soil layers or biofilters.

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PROBLEMY EKOROZWOJU – PROBLEMS OF SUSTAINABLE DEVELOPMENT
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Sustainable Development versus Prospecting and Extraction of Shale Gas

Zrównoważony rozwój a poszukiwanie i wydobywanie gazu łupkowego

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Abstract

Energy issues are very important for our civilization. Taking into account the perspective of sustainability a lot of attention is devoted to the sources of primary Energy characterized with low emission. Among them shale gas has gained in importance as the primary energy source.
The paper presents the role of shale gas in the implementation of the main paradigm of sustainable development, i.e. the intergenerational equity. As the reference, the necessity of implementing water intakes monitoring has been pointed out.

Key words: sustainable development, shale gas, water pollution

Streszczenie

Kwestie energetyczne odgrywają kluczową rolę w rozwoju współczesnej cywilizacji. Patrząc z perspektywy zrównoważoności poszukuje się niskoemisyjnych źródeł energii, wśród nich coraz więcej uwagi poświęcając gazowi łupkowemu.
W niniejszym artykule przedstawiono role jaką może odegrać gaz łupkowy w realizacji głównego paradygmatu zrównoważonego rozwoju sprawiedliwości międzygeneracyjnej. Wśród zaleceń zwrócono uwagę na potrzebę monitoringu zanieczyszczeń ujęć wodnych.

Słowa kluczowe: zrównoważony rozwój, gaz łupkowy, zanieczyszczenie wody

Introduction

Energy is of paramount importance in the modern world. It is difficult to imagine how people could function without energy, which is absolutely necessary in four economics sectors: residential, commercial, transportation and industrial. Implementation of the two main paradigms of sustainable development largely depends on the sufficient amount of energy available for everyone (Pawłowski, 2009; Cholewa, Pawłowski, 2009).
Processing primary Energy into various forms of usable energy seriously threatens the paradigm of intergenerational equity by depleting resources on the one hand, and by degrading the environment in the process of fossil fuels combustion on the other.
Therefore, a lot of attention is devoted to the sources of primary Energy characterized with low emission. One of the most extensively developed sources of primary Energy comprises various forms of biomass and wastes (Claassen et al., 1999; McKendry, 2002; Murphy, McKeogh, 2004; Montusiewicz et al., 2008; Pawłowska, Siepak, 2006; Lebiocka et al., 2009).
In the recent years, shale gas has gained in importance as the primary energy source (EIA, 2013; JRC, 2012; Polish Academy of Sciences, 2014). Combustion of the natural gas yields substantially

lower carbon dioxide emissions – i.e. 56.1 kg CO_2/GJ – in comparison to coal, which produces 94.6 kg CO_2/GJ.

Substituting coal with natural gas from shale gas deposits would allow for a significant reduction in emissions of CO_2 (Heath et al. 2014, Newell and Raimi 2014).

However, extracting shale gas from a deposit negatively impacts the aquatic environment (Coulton et al., 2014; Rahm, 2014, Kujawska et al., 2016). Releasing shale gas necessitates employing hydraulic fracturing (Williams, 2013; Vidic, 2013; Vengosh et al., 2013). This method requires large amounts of water, ranging from 3500 to 7200 m^3 for each drilling, which has an impact on the local water economy.

After hydraulic fracturing, the pressure decreases, thus allowing the drilling fluid mixed with water from the deposit to flow back.

At first, flowback water runs quite intensively, with the rate of approximately 1300m^3/day for 2-3 weeks; then, the rate decreases to roughly 50m^3/day and finally stabilizes during the exploitation at the level of 0.5-1.6m^3/day. This stable stage yields so called *produced water*. Depending on how much water there is in a deposit, the amount of flowback water varies from 10% to 80% of volume of the drilling fluid pumped in. For a dry deposit, such as Marcellus Shale in the USA, it amounts to 15-20%. On the other hand, in the case of Barnett Shale in the USA, the volume of flowback water increases up to 75% (Hoffman et al., 2014; Stark et al., 2012; Houston et al., 2009).

