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Table of Contents – Spis treści

Editorial: Sustainable Development Integrated in the Concept of Resilience

Od redakcji: Zrównoważony rozwój a koncepcja resilencji

*Jürg Bloesch, Michael von Hauff, Klaus Mainzer, S. Venkata Mohan,
Ortwin Renn, Verena Risse, Yonghui Song, Kazuhiko Takeuchi, Peter
A. Wilderer* 7-14

Uneven Integration and Blocked Spillovers: Why Environmental Governance in Northeast Asia does not Converged to the EU Model?

Niejednolita integracja i zablokowane skutki pośrednie: dlaczego zarządzanie środowiskiem w Azji Północno-Wschodniej nie jest zbieżne z modelem przyjętym w UE?

Dong Liang 15-20

The Issue of Environmental Resources Management in the Light of the Model of Tragedy of the Commons – Systemic Approach

Problematyka gospodarowania zasobami środowiska w świetle modelu tragedii współzależności – ujęcie systemowe

Mariusz Dacko 21-30

Religion versus Sustainable Development. The Problem of Human Eco-development in the Teachings of John Paul II and Benedict XVI

Religia a rozwój zrównoważony. Problematyka ekorozwoju człowieka w nauczaniu papieża Jana Pawła II i Benedykta XVI

Artur Niechwiej 31-40

Environmental Regulations and Industrial Performance Evidence from the Revision of Water Pollution Prevention and Control Law in China Regulacje środowiskowe i wskaźniki ekonomiczne wynikające z nowelizacji prawa odnoszącego się do kontroli i zapobiegania zanieczyszczeniu wód w Chinach <i>Wei Yu, Qiang Chen</i>	41-48
Sustainable Development as Seen by the Residents of Eastern and Western Europe on the basis of ISSP Environment Data Problematyka zrównoważonego rozwoju w opiniach mieszkańców Europy Wschodniej i Zachodniej na podstawie danych ISSP Environment <i>Paweł Rydzewski</i>	49-53
Biofuel's Sustainable Development under the Trilemma of Energy, Environment and Economy Zrównoważoność biopaliw w kontekście triady energia, środowisko i ekonomia <i>Heqing Liu</i>	55-59
Joseph Kozielski's Concept of Transgressive Man and the Problems of Sustainable Development Człowiek transgresyjny w ujęciu Józefa Kozielskiego a problematyka zrównoważonego rozwoju <i>Marek Tański</i>	61-66
A Process Model of Building Sustainable Competitive Advantage for Multinational Enterprises: An Empirical Case Study Model procesu budowania zrównoważonej przewagi konkurencyjnej dla przedsiębiorstw wielonarodowych: Studium przypadku <i>Mengmeng Shan, Jianxin You, Yulu Wang, Huchen Liu</i>	67-78
The Development of Organic Food Market as an Element of Sustainable Development Concept Implementation Rozwój rynku ekologicznych produktów żywnościowych jako element realizacji koncepcji zrównoważonego rozwoju <i>Paweł Bryła</i>	79-88
Challenges to Sustainability of Resource-exhausted Cities: A Case Study of Lengshuijiang, China Wyzwania dla zrównoważoności odnoszące się do miast pozbawionych surowców: przypadek Lengshuijiang w Chinach <i>Guocun Zuo, Qiang Chen</i>	89-98
Application of Environmental and Social Sustainable Measures by Port of Koper: The Basis for the Regional Approach Aplikacja środowiskowych i społecznych inicjatyw w porcie Koper: przykład podejścia regionalnego <i>Bojan Beškovnik, Patricija Bajec,</i>	99-106

The American Lawn Revisited: Awareness Education and Culture as Public Policies Toward Sustainable Lawn

Amerykańskie trawniki z bliska: świadomość, edukacja i kultura jako motywy polityki publicznej prowadzącej w kierunku zrównoważoności

Yaoqi Zhang, Bin Zheng, Ge Sun, Peilei Fan 107-115

Sustainable Mitigation of Methane Emission by Natural Processes

Zrównoważone ograniczanie emisji metanu z wykorzystaniem naturalnych procesów

Cao Yucheng, Wojciech Cel 117-121

Sustainable Bridge Design

Zrównoważone projektowanie mostów

Stanisław Karaś, Janusz Bohatkiewicz 123-132

BOOK REVIEW/RECENZJA

How to Teach on Sustainable Development Issues?

G Venkatesh, *Water For All and Other Poems*, Cyberwit.Net, 2014

Jak uczyć o rozwoju zrównoważonym?

G Venkatesh, *Woda dla wszystkich i inne wiersze*, Cyberwit.Net, 2014

Artur Pawłowski 133

INSTRUCTIONS FOR AUTHORS/ NOTA DO AUTORÓW 135-136

Sustainable Development Integrated in the Concept of Resilience

Zrównoważony rozwój a koncepcja resilencji

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Abstract

The purpose of sustainable development is to minimize the likelihood of dynamic natural and/or man-made systems to exceed tipping points, when exposed to disturbances. In effect, the systems are protected from losing identity and integrity. The authors of this paper suggest accepting resilience thinking as a basis of setting sustainability goals and reaching the respective targets. The resilience theory provides the method needed to maintain identity and integrity, and to manage system's dynamics. Of concern are three interwoven systems: environment, society and economy, forming a complex super-system coined *eco-social triad*. Sustainable development of the triad applies to each of the three sub-systems despite conflicting interests of the various actors within each. Resilience is expressed by the ability of natural or man-made systems to respond dynamically to changes of ambient conditions with the aim to retain their inherent function, structure and feedbacks. To manage such changes and associated disturbances a repetitive sequence of processes (also called *adaptive cycle*) needs to be executed. In ecosystems these cycles are self-regulated and characterized by recycling of materials and energy. In systems dominated by humans adaptive cycles are characterized by phases such as re-evaluation, re-orientation and re-commencement. The concept of adaptive cycles and adaptive management embedded in the resilience theory is considered a promising method to satisfy sustainability goals and reach respective targets.

Key words: sustainable development, resilience, adaptive cycle, economy, society, ecosystems

Streszczenie

Celem zrównoważonego rozwoju jest zminimalizowanie prawdopodobieństwa przekroczenia punktów krytycznych dynamicznych systemów naturalnych i/lub sztucznych (co może się zdarzyć, gdy systemy te są narażone na zakłócenia). W rezultacie uzyskują one ochronę przed utratą tożsamości i integralności. Autorzy niniejszego artykułu sugerują przyjęcie podejścia zgodnego z koncepcją resilencji podczas wyznaczania celów prowadzących ku zrównoważoności. Teoria resilencji odnosi się do umiejętności, dzięki której systemy utrzymują tożsamość i

integralność, a także prawidłowo zarządzają własną dynamiką. W obszarze zainteresowania znajdują się trzy przeplatające się systemy: środowisko, społeczeństwo i ekonomia, tworzące złożony super-system określany jako *eko-społeczna triada*. Zrównoważony rozwój triady dotyczy każdego z trzech podsystemów, pomimo sprzecznych interesów różnych podmiotów działających w ramach każdego z nich.

Resilencja wyraża się w zdolności systemów naturalnych do dynamicznego reagowania na zmiany warunków w ich otoczeniu, w celu zachowania funkcjonalności, struktury i zapewnienia właściwego sprzężenia zwrotnego. Aby zarządzać takimi zmianami i związanymi z nimi zaburzeniami wymagana jest powtarzalna sekwencja działań (zwana także *cyklem adaptacyjnym*). W ekosystemach takie cykle charakteryzuje samoregulacja oraz recykling materiałów i energii. W systemach zdominowanych przez ludzkie cykle adaptacyjne występują fazy ponownej oceny, reorientacji i ponownego rozpoczęcia. Idea cykli adaptacyjnych i adaptacyjnego zarządzania zawarte w teorii resilencji można uznać za obiecującą metodę prowadzącą do zapewnienia celów zgodnych ze zrównoważonym rozwojem.

Słowa kluczowe: rozwój zrównoważony, resilencja, cykl adaptacyjny, ekonomia, społeczeństwo, ekosystemy

Introduction

Discussion about sustainable development should begin with a debate about ecosystems and their functions which are considered the basis of the evolution and persistence of life on Earth. In particular, ecosystem functions provide the essential conditions for humans to exist and strive. The difficulty with this approach is the high complexity and the different scales of ecosystems, both in time and space. Although scientific research in ecology has made significant progress, our current knowledge is far from being complete (Hooper et al., 2005). Nevertheless, a series of traits widely accepted by the scientific community are characteristics for natural ecosystems as well as for social systems. Such traits include recycling of energy and matter, self-regulation, adaptability, transformability, stability and resilience (Folke et al., 2010).

Stability and resilience theories have been studied for many years already, based on physics, engineering and mathematics and have been applied in ecological modeling (e.g. Justus, 2008). It is widely accepted that ecological resilience and stability are tightly linked together. Considering alternative stable states of ecosystems (Scheffer et al., 2001) resilience is defined as *the ability of a system to absorb disturbances and still retain its basic function and structure*. As explained by Walker and Salt (2006) a system remains resilient as long as it is able to continuously adjust to the changing ambient conditions, so that the overall system functionality and integrity is preserved (Dawson et al., 1994). This is in accordance with the theory that natural ecosystems are usually in a quasi-stable equilibrium (homeostasis), an assumption that competes with the chaos or catastrophe/disturbance theory.

As humans are part of ecosystems, these concepts have been extended to social-ecological systems (SES) combining ecosystem function with functions of human society (Walker et al., 2004). In this respect we have to consider the dominance and ambivalent character of *Homo sapiens*, his obsession with greed and power (Gigantès, 2012), which counteracts social care and environmental protection.

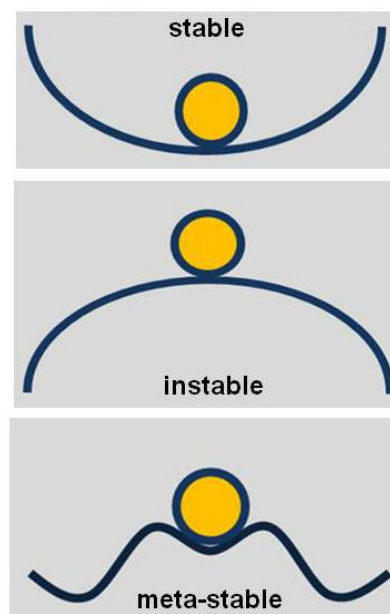


Figure 1. Scheme of the three states of (eco-) systems: stability, meta-stability, and instability. In terms of equilibrium, this translates into quasi-stable equilibrium, labile equilibrium, and semi-labile equilibrium. Meta-stable and instable systems are subject to major shifts or collapse under strong disturbance. Adopted from von Hauff (2014, p. 26).

A system loses its identity and integrity when exceeding a tipping point and being transferred from the state of stability or meta-stability to instability (Figure 1). In case of significant or abrupt environmental changes, also described as *shock*, ecosystems can shift from one state or mode to another. Such shocks might be caused either by natural stochastic events or induced intentionally or unintentionally through human activities (Biggs et al., 2009). As the functional thresholds are exceeded, ecosystems are transferred to a world controlled by a different regime. Such a transfer might be interpreted as collapse. In this context, scaling matters. From historical records we know that despite collapse of ecosystems life persisted under the *new* regime. However, if human activity will lead to the collapse of the global ecosystem persistence of life is more than

doubtful. When considering the Gaia-ecosystem *Earth* (Lovelock, 1988), we should not forget that our planet can hardly be replaced by another one.

In ecosystems, adjustment to changing ambient conditions is driven mainly by self-regulation processes (Odum and Barrett, 2004). Most likely, those processes were responsible for the development of life on Earth over the past billions of years (Lovelock, 1988; Gorshkov et al., 2000). Assuming the correctness of this hypothesis, humankind is well advised to avoid interference with or destruction of natural self-regulation processes. This applies particularly to very large ecosystems such as the oceans, tropical and boreal forests, and very vulnerable ecosystems such as the alpine, Arctic and Antarctic regions. In natural ecosystems, population dynamics is balanced by birth and death rates, amongst other environmental factors. Exponential growth for ever is not possible but self-regulated in nature. Hence, increasing human population, the subsequent growth of quantitative and qualitative demands, and the contemporary paradigm of economic growth become a severe threat of ecosystems if they are not protected.

Social-Ecological Systems (SES) and the concept of sustainability

The expression *sustainable development* (in German: *nachhaltige Entwicklung*) emerged in the 18th century's forestry industry. To keep wood available for ship building, construction of houses, reinforcement of mining shafts and the production of charcoal for smelting metals, Hans Carl von Carlowitz (1713) suggested adjusting the cutting rate to the growth rate of trees. The intention was entirely oriented towards the preservation of economic stability. However, this measure reflects unintentionally a fundamental ecological principle and a human characteristic: the limits of growth and overexploitation of resources, respectively.

In 1818 the Swiss forester, Karl Albrecht Kasthofer translated the German term *nachhaltige Entwicklung* in the French language as: *produit soutenu et égal d'une forêt* (timber shall remain a consistent product of forests). The English translation of *soutenu* (It.: *sustenare*) is *sustain*. Until deep into the 20th century the ability to sustain the function of forests to deliver wood remained a major concern of forestry.

After the industrial revolution and the economic boom during the second half of the past century the term *sustainability* gained a new dimension and came into political focus. In the 1980s, the Brundtland Commission started working on an agenda for developing long-term environmental strategies and international cooperation. In the report of this commission entitled *Our Common Future* (1987) sustainable development was defined *inter alia* as an obligation to meet the needs of the present generation without compromising the ability of future gen-

erations to meet their own needs (WCED, 1987). The focus of the report was on intergenerational ecological justice with respect to the natural resources that humans use for their existence and welfare. Meeting such goals will require an integral change in the use of natural resources and in the performance of investments, technology and institutions. In the aftermath of the Brundtland report, the concept of sustainability was expanded. While integrating ecological systems and social systems into socio-ecological systems (SES) (Walker et al., 2004) harmony between people and nature, and human well-being became of general interest. Earlier, Meadows et al. (1972) had suggested that the Earth needs to be considered a limited resource of not only wood but also fossil fuels amongst others. It was generally recognized that overexploitation of such resources and pollution bear the risk of violating the right of future generations to live a decent life. This concept of sustainable development neglects largely the ecological functions of nature. Moreover, the term sustainability not only underwent an inflation of more than 200 definitions, but also greatly lacked implementation (Jucker, 2002).

Meanwhile, our world has entered a new geologic era commonly called the *Anthropocene* (Crutzen, 2002). The anthropocentric world view of the Earth system has been challenged by James Lovelock (1979) and others (e.g. Gorshkov et al., 2000). Lovelock noted that on Earth – in contrast to Mars – relatively constant conditions persisted enabling life (temperature, composition of gaseous substance in the atmosphere etc.). According to Lovelock, this phenomenon can only be explained by the influence of life itself. He concluded that physical, chemical and biological interrelationships form a single self-regulating organism, which he coined *Gaia*. According to the Gaia theory, living organisms shape, but simultaneously also adapt to changes of their environment. In this context Makarieva et al. (2013) speak of *biotic regulation* meaning the capacity of ecosystems to regulate the surface temperature and the water cycle on Earth. Considering the fundamental significance of ecosystems for the life conditions on Earth it appears extremely important to strengthen ecosystem functions in the agenda of sustainable development.

The new dimension: Economy, an equal part of the Eco-Social Triad

The economy is an integral part of the human social system. The technical revolution transformed the mostly rural societies into a producing and trading, i.e. an industrial society, which later changed to a service society and further turned into a consumer society. Economic development gained importance. In the 1990s, as a follow-up to significant large-scale political changes extensive globalization occurred in response to the new political trend of neo-liberalism

and neo-colonization (von Hauff, 2014). Even environmental NGOs, such as the WWF, realized a paradigm change in creating links with the so-called *green economy* (Huisman, 2012).

In 1992, the *Agenda 21* was adopted by 178 Governments at the Conference on Environment and Development (UNCED) held in Rio de Janeiro (United Nations 1992). It differentiates between the Earth providing the basic life supporting function, and the interests of the human society and its economy. Recognizing the economy having evolved into a powerful entity of its own (von Hauff, 2014) becoming a significant driver of global overexploitation and ecosystem deterioration the *Agenda 21* calls for counteraction. It is an action plan with regard to sustainable development of the human civilization in harmony with nature. Hence, another frequently used definition of sustainability emerged: the balance of the social-ecological system (SES) also called socio-ecological triad (Adams, 2006).

The tight entanglement of the three systems (ecology, economy, society) can be visualized by the Venn diagram (Venn, 1881) showing the logical interrelation of the three sub-systems (Figure 2). The eco-social triad with the three interwoven circles is to be understood as a paradox of *unity through distinction* (Katz cited in Grambow, 2013, p. 61). To the outside world the three sub-systems represent themselves as a unity but internally they must keep their identity and act as individual but interdependent systems to remain resilient. Maintenance of balance in the eco-social triad requires that the three components have the same weight. However, the recently emerged power of globalized economy has offset the balance. Good reasons exist for reducing and limiting economic power within the triad. Safeguarding ecosystem function should be given an equivalent importance to the function of economies and societies (Griggs et al., 2013).

Considering the present primacy of humans and their economy, it is not surprising that the relationship between the sub-systems of the eco-social triad is full of conflicts. Psychological studies suggest that a proper understanding of the relationships governing the triad's sub-systems can lead to effective conflict resolution (Bühl, 1972). Among the required tools of conflict resolution are empathy (understanding motivation and limits of the others), introspection (realizing own motivations and limits), tolerance (allow alternative actions and reaction happen) and monitoring (gain feedback from taking a neutral position for observation of the three-angular processes and effects in action).

This concept is considered to be applicable for conflict management within the limits of the eco-social triad, provided eco-systems are given a voice. Science based intergovernmental institutions and environmental NGOs could take the role of advocates of nature. Understanding ecosystem processes and function, as well as flexible, multilevel and cross-

cutting networks within the triad are a prerequisite for adaptive governance of SESs (Folke et al., 2005).

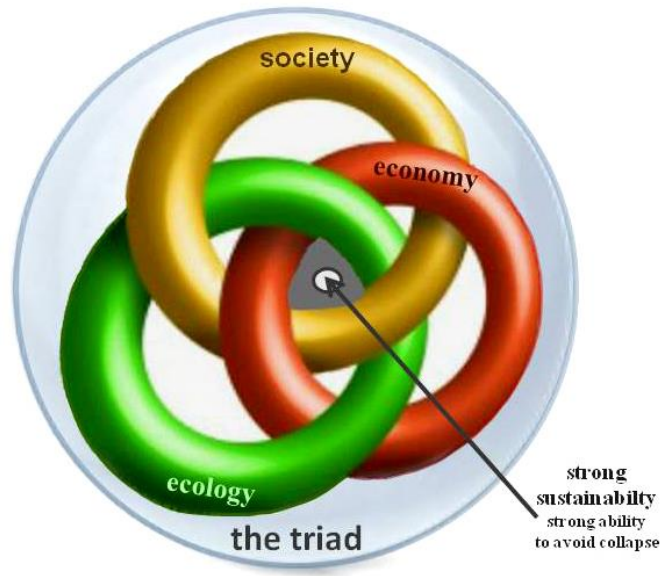


Figure 2. 3D modified 2D Venn diagram (Venn, 1881) representing the eco-social triad and its sub-systems. The grey area represents strong sustainability as all three entities are covered and considered.

Sustainable development based on resilience: Bridging the gap between theory and practice

The current *Millennium Development Goals* (MDGs) set by the United Nations, the respective targets, indicators and metrics have mostly failed to match the need for resilience of SESs. For example, the ecological footprint (Wackernagel, 1994) of developed countries is still far too big and exceeds the carrying capacity of the Earth. Resource exploitation has intensified despite introduction of recycling strategies and new technologies during the last three decades, thus threatening the ecosystem's resilience. The discrepancy between the rich and the poor is constantly increasing, and wars, violence, mismanagement and corrupt regimes counteract truly sustainability and equity, thus threatening societal resilience. And the financial crisis in 2008 revealed that the globalized economy is far from being a resilient system. The development goals and targets expressed in political documents turned out to be rather fuzzy and no more than generalized statements that are mostly not implemented in real policy. However, in a more optimistic view, such statements of high level policy may have a signaling effect (Galaz, 2014).

In SESs, the ability to remain resilient is expressed by continuous repletion of phases such as growth, consolidation, re-evaluation, re-orientation, and re-commencement, summarized as *adaptive cycle* (Figure 3). This concept is based on the self-regulated processes of recycling energy and matter in natural

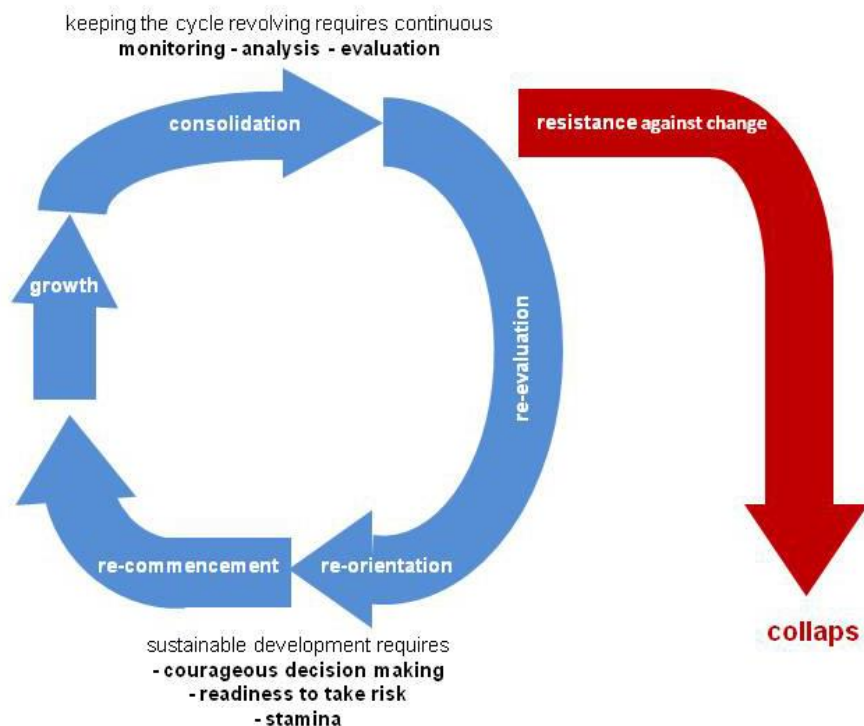


Figure 3. Graphical representation of one of the adaptive cycles within a panarchic system, adopted from Walker and Salt (2006). The blue cycle shows the human-regulated process in anthropogenic systems in response to changing political, economic or societal conditions. It corresponds to the self-regulated recycling of energy and matter in natural systems, where populations feature a growth phase, followed by climax and release. If humans conceptually are inflexible and resistant to adapt for environmental, social or economic changes, then the adaptive cycle is disrupted and the system is likely to collapse (red arrow).

ecosystems. In systems dominated by humans adaptive cycles are to be regulated and controlled on the basis of knowledge, experience and responsibility (Pisano, 2012). Adaptive cycles operate over many different scales of time and space. The manner in which they are linked across scales is crucially important for the dynamics of the triad as a whole (Walker and Salt, 2006; Gunderson and Holling, 2002; Holling, 2004)

In human systems, the adaptive cycle is driven by changes of economic and political conditions, enhancement of scientific knowledge and progress of technical and societal innovation, for instance. Adaptive management leads to long-term success of enterprises. For example, growth and total revenue of an enterprise is limited by conservation of business patterns. In case of threatening inconvenience the undesirable failure is substituted by an innovative strategy to adjust (Figure 3). Neglecting a proper risk assessment and the need to adapt might end in collapse (see red arrow in Figure 3). The case studies presented by Olsson et al. (2006) demonstrate the importance of leadership for successful transformation of SESs towards adaptive governance. Decentralized systems are usually more resilient and flexible than centralized or globalized systems; however, in reality, we have to balance the two. Careful management of adaptive cycles appears to be a

promising method of keeping societal and economic systems resilient.

The global threats initiated by humankind (e.g., disturbance and even loss of ecosystem function, inability to satisfy the demand of human society and economy for raw materials, energy, drinkable water, safe food, durable shelter; education; job availability; pollution control) are fundamentally cross-disciplinary and will require respective studies in systems science. In socio-technical systems, information and communication technology are being applied to societal infrastructures (e.g., smart grids, smart cities) to manage the complexity of human civilization (Mainzer, 2013). New integrative research and teaching centers should be established to train students in interdisciplinary networking and to cooperate in interdisciplinary/transdisciplinary teams. Such teams, committed to solve environmental problems, are also demanded in industry, economy, and governmental institutions. In this respect, predictive modeling is a powerful tool to elucidate sustainable development scenarios; however, uncertainties and surprises need to be taken into account.

The intense interconnectedness of all spheres and countries on this planet makes it essential to consider environmental aspects as a major factor for development processes in the 21st century. No sub-system can stand alone and independent of the other sub-

systems of the triad. This enhances enormously the possible effects of a small shift in one of the sub-systems on the other sub-systems. The future Post-2015 Development Agenda based on Sustainable Development Goals (SDGs) and targets will improve the old MDGs in scope, provided they respect the complexity of dynamic systems, thus drawing on the resilience concept (Bloesch et al., 2015). They are to be focused on the mitigation of the anticipated environmental effects which have a big impact on social and economic systems as well. They should foster the reconnection of people to the biosphere and build a new responsible stewardship for our planet (Folke et al., 2011).

In the context of theory and practice, the triad concept is not free of inconsistency. It is an anthropocentric model, as the one fundamental natural system is accompanied by two human systems. There is also a paradox in individual and community human behavior itself, e.g. between the good and the evil, modesty and vanity, the rational and emotions. This reflects the inherent duality or bipolarity of nature (Haber 2013). The duality of humans makes trade-offs between conflicting interests, objectives or goals difficult as these depend on the negotiation of good compromises. However, this top-down approach contradicts bottom-up participation of local stakeholders which constitutes the basis for sustainable development. As Galaz (2014) points out, both approaches should be balanced and complementing. Since the overlapping area of the three sub-systems is rather small (Figure 2), there is not much margin for truly sustainable solutions that treat the three sub-systems equally. This small common area reflects the reality of conflicting interests between developing and industrialized countries, and countries in transition. However, there are always possibilities to balance the conflicting sub-systems and to design policies that strengthen resilience on all three entities. Even suboptimal solutions in each one of the sub-systems can have a beneficial overall effect on the triad and, hence, set the right vector to approach the state of sustainability.

Summary and conclusions

Sustainable development is a process, which can be positively influenced by sound management and responsible governance. With respect to the basic concept of the resilience theory, the readiness to respond proactively to changes is an important pre-condition of maintaining system's resilience and of supporting the process of sustainable development. In this context the concept of adaptive cycles provides a guideline to a constructive response to changes of environmental, economic and/or political conditions. It requires the willingness of all relevant actors within the eco-social triad to recognize at the earliest point in time such changing conditions and draw respec-

tive decisions based on scientific knowledge, experience and wisdom. It is necessary to take risks associated with the departure from accustomed practices, re-orientation and recommencement. In summary, we consider the resilience theory a promising basis for making progress in sustainable development. It is advisable to consider strengthening the resilience and supporting sustainable development of the three sub-systems of the eco-social triad, the ecology, the society and the economy equally important. Based on such considerations some authors of this paper engaged themselves in a project on Sustainable Development Goals as part of the UN Post-2015 Development Agenda presented in part 2 of this paper (Bloesch et al., 2015). Research and innovation in thinking, understanding and acting support the accurate tradeoffs between the three sub-systems. Moreover, sustainable development of the triad requires simultaneous balancing of each of the three sub-systems despite of conflicting interests of the various actors in each sub-system. Conflict management is an important task, and with reference to psychological studies the application of characteristic traits such as introspection, empathy and tolerance are important in the process of sustainable development.

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References

1. ADAMS W. M., 2006, *The future of sustainability: Re-thinking environment and development in the twenty-first century*, Report of the IUCN-Renowned Thinkers Meeting 29-31 January 2006, 19 pp.
2. BIGGS R., CARPENTER S. R., BROCK W. A., 2009, Turning back from the brink: Detecting an impending regime shift in time to avert it, in: *PNAS*, 106(3), p. 826-831.
3. BLOESCH J., von HAUFF M., MAINZER K., K., MOHAN S.V., RENN O., RISSE V., SONG Y., TAKEUCHI K., WILDERER P.A., 2015, Contribution to the UN Post-2015 Development Agenda Based on the Concept of Resilience, in: *Problemy Ekorozwoju/ Problems of Sustainable Development*, vol. 10 no 2, in print.
4. BÜHL W. L., 1972, *Konflikt und Konfliktstrategie (Conflict and conflict strategy)*. Nymphenburger Verlagshandlung, Munich.
5. CRUTZEN P. F., 2002, Geology of mankind, in: *Nature*, vol. 415, p. 23.
6. DAWSON R., SHARON B., BROOKS K., MCGUIRE W. J., 1994, *Coping and Adaptation:*

- Theoretical and Applied Perspectives*, US National Technical Information Service.
7. FOLKE C., CARPENTER S. R., WALKER B., SCHEFFER M., CHAPIN T., ROCKSTRÖM J., 2010, Resilience thinking: Integrating resilience, adaptability and transformability, in: *Ecology and Society*, 15(4), p. 20.
 8. FOLKE C., HAHN T., OLSSON P., NORBERG J., 2005, Adaptive governance of social-ecological systems, in: *Ann. Rev. Environmental Resources*, 30, p. 441-473.
 9. FOLKE C., JANSONS A., ROCKSTRÖM J., OLSSON P., CARPENTER S. R., CHAPIN III F.S., CREPIN A-S., DAILY G., DANNELL K., EBBESSON J., ELMQVIST T., GALAZ V., MOSBERG F., NILSSON M., ÖSTERBLUM H., OSTROM E., PERSSON A., PETERSON G., POLASKY S., STEFFEN W., WALKER B., WESTLEY F., 2011, Reconnecting to the biosphere, in: *Ambio*, 40, p. 719-738.
 10. GALAZ V., 2014, *Global Environmental Governance, Technology and Politics: The Anthropocene Gap*, E. Elgar Publ. Cheltenham,.
 11. GIGANTES P., 2012, *Macht und Gier in der Weltgeschichte*, Anaconda Verlag, Köln.
 12. GORSHKOV V.G., GORSHKOV V.V., MAKARIEVA A.M., 2000, *Biotic Regulation of the Environment*, Springer Praxis Publishing, UK.
 13. GRAMBOV M. (ed.), 2013, *Nachhaltige Wasserbewirtschaftung: Konzept und Umsetzung eines vernünftigen Umgangs mit dem Gemeingut Wasser (Sustainable water management: Design and implementation of a sensible handling of water as a global common)*, Springer Vieweg, Wiesbaden.
 14. GRIGGS D., STAFFORD-SMITH M., GAFFNEY O., ROCKSTRÖM J., ÖHMAN M.C., SHYAMSUNDAR P., STEFFEN W., GLASER G., KANIE N., NOBLE I., 2013, Sustainable development goals for people and planet, in: *Nature*, vol. 495, p. 305-307.
 15. GUNDERSON L.H., HOLLING C. S., 2002, *Panarchy: understanding transformations in human and natural systems*, Island Press, Washington D.C.
 16. HABER W., 2013, Ökologie: eine Wissenschaft unbequemer Wahrheiten – auch für die Ethik, in: Aus: Vogt M, Ostheimer J, Uekötter F (Eds.), *Wo steht die Umweltethik? Argumentationsmuster im Wandel*, p. 325-343. Marburg, Metropolis. (Beiträge zur sozialwissenschaftlichen Nachhaltigkeitsforschung Bd. 5, 457 S).
 17. HOLLING C.S., 2004, From complex regions to complex worlds, in: *Ecology and Society*, 9 (1), p. 11.
 18. HOOPER D. U., CHAPIN III F. S., EWEL J. J., HECTOR A., INCHAUSTI P., LAVOREL S., LAWTON J. H., LODGE D. M., LOREAU, M., NAEEM S., SCHMID B., SETÁLÁ H., SYMSTAD A. J., VANDERMEER J., WARDLE D. A., 2005, Effects of biodiversity on ecosystem functioning: A consensus of current knowledge, Ecological Society of America (ESA) Report, in: *Ecological Monographs*, 75(1), p. 3-35.
 19. HUISMANN W., 2012, *Schwarzbuch WWF: Dunkle Geschäfte im Zeichen des Panda*, Gütersloher Verlagshaus, 3. Auflage, 256 pp.
 20. JUCKER R., 2002, Our common illiteracy – Education as if the Earth and people mattered, in: *Serie Umweltbildung, Umweltkommunikation und Nachhaltigkeit*, Vol. 10, Peter Lang Verlag, Frankfurt a.M.
 21. JUSTUS J., 2008, Ecological and Lyanupov stability, in: *Philosophy of Science* 75(4): p. 421-436.
 22. KASTHOFER K.A., 1818, cited in GROBER U., 2010, *Die Entdeckung der Nachhaltigkeit (The discovery of sustainability)*, Verlag A. Kunstmann, Munich.
 23. LOVELOCK J., 1979, *Gaia – A new look of life on Earth*, Oxford University Press.
 24. LOVELOCK J., 1988, *The Ages of Gaia*. Oxford University Press.
 25. MAINZER K., 2013, The New Role of Mathematical Risk Modeling and its Importance for Society, in: *The Risk Book* (online), Technische Universitaet Muenchen, Munich.
 26. MAKARIEVA A. M., GORSHKOV V. G., SHEIL D., NOBRE A. D., LI B., 2013, Where do winds come from? A new theory on how water vapor condensation influences atmospheric pressure and dynamics, in: *Atmospheric Chemistry and Physics*, vol. 13, p. 1-18.
 27. MEADOWS D. H., MEADOWS G., RANDERS J., AND BEHRENS III. W.W., 1972, *The Limits to Growth*, Universe Books.
 28. ODUM E.P., BARRETT, G.W., 2004, *Fundamentals of Ecology*, Cengage Learning, 5th ed., 624 pp.
 29. OLSSON P., GUNDERSON L. H., CARPENTER S. R., RYAN P., LEBEL L., FOLKE C. AND HOLLING C. S., 2006, Shooting the rapids: Navigating transitions to adaptive governance of social-ecological systems, in: *Ecology and Society*, 11(1), p. 18
 30. PISANO U., 2012, Resilience and sustainable development: Theory of resilience, systems thinking and adaptive governance, in: *European Sustainable Development Network (ESDN) Quarterly Report*, no. 26, 50 pp.
 31. SCHEFFER M., CARPENTER S. R., FOLEY J. A., FOLKE C. AND WALKER B. H., 2001, Catastrophic shifts in ecosystems, in: *Nature*, 413, p. 591-596.
 32. UN, 1992, *Agenda 21 – Sustainable Development*, United Nations Conference on Environment and Development, Rio de Janerio.
 33. VENN J., 1881, *Symbolic Logic*, Macmillan, London.

34. von CARLOWITZ H. C., 1713, *Sylvicultura oeconomica: Anweisung zur wilden Baumzucht*. Reprint, 2000, TU Freiberg, Report 135.
35. von HAUFF, 2014, *Nachhaltige Entwicklung aus der Perspektive verschiedener Disziplinen*, Nomos Verlag, Baden-Baden.
36. WACKERNAGEL N., 1994, *Ecological footprint and appropriated carrying capacity: A tool for planning towards sustainability*, PhD-Thesis, School of Community and Regional Planning, The University of British Columbia, Vancouver.
37. WALKER B., SALT D., 2006, *Resilience Thinking – Sustaining Ecosystems and People in a Changing World*, Island Press, Washington D.C.
38. WALKER B. H., HOLLING C. S., CARPENTER S.R., KINZIG A., 2004, Resilience, adaptability and transformability in social-ecological systems, in: *Ecology and Society*, 9(2), p. 5.
39. WCED, World Commission on Environment and Development, 1987, *Our Common Future*, Oxford University Press, New York.

Uneven Integration and Blocked Spillovers: Why Environmental Governance in Northeast Asia does not Converged to the EU Model?

Niejednolita integracja i zablokowane skutki pośrednie: dlaczego zarządzanie środowiskiem w Azji Północno-Wschodniej nie jest zbieżne z modelem przyjętym w UE?

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Abstract

The EU environmental governance is recognized as an effective path to the management of regional environment. This model is based on rules, directives, top-bottom coordination and also in the characteristics of multi-level governance, which has become an example for various regions to imitate in the world. By contrast, environmental governance in Northeast Asia, equally with a strong demand in dynamic cooperation, failed to deal with the increasing environmental problems and it also doesn't converge to the EU environmental governance over the years. Instead, it established a non-binding cooperation in nature. The Northeast Asia model is a kind of cooperation lack of effectiveness, coordination between regional environmental regimes, without a stable financial arrangement for each cooperative initiative, mainly dominated by the governments, and also lacking of other actors involved in environmental issues. This model is caused by regional security tension which changes the cooperation preference overall, nations especially between China and Japan do not share political trust in high politics. This situation makes regional environmental governance to be a more independent area, with rarely high political interference and without spillover channels to other issues. Theoretically speaking, the Northeast Asia cooperation in environment is based on inter-governmental arrangements, thus, Neo-Functionalism's spillover effects were significantly inhibited. That means to enhance environmental governance in Northeast Asia will mainly rely on intergovernmental push in the future.

Key words: the EU, environmental governance, Northeast Asia, convergence, neo-functionalism

Streszczenie

Przyjęty w UE system zarządzania środowiskowego jest uznawany za efektywny sposób regionalnego zarządzania. Model ten oparty się na zasadach, dyrektywach i kompleksowej koordynacji, a także charakterystyce zarządzania wielopoziomowego, stał się wzorem dla różnych regionów świata. Jednak Azja Północno-Wschodnia, z silnym popytem charakterystycznym dla form dynamicznej współpracy, nie radzi sobie z coraz większymi problemami z zakresu ochrony środowiska i jest odległa od standardów UE. Funkcjonujące tu formy współpracy nie są wiążące. Model współpracy z Azji Północno-Wschodniej charakteryzuje się brakiem efektywności i kompatybilności pomiędzy poszczególnymi regionalnymi systemami ochrony środowiska, bez zapewnienia stabilnego finansowania dla podejmowanych inicjatyw, zdominowaniem przez rządy i brakiem innych podmiotów zaangażowanych w kwestie ochrony środowiska. Na ten model ma wpływ kryzys bezpieczeństwa, który objawia się w szczególności sposób we wzroście napięcia pomiędzy Chinami a Japonią. Ludzie nie darzą tu zaufaniem świata wielkiej polityki. Ta sytuacja sprawia, że regionalny zarządzania środowiskiem może być bardziej niezależny, stykać się z wielką polityką i bez skutków ubocznych odnoszących się do innych kwestii. Teoretycznie rzecz biorąc,

współpraca Azji Północno-Wschodniej w zakresie ochrony środowiska opiera się na uzgodnieniach międzyrządowych, w ten sposób, neo-funkcjonalne skutki uboczne zostają znacząco ograniczone. Oznacza to, że także w przyszłości w celu poprawienia zarządzania środowiskowego w Azji Północno-Wschodniej Azji uzgodnienia międzyrządowe będą kluczowym czynnikiem.