Flowback water contains the components of drilling fluid, as well as dissolved salts and suspended loam. The most problematic factor is salinity, which mainly consists of sodium and calcium salts. During the initial flowback stage, salinity increases rapidly throughout the first 14 days. Afterwards, this increase slows down. After 90 days, salinity usually reaches 200 000mg/L.

These ions mainly come from the salts washed off from a deposit. As it was mentioned earlier, the composition of flowback water varies, depending on how much water and soluble substances a deposit contains.

When exploitation begins, a certain amount of produced water flows out along with the extracted gas. Produced water mainly comes from the dewatering of a deposit and contains dissolved salts with a small addition of the remains of drilling fluid. Therefore, its composition varies and depends on the geological structure of a deposit. In general, produced water contains following groups of chemical compounds:

- soluble salts,
- oils and fats,
- natural inorganic and organic compounds,
- natural radioactive compounds.

Prospecting and extraction of shale gas meets with the protests of local communities which blame the pollution of drinking water intakes on the process. Adequate monitoring, which would allow for an early detection of potential sources of pollutants, is necessary.

Identification of characteristic pollutants in the flawback and produced water

In order to determine to what extent prospecting and extraction of shale gas may influence polluting of water intakes, it is necessary to identify characteristic pollutants found in the flowback and produced water. These substances may infiltrate to deep water intakes and to rivers and streams.

In the case of deep waters, the infiltration of pollutants may result from the percolation of drilling fluids. In the case of surface waters – rivers and streams – the possibilities are more numerous. On the one hand, it is possible that the pollutants may infiltrate from the drilling fluids, as well as flowback and produced water, spilled on the ground.

The intensity of this problem depends on the carefulness of performing surface operations.

On the other hand, large amounts of flowback and produced water must be disposed of. Therefore, it needs to be checked whether the employed methods enable disposal of pollutants to a sufficient degree, so as not to contaminate the surface waters.

Answering these questions requires identifying the characteristic pollutants found in the flowback and produced water.

Identification of pollutants from prospecting and extraction of shale gas in the environment

In order to track the movement of pollutants from prospecting and extraction of shale gas in the environment, it is necessary to identify the compounds which are typical for these processes.

Usually, wastewater produced during the above-mentioned operations is characterized by high salinity, reaching up to 400 g/L (Gleason, Tangen, 2014). It also contains such compounds – found in drilling and fracturing fluids – as heavy metal ions, compounds washed off from geological deposits, and radioactive elements (Haluszczak et al., 2013; Kharaka, Hanor, 2014; Vengosh, 2013). Generally, both flowback and produced water contain characteristic radioactive isotopes and elevated concentration of Ba^{+2}, Sr^{+2}, I^-, Br^-.

These pollutants are characteristic, and their presence in examined water intakes may mean that they had been polluted during prospecting and extraction of shale gas.

Pollution of deep water intakes is rather unlikely to occur if the drilling operations are carried out with due carefulness. Nevertheless, monitoring is of huge importance, as it alleviates social unrest. In the case of surface waters, the situation is more complex. Usually, it is difficult to avoid spilling some amount

of the polluting fluids. Moreover, flowback and produced water is treated both in the existing treatment plants, and special plants built specifically for the purpose of treating this kind of fluids. In this case, proper disposal of fluids containing radioactive elements is problematic. Moreover, J^- and Br^- ions are not removed in these processes. Although they do not negatively impact the biocoenosis of surface waters, they hinder the intake of drinking water. This is because these ions oxidize to bromates and iodates during disinfection, acquiring mutagenic properties. Therefore, monitoring of pathways (spreading) of these compounds in the environment should be considered necessary.

Summary

Exploitation of shale gas can be seen as a solution which aids in the implementation of the intergenerational equity paradigm of sustainable development, as its large deposits will also be available for the future generations. However, extraction should be carried out in such a way, so as to avoid the degradation of water resources, the protection of which is as important as the supply of energy.

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