Słowa kluczowe: UE, zarządzanie środowiskowe, Azja Północno-Wschodnia, zbieżność, neofunkcjonalizm

Two Different Regional Environmental Governance

In 1991, the EC at the Maastricht summit adopted a treaty to establish a *European Economic and Monetary Union* and *European Political Union*, which is remembered as the famous *Maastricht Treaty* (Laursen, 2012). The following year, the treaty was signed, along with the establishment of the Council, the Commission, the Parliament, which is a gradual transformation from regional economic co-development to regional political and economic integration. After the *Maastricht Treaty* entered into force, the European Union was formally established, which marked the transition from an economic entity to an economic and political entity, while developing a common foreign and security policy, and also to strengthen the judicial and internal affairs. Member States have been given part of their national sovereignty to the organization, making the EU more and more like a federal state. The Union now has 28 Member States. Among them, Germany and France were recognized as the EU's core states, Germany is also regarded as the most powerful driving force in the EU's environmental policy integration (Haibin, 2008). By contrast, Northeast Asia (namely China, Japan, South Korea, Russia, Mongolia and North Korea) is located in the Pacific Northwest, where the location is connected within an ecosystem, and also in the same monsoon zone. Geographical environment in Northeast Asia makes that a country's pollution can easily spread to neighboring countries, causing trans-boundary environmental problems. Among them, China, Japan and South Korea are more active in the environment cooperation and are far more important actors (Komori, 2010). Since the end of the Cold War, the rapid economic development in Northeast Asia has made it one of the world's most active political and economic places in the world. In this process, the region is also facing increasingly serious environmental problems. Currently, the regional environmental problems in Northeast Asia are mainly air pollution, land degradation, dust storms, ocean pollution, biodiversity loss, waste pollution, chemical pollution and poor regional environmental governance etc., coupled with the background of disputes between states in the region in territory, historical issues etc.. Nowadays the environmental governance in the region has been quite worrying.

Admittedly, European environmental governance is significantly more effective than the governance in Northeast Asia. The EU realizes the importance of environmental issues and also shapes the interna-

tional environmental regimes through norms and standards as a world-leading role (Burns, Carter, 2012), thus makes this model worth attention and learning. The so-called European model, is the legalization of environmental governance, and emphasizes on the multi-level governance in its nature. Environmental cooperation in Europe leads to environmental standards, and these standards has become a strong driving force for environmental management in Europe, so the European experience in international environmental cooperation symbolizes the importance of this legalization trend. For example, if a Member State does not comply with a particular directive, the European Commission has the responsibility to enforce the law. European Court of Justice is the final arbiter, the EU countries often based on the political necessity considerations are usually subject to judgment (Bell, McGillivray, Pedersen, 2013).

Since 1992, the Rio Earth Summit, the Northeast Asian region (in addition to bilateral environmental cooperation) formed a number of major regional environmental cooperation regimes, including China, Japan and South Korea Environment Ministers Meeting (TEMM), North-East Asian Subregional Programme for Environmental Cooperation (NEASPEC), Northeast Asian Conference on Environmental Cooperation (NEAC). There are also specific mechanisms and frameworks for cooperation on specific issues, such as the Northwest Pacific Action Plan (NOWPAP), Acid Deposition Monitoring Network in East Asia (EANET), regional dust technical support plan (DSS-RETA), Yellow Sea Large marine Ecosystem Strategic Action project (YSLME) and remote air pollution in Northeast Asia joint research (LTP). These cooperation mechanisms are based on regular meetings of intergovernmental arrangements, publish reports and implement specific action plans to raise funds for the project, and also establish cooperation between the secretariat and other ways to promote the continuous development of environmental cooperation in Northeast Asia. Naturally, Northeast Asia environmental governance has become an important part of governance in Northeast Asia (Komori, 2010).

Characteristics of environmental governance in Northeast Asia

Over the years, China, Japan and South Korea tripartite environment ministers meeting (TEMM), North-East Asian Subregional Programme for Environmental Cooperation (NEASPEC), the northeast Asia

environmental cooperation conference (NEAC) and the northwest Pacific action plan (NOWPAP), have set up the regular meeting forms, financing arrangements, and decision-making procedures of the mechanism achieved certain progress. But problems like the agendas crisscross and lack of contact between these mechanisms are all evident. In addition to overlapping contents, personnel allocation and use is also not well-organized. There is obvious competition relations between these mechanisms (Yoon, 2008). Such as China, Japan and South Korea tripartite environment ministers' meeting and the North-East Asian Subregional Programme for Environmental Cooperation was established under the advice and support of South Korea, and Japan is to support the acid deposition monitoring network in east Asia, and so both sides compete on the control of the northeast Asia environmental cooperation. Despite the coordination between mechanism have been discussed in different meetings and places, but rarely the actual effort are made or achieved (Takahashi). Judging from the historical process of environmental governance, striking difference between northeast Asia environmental governance and European environmental governance can be found: the first difference is the lack of binding arrangements in Northeast Asia. Northeast Asia environmental cooperation and management so far has not yet formed a binding agreement or protocol yet. The consensus approach is widely used in East Asia, nations have a natural resistance on international legislation. There is no doubt that this non-binding tradition is rational decision to choose, is also the result of countries interaction in the process of negotiation. This is based on the principle of non-interference in Northeast Asia cooperation, rather than the legal procedures agreed through consultation. The second is focus more on bilateral cooperation rather than multilateral cooperation. The northeast Asia environmental cooperation is occupied bilaterally. The northeast Asia environmental cooperation started in the bilateral rather than regional multilateral coordination. In terms of bilateral environmental cooperation, Japan has a unique position. Japan to regional countries such as China, Korea, Mongolia and Russia provides a large number of loans related to environment, including against acid rain, forest management, groundwater development and several issues, such as renewable energy plants. The Japanese government emphasized the environmental cooperation as an important part of economic cooperation (Xiaopeng, Haibin, 2013). Besides, Northeast Asia active bilateral cooperation is mainly driven by economic interests. Northeast Asia fast development of environmental industry market and the nature of the environmental technology complement each other. Environmental technology in Japan, is seeking to permeate the rapid growth of the Asia-Pacific market of environmental protection.

Table 1. The Comparison of major environmental cooperative mechanisms in Northeast Asia (Qinghua, 2006)

	TEMM	NEASPEC	NOWPAP
Member States	China, Japan, South Korea	China, Japan, Korea, Mongolia, Russia, DPRK	China, Japan, Korea, Russia
Mechanism Arrangements	Relative independent cooperative areas.	Relative Independent cooperative areas.	The United Nations environment programme (UNEP) regional sea plan.
Time of foundation	1999	1993	1994
Level of Cooperation	Environment Ministers Meeting.	The northeast Asia environmental higher-level official meeting.	Intergovernmental meeting.
Governing Organizations	No specialized agency for management, conference held once a year, the three countries held alternately.	Senior Officials on Environmental Cooperation in Northeast Asia is the decision-making bodies and it is the United Nations operational activities of the ESCAP secretariat.	Decisions, made by regional activity centers and executed by regional coordination Office.
Content of Cooperation	Environmental policy exchanges and strengthen transboundary movements of e-waste electronic waste prevention and conduct research, promote the establishment of mechanisms for the protection and benefit sharing of genetic resources and biodiversity, etc.	The main concerns are transboundary environmental issues, including cross-border nature conservation in Northeast Asia, Northeast Asia, transboundary air pollution, transboundary marine pollution.	Marine environment, including integrated coastal and watershed management, periodic assessment of the marine environment, prevent and reduce pollution, biodiversity conservation, and so on.
Financial Arrangements	Three nations co-financing.	Voluntary contributions from member states to establish NEASPEC core funds to get the project implementation by UNDP, the United Nations Secretariat of the Convention to Combat Desertification, the ADB and other funding agencies.	Establish the trust of northwest Pacific action plan, also source of funds for each member's voluntary contributions.

Reasons for Non-convergence under Neofunctionalism

After 20 years of development after the Cold War, why Northeast Asia environmental governance was not able to follow of the EU development path, why still uses the loose, non-binding nature of mechanisms for cooperation? This article employs the neo-functionalism's perspective to analyze the regional economic, legal and political integration in Northeast Asia. International environmental politics has traditionally been regarded as low politics by realists, the neo-functionalism focus on low-level political attention and cooperation, like cooperation between countries in specific functional areas. In these specific functional areas, and share common interests and the means of access to the common interests of all countries rely on joint efforts. As in recent years, the tension of the security situation in Northeast Asia, governments gain increasing political distrust, and what this situation results is that spillovers of environmental governance is deliberately limited (Haibin, 2008). Nevertheless, the environmental cooperation in Northeast Asia has slowly developed into a field, which is able to avoid the security risks in this region (Vogler, 2005).

Neo-Functional theorist Philippe Schmitter stressed that the process of integration as an important spillover refers conducted to provide a basis for the integration process. In particular, the integration of the peace process beyond the nation-state, its evolution depends on the participation of all parties recognize common needs. Ernst Haas believe this process will turn a new center of the process, the organization that owns the center or require mastery of each nation state with jurisdiction. Karl W. Deutsch considered political integration process is that people get a sense of community, a sense of institutional and practical sense.

Similarly, Haas believes the policy interdependence does not necessarily lead to policy integration. Neofunctionalism emphasizes supranational mechanism advocated by the spillover mechanism enables integration gradually and expands from the technical department to political department, the eventual establishment of institutionalized regional supranational institutions. Neofunctionalism spillover and supranational theory has been clearly reflected in the European Community. In addition, Haas argues if elites can benefit from a national organization's activities in the country, they might have similar thoughts with foreign elite transnational cooperation. Haas considered most likely to achieve the integration of Western Europe in accordance with its spillover theory. The core of Joseph S. Nye, Jr.'s Neofunctionalism is the potential integration; he puts forward four conditions of international cooperation (Dougherty, Pfaltzgraff, 2003):

- (1) fair trade, and the level of integration and economic development

- (2) elite beliefs, the higher the degree of complementarity between the elites, the greater the likelihood of the development of regional integration.
- (3) the existence of pluralism, the higher the degree of diversity among nations and promoting better conditions for the integration process through feedback mechanisms.
- (4) adaptability and responsiveness of nations, the more stable domestic capacity of the key political decision-makers, the more effectively member states can respond to issues.

Nye argues integration is a multidimensional phenomenon, and it needs to be categorized into economic, political, legal integration. And it can also be divided into specific measurable sub-types. Integration of EU environmental legislation led to the capacity building of EU environmental governance. Separation of the political and economic situation in Northeast Asia continued, therefore, the gap between the political and economic insurmountable. In this case, the integration of environmental laws across countries cannot have the prerequisite and power to achieve the subjectives (Dougherty, Pfaltzgraff, 2003).

Although affected by de Gaulle *empty chair* crisis in the 1960s and 1970s, the theory of integration marginalized from mainstream, Wayne Sandholtz and Alec Stone Sweet further add to improve neo-functionalism doctrine, they believe that the three constituent elements are a necessary precondition which exert influences:

- (1) actors with transnational goals and interests;
- (2) the ability of transnational institutions' autonomy (autonomous capacity);
- (3) have an impact on polity or system of rules.

Through empirical research, they think that the new functionalism still has important explanatory power in explaining international cooperation (Sandholtz, Sweet, 2012).

Northeast Asian Factors that Hinder Environmental Spillovers

Integration of EU environmental legislation led to better capacity building. In Northeast Asia although there are common environmental interests existing which is essential to institutionalize cooperation (Sandholtz, Sweet, 2012), the separation of the political and economic aspects continue, therefore, the gap between the political and economic is insurmountable. In this case, the integration of environmental laws across countries cannot have the prerequisite and power to achieve its goal. Spillover effect was lowered and limited for obvious political reasons. Therefore, maintaining as a relatively stable cooperation in Northeast Asia, the factors that hinder cross-border spillover factors include:

First, it's the high politics instability, especially the impact of the security situation in political sphere.

China, Japan and South Korea has a complex three-way relationship between history and reality, because the Japanese militarists invaded China and South Korea's national consciousness, they also determine the policy orientation. Moreover, in recent years, China and Japan are facing conflicts on the Diaoyu Islands. Therefore, the perception of sovereignty, coupled with strong nationalist sentiments of mistrust so that the high cost of transferring sovereignty to form a binding supranational environmental cooperation mechanism in Northeast Asia, not reality. Diaoyu Islands issue between China and Japan continued to ferment. Territorial disputes are often intricately linked with the historical factors issues, domestic politics, and so-called transfer of power together, increasing the difficulty of solving the problem.

Secondly, the uneven levels of development among Northeast Asian countries. Joseph Nye Jr. argues that economic equality between countries, trade, integration and level of development are interrelated, uneven development is an important factor that hinders spillovers. This situation seriously hampers the development of regional integration and legal environment. Environmental issues in Northeast Asia are mostly cross-border environmental pollution, pollution emissions for each country is both a victim who is.

Third, the cooperation mechanism does not have the ability to self-autonomy, also with financial difficulties (Sandholtz, Sweet, 2012). Multinational organizations with the ability of self-autonomy, in order to better resolve disputes and set rules. However, environmental cooperation mechanism in Northeast Asia does not have these capabilities. Only from the aforementioned problem areas covered by the mechanism can be seen, some of the problems in the region, such as air pollution and loss of biodiversity has been too much attention, and some other problems such as the environment and energy issues as well as issues such as land degradation do not get the attention they deserve; at the operational level, each mechanism run independently, have different decision-making mechanisms; each cooperative mechanism has its own secretariat or department to perform the functions of the secretariat, thus making the action plan and projects inevitably overlap each other punch. For example, to solve trans-boundary air pollution problems in Northeast Asia's two bodies EA-NET and LTP, the two mechanisms in Northeast Asia simultaneously monitor data on emissions of air pollutants gathering activities, which leads to waste of resources.

Fourth, environmental cooperative mechanisms in Northeast Asia between are lack of coordination. Neo-functionalism argues if transnational actors want to achieve success, they need to have common goals and interests. In Northeast Asia, the lack of environmental coordination mechanisms must make it difficult to reach this goal. Finally, the state acts as

the main actors, along with inability of transnational elites. Non-state actors participate in a limited body of Northeast Asia. Actions of non-state actors are also on the role of regional environmental cooperation has very limited impact on the national environmental decision-making, which can be negligible. Therefore, the state-based environmental cooperation lack of participation of non-state actors and the Northeast Asia cooperation in environment rely entirely on the willingness and ability of governments and lower levels of governance.

Similarly, scientists from various countries have different conclusions on trans-boundary environmental issues, which are reflected in the results of a number of scientific and political factors. Epistemic Communities theory suggests that for cross-border environmental problems if scientists could not reach a consensus, they inevitably lack of influence in the policy (Davis Cross, 2013).

Conclusions

After 20 years of development, environmental governance in Northeast Asia embarked on a so-called Northeast Asian model, is not convergent with the EU environmental governance due to lagging regional integration in this area. In this region, the effectiveness of regional environmental governance is inevitably inadequate. And the future for Northeast Asia environmental governance remains to be government-led. Therefore, governmental push is prominent and is still the way in environmental cooperation for Northeast Asia. In addition, other conditions for the integration should also be cultivated, especially the proliferation of transnational elite knowledge and advocacy, because the scientific consensus is a prerequisite for any environmental cooperation and governance. Northeast Asia should strengthen exchanges and the research of environmental science, and help achieve national interests and the needs of environmental cooperation among nation-state actors. Due to the very limited political and legal integration in Northeast Asia, so to deal with the integration of loose existing mechanisms and thus enhance the effectiveness of governance is extremely important. With the realization of the importance of environmental issues within countries, regional environmental governance has developed into an independent issue area, and become an important field of cooperation. Moreover, to some extent, the environmental cooperation seems more like a reservations ground for governmental dialogue during high political rupture. Therefore, Northeast Asian cooperation should take the overall situation into consideration, and reflect on the moral dimension of the environment, so as to gradually open up the spillover channels and seek to promote the environmental integration in the future.

References

1. BELL S., MCGILLVRAY D., PEDERSEN O., 2013, *Environmental Law*, Oxford University Press, Oxford, pp.210-213.
2. BURNS CH., CARTER N., 2012, Chapter 36 Environmental Policy, in: Jones E., Menon A., Weatherill S. (eds.), *The Oxford Handbook of the European Union*, Oxford: Oxford University Press, p.512.
3. DAVIS CROSS M.K., 2013, Rethinking Epistemic Community Twenty Years Later, in: *Review of International Studies*, vol. 39(1), pp. 138-139.
4. DOUGHERTY J.E., PFLATZGRAFF R.L. Jr., 2003, *Contending Theories of International Relations: A Comprehensive Survey* (5th Edition), Pearson, Chinese Edition, Beijing, pp.543-556.
5. HAIBIN Z., 2008, *Environment and International Relations (Huanjing yu guojiguanxi: quanqiu huanjing wenti de lixing sikao)*, Shanghai's People Press, Shanghai, p.35.
6. HAIBIN Z., 2008, From Absorber to Engine: The Sino-Japanese Cooperation on Environment faces Important Change, in: *Shijie Huanjing (World Environment)*, vol.4, pp.76-79.
7. KOMORI Y., 2010, Evaluating Regional Environmental Governance in Northeast Asia, *Asian Affairs*, in: *An American Review*, 37(1), p.21.
8. LAURSEN F., 2012, Chapter 9 The Treaty of Maastricht, in: Jones E., Menon A., Weatherill S. (eds.), *The Oxford Handbook of the European Union*, Oxford: Oxford University Press, p.121.
9. SANDHOLTZ W., SWEET A.S., 2012, Chapter 2 Neo-functionalism and Supranational Governance, in: Jones E., Menon A., Weatherill S. (eds.), *The Oxford Handbook of the European Union*, Oxford: Oxford University Press, pp.18-19.
10. TAKAHASHI W., *Environmental Cooperation in Northeast Asia*, see at: <http://pub.iges.or.jp/modules/envirolib/upload/1704/attach/neasia.pdf> (28.12.2014)..
11. VOGLER J., 2005, The European Contribution to Global Environmental Governance, in: *International Affairs*, vol. 81, no. 4, p. 841.
12. QINGHUA X. (ed.), 2006, *Zhongguo guoji quyu huanjing hezuo huibian* (China International regional environmental cooperation documents), hina Environmental Science Press, Beijing, p.347.
13. XIAOPENG X., HAIBIN Z., 2013, Choices for Environmental Governance in Northeast Asia: the European Model or the Northeast Model?, in: *International Politics Quarterly*, vol. 3, pp.56-58.
14. YOON E., 2008, Cooperation for Transboundary Pollution in Northeast Asia: Non-binding Agreements and Regional Countries' Policy Interests, in: *Pacific Focus*, 22(2), p. 78.

The Issue of Environmental Resources Management in the Light of the Model of Tragedy of the Commons – Systemic Approach

Problematyka gospodarowania zasobami środowiska w świetle modelu tragedii współzútutowania – ujęcie systemowe

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Abstract

In 1968, a paper appeared in the *Science* journal outlining a macroeconomic concept referring to the problem of common use of environmental resources. Its author, Garret Hardin, stated that the natural human desire to maximise individual economic benefits led to overexploitation of environmental resources to the detriment of the whole society.

The problem brought up by Hardin is very important from the perspective of the idea of sustainable development. After all, the relationships in which the pillars, or subsystems (ecological, social and economic ones), of sustainable development remain should be harmonious enough to enable simultaneous maximisation of their objectives. In particular, the social, economic and ecological subsystems should not exclude one another. However, the tragedy of the commons is a classic example of a situation where the economic subsystem is in conflict with the ecological and social subsystems. As Hardin pointed out, this phenomenon occurs in various spheres of human activity and cannot be overcome by only technical means.

Observing the grazing of cattle on a commons, Hardin noticed that the commons became completely depleted, although this was not in the interest of the local community. It is not only in farming that ecological and social problems appeared as consequences of an individually rational economic activity. Hardin's concept found confirmation in overexploited water supplies, depleted fisheries, cleared forests, illegal rubbish dumps, and rivers degraded by sewage.

It is in the vital interest of the society to better get to know and bring under control the mechanism that leads to exceeding of the environment regeneration capacities and results in its users starting to incur losses instead of benefiting from it. This issue is examined by a systemic approach to management which identifies the universal pattern of system behaviour referred to as the archetype of the tragedy of the commons. Thus, the phenomenon is systemic in origin, and we can learn more about its development in time (or even neutralise it) by means of the method of system dynamics. A system affected by the tragedy of the commons functions in a way that diverges from the idea of sustainable development. It contradicts not only the postulate of intergenerational justice (there is overexploitation of environmental resources which can even lead to their irretrievable loss), but also intragenerational one (actions of some users of the environment cause inconveniences that will afflict the whole society). Therefore, we cannot ignore the symptoms of the tragedy of the commons while trying to implement local ideas of sustainable development.

The article explains the mechanism of the tragedy of the commons based on the system theory using the model of system dynamics. A systemic archetype has been discussed on the basis of which a dynamic model has been developed, and a simulation of the common resource exploitation has been carried out. Further on, possibilities of preventing the scenario of resource depletion have been discussed.

Key words: environmental resources, the tragedy of the commons, archetype, system, model

Streszczenie

W 1968 roku na łamach czasopisma *Science* przedstawiony został zarys koncepcji mikroekonomicznej odnoszącej się do problemu współużytkowania dóbr środowiska. Jej autor, amerykański ekolog Garret Hardin stwierdził, że naturalne ludzkie dążenie do maksymalizacji indywidualnych korzyści ekonomicznych prowadzi do nadmiernej eksploatacji dóbr środowiska przynosząc straty całemu społeczeństwu.

Z punktu widzenia idei rozwoju zrównoważonego problem poruszany przez Hardina należy uznać za bardzo ważny. Wszak filary, a zarazem podsystemy owego rozwoju (ekologiczny, społeczny i ekonomiczny) powinny pozostawać względem siebie w relacjach na tyle harmonijnych, aby możliwe było jednoczesne maksymalizowanie ich celów. W szczególności podsystemy: społeczny, ekonomiczny i ekologiczny nie powinny się nawzajem wykluczać. Tymczasem tragedia dóbr wspólnych to klasyczny przykład sytuacji, podczas której podsystem ekonomiczny wchodzi w konflikt z podsystemami ekologicznym i społecznym. Jak wykazywał Hardin, zjawisko to występuje w różnych sferach ludzkiej działalności i nie da się go przezwyciężyć przy użyciu samych tylko środków technicznych.

Obserwując wypas bydła na wspólnych pastwiskach Hardin zauważył, że dochodziło do ich zupełnego wyeksploatowania, choć nie było to w interesie lokalnej społeczności. Ale nie tylko w gospodarce rolnej problemy ekologiczne i społeczne pojawiały się jako skutki indywidualnie racjonalnej działalności ekonomicznej. Koncepcja Hardina znalazła swe potwierdzenie w wyeksploatowanych ujęciach wód, przetrzebionych łowiskach ryb, wykarczowanych lasach, dzikich wyspiskach śmieci i zdegradowanych ściekami rzekach.

W żywotnym interesie społeczeństwa jest lepsze poznanie i opanowanie mechanizmu, który prowadzi do przekraczania zdolności odtworzeniowych środowiska i sprawia, że jego współużytkownicy zamiast odnosić z gospodarowania nim korzyści, zaczynają ponosić straty. Zagadnienie to rozpatruje systemowy nurt zarządzania wyróżniając uniwersalny wzorzec zachowania systemu zwany archetypem tragedii współużytkowania. Podłoże zjawiska ma więc charakter systemowy, a jego przebieg w czasie może zostać lepiej poznany (a nawet zneutralizowany) przy użyciu metody dynamiki systemów. System dotknięty tragedią współużytkowania funkcjonuje w sposób daleki od idei zrównoważonego rozwoju. Zaprzeczeniu ulega nie tylko postulat sprawiedliwości międzypokoleniowej (dochodzi do nadmiernej eksploatacji dóbr środowiska prowadzącej nawet do ich bezpowrotnej utraty) ale także i wewnątrzpokoleniowej (część użytkowników środowiska swym działaniem przyczyni się do uciążliwości, które dotkną całą społeczność). Nie można więc bagatelizować symptomów tragedii dóbr wspólnych chcąc zarazem wdrażać w życie lokalne idee rozwoju zrównoważonego.

W artykule wyjaśniono mechanizm tragedii współużytkowania na gruncie teorii systemów przy wykorzystaniu modelu dynamiki systemu. Przedyskutowano systemowy archetyp, na podstawie którego opracowano model dynamiczny i przeprowadzono symulację eksploatacji wspólnego dobra. Następnie omówione zostały możliwości przeciwdziałania scenariuszowi jego wyczerpania.

Słowa kluczowe: zasoby środowiska, tragedia współużytkowania, archetyp, system, model

Introduction

The concept of the tragedy of the commons has been known for almost half a century. It refers to the problem of managing the environment, a problem which closely fits in with the issue of sustainable development as it is important not only from an ecological point of view, but also for social and economic reasons. When there are many users of a common good, they tend to exert an increasing pressure on it, which results in consumption exceeding its regeneration capacities. Consequently, the good becomes less accessible or it is exhausted completely, and it is either impossible or too time-consuming and costly to restore it. It is paradoxical that the individual rationality leads to a state which is socially not optimal and in which the assimilative or regeneration capacities of the environment are exceeded. Hardin (1968) notes that the mechanism he described contradicts the concept of an *invisible hand* advocated by an economics classic, Adam Smith. In his work, Hardin refutes Smith's view that an individual who intends

only his own gain is led by an *invisible hand* to promote the public interest. He also provides examples that undermine the laissez-faire belief that decisions reached individually are the best decisions for society as a whole, and so they should not be curbed. The problem of the tragedy of the commons is undoubtedly connected with the issue of freedom of human actions, a freedom that Smith advocated. However, the solution to this problem cannot be found only on the grounds of human freedom. It should be remembered that Hardin formulated his concept when he was observing rural communities grazing cattle on a common pasture. Assuming that the main reason why the pasture got depleted was the fact that it was shared by many users, a simple and obvious solution would be to divide and privatize the commons. In fact, supporters of economic liberalism often advocate privatization of the environmental goods. Almost two centuries ago, a British economist Arthur Young, who was called an *apostle of progress in agriculture* by Manteuffel, expressed the view that the magic of property turned sand to gold. Young said:

Give a man the secure possession of a bleak rock, and he will turn it into a garden; give him a nine years' lease of a garden, and he will convert it into a desert (Falkowski and Kostrowicki 2001). It is difficult to refute the argument that being an owner, in contrast to being a mere user or leaseholder, gives a powerful incentive to manage one's property responsibly. But is this incentive sufficient enough? It does happen that valuable environmental resources are overexploited by their very owners. In industry, companies abandon devastated areas recklessly. In agriculture, farmland left uncultivated loses its productivity, and over time becomes degraded and overgrows with weeds and bushes. Moreover, not all resources can be as easily privatized as, for example, forests, farmland, or development and construction areas. Inland flowing waters, sea waters, fisheries, or even air are also common goods which can be subject to degradation just like common pastures, but are inherently difficult to divide. Supporters of interventionism favor solutions in which access to public goods is administratively regulated, and supervised and controlled by the state. However, administration is well known for its tendency to grow excessively, and the more control it exercises over the society, the more prone to corruption it becomes. Furthermore, it often fails in situations that require a prompt and radical reaction typical of a private owner. The belief in the validity of administrative solutions collides with reality also in the tendency to implement laws and various procedures where the homeostatic and balancing function of free market and common sense would be more efficient. That is why, Hardin (1968) rightly pointed out that the tragedy of the commons was a type of no technical solution problem. Neither discoveries in natural and technical sciences that increase the environment efficiency, nor innovative economic or management solutions are enough to deal with this problem. If human actions cannot find a fundamental extension in morality, the situation of common goods will not improve, be it by giving people complete freedom, or by radically restricting it. According to Hardin (1968), a fundamental change should concern human values. They need to be cherished and fostered in a responsible and consistent way from generation to generation.

Respecting the nature's capacity for regeneration is one of the prerequisites for sustainable development (Durbin 2008). So why is this respect lacking in so many areas of human activity? This is because it is a kind of problem that involves the moral sphere; it is connected with a sense of constant dissatisfaction with what we have that is so characteristic of human beings and common-sense limits that should be placed on this sense of dissatisfaction. This problem is examined in an interesting way by a representative of social psychology, Philip Zimbardo. In his work devoted to the anatomy of evil, Zimbardo (2008) writes about the so-called *sins of the wolf*. The metaphor refers to the condition of being so greedy and

desire wealth so much that no amount of it can ever satisfy this greed – just like it is difficult to fill the voracious wolf's throat. Hull (2007), quoting Korten states that multiplying money, which is considered to be the real wealth, has become the main pillar of the modern-day value system. It determines human actions together with all their negative socio-economic, political and ecological consequences (Hull 2007). Filled with the desire for more wealth, we draw increasingly more from what surrounds us (especially from the environment) and still are never satisfied. Moreover, when wealth becomes the overriding objective, this gives rise to conformist behavior, dishonesty, distrust and unwillingness to communicate. When such behavior patterns develop, it is impossible to avert the tragedy of the commons either by means of individual freedom, or by the strictest collective regulations. The human must mature to be able to exercise his freedom as well as to comply with rules. This maturity clearly manifests itself in being able to take responsibility for one's own actions. These issues were pointed out by a French economist Frederic Bastiat, already two centuries ago. A supporter of liberalism, he wondered whether God creating the world made sure that human interests were in harmony and not in conflict. Bastiat came to the conclusion that if God wanted good for the man, the laws of Providence cannot by themselves lead humanity to disaster. Numerous sufferings and problems stem from the fact that divine laws do not act in their plenitude as they are troubled by human solutions. The fundamental problem lies in the fact that enjoying our freedom we have to bear consequences of our choices, and not transfer these consequences onto others. According to Bastiat, any human error engenders useful suffering as long as this suffering affects the one that erred. It will quite naturally bring responsibility into his actions. However, suffering often and not by accident affects others that are free from error and then it sets in motion a misplaced solidarity. In Bastiat's view, responsibility along with the ability to connect effects with their causes, should bring us back into the way of what is good and true (Bastiat, 1850). Unfortunately, human solutions often stretch solidarity in an artificial way, which destroys responsibility and does not allow man to learn from his errors – also when it comes to environmental management.

The tragedy of the commons is not only connected with the issue of sustainable development and of human freedom, responsibility and morality that accompany this development, but also with the collective action theory. This theory attempts to explain why, under what circumstances and how people give up certain behavior patterns and take up collective action; for example, when those using a well spontaneously and voluntarily agree to comply with some rules to prevent overexploitation of water supply. What is the logic of collective action? Are there any analogies between collective action and actions

taken by individuals? Is it possible to influence groups in the same way as individuals? This problem has been studied by an American economist and sociologist Mancur Olson (2012), among others. He has made a significant contribution to institutional economy, especially with regard to the role of private property, tax law, public goods and collective action. According to Olson's theory, members of a group will not work for a common good (with the exception of pure altruism) unless they personally benefit from such actions. Sufficiently strong motivation of group members constitutes the key to working towards a common goal (this can be, for example, a good condition of the environment). Unfortunately, in large groups this might be difficult, as their members can easily succumb to the temptation of passivity: *if I do not do anything, there is likely to be someone else who will take care of something that requires effort from me*. Another temptation for members of large groups is becoming a free-rider – *If I do something which is forbidden (e.g., take more water from a common well, than it has been agreed on), but others do not do that, ultimately nothing will happen*. Zimbardo (2008) demonstrates that antisocial behavior may result from a sense of anonymity, which is characteristic for large groups. So perhaps, a small number of users that know each other is the key to respecting the common good? It is hard to doubt it if we compare staircases in small houses inhabited by a few families with those in high-rise blocks. It is not just common areas in large buildings that are devastated. The same is true about bus stops, public toilets, waiting rooms at railway stations, subways, community parks, and urban beaches. The number of users has definitely a significant influence on the rationalization of the common goods use. This rationalization is also influenced by the rules agreed upon and then implemented by the users themselves. Elinor Ostrom, an American political economist who received the Nobel Prize for her analysis of economic governance of the commons, believes that people are able to effectively organize themselves to manage common goods (1990). However, it is necessary to determine a few basic principles, for example:

- define who may use a commons,
- determine to what extent a commons may be used,
- monitor whether allocated limits are not exceeded,
- familiarize users with sanctions for breaking the rules of using a commons,
- develop mechanisms for resolving conflicts,
- determine who can change the rules.

Ostrom (1990) emphasizes the role of communication, monitoring, sanctions and adaptation to changing conditions in designing mechanisms for rational management of common goods. Undoubtedly, this communication and adaptation can be greatly facilitated

by a systemic approach. This approach helps to discover general mechanisms that lead to problems and can be grounded in some mind-sets which other users of the commons follow. In this way, it enables to take a holistic view of the complex reality surrounding us. It is then that we begin to see the importance of dialogue. Therefore, it is not accidental that the tragedy of the commons has been creatively expanded in the systemic approach to management. Peter Senge (2006), an American management theorist, mentions the tragedy of the commons as one of ten fundamental systemic patterns of behavior which are called archetypes. In a systemic approach, the tragedy of the commons is seen as the universal behavior observed wherever individuals use some common, but finite resource. Their individual rationality results in situations which are far from optimal; it leads to over-exploitation of the resource, and causes difficulties and dysfunctions in the operation of a system. According to Senge, this can be observed not only in environmental management, but also organization management (e.g., in the case of an office that serves a few units in some organization and is overexploited, as a result). In trade, the symptom of the tragedy of the commons may be overflowing the market niche by too many new businesses. In computing, the tragedy of the commons can be seen when a computer annoyingly slows down or completely hangs because too many programs draw from its limited memory and processor simultaneously. In transport, an example would be a congested highway when too many drivers decide to use it at the same time. Generalizing the tragedy of the commons problem, it can be stated after Senge (2008) that a system itself (i.e., a set of synergistically interacting elements) is the cause of its own problems. The influence of a system on human behavior has also been noticed in social psychology. To explain it, Zimbardo (2008) moves from the level of an individual to the level of a situation, and finally to the level of a system. According to Zimbardo, in order to understand complex patterns of human behavior, it is necessary to take into account not only individual predispositions and the situation in which the individual has found himself, but most of all, a system in which he is functioning. A systems theory suggests that the system structure determines the individual behavior. This structure is spontaneously and often unconsciously created by individuals themselves.

Garrett Hardin (1968), the author of the tragedy of the commons, repeatedly emphasized its systemic context. When describing the waste problem, he notes that the individual rationality compels him to dispose of waste and avoid the cost of purifying it. From the point of view of the individual, this does not seem to lead to the destruction of the environment. However, since this is true for everyone, we are closed into a system of fouling our own nest. Hardin also expresses the view that the morality of an act is a function of the state of the system at the time

it is performed. Two centuries ago, a white man on the American Prairie could shoot the bison and cut out only its tongue (considered to be the delicacy), discarding hundreds of kilograms of meat. Such behavior was not considered wasteful. Similarly, no one was concerned too much about polluting rivers, because it was believed that flowing water purified itself every 10 miles. Today this would be difficult to accept. Another example of being *locked in a system that Hardin gives is that of users of a common pasture: (...) each man is locked into a system that compels him to increase his herd without limit, in a world that is limited.*

The tragedy of the commons is a serious and complex problem, and it is closely connected with the idea of sustainable development. There can be no sustainable development if the system is persistently embedded in the tragedy of the commons. Therefore, taking into account the systems theory, it is worth exploring in more detail this mechanism of being locked in a system in order to find some solution to the problem. This will be done by analyzing the archetype, constructing a model of system dynamics and simulating the common use of the environmental resource.

A systemic model of the tragedy of the commons

Peter Senge, the author of the *fifth discipline* – a systemic approach to management, states that the tragedy of the commons occurs when people benefit individually by drawing from common resources (Senge et al., 2008). Individuals keep intensifying their use of the commons until they start to experience severely diminishing returns and difficulties in the operation of the system. The commons include not only natural resources. The tragedy of the commons affects public roads, open space, time and capital, human productive capacity, and even the size of the market – simply speaking, everything that different groups of people can jointly use. Senge (2006) states that when we experience the tragedy of the commons, the system sends us a signal that there is some problem which cannot be effectively solved by an individual, but requires cooperation of all users. This confirms the importance of communication and dialogue, which were postulated by Ostrom (1990) as the first step towards the rationalization of resource management. The symptoms of the tragedy of the commons are increasing difficulties in the use of a common good, difficulties that require more and more effort from the users. As the total activity of resource users increases, individual benefits increase at a significantly slower rate and after reaching the peak values, they begin to fall. Finally, the total activity collapses, as well.

For the sake of simplicity, the tragedy of the commons archetype considers the activity of two users. To construct this archetype, Senge et al. (2008) use two interrelated archetypes of limits to growth,

which share the resource availability constraint (Fig. 1). Alongside with the scale of total activity, the constraint determines how much users A and B benefit from their individual activities.

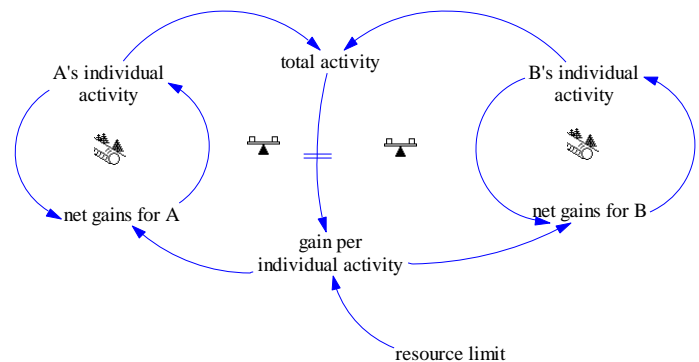


Figure 1. Systemic archetype of the tragedy of the commons. Source: own study based on Senge, 2006

The archetype consists of two reinforcing loops and two balancing loops (Fig. 1). Reinforcement results from intensification in the individual's activity, which brings more benefits, and these in turn contribute to intensification of the activity. Individual activities of users A and B are summed up to give the total activity. The closer this total activity approaches the natural resource limit, the more it will restrain the benefits from individual activities. Balancing loops show the influence of the total activity of A and B on their individual benefits.

By combining elementary structures of positive (growth driving) and negative (balancing) feedback loops, the archetype of the tragedy of the commons helps to understand the logic of the system. It also indicates how its performance can be improved. The first step towards this improvement is involving the resource users in a dialogue. Thanks to the archetype, they can clearly see the harmful structure that they create themselves, and then they can jointly take up the challenge to change it. It is worth recalling that acting on one's own cannot avert the tragedy of the commons. Senge (2006) emphasizes that systemic archetypes are to change our perception so that we can clearly see the operation patterns in systems and their reinforcement effect. In this context, let us mention an interesting example of a team working on the luxury model of Ford in the 90s (Senge et al., 2008). It was equipped with so many electrical devices that their total energy demand significantly exceeded the battery capacity. However, the designers did not want to give up any of the components. Instead, they sought solutions by trying to increase their functionality, which would justify the allocation of a limited amount of energy from the common resource. Only when the employees involved in the project took the effort to understand the tragedy of the commons, did they realize that the system pushed them towards achieving their own goals, rather than optimizing the whole system (Senge et al., 2008).

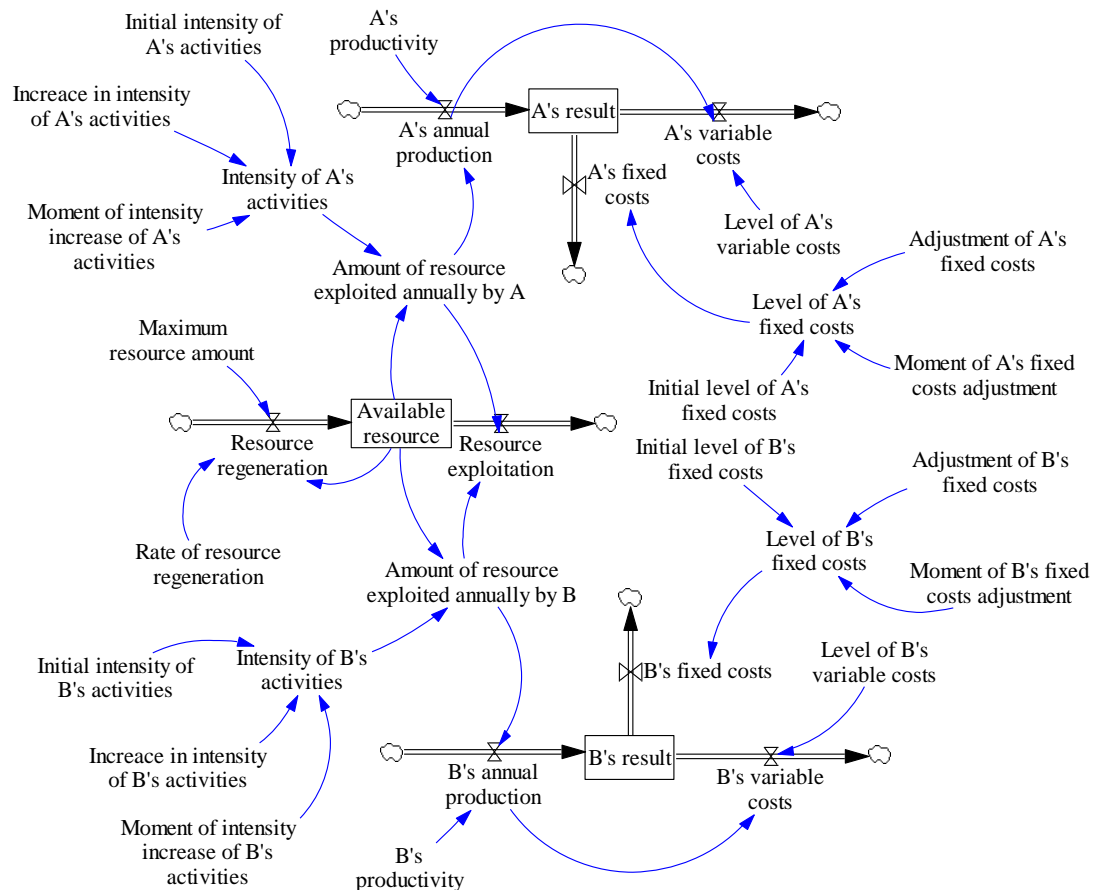


Figure 2. Flow diagram of the model of the tragedy of the commons. Source: own study

The use of archetypes is not limited to discovering the general structures of systems, which are sometimes created by man and which he is always part of. Archetypes are also useful as the starting point for developing dynamic models, which allow to simulate systems and to observe different scenarios of how they function over time (Fig. 2).

Let us assume (as in the case of the archetype presented above) that we have two users (A and B) of a common good with a limited capacity for self-restoration. The capacity will be described by the parameter, which we will call the resource recovery rate. Additionally, let us assume that even under the most favorable conditions, the resource cannot exceed a certain maximum size, which is connected with the limited carrying capacity of the environment¹. The rate of resource consumption will depend on how much of it is left at a given point and how intensively users A and B benefit from it. The intensity may, but need not be constant. Specifically, according to the archetype of the tragedy of the commons, it is increasing over time. The results of the users' activities will be determined by their production and costs connected with it. Both users, acting reasonably, will

look for opportunities to maximize their results. Both of them will be forced to bear fixed costs independent of how much they produce. The production volume is expressed by the simple function of the resource amount obtained by the user and his productivity (i.e., the relation between production and the amount of resources that were used up to carry it out). Environment users will bear variable costs expressed by the product of the annual production and the parameter describing the level of variable costs (Fig. 2).

For the sake of simplicity, reinforcing loops showing that the intensification in the individual activity of the user brings more benefits, which in turn contribute to the activity intensification, were omitted in the model. This pattern, however, was simulated by modifying the intensity of users' activities in one of the scenarios presented further on.

To create the model described above, the Vensim software has been used. In the first scenario, it is assumed that both users will draw from the environment with the same moderate initial intensity, which will remain unchanged for the entire duration of the simulation. In every calculation period, the resource

¹ This is the case with groundwater intakes, farmland resources, pastures, forests, wild game or fish stocks, to name a few.

will be depleted by roughly 1/3 of its size, starting with the maximum (100%) at the beginning of the simulation. Both users will bear the same fixed and variable costs. A's activity will be characterized by constant productivity enabling to produce one unit of the product from any two units of the environment good. On the other hand, B will have lower productivity and will need more than three units of the resource to produce one unit of the product. For the purposes of the model, it is assumed that unless completely exhausted, the resource will be able to reproduce itself according to the function – at most, by half of its amount per year. Once the limit of its carrying capacity is reached, the resource recovery rate will drop to zero². The simulation time has been set for 30 years, and the simulation step: $dt = 1$. A set of equations describing in detail the model and its parameters, has been generated with Vensim. It is as follows:

Available resource = INTEG (Resource regeneration – Resource exploitation, 100)

Amount of resource exploited annually by A = Available resource * Intensity of A's activities

Amount of resource exploited annually by B = Available resource * Intensity of B's activities

Intensity of A's activities = Initial intensity of A's activities + RAMP (Increase in the intensity of A's activities, Moment of intensity increase of A's activities, 30)

Intensity of B's activities = Initial intensity of B's activities + RAMP (Increase in the intensity of B's activities, Moment of intensity increase of B's activities, 30)

Initial intensity of A's activities = 0.15

Initial intensity of B's activities = 0.15

Moment of intensity increase of A's activities = 0

Moment of intensity increase of B's activities = 0

Increase in intensity of A's activities = 0

Increase in intensity of B's activities = 0

A's fixed costs = Level of A's fixed costs

B's fixed costs = Level of B's fixed costs

A's variable costs = A's annual production * Level of A's variable costs

B's variable costs = B's annual production * Level of B's variable costs

Maximum size of the resource = 100

Level of A's fixed costs = Initial level of A's fixed costs – STEP (Adjustment of A's fixed costs, Moment of A's fixed costs adjustment)

Level of B's fixed costs = Initial level of B's fixed costs – STEP (Adjustment of B's fixed costs, Moment of B's fixed costs adjustment)

A's initial fixed costs = 2

B's initial fixed costs = 2

Moment of A's fixed costs adjustment = 0

Moment of B's fixed costs adjustment = 0

Adjustment of A's fixed costs = 0

Adjustment of B's fixed costs = 0

Level of A's variable costs = 0.2

Level of B's variable costs = 0.2

A's annual production = Amount of resource exploited annually by A * A's productivity

B's annual production = Amount of resource exploited annually by B * B's productivity

A's productivity = 0.5

B's productivity = 0.3

Resource regeneration = Available resource * Rate of the resource regeneration * (1 – Available resource / maximum size of the resource)

Resource exploitation = Amount of resource exploited annually by A + Amount of resource exploited annually by B

Rate of resource regeneration = 0.5

The first scenario does not show the tragedy of the commons yet, though in the first 10 years of the simulation, the amount of available resource decreases rapidly (Fig. 3).

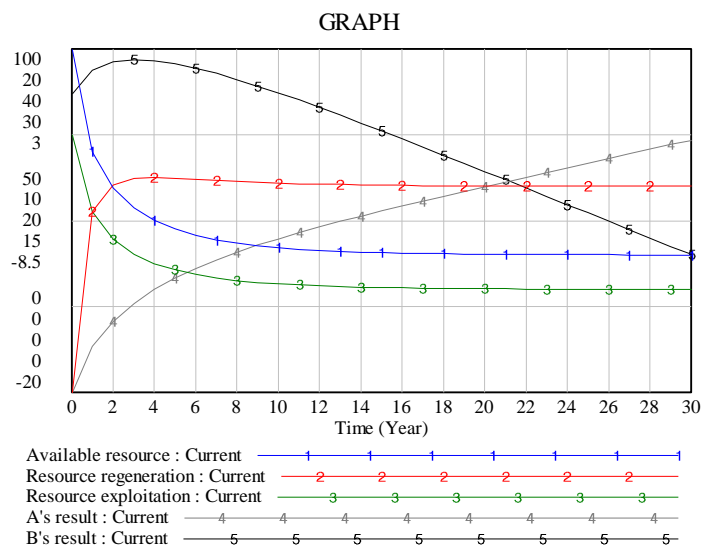


Figure 3. Model of the tragedy of the commons – scenario 1, source: own study

During this period, it regenerates more slowly than it is exploited. After 20 years, the resource is depleted to 40% of its initial amount. At that point, we can talk about a relative balance. Because of the moderate total activity of both users (which is constant throughout the whole simulation), the resource consumption rate is almost the same as its recovery rate. The results of the resource users, however, show two different scenarios due to their different productivity. In the first three years, these results are increasing, but later on only user A, whose productivity is higher, is able to improve his result year by year. After the third year of the simulation, the result of B gradually gets worse and after 10 years, it equals zero. Without adjusting its activities, user B would end up with a negative result because the benefits generated by his activity would not be sufficient to cover fixed costs (Fig. 3).

What (except for giving up his activity) can the environment user do if he is not able to significantly reduce the costs of his activity or improve his

² Let us note that the amount of available pasture grass has its absolute limit just as the fish stock, groundwater or wild

game – when this limit is reached, the resource can no longer increase.

productivity in the short term? Taking into account the fact that he still bears fixed costs (no matter how big his production is), he may try to increase the intensity of resource exploitation by processing it in such a way that will allow surplus production in relation to the costs incurred. Let us consider, therefore, a scenario in which user B will be gradually increasing the demand for the available environment good by 1.5%/year starting from the fourth year (i.e., from the time he notices a decrease in his productivity) (Fig. 4). This behavior is reflected in the model by modifying the parameters of RAMP function, a function which is used to describe the intensity of B's activity (see the model equations). The moment of the intensity increase will take the value of 4, and the intensity increase of his activities will equal 0.015.

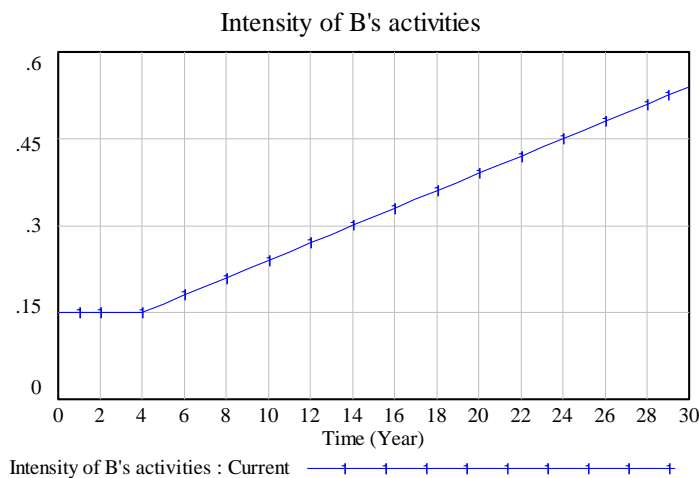


Figure 4. Increase in the intensity of B's activities in the fourth year of the simulation, source: own study

Consequently, already half-way into the simulation time, user B will draw from the common resource more than both of them have done so far. By the end of the simulation, he will have used more than half of the available resource (Fig. 4).

Increasing the scale of his activities, user B will maintain his result at a similar level for several years (Fig. 5). However, excessive exploitation of the resource cannot prevent the failure of his business. This failure will just be postponed by 10 years. User B will not only finish the simulation at a loss, but also will contribute to the losses of A, whose result will become negative in the 26th year of the simulation. At the end of the simulation, both users will have suffered significant losses. These result from the fact that their total consumption has exceeded the regeneration capacity of the environment so much that after 30 years the available resource has shrunk to less than 3% of its original size (Fig. 5). If user A wanted to improve his result by taking more from the commons, the resource would be completely exhausted in a very short time. Its regeneration capacity would be lost, and both users would have suffered even greater losses. This would be a typical scenario of the tragedy of the commons. With many users of

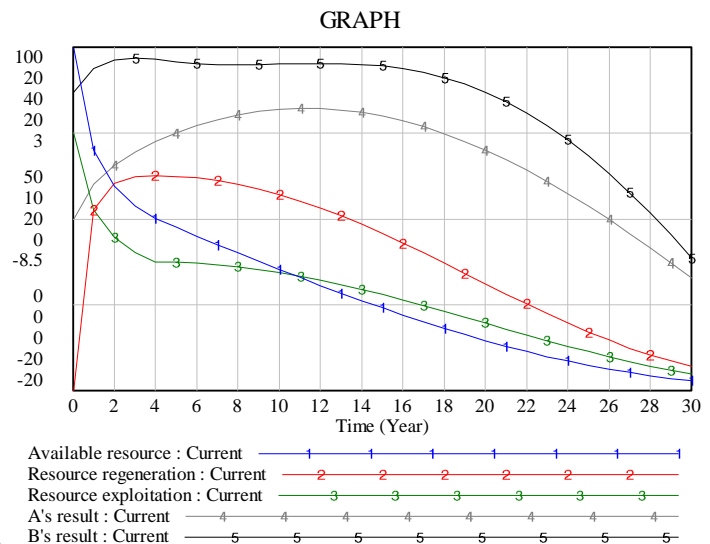


Figure 5. Model of the tragedy of the commons – scenario 2, source: own study

a common good, such a scenario seems very likely. Olson (2012) aptly states that when multiple users compete for the same public good, no one will feel that it is easier available if only one person reduces his demand. Let us also recall Hardin's reflection (1968) that a reasonable individual locked in the system of the tragedy of the commons will seek to increase the scale of his activities rather than to reduce it. This problem can only be resolved by means of communication and cooperation of all users (Senge, 2006). A dialogue is the prerequisite for sustainable management of a common good. However, as it is emphasized by Ostrom (1990), the dialogue alone, without monitoring and sanctions, is not enough.

To solve the problem of the tragedy of the commons, the users need to jointly determine the rules for using the good and to monitor both the condition of the commons and whether the limits agreed on are not exceeded. It is also necessary to introduce sanctions that will determine how to punish the user who uses up more than he has been allowed to (by modifying the model, it would also be possible to simulate what effect these sanctions would have on the resource improvement). These rules and sanctions would be presented as new feedback loops in the model. They adjust resource consumption to the pace of its recovery. For lack of space, this modified model will not be shown here. Let us assume, however, that users A and B, observing environmental impacts of their activities jointly agree to limit exploitation of the commons so that it does not exceed some predetermined value. In such a situation, even if they were incurring losses they could minimize them by controlling the size of available resource year by year and not allowing it to become completely depleted. It is also possible that the feeling of shared responsibility for the commons would make them cooperate more closely with each other and exchange experiences that would lead to improved productivity and reduced

costs. It can be easily indicated what target productivity and/or what level of fixed costs would enable them to share the resource without exceeding a certain determined limit of its exploitation. Referring to the first scenario (Fig. 3), let us note that it would be sufficient if user B slightly increased his productivity (up to a level reached by A) instead of seeking solutions in increasing his demand on the common good. Let us note that user A would also be interested in exchanging experience, as his result heavily depends on the resource availability, and so not on its increased consumption by B. With other parameters remaining the same, both users could carry out their activities depleting the resource to only 40 % of its maximum size.

With the help of the model, one can ask a question about the costs: how much would user B have to reduce the costs to make his business profitable without increasing the pressure on the environment and without increasing productivity? Obviously, there are some categories of costs that cannot be avoided, but some of the fixed costs can be reduced by working together in a group. Let us assume that in this way, user B will manage to bring down the fixed costs to 1/4 of their initial amount in the fourth year (Fig. 6).

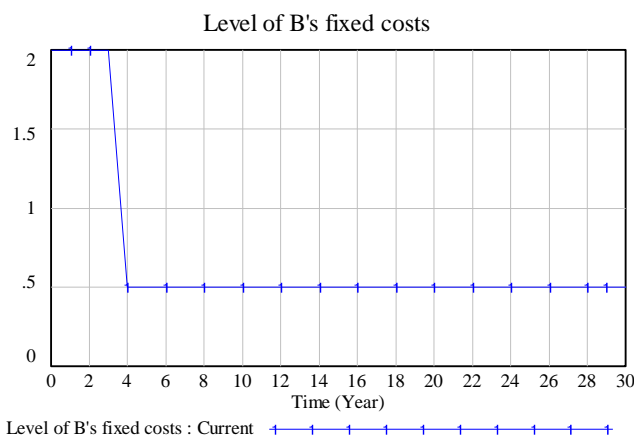


Figure 6. Reduction of the fixed costs by user B in the fourth year of simulation, source: own study

By reducing fixed costs, even at lower productivity, user B would get the result which is only slightly worse than that of user A (Fig. 7). This scenario was tested by restoring the original settings of the model and by modifying the parameters of STEP function used to describe the fixed costs incurred by B. The adjustment moment of fixed costs was set to equal 4, and its value was set at 1.5 (Fig. 6). The resource is not depleted below the level agreed on, and both users conduct their activities at a profit – though each of them with different productivity and at a different cost (Fig. 7).

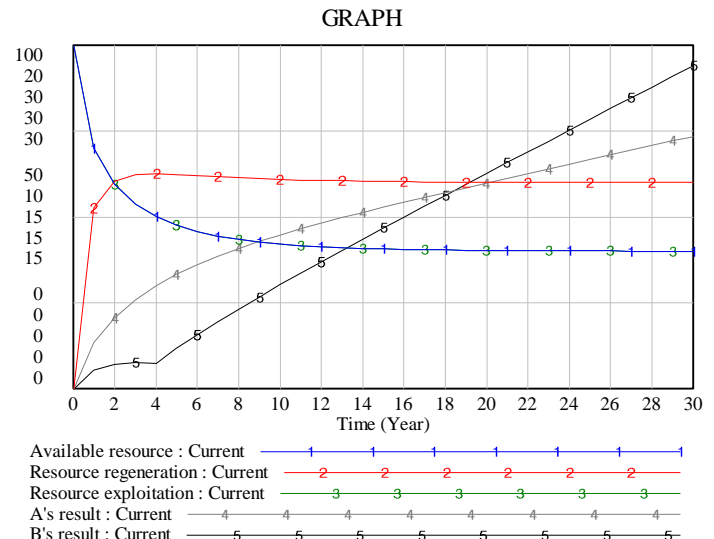


Figure 7. Model of the tragedy of the commons – scenario 3, source: own study

Summary

The tragedy of the commons reveals some truths about the functioning of systems, truths which are often underestimated. Firstly, the system components have mutual influence on each other. Components of sustainable development also interact continually and the dysfunction of one of them (for example, of an ecological component) must affect the remaining ones (social and economic components). In addition, modifying only some points of the system does not always bring about its overall improvement. In the case of the tragedy of the commons, it is not enough to change the operation of one element. To effectively eliminate the cause of the growing unsustainability, it is necessary to introduce some rules that everyone will obey. These rules constitute a purely technical solution. However, the formulation of these rules, social acceptance and compliance with them is a moral issue, which was clearly emphasized by Hardin.

The tragedy of the commons takes place when there is no communication in society and there is no holistic approach to the problem that cannot be solved individually. One farmer, reducing the size of his herd will not improve the poor conditions of a common pasture. One fisherman, limiting the size of his catch, will not save the dwindling fish stocks exploited by hundreds of fishing boats. The agreement of all resource users is difficult, because when it comes to common goods, their interests not only converge, but also conflict. We are all interested in benefiting from the environmental goods. What we do not notice is our shared interest in bearing the responsibility for protecting these goods. We would like to benefit from them regardless of what others are doing. Overcoming this way of thinking seems to be particularly important in order to implement the idea of sustain-

able development in the local life. How can we convince the system users of the fact that subordinating their individual rationality to the priority of social optimality can be in the interests of all and each separately? Presenting the systemic archetype which reveals how the tragedy of the commons originates could make a persuasive argument. It would also be convincing to present the model of system dynamics and together discuss different scenarios. The solution to the tragedy of the commons can be found when the resource users enter into a dialogue, recognize common problems and share the responsibility for the environment. Cooperation, mutual learning and exchange of experiences may help to overcome the resource limit. The tragedy of the commons is a characteristic of systems that forces us to cooperate. As Bastiat rightly noted (1850): *In the state of isolation, our wants exceed our productive capacities. In society, our productive capacities exceed our wants.*

References

1. BASTIAT F., 1850, Economic Harmonies, http://files.libertyfund.org/files/79/0187_Bk.pdf (30.12.2014).
2. DURBIN P.T., 2008, Is there a best ethic of sustainable development?, in: *Problemy Ekorozwoju/Problems of Sustainable Development*, vol. 3, no 2, p. 5-14.
3. FALKOWSKI J., KOSTROWICKI J., 2001, *Geografia rolnictwa świata*, PWN, Warszawa.
4. HARDIN G., 1968, The Tragedy of the Commons, in: *Science*, vol. 168.
5. HULL Z., 2007, Czy idea sustainable development ukazuje nową wizję rozwoju cywilizacyjnego?, in: *Problemy Ekorozwoju/ Problems of Sustainable Development*, vol. 2, no 1 p. 49-57.
6. OLSON M., 2012, *The Logic of Collective Action*, Harvard University Press, Harvard.
7. OSTROM E., 1990, *Governing the Commons: The Evolution of Institutions for Collective Action*, Cambridge University Press, Cambridge.
8. SENGE P., 2006, *Piąta dyscyplina. Teoria i praktyka organizacji uczących się*, Wolters Kluwer, Kraków.
9. SENGE P., KLEINER A., ROBERTS Ch., ROSS R., SMITH B. J., 2008, *Piąta dyscyplina, materiały dla praktyka*, Wolters Kluwer, Kraków.
10. ZIMBARDO P. G., 2008, *The Lucifer Effect, Understanding How Good People Turn Evil*, Random House, New York.

Religion versus Sustainable Development. The Problem of Human Eco-development in the Teachings of John Paul II and Benedict XVI

Religia a rozwój zrównoważony. Problematyka ekorozwoju człowieka w nauczaniu papieży Jana Pawła II i Benedykta XVI

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Abstract

The problem of sustainable human development, in terms both of individual people and societies, represents an integral part of the Christian anthropology and Catholic doctrine. The Magisterium of the Catholic Church has expressed its view on this issue on many occasions. This topic was also commented on by two popes – John Paul II and Benedict XVI. Eight encyclicals have been analysed by the analytical-critical method. Those written by John Paul II are *Redemptor Hominis*, *Laborem Exercens*, *Sollicitudo Rei Socialis*, *Centesimus Annus* and *Evangelium Vitae*, whereas those created by Benedict XVI are *Deus Caritas Est*, *Spe Salvi* and *Caritas in Veritate*. The popes' manifestos were to a large extent universal messages addressed to the whole mankind. Their main theses, which were formulated in the context of sustainable development, are:

- Man is not only the master, but also a part of the creation. That is why he is responsible for and has to take care of animate and inanimate world.
- One should rather *be* than *possess*.
- The human progress is something desirable. The lack of equal division of natural resources and their wasteful exploitation are among the main reasons behind disproportions in the steady development of societies.
- *Ecology of man*, understood as a set of actions undertaken to improve the natural and moral structure of societies, should be prioritized as one of the activities aimed at facilitating sustainable development.
- In the era of quickly progressing globalisation ethics should have primacy over technology.
- It is necessary to respect each person's dignity and life from their conception until their natural death as a way of building *the civilisation of love*.
- In the globalised world people should follow the logic of love for another human being and the whole creation and they should work for the common good.
- Globalisation as such morally neutral. It is as man who gives it an ethical (bad or good) meaning by his actions.

Key words: the social teaching of the Church, John Paul II, Benedict XVI, sustainable development

Streszczenie

Zagadnienie zrównoważonego rozwoju człowieka, w kategoriach jednostek i społeczeństw, stanowi integralną część antropologii chrześcijańskiej i doktryny katolickiej. Magisterium Kościoła Katolickiego wypowiadało się wielokrotnie na ten temat. Problematykę tę podejmowali także papieże Jan Paweł II i Benedykt XVI. Metodą analityczno-krytyczną zbadano pięć encyklik papieża-Polaka: *Redemptor Hominis*, *Laborem Exercens*, *Sollicitudo Rei Socialis*, *Centesimus Annus*, *Evangelium Vitae* oraz trzy encykliki Benedykta XVI: *Deus Caritas Est*, *Spe Salvi*, *Caritas in Veritate*. Orędzia papieskie były w dużej mierze przekazami uniwersalnymi, skierowanymi do całej ludzkości. Oto ich główne tezy, sformułowane w kontekście zrównoważonego rozwoju:

- człowiek jest panem, ale i częścią stworzenia, zatem spoczywa na nim odpowiedzialność i troska o przyrodę ożywioną i nieożywioną;
- należy bardziej *być* niż *mieć*;
- postęp ludzkości jest czymś pożądanym, brak sprawiedliwego podziału dóbr naturalnych i rabunkowa gospodarka nimi są jednymi z głównych przyczyn dysproporcji w zrównoważonym rozwoju społeczeństw;
- *ekologia człowieka* jako działań podejmowanych na rzecz poprawy naturalnej i moralnej struktury społeczeństw, winna być priorytetem w działaniach na rzecz zrównoważonego rozwoju;
- w dobie postępującej szybko globalizacji etyka powinna mieć prymat nad techniką;
- konieczne jest poszanowanie godności i życia każdego człowieka od poczęcia do naturalnej śmierci, w duchu budowania *cywilizacji miłości*;
- ludzie w zglobalizowanym świecie muszą posługiwać się logiką miłości bliźniego i stworzenia oraz pracować dla dobra wspólnego;
- globalizacja jako taka jest moralnie neutralna, to człowiek swymi działaniami nadaje jej zabarwienie etyczne: dobre lub złe.

Słowa kluczowe: społeczna nauka Kościoła, Jan Paweł II, Benedykt XVI, rozwój zrównoważony

Introduction

The Christian and Catholic tradition has always discussed the problem of balanced and peaceful co-existence between man and other animate things as an important issue. It can be easily noticed in biblical sources, as the Holy Scripture serves as *norma normans non normata* for Catholic theology. At the very beginning of the Bible, in Genesis, there are words which define the relationship between man and nature – man should *subdue* the earth (Gen 1:28). However, the biblical description emphasizes, that both the animate creatures and the inanimate nature, i.e. the whole creation, were *very good* (Gen 1:31). This goodness results from the fact that the source of all creation is God, and *there is none good but one, that is God* (compare Mk 10:18). In every animate thing there is *life* (Gen 1:30). It exists also in man. And yet man, apart from being given *the breath of life*, possesses also something else – he has been created in God's *own image* (Gen 1:27). This enables him to use his reason and free will. Therefore, he is charged with an enormous responsibility – he should not only *subdue the earth*, but also take great care of everything he has been entrusted with. It is because both man and other creatures are *good*, that is coming from God. This is the reason why God wants them and supports their existence.

In Genesis there are two descriptions of the creation of man. One of them derives from the older Yahwistic tradition, whereas the other has its origins in the younger sacerdotal tradition. However, both these descriptions emphasize that God subjected all the living creatures inhabiting the earth to man and none of them is equal to him, as he has been created in God's image (compare Gen 2). One of man's important tasks was to use his own fertility in order to *replenish the earth* with human beings (Gen 1:28). *Subduing the earth* is closely connected with the fulfillment of a certain kind of *first commandment*, which man received from God. As a result, the issues connected with the human sexuality and demography are an integral part of the teachings and

work of the Catholic Church concerning sustainable development.

From the Antiquity to the Enlightenment period, the stance on the relationship between man and the environment, taken by the Catholic Church, did not require any major revision or specification. The progress of civilisation which then took place did not disturb significantly the ecological balance in man's environment. Although the human population was still increasing steadily, there were periods when its number was on the decline, which was caused by epidemics, wars and hunger. Extensive agricultural economy and craft would not have been sufficient to satisfy the needs of a significantly greater number of people. Thus, there were no dangers of anthropogenic character, which could not have been overcome by natural processes occurring within ecosystems in a relatively short time. An exception here can be e.g. the elimination of forest areas, which has caused permanent deforestation in, among other territories, the British Isles and Ireland.

The industrial revolution of the 18th century, in combination with the new scientific, philosophical and ideological trends, forced the Catholic Church to, as it were, revise its views on the man-to-man and man-to-nature relationship. The emerging trends were very often openly hostile to the Church. They were either atheist or deist in nature and contributed to the development of axiological systems, which dissociated themselves from the teachings of the Catholic Church or Christianity in general. Therefore, it is not surprising that the Church reacted to this allergically by labeling both valuable, pro-development concepts and those openly denying universal truths about man and the world as modernist and anticlerical.

In the 19th century, the Catholic Church was faced with, on one hand, post-hegelian development of sciences, emergence of socialism, as well as independence movements in Europe, and, on the other hand, with Darwinism and natural sciences. This forced the Church to respond to new challenges presented by the run-away progress of civilisation. This

concerned both individual people and societies and resulted in the constant confrontation of man (*Homo faber*) with the created world.

A milestone in this series of events was marked by the first papal social encyclical, *Rerum novarum*, written by Pope Leo XIII. Since then, successive popes and, as a result, the Magisterium of the whole Common Church, have been expressing their views on the changes taking place in the development of mankind. Popes of the 20th century pointed to the dangers created by the misuse of the achievements of civilisation, which, instead of advancing the development, led more than once to the destruction of the human life and natural environment. After the traumatic experiences of two World Wars, as well as the Nazi and Stalinist totalitarian systems, this issue has become particularly valid. In his encyclical, *Pacem in terris*, Pope John XXIII touched upon the problems which were later developed and analysed in more detail in *Gaudium et spes* – the Pastoral Constitution on the Church in the Modern World, enacted by the Second Vatican Council. In his encyclical, *Populorum progressio*, Pope Paul VI resumed the post-Council reflection on this issue.

Nearly twenty six years of the pontificate of John Paul II, i.e. Karol Wojtyła, were the time when the teachings of the Catholic Church, concerning the man-to-man and man-to-nature relationship, were further developed. This resulted, among other things, from the fact that the Polish pope, who was also a professor of ethics, acted in accordance with the personalistic and phenomenological approach to the issues he was considering and was able to regard them through the perspective of the Catholic teachings and the Christian axiological system. Also pope Benedict XVII in his encyclicals touched upon issues connected with the problem of sustainable development and wrote about them at length, especially in his social encyclical, *Caritas in Veritate*. He tried to show the problems faced by the modern world in the era of globalization as a challenge for the Christian love and truth. In the synthesis presented below there are juxtaposed the most important theses from the teachings of John Paul II, which were included in some of his encyclicals. These are documents of the utmost importance, as they also contain the papal teachings concerning the sustainable development of individual people and societies, as well as the relationship between man and natural environment.

The teachings of John Paul II on sustainable development

In each of his fourteen encyclicals there are elements of John Paul II's teachings connected with sustainable development, based on the respect for natural environment. In some of them, however, this topic is covered more extensively and even represents a major part of the whole document. Below the reader can find an analysis of original texts of five encyclicals

of John Paul II. The analysis attempts to put particular emphasis on those important elements of his teaching, which are directly or indirectly connected with issues presented in the introduction.

Redemptor Hominis (1979)

In his first encyclical John Paul II stressed the concern of Jesus Christ and His Church for the dignity and humane character of every person's life, while referring to the teachings of the Second Vatican Council (GS 38:91). The thing which is noticeable here is the care for holistic development of the human being. The aim of this development is to make use of *man's similarity to God*, which has been embedded in man by God (compare Gen 1:27). The pope reminds the people that man as such is an exceptional being and has been created for his own sake (GS 24, RH 13). God has subjected the earth and all which exists on it to man's rule, as man is God's most beloved creation. At the same time each person, with his or her individual life history, has been included in wider social structures – a family, clan, nation, mankind. That is why, on one hand man has to be aware of everything which makes it easier for him to fulfill his life mission, as well as his social and individual role, whereas, on the other hand, he has to take into consideration everything which hampers his achievement of this. Although he is burdened with this kind of inner dilemma, he still remains *the route that the Church must travel* (RH 14). Meanwhile, the modern man is constantly in danger posed by the products of his own intellect and resourcefulness. He is continuously afraid of the power which he was given, so he could *subdue the earth* and which can turn against him. This danger has many sources. One of them is the unsustainable management of natural resources. The goals of this exploitation can be not only peaceful, but also military. This causes man to become more and more alienated from the world of nature. Such a situation is in contradiction of the Creator's plan as He has appointed man to be the master of nature but not its ruthless exploiter. Such a status quo provokes the following question: does the progress of mankind make the life of an individual more dignified and does this individual develop in the personal and ethical sense? (RH, 15).

So as the technical progress must not lead to the regression of human spirit, it is necessary that ethics have primacy over technology, the person be more important than the object and the spirit have advantage over the matter. Only such a state of things will make it possible to use the technical progress in favour of authentic human development based on the respect for rights and dignity of an individual, social justice as well as proper understanding of the call to *subdue the earth*. Man has to *be* rather than *have*, which will allow him to really become *the master* of the created world and not *the slave* of his possessions. The lack of proper balance in this matter re-

sults in the development in the spirit of consumerism, in which the surplus of produced goods is accompanied by malnutrition and hunger. The consumerist attitude is the reason behind the wasteful management of natural material and energetic resources as well as the degradation of natural environment. The scientific and technological progress cannot be treated as superior to ethics and morality. In such a case the most profound meaning of man's freedom is lost, whereas this freedom should govern economic development and not be governed by it.

Laborem Exercens (1981)

The pope emphasizes that, if man subjugates the earth by engaging his own work, he fulfills the God's commandment from Genesis. This commandment refers first and foremost to the part of earth on which a particular person is living, but it also covers the whole planet with all its resources. Those resources can be discovered and used by man. This order given by the Creator is valid throughout all historical epochs and at all stages of the progress of civilisation and it is addressed to all people without exception (LE 4). Man's rule over the earth involves his work: cultivating the soil, domestication and breeding of animals as well as extraction and processing of natural resources (LE 5). If the progress of mankind is not to turn merely into material progress, it has to treat the human being as the subject of work and not its object (LE 7). In this case John Paul II made references to the content of two encyclicals: *Mater et Magistra* by John XIII and *Popularum Progressio* by Paul VI.

Sollicitudo Rei Socialis (1987)

In his document the pope referred directly to *Popularum progressio*, the encyclical written by Paul VI, on the 20th anniversary of its promulgation. Apart from deepening divisions between the rich North and the poor South, the pope also noticed some positive aspects of the progress of civilisation, including the man-to-nature relationship. People are becoming increasingly aware of the limited amount of natural resources and the necessity to respect the laws of nature in the planning of further economic progress, which the pope described as *ecological concern* (SRS 26). The experience of totalitarian systems of the 20th century is a reminder that the sole technical progress does not guarantee successful development of societies and individuals. The mere economic concept and mechanistic optimism, if they are not guided by moral and ethical standards, quickly turn into enslavement of man (SRS 27-28). The thing which is as dangerous as underdevelopment is overdevelopment, which means that an excessive number of possessions lie in the hands of a small group of people. The sole fact of possession of means and fruits of production does not ensure that progress and sustainable development in the holistic sense will take place. Once again the pope called on people to

be rather than *possess*, thus referring to Council documents (GS 35). The proper hierarchy of possession of material goods is shaped by the primacy of *to be* over *to have* (SRS 28).

Man, to whose care God has entrusted other creatures, shares, on one hand, their material nature which is formed *of the dust of the ground* (Gen 2:7), but, on the other hand, is God's own image (Gen 1:27). That is why, he has been not only called on to use other creatures, but also to look after them and care for their well-being. This results from a certain kind of *kinship* between God and man, according to which the similarity between them should govern both the possession and use of things (SRS 29). Human development is not only a secular phenomenon, but also a theological one. Man and woman should care for the whole creation because of their affinity with God, the main principle of which is their submission to the natural law. The result of this is the universal human vocation to become host of the planet. Realization of this task has been made more difficult and marked by obstacles because of the sin committed by the first parents (Gen 3). The faithful regard human development as being an integral part of the order of creation, as well as being based on the work of individuals and societies. Disobedience to God weakens the man's position as *the protagonist of development* (SRS 30).

Following the same course of thought, John Paul II emphasizes that new perspectives for the holistic development of individuals and the whole mankind were provided by the Gospel of Jesus from Nazareth. The idea of unlimited development has been given a new dimension by Him. While believing in the Resurrection of Christ, Christians hope that the lack of balance between *underdevelopment* and *overdevelopment* will be overcome by the final adoption of God's image by man. It will be possible because Christ, through His saving act, has offset negative effects of Adam and Eve's sin. Thus, the history of the work and development effort of the whole mankind takes on a new, not only wordly dimension. In this way, the person who chooses the guidance of the Gospel is sometimes called on to relinquish his or her own *having* for the sake of somebody else's *being* as part of the effort leading to sustainable human development (SRS 31). The need for sustainable development is a transcendental value. Universalism, however, should not be confused with uniformity – cultural diversity can greatly enrich sustainable development (SRS, 32). Real development makes everybody equal in their right to benefit from its achievements. While making this point John Paul II refers to Paul VI, who described such an order of things as *the civilisation of love* (SRS 33).

John Paul II gave three reasons, why man should behave respectfully towards other material beings, both animate and inanimate. Firstly, he should not use those beings for his own selfish purposes with impunity and unreasonably, while he does not understand

their specific character and the role they play in the universe as well as their mutual connections. Secondly, natural resources are limited, which also means that they are in some way non-renewable. In the context of life of future generations such a situation obliges today's people to accept certain duties. Finally, environmental pollution resulting from industrialisation has a negative influence on people's health and lives. Man has been called on by the Creator to use the nature, but not to exploit it unthinkingly. Man should benefit from the goods of nature while respecting not only biological laws, but also moral ones (SRS 34).

Centesimus Annus (1991)

The title itself refers to another anniversary – the centenary of promulgation of *Rerum Novarum*, Leon XIII's encyclical. While commenting and elaborating on his predecessor's thoughts, John Paul II stresses that the Creator has equally divided the dominion of the earth among all people. Thus, the created goods have a value recognized by all people. The earth yields its crops, which nourish man only when he puts in his own physical and intellectual effort, i.e. his work. The common availability of natural resources is not in contradiction with personal property. Especially nowadays, the importance of the common effort in obtaining the goods of the earth has increased. While reminding of and specifying the dangers connected with consumerism and the primacy of *having* over *being*, the pope calls for the protection of man's natural and moral environment of development. Whereas, he says, it is necessary and advisable from the point of view of the Church to protect nature, it is even more crucial to pay a lot of attention to the guardianship of man's natural and moral structure. The pope describes it as *human ecology*. The building of favourable social structures of life and work makes it possible to fully realize a person's vocation to live with dignity and be liberated from the destructive influence of the structures of sin, e.g. addictions (CA 38).

The basic unit of *human ecology* is the family. It represents a *sanctuary of life* – a place where life is passed on and where one can develop. The family functions as a centre of *life culture* and it acts as an opposition to the *culture of death*. Referring to his former documents (e.g. the encyclical *Sollicitudo rei socialis*), John Paul II condemns actions of certain countries and social organisations concerning *pro-creative policies*. According to the pope, such actions constitute an attack on the family and *human ecology*. The policies mentioned include, among other things, artificial birth control, abortion or euthanasia (SRS 25).

Protection of natural and human development cannot depend only on free market mechanisms. It has to be supervised by countries and governments. Although such mechanisms make it possible to obtain and use

natural resources, they are not sufficient. It is because there are collective and qualitative needs which cannot be satisfied by means of tools offered by the free market (CA 40). Sustainable social development should be correlated with integral development of the human being and result from it (CA 43). It can be achieved only in the atmosphere of respect for the dignity of fellow human beings and their right to live in peace. That is why John Paul II reiterated the opinion of Paul VI, who claimed that *another name for peace is development* (PP 77-78). Support for sustainable development lies within the collective responsibility of mankind. This may mean that well-developed economies will have to make some sacrifices, whereas societies with a consumerist attitude will have to change their lifestyles and limit their wasteful exploitation of environmental and human resources (CA 52).

Evangelium Vitae (1995)

This is an encyclical which aims to sensitize people to the issues connected with protection of the human life, since its conception to natural death. The pope described all attempts to strip people of their dignity both in prenatal and postnatal life as disgraceful. This includes both a direct attack on the inalienable right of life and self-determination as well as creation of external conditions which infringe upon this right (EV 3-4). A particularly significant part of the pope's text was devoted to the problems connected with the presence of abortion and euthanasia in the contemporary world as well as moral, psychological, demographic and sociological consequences of these suspicious procedures. Among things which, according to John Paul II, constitute a threat to the peaceful human existence (also to the life of the youngest part of mankind), there are the unequal division of goods on earth and the upsetting of natural ecological balance (EV 10). Disorders in the demographic development of societies, which are accompanied by disproportions in the division of goods between the rich North and the poor South, are one of the sources of the lack of sustainable development (EV 16).

In today's world, *the law of freedom* sometimes degenerates into *freedom without a law*, which is the lack of respect for someone else's right to live, as well as their right to develop at a personal and social level (EV 22). There is too much emphasis put on the quality of life, whereas only the material aspect of this quality is stressed (EV 23). The consent given by the human conscience to the progressing *materialization* and objectification of life blurs the borders between the good and the evil, facilitating the development of *civilisation of death* which remains in contradiction to *the civilisation of life*.

The pope reminds, that every life is good. It is wanted and supported by the Creator (compare Gen 1,31). Through granting the gift of life God, as it were, gives His every creation a small part of Him-

self. Therefore, the aim of the whole individual development of man is the union with God as the Source (compare EV 35). Everybody should respect their own life, as well the life of other human beings and all creation. As the image of God is embedded in each person (comp. Gen 1,27), everyone should share the collective responsibility for the protection of life. This includes both the act of procreation, in which two people pass on life to a new human being and the protection of the whole created reality. The same idea was expressed in the biblical excerpt of placing the first people in the garden of Eden, which had to be cultivated and cared for by them (Gen 2,15). The pope says emphatically that: *It is the ecological question – ranging from the preservation of the natural habitats of the different species of animals and of other forms of life to 'human ecology' properly speaking – which finds in the Bible clear and strong ethical direction, leading to a solution which respects the great good of life, of every life* (EV 42). However, the use of the gifts of nature is not limited, but is subject to certain regulations, which are symbolically expressed by the prohibition of eating fruit from the tree, which is standing in the middle of the garden (Gen 2, 16-17). This vocation of man to be responsible for life is later specified in the commandment *Thou shalt not kill* (Deut. 5,17). Thus man is not the master of life, although the earthly beings have been subjected to him. Only the Creator, who is the Source of life, has the right to give it or take it away (comp. EV 53, 77).

According to the idea propagated by John Paul II, Christians are *people of life* – they have been given life by the Creator, whereas the Saviour, Jesus Christ, has renewed the life in them by sacrificing Himself. That is why, they are called on to preach *the gospel of life* and advocate the protection of life (EV 79). The concern shown for harmonious and sustainable development of individuals, especially those marginalized, is also a service done to life and a sign of humanitarianism (EV 87-88). In order to act in accordance with the spirit of this concern, it is necessary to undertake activities aimed at solving demographic problems of mankind – not through the policy of birth control, which affects the basic rights of parents and children, but through creating proper conditions for sustainable and sanitary development of various parts of the world (EV 91).

The teachings of Benedict XVI regarding sustainable development

The problem of sustainable development of individuals and societies, as seen through the perspective of the Catholic social science, represented also an object of interest for pope Benedict XVI. In three of his encyclicals he resumed and developed the course of thought pursued by his predecessors by trying to newly define the role of the Church in the globalized

reality, especially in the situation which followed the worldwide economic crisis of 2008.

Deus Caritas Est (2005)

In this encyclical pope Benedict XVI referred to the issue connected with the realization of Christian love in social life. He emphasized, that since 19th century the Catholic Church had been focusing more on matters concerning social justice and sustainable development of societies. Until then, *caritas* shown towards another human being had been associated mainly with charity (DCE 26-27). Since the publication of Leon XIII's encyclical, *Rerum novarum*, the Church has been paying more attention to the problem of creating favourable conditions for sustainable social development.

Benedict XVI regards politics as service in the name of social justice. The practical reason, which in the political life constantly tries to answer the questions *How to realize justice?* and *What is justice?*, has to be repeatedly purified and guided by ethics. From the point of view of the Church, the medium through which this ethics can be transmitted, is the Christian faith. Faith does not usurp superior power over the political order, but it wants to have its share in the process of *purifying* and *guiding*. This sphere of action of the Christian faith can be identified with the Catholic Social Science. The Church should not adopt the tasks of politics, while building social justice but it should help to open the human intelligence and will to the requirements of the good. At the same time, however, the fact that politics can realize tasks connected with the introduction of social justice does not exclude actions undertaken by the Church in the sphere of *caritas*. Charitable service done in the spirit of love for fellow human beings will always be valid and needed, independently of the efficiency of the state in this matter. The Church not only takes care of the human body, but also the human soul (DCE 28). Although direct political involvement of the Church as an institution is not advisable, the faithful have an obligation to engage in activities aimed at building just social structures, which will ensure sustainable development of individuals. Various economic, political and social actions undertaken by Christians can be treated as a practical aspect of the love for other human beings (DCE 29).

The pope stresses, that the phenomenon of globalization, which is accompanied by an efficient and quick exchange of information between different parts of the world, can facilitate the realization of the commandment connected with the love for other human beings. The concern for harmonious development of individuals and societies can nowadays assume new forms and reach beyond national communities. The Church contributes to the process of building a sense of solidarity among people. This has given rise to various forms of cooperation between the Church, states and charities, which increases the

efficiency of charitable service. The goal should be the same for all of them – building true humanitarianism (DCE 30). As far, as its actions aimed at realizing the commandment of love for fellow human beings are concerned, Christianity reaches beyond the framework of the Church and faith. Charitable help offered in the Christian spirit is supra-denominational and cannot be used in the service of any ideology. The historical experience has shown, e.g. by attempts to realize the Marxist utopia, that it is not possible to build harmoniously developing societies by relying solely on the ideology of progress. It is necessary to notice an individual man and approach his problems in the spirit of love, i.e. in the spirit of the good Samaritan. It is *faith, which worked by love* (Gal 5,6). At the same time the man who believes in God is aware, that through his service in the name of love he becomes a tool in God's hand. It is a kind of protection against the temptation of discouragement – I cannot help everybody and I cannot save the world by myself, but it does not belong to my tasks as a Christian. A lack of such a safety valve can lead to two extreme positions – passivity and discouragement or activism and turning towards utopian ideologies (DCE 35-36).

Spe Salvi (2007)

Pope Benedict XVI reflects upon the modern belief in progress and criticises such an approach. He points to the danger, which occurs when people are under the delusion that the human reason and will are enough to build social justice. If the practical reason and the ability to act are not enlightened by faith and taught by it to know the right from wrong, they will jeopardize the human freedom and well-being of other creatures. The process of building the freedom of societies and interest groups should go hand in hand with the respect for the freedom of individuals. Thus it is necessary to have a common criterion which is rooted in faith, and eventually in God. The fact of rejecting God sooner or later leads the human mind astray as it allows it to believe unreservedly in progress and to negate, in the name of this progress, someone's freedom (SpS 22-23).

The moral heritage of mankind remains a free choice – the modern man can draw from it or reject it. This freedom is helpful in developing the inner conviction about the rightness of undertaking certain actions and adopting certain attitudes. The sole universal and global structures are not enough to ensure the creation of *a better world*. Building of such a reality has to be connected with a rational and free choice made by individuals. The conviction that man can be *saved* by science or technological progress is false. Sustainable development and progress of mankind is not simply a sum of technological achievements. Each generation has to newly discover and choose freely the moral foundation on which it will build its own development (SpS 25-26). The fact of freely choosing God as the Giver of this foundation makes it pos-

sible to translate the truth about Christian hope into a language of concrete moral positions, which serve to promote justice in the world (SpS 28).

The kind of activity, which supports equitable development of societies and individuals, is the fight against suffering in all its manifestations. The obligation to come with aid to innocent suffering people in the physical, psychological and spiritual sphere is one of the basic duties of a Christian, as someone propagating justice. The human suffering urges us to undertake actions which serve, on one hand, to prevent this suffering and, on the other hand, to alleviate it. Those actions involve not only human beings but also other creatures, treated as a gift (SpS 35-36). The way in which a particular society responds to the suffering of people and other creatures is a measure of its development as a part of civilization (SpS 38).

Caritas in Veritate (2009)

The document deals extensively with a range of complex social issues. Benedict XVI devoted this encyclical to the problems concerning integral human development, which should be based on love experienced in truth. Love (*caritas*) is the way followed by the social teaching of the Catholic Church. For the Church, which is guided by the Gospel of Jesus Christ, love provides the basis for all kinds of human relationships and ties. The pope tries to convince people, that the choice of Christian values as a way of realizing love in truth is essential to build a good society and encourage integral development of individuals (CiV 4). The task which the social teaching of the Church has to undertake is to respond to the dynamics of God's love for the created world. This response involves the propagation of love in truth within the framework of existing social structures. Without love and truth, which Christianity tries to promote, it is not possible to stimulate development and prosperity and to solve economical-social problems in the era of globalization. The globalized society has to pay particular attention to two categories – justice and the common good. Justice is the integral part of the process connected with the fulfillment of love in truth. Love is superior to justice, but the former cannot exist without the latter. This is because, on a global scale, it translates into the respect for the right to develop which each man, nation and community has. Engagement in the process of building the common good is the more complete and authentic, the more it results from the love for another human being. Only if love is involved in the process of building a globalized society, it can ensure fair division of goods between particular societies and become a source of a complete, not only technological development (CiV 9).

Benedict XVI reflects at length upon the encyclical written by Paul VI, *Popularum Progressio*. He reiterates his predecessor's view, that development constitutes a part of the man's vocation. Thus, it not only has a strictly technical aspect, but also a transcendent

one. It is realized most completely when man turns in the direction of the Absolute (CiV 10-20). The assumptions of Paul VI's social teaching still have not been fully realized. The question which is still valid nowadays is how to translate the economic profit into fair division of goods and elimination of destitution, so that development could involve everybody in a sustainable way (CiV 21). Whereas it is true that in today's reality of the globalized world the level of global richness rises, there are increasing inequalities connected with unfair division of the profit made. There are many reasons behind these disproportions and one of them is insufficient involvement of developed societies in the process of sharing the achievements of their cultural progress.

Forty years after the publication of *Populorum Progressio*, the geopolitical and economic situation is different from that in which Paul VI made his social diagnosis. Sovereignty of the development of countries is limited by the global economic-financial context. The process of building social justice in the reality of the global market seems to be more and more difficult. The pursuit for lowering production costs have adverse consequences for workers (CiV 25). The phenomenon, which can be noticed in the global society, is the cultural uniformization which poses a danger to the autonomy of particular cultures and favours axiological relativism. At the same time, the intercultural dialogue is often superficial or even fictitious (CiV 26). One of the most distressing symptoms of development disproportions in the era of globalization is the still unresolved problem of hunger in the world. Benedict XVI reminds his readers, that hunger is not so much a result of insufficient natural resources, but a product of their defective division. The pope points to several ways of eliminating development disproportions in this respect, these are for example: propagation of modern and sustainable agriculture, development of transport, elimination of exploitative economy, agrarian reforms and protection of the natural environment. On the basis of international solidarity people should be given one of their fundamental rights, i.e. the right to food and water (CiV 27).

The practices, which the pope considers to be completely erroneous and harmful, are those connected with birth control, which is propagated – or even imposed – on people living in societies characterized by high levels of development disproportions. He emphasizes, that without acceptance of new life, there is no authentic and complete development. Another phenomenon, which the pope regards as infringing the right to sustainable development, are the actions against religious freedom. This includes, on one hand, fundamentalist ideologies which appear in the world and, on the other hand, practical atheism imposed by political systems. In this way, the perspective, through which the development of a human being is perceived, is narrowed. If economic development is not followed by the moral one, it means re-

gress (CiV 29). The interdisciplinary aspect of the social teaching of the Church encourages cooperation between theology, metaphysics and specialized sciences on the basis of a holistic approach to human development. It broadens the scale of opportunities for solving development problems of modern societies and allows for a better management of economic resources, including the human ones. Such an interdisciplinary approach, which equips economy with humanitarian tools, makes it possible to implement a long-term development policy and prevents the occurrence of neocolonialism (CiV 32-33). The economy of the global market should comply with two rules promoted by the social teaching of the Church. These are rules of distributive justice and social justice. Elimination of moral norms from free market rules leads to the deepening of development disproportions. The goal of multiplying the common good should be achieved not only by free market mechanisms, but also through political decisions. It was proven by the world economic crisis, which began in 2008. The economic sphere is not ethically neutral, but assumes the shape which man gives to it. Sustainable global economic development requires the following rules to be abided by: social solidarity, transparency, honesty, responsibility, brotherhood or selflessness. Economy in the era of globalisation is subject to the influence of various cultures. Points of encounter indicated by Benedict XVI are three kinds of logic: logic of contractual exchange, political logic and the logic of unconditional gift (CiV 37). Fulfillment of these requirements encourages development of a civil society. In order to overcome the problem of underdevelopment it is necessary that the global economic structures adopt the elements of selflessness and communion (CiV 39). The pope warns people against regarding globalisation as something of fatalistic significance; in its essence, globalisation is neither good nor bad. It will assume the character given by people. The solution to the problem is to use the mechanisms of global exchange of material and immaterial goods in order to propagate justice and multiply the common good (CiV 42). Man and his needs should be placed at the heart of economic development. This is the man who is tied to other people by mutual relationships, while all of them live in the global reality.

Benedict XVI reminds his readers, that the natural environment should be treated as God's gift for man. A gift which should be looked after and cared for. However, he cautions against regarding the natural environment as more important than man or *vice versa* – perceiving it in purely economic terms. Attitudes of greater ecological awareness in underdeveloped societies can be shaped by a greater solidarity, shown by energy industries in rich countries. As the exploitation of natural resources has taken on an international aspect, the responsibility for sustainable management of natural goods should assume an international character as well. Peaceful co-existence

of nations and exchange of technological achievements will make it easier to protect natural resources of our planet. The Church shares the responsibility for the fate of man and the fate of his natural environment. Therefore, it calls upon nations to implement the idea of *the ecology of man* perceived in the spirit of love and truth, which will lead to a greater understanding of *the ecology of the natural environment* and protect mankind from its self-destructive tendencies. It is not enough to introduce legal regulations. It is necessary to change people's mentality and attitude towards the sanctity of life (CiV 51).

That is why, sustainable development is conditioned by the involvement of every person in the relations of one human family without excluding anyone. All cultural attitudes, which do not adopt the position of love, truth and peace, act against the development of mankind. They represent negative aspects of the process of globalization and do not lead to the meeting of people but set them apart. Between all the cultures there are points of encounter on the ethical ground, which can be called the natural law. They can provide the basis for an intercultural dialogue in the globalized society (CiV 59). Common human values manifest themselves e.g. in the sphere of education. Creation of a more equitable access to education is considered by the pope to be one of the basic aspects of equalizing the chances of development on an international scale (CiV 61). The phenomenon which poses a challenge for the modern global reality is the movement of people. It refers particularly to migration, exile and even tourism. In case of both positive and negative consequences of this phenomenon it is necessary for nations to cooperate more extensively (CiV 62). Another major problem is that of unemployment, which concerns also nations regarded so far as well-developed and which is directly correlated with the problem of destitution. Meanwhile, the respect shown for each person's dignity is inseparably connected with the process of enabling them to get a job which will ensure their stable development. In this context the pope also touches upon equality of rights and sex discrimination (CiV 63).

The inseparable element of development is technological progress. However, it has different aspects. Besides obvious advantages resulting from the subjugation of forces of nature and the practical use of physical laws, technological progress also involves certain dangers. They become more real if the modern man stops asking himself the question *why?* and satisfies himself with the question *how?* Behind technological progress there is always man with his reason and free will, who is created in God's image. The human intelligence, which is the author of this progress, represents man in a holistic way, not as a participant in some kind of world technocracy. Such progress in the field of technology will not take place without deep, moral formation of the people responsible for it. In the future, this should prevent technological progress from being misappropriated by

some maleficent ideology, which could oppose one part of mankind against another (CiV 68-72).

Today, one of the motive forces behind globalization are electronic media. The pope emphasizes the necessity to look carefully at the consequences of man's functioning in the virtual reality. The facility with which information is exchanged is not enough to nurture dignified and sustainable development of individuals and societies. Another important factor is the quality of the content communicated through electronic media. They should not strip anyone of their dignity (CiV 73). The respect for human dignity concerns human life from its conception to its natural death. It is because technological progress makes ample room for bio-manipulation, also in relation to human beings. This is connected both with methods of artificial fertilization and genetic manipulations (e.g. the creation of hybrids). This, according to Benedict XVI, endangers integral development of individuals and societies (CiV 74).

Summary

Popes John Paul II and Benedict XVI addressed their teachings not only to Catholics and Christians, but also to *all people of good will*, which they emphasized in all their encyclicals described above. As a result, their message has a universal meaning. While their teaching was deeply rooted in the sources of revelation of the Catholic Church – the Holy Scripture and Tradition – they continuously made references to values common to all, universal truths which were given the name of the natural law by philosophy and Catholic theology. With regard to both the man-environment relationship and the sustainable development of individuals and communities, they touched upon issues concerning mankind as a whole. By using biblical sources and invoking teachings of the Church from past centuries they formulated diagnoses about the state of the progress of civilisation which had a supra-denominational character. They also pointed to the problems and dangers connected with this progress, as well as suggested some ways of dealing with them.

John Paul II frequently referred to the Book of Genesis, as it describes the creation of the world and man. At the same time, the pope reiterated the view, that man had been appointed to be *the master of the earth*, but he also called attention to the fact that man had not been given the absolute power – such power can be only wielded by the Creator. The rule over the earth is understood here as the concern and care shown for the whole creation. It should not be regarded as ruthless exploitation. Man is a part of the creation – he is both material and spiritual. He has his share in God's image and thus is called upon to act reasonably and respectfully in relation to the fact that all beings are *good*. He can satisfy his needs, but should remember that the resources of the earth are not unlimited. In order to resolve problems resulting

from the lack of respect for the laws of nature, he is obliged to make every effort to know those laws and abide by them. Such an attitude to the created world is possible only when ethics and morality have primacy over material things.

John Paul II noticed some basic dangers to the sustainable development in the contemporary world. In his opinion, the main cause of economic and social disproportions between the nations of the North and the South is the unequal division of natural goods. The consumerism of rich societies, which are obsessed with maintaining or improving the quality of their lives, appeals to the baser instincts – it is *to have* rather than *to be*. It leads to the lack of solidarity among people, wasteful exploitation of natural resources and treatment of man as the object of work, not its subject. Possession of too many goods can be as disorderly in nature as destitution and make one ignore someone else's needs.

The Polish pope used to point out that it is not enough to take care of ecology understood solely as the good state of natural environment. In the contemporary world, whose ambitions include sustainable development, priority should be given to *the human ecology*. This term was applied by the pope to denote a set of actions undertaken to improve the natural and moral structure of man. Primacy of ethics over materialism guarantees, that man will lead his life in an *ecological environment*, i.e. such an environment which will enable him to fulfill himself as a free and rational person, who is a part of nature.

John Paul II strongly emphasized that one of the inalienable rights of an individual and a family is the right to live and procreate. An equal division of goods was considered by the pope to be the basic requirement of a correctly understood policy of sustainable demographic development. The human dignity, which is a result of being created in *God's likeness and image*, is insulted by actions aimed at invasive interference in the process of procreation. The pope particularly stigmatized abortion and euthanasia. The former constitutes an attack on the human life which is not created by man, but only transmitted by him, whereas the latter undermines the fundamental basis of existence and development of societies. He was a great advocate of *the civilisation of life*.

Benedict XVI, in his turn, reflected upon sustainable development of individuals and societies in relation to problems connected with widely understood globalization. Referring to his predecessors on St. Peter's throne – Paul VI and John Paul II – he stressed the importance of noticing a human being in the world economy. Free market laws do not constitute a superior authority and do not have omnipotent decision-making power over the fate of individuals and societies. Without a moral backbone, economy becomes a system of exploitation, which is susceptible to the influence of destructive ideologies. Technological progress should serve mankind, not the other way round. The tasks with which global politics,

economy and uniformizing culture are faced are the service in the name of justice and multiplication of the common good. This should be done in the spirit of love and truth, the carrier of which is the Christian faith and, more comprehensively, the natural law.

Benedict XVI claims that only technology and economy enlightened by *caritas* will be able to rise to the challenges posed by globalization. By this he means a more equitable division of natural resources and goods produced by the global market, elimination of large disproportions in technological and cultural progress between societies, fight against famine, respect for the human life since its conception to its natural death and, finally, sustainable management of natural resources of the planet. The logic of justice and love will allow people, belonging to one global human family, to respect the right to work, education, free movement, procreation and life in general. It will protect mankind from the danger arising from such a kind of technological progress which excludes moral progress and thus turns into regress.

In Benedict XVI's opinion, globalization presents a lot of challenges, but as such it is ethically neutral. It depends on the modern people, including politicians, whether it will acquire bad or good characteristics in the future. Modern electronic media, rapid exchange of information and achievements of the modern science (also in the field medicine and genetics) can create great opportunities for sustainable development of different parts of the world, but can also threaten the well-being and even existence of mankind. The Church feels responsible for the man thrown into the mainstream of global society.

References

1. BENEDICT XVI, *Caritas in Veritate* (CiV), Rome 2009.
2. BENEDICT XVI, *Deus Caritas Est* (DCE), Rome 2005.
3. BENEDICT XVI, *Spe Salvi* (SpS), Rome 2007.
4. JOHN PAUL II, *Centesimus Annus* (CA), Rome 1991.
5. JOHN PAUL II, *Evangelium Vitae* (EV), Rome 1995.
6. JOHN PAUL II, *Laborem Exercens* (LE), Rome 1981.
7. JOHN PAUL II, *Redemptor Hominis* (RH), Rome 1979.
8. JOHN PAUL II, *Sollicitudo Rei Socialis* (SRS), Rome 1987.
9. JOHN PAUL II, *Populorum Progressio* (PR), Rome 1967.
10. *The Holy Bible: Det: the Book of Deuteronomy, Gal: the letter of saint Paul to the Galatians, Gen: the Book of Genesis*.
11. *Vaticanum II, Gaudium et Spes* (GS), Rome 1965.

Environmental Regulations and Industrial Performance Evidence from the Revision of Water Pollution Prevention and Control Law in China

Regulacje środowiskowe i wskaźniki ekonomiczne wynikające z nowelizacji prawa odnoszącego się do kontroli i zapobiegania zanieczyszczeniu wód w Chinach

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Abstract

Stringent environmental regulations are urgently needed as China's environmental pollution is increasingly become an important issue both domestically and internationally. Based on a natural experiment of water pollution prevention and Control Law's revision in 2008(WPPCL2008), this study investigates the effects of environmental regulatory policy on industry in China by using the industrial sectors' data from 2003-2011. The results show that the WPPCL2008 significantly increases the total labor productivity, but has no ROA-inducement effect for water pollution-intensive sectors. Furthermore, WPPCL2008 has an insignificant negative influence on employment level of the water pollution-intensive sectors. At the same time, this study provides evidence on the effectiveness of the current written environmental laws in China.

Key words: environmental regulations; water pollution prevention and control law; industrial performance; a differences-in-differences approach

Streszczenie

Tworzenie rygorystycznego systemu prawa środowiskowego jest w Chinach niezbędne, z uwagi na rosnący poziom zanieczyszczenia środowiska i to tak w wymiarze krajowym, jak i międzynarodowym. Artykuł jako przykład analizuje konsekwencje nowelizacji prawa odnoszącego się do kontroli i zapobiegania zanieczyszczeniu wód, w oparciu o dane z lat 2003-2011. Uzyskane wyniki pokazują, że akt prawny WPPCL2008 doprowadził do znacznego wzrostu wydajności pracy, zarazem towarzysząca mu zmiana wskaźnika rentowności aktywów nie wpłynęła w znaczący sposób na funkcjonowanie przemysłu odpowiedzialnego za największą część zanieczyszczenia wód. Ponadto wprowadzeniu WPPCL2008 towarzyszył niewielki negatywny wpływ na poziom zatrudnienia w sektorach intensywnie zanieczyszczających wody. Artykuł omawia także aktualnie przygotowywane akty prawne, które mają szansę wyeliminować te niedogodności.

Słowa kluczowe: regulacje środowiskowe, prawo kontroli i ochrony zanieczyszczania wód, wydajność przemysłu, metody ekonometryczne

1. Introduction

Along with economic development, the accompanied pollutions created by economic activities have seriously harmed global environment and further caused climate change. Coping with the challenges of climate change has become a crucial task for both scientists and economists (Yang et al., 2012). Theo-

retically, pollution is recognized as a public good with negative externality, and environmental consumption is non-excludability and non-rivalry. Economic development generally leads to the overproduction of pollutants if there is no policy intervention. Therefore, reducing the emission of industrial pollutants and protecting environment require proactive environmental regulations from government.

In the last three decades, China has achieved a veritable economic miracle, but her rapid development of manufacturing industries lead to the deterioration of environment. China's environmental pollution is increasingly become an important issue both domestically and internationally. China's total CO₂ emissions by fossil fuel consumption were estimated to be 2.63 billion tons in 2012, which ranked China first in the world (Boden et al., 2013). Hence, as the largest developing country, China has been under intense international pressure to reduce its environmental pollution. At the Copenhagen Climate Summit 2009, the Chinese government has made the commitment of reducing CO₂ emissions per unit of GDP by 40%-45% in 2020 compared with 2005 (Ma et al., 2013), and China's twelfth five-year plan (2011-2015) also proposed binding target – 16% reduction in energy consumption per unit of GDP and 17% reduction in CO₂ emission per unit of GDP.

But worryingly, stringent environmental regulations may erode China's industrial competitiveness. According to conventional wisdom among economists (Jenkins, 1998; Luken, 1997; Clift and Wright, 2000), environmental regulations such as technological standards, environmental taxes, or tradable emissions forces firms to allocate some inputs (labor, capital) to pollution reduction, which is unproductive from a business perspective even if it offers environmental or health benefits to society. But this traditional paradigm was contested by a number of economists, notably Professors Michael Porter and Claas van der Linde (1995). Relying primarily on case studies, they argue that more stringent but properly designed environmental regulations can *trigger innovation that may partially or more than fully offset the costs of complying with them* and then lead to improved competitiveness. This is the so-called Porter hypothesis: stringent environmental regulations can achieve a win-win situation in which an economy can simultaneously attain both goals of a cleaner environment and competitiveness.

If stringent environmental regulations are enforced, whether the Porter hypothesis holds in the case of China and regulatory stringency leads to improved industrial competitiveness in terms of industrial performance, resulting in a win-win situation? The answer to this question may not only help clarify the theoretical divergence between environmental regulations and competitiveness, but also have great practical significance to the improvement of environmental regulatory policy in China. In this paper, we examine the impact of environmental regulations on industrial performance based on a natural-experiment of the revision of China's water pollution and control law in 2008 (WPPCL2008). From the analysis, we find that WPPCL2008 significantly increase the total labor productivity, but there is no ROA-inducement effect for water pollution-intensive sectors. Besides, interesting and importantly, we find

that WPPCL2008 has an insignificant negative influence on industrial employment level.

This study contributes to the literature in the following ways.

First, this study utilizes a natural-experiment – the revision of China's water pollution and control law in 2008 (WPPCL2008) to evaluate the impact of environmental regulations on industrial performance. Owing to the difficulty to acquire proper indicators to directly measure government regulatory stringency, the existing studies mainly adopt pollution abatement and control expenditure (PACE) and sewage charge as the proxy variable for environmental regulations (Keller and Levinson, 2002; Brunnermei and Cohen, 2003; Cole et al., 2005; Yang et al., 2012). But these indicators may have serious measurement error, which may impart a bias for estimation. This study can avoid the above problem and thus obtain more robust results in contrast to previous studies with the help of a natural-experiment.

Second, previous studies generally adopt productivity as a proxy for *competitiveness* to test the Porter hypothesis, which links environmental regulations to productivity. There are two opposing views on this relationship, resulting in an uncertain result *a priori*. In contrast to previous studies, this study examines the effects of environmental regulations on industrial performance including Return on Assets (ROA), Overall Labor Productivity (LABOR) and total employment (EMPLOYMENT). These indicators may serve as more satisfactory indicators and enable to obtain insight analyses for the Porter hypothesis.

Third, this study provides evidence on the effectiveness of the current environmental regulatory system in China. Since 1980s, China has enacted a series of environmental laws. However, regulators are keenly aware of the *enforcement gaps* limiting the effectiveness of the current regulatory system (Stokoe and Gasne, 2008). The general consensus is that the legal system is undermined by weak local enforcement. Beyer (2006) points out that no effective oversight mechanism exists to ensure policy set at the national level is actually enforced at the local level. This study helps to rationally evaluate the real effectiveness of environmental laws in China.

The rest of this paper is organized as follows. The next section briefly reviews the literature. Section 3 presents the empirical model, explains the data and defines variables. Section 4 presents the empirical results and related discussions. Section 5 concludes the study and provides some policy implications.

2. Previous Literature

The empirical research on the relationship between environmental regulations and business performance, which is often measured by productivity to test the Porter Hypothesis, displays different results. Most papers reviewed in Jaffe et al. (1995) highlight

a negative impact of environmental regulation on productivity. For instance, Gollop and Roberts (1983) estimate that SO₂ regulations slowed down productivity growth in the United States in the 1970s by 43 percent. Barbera and McConnell (2001) separate the productivity effects of environmental regulations into direct (abatement costs) and indirect effects (via other inputs and production). Estimating the cost function for five American emission-intensive industries, they find a decline in productivity in every sector following more stringent abatement requirements in the 1970s. Taking the plant vintage and technology differences into account, Gray and Shadbegian (2003) find that US pulp and paper mills with higher pollution abatement operating costs have significantly lower productivity levels, especially in integrated paper mills. This suggests a strong significant negative effect of environmental regulations on productivity.

However, several more recent studies find more positive results. For example, Berman and Bui (2001) report that refineries located in the Los Angeles area enjoyed significantly higher productivity than other US refineries despite the more stringent air pollution regulation in Los Angeles. Similarly, Alpay et al., (2002) find that the productivity of the Mexican food-processing industry is increasing with the pressure of environmental regulation, which leads them to conclude that more stringent regulation is not always detrimental to productivity. Other studies including Managi et al., (2005), Hamamoto (2006), Laonie et al., (2008) and Yang et al., (2012) all find a positive relationship between environmental regulations and productivity. The most recent contribution by Teng et al., (2014), by utilizing a sample of publicly listed corporations in Taiwan over the period 1996-2008, find that the relationship between economic performance and environmental commitment is neither strictly negative nor strictly positive, but is instead U-shaped. The evidence suggests that, although a firm bears costs for environmental management in the short term, the benefits of it accumulate over time, and a firm benefits from environmental management in the long term.

Reviewing the literature, we find more stringent environmental regulations seem to have an uncertain influence on performance. But all the above literature is still problematic. Most studies use pollution abatement control expenditure (PACE) to measure the stringency of environmental regulations. In fact, PACE cannot accurately reflect the economic costs of environmental regulation. For example, if a plant replaces an old boiler and the new equipment is more efficient and thus produces less emission, managers must decide whether part or all of this expenditure should be classified as abatement. The PACE questionnaires are often confusing on this point, asking them classify as PACE all expenditures that they would not have made if no pollution regulations were in place (Berman and Bui, 2001). Therefore,

PACE will result in serious measurement error, which may impart a bias on the relationship between environment regulation and economic outcomes. This paper, using the natural-experiment of the revision of China's water pollution and control law in 2008 (WPPCL2008) to examine the effects of Chinese environmental legislation on industrial performance, can avoid the measurement error and obtain more objective and accurate conclusion.

3. A Natural Experiment – The Revision of Water Pollution Prevention and Control Law of China in 2008

Water pollution is becoming one of the most serious problems that China faces. According to data released by the Ministry of Environmental Protection (MEP) in 2013, 59.6% of the total 4778 groundwater quality monitoring points are inferior, and 10.3% of the total control sections of surface water are at grade V, only 64.1% are at grade III (MEP, 2013). Moreover, more than 1700 water pollution accidents happened every year in recent years, and 1.4 billion inhabitants are seriously affected by the insecurity of water quality (Xinhuanet, 2014).

To echo the emerging public concern for rapid deterioration of water quality, the Chinese government enacted Water Pollution Prevention and Control Law (WPPCL) in 1984 and revised the law in 1996 (WPPCL1996). The WPPCL1996 clearly defined responsibilities and duties of water protection for local governments and the ministries of the state council, and the discharge requirement and responsibilities of enterprises. With the pollution of environment becoming increasingly serious and economic system reform getting constantly perfect, the Chinese government implemented the second revision of WPPCL in 2008, raising the number of law articles included in WPPCL1996 from 62 to 92.

The second revision of WPPCL in 2008 (WPPCL2008) further enriched the contents and legal norms of Water Pollution Prevention and Control Law. Specifically, WPPCL2008 specified the responsibilities of local governments for water pollution prevention, expanded the power of local governments and environmental protection department, improved regulatory system of conservation areas for drinking water and compensation system of water pollution, strengthened control system of total discharge for major pollutants, and raised the penalties for illegal sewage.

Therefore, we can use the revision of Water Pollution Prevention and Control Law in 2008 (WPPCL2008) as a natural-experiment to assess the impacts of environmental regulations on China's industrial performance. If environmental regulations indeed significantly affect industrial performance, there will be apparent difference in the growth trend of industrial performance between water pollution-intensive sectors and non water pollution-intensive sectors after the revision of WPPCL in 2008.

4. Empirical Model and Data Sources

In this study, we apply a differences-in-differences approach (Allers and Hoeben, 2010) to estimate the effect of the revision of WPPCL2008 on China's industrial performance. First of all, we consider the water pollution-intensive sectors as treatment group, the rest sectors – non water pollution-intensive sectors are considered as control group, and then we divide time-series interval (2000-2012) of the sample into two periods according to the year in which WPPCL2008 was revised. In the end, we divide the above sample into four sub-samples by setting two dummy variables du and dt . Referring to specification, the basic regression equation is specified as follows:

$$Performance_{it} = \beta_0 + \beta_1 du_{it} + \beta_2 dt_{it} + \beta_3 du_{it} \times dt_{it} + \varepsilon_{it} \quad (1)$$

where i denotes industries and t years. *Performance* represents an industrial sector's performance, which is measured by various indices including Return on Assets (*ROA*), Overall Labor Productivity (*LABOR*) and total employment (*EMPLOYMENT*). *ROA* fully captures an industrial sector's financial performance, measured as the ratio of total assets to industrial output. *LABOR* mainly captures an industrial sector's production efficiency, measured as the ratio of industry value added to the annual average number of employed personnel. *EMPLOYMENT* mainly captures an industrial sector's employment level, measured as the annual average number of employed personnel.

In model (1), di is industry dummy variables, if industry i belongs to the treatment group, then $du_{it}=1$. If industry i belongs to the control group, then $du_{it}=0$. dt is time dummy variables, if year t (2003-2008) is ahead of the revision of WPPCL2008, then $dt=0$, otherwise, $dt=1$. Therefore, by estimating the coefficient β_3 of interaction term $du_{it} \times dt_{it}$ (differences-in-differences estimator), we can evaluate the real impact of the revision of WPPCL2008 on industrial performance. If $\beta_3 > 0$, we can conclude that industrial performance of the treatment group will increase more than the control group after the revision of WPPCL2008. Finally, ε_{it} is a residual error term capturing all other effects.

Besides environmental regulations, we also include industrial characteristics including industrial size (*SIZE*), industrial growth (*GROWTH*) and industrial cost (*COST*) as control variables in our regressions (see, e.g., Tosi et al., 2000). So we expand equation (1) as follows:

$$Performance_{it} = \beta_0 + \beta_1 du_{it} + \beta_2 dt_{it} + \beta_3 du_{it} \times dt_{it} + \beta_4 SIZE_{it} + \beta_5 GROWTH_{it} + \beta_6 COST_{it} + \varepsilon_{it} \quad (2)$$

where *GROWTH* is measured by the growth rate of industry sales, *SIZE* is represented by an industry's fixed assets (Bloom & Milkovich, 1998; Finkelstein & Boyd, 1998), *COST* is measured as the ratio of profit to cost in an industry.

This paper selects the panel data of 37 two-digit manufacturing industries under China's industrial

classification system from 2003-2011. Two manufacturing industries – *Mining of Other Ores* and *Utilization of Waste Resources* are omitted due to missing data, so we exclude the two manufacturing industries from the sample (See Appendix: Table 6 for 37 two-digit industry category in China). We deflate the data using industry-specific price deflators to obtain real series.

Table 1. Descriptive statistics

Variables	Mean	S.D.	Min.	Max.
<i>ROA</i>	0.1457	0.1145	0.0008	0.8354
<i>LABOR</i>	13.0247	0.7126	11.0865	15.1962
<i>EMPLOYMENT</i>	4.3512	0.9726	2.3125	6.5833
<i>SIZE</i>	2.1845	1.02435	1.0043	6.5833
<i>GROWTH</i>	0.2354	0.1569	-0.2972	1.0672
<i>COST</i>	0.1015	0.1254	-0.0531	0.9924
Industry	37	37	37	37
Obs.	333	333	333	333

5. Empirical Results

5.1 Baseline regression results

As WPPCL was enacted to restrain the emission of water pollution of enterprises, the impact of the revision of WPPCL on water pollution-intensive sectors and non water pollution-intensive sectors is significantly different. In this study, we regard the manufacturing industries of which waste water emissions per unit of output value exceed the average of total manufacturing industries as water pollution-intensive and treatment group. Other manufacturing industries of which waste water emissions per unit of output value are below the average of total manufacturing industries are regarded as non water pollution-intensive and control group.

This study utilizes panel data regressions to estimate the effect of WPPCL2008 on China's industrial performance. Firstly, we utilize OLS to estimate regression equation. Table 2, Table 3 and Table 4 report the estimation results for three indices of industrial performance (*LABOR*, *ROA* and *EMPLOYMENT*) respectively. We include year dummy to capture the time-invariant constant effect of WPPCL2008 in the base regression.

The results in Table 2 show that the estimated coefficient for $dt \times du$ is positive and statistically significant at the 1% statistical level when we include no control variables in regression equation (column 1 in Table 2), moreover, the estimated coefficient for $dt \times du$ is still positive and statistically significant at the 1% statistical level with control variables included (column 2 in Table 2). However, the regression result with OLS may not be valid as Breusch-Pagan test displays that there are significant autocorrelation and heteroscedasticity with regression equation. Therefore, we further conduct regression with panel-corrected standard errors (PCSE) (columns 3 and 4 in Table 2). The results with PCSE show that the estimated coefficients for $dt \times du$ are still positive

and statistically significant at the 10% and 5% statistical level respectively, implying that WPPCL2008 can significantly improve the total labor productivity of China's manufacturing industries, specifically, the total labor productivity of water pollution-intensive manufacturing industries would be triggered to increase by about 0.15% by WPPCL2008 annually. The above results support the Porter hypothesis that stringent environmental regulations are positively related to industrial total labor productivity, suggesting that the possibility of the win-win situation in which both a better environmental quality and firm total labor productivity can coexist. As for the influences of other control variables, the results obtained overall are consistent with theoretical estimations.

Table 2. Effects of WPPCL2008 on LABOR

Variable	Model 1(OLS)	Model 2(OLS)	Model 3 (PCSE)	Model 4 (PCSE)
$dt \times du$	0.163*** (0.000)	0.135*** (0.000)	0.089* (0.056)	0.101** (0.016)
dt	1.090*** (0.000)	1.555*** (0.000)	1.147*** (0.000)	1.114*** (0.000)
du	-0.202 (0.335)	-0.200 (0.340)	-0.232*** (0.000)	-0.248*** (0.000)
$SIZE$		-0.176*** (0.000)		-0.004 (0.923)
$GROWTH$		0.131 (0.101)		0.072 (0.379)
$COST$		0.793*** (0.000)		0.626*** (0.000)
C	12.473*** (0.000)	12.711*** (0.000)	12.450*** (0.000)	12.403*** (0.000)
Industry dummy	Yes	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes	Yes
R-square Industry	0.8544 37	0.8736 37	0.9943 37	0.9971 37
Observations	333	333	333	333

Note: Figure in parentheses are P-values.

* Significance at 10% levels; ** Significance at 5% levels;

***Significance at 5%levels.

Table 3 displays the estimates obtained using ROA as the dependent variable. Estimates in columns (1)-(2) in Table 3 are obtaining by OLS, showing that the estimated coefficient for $dt \times du$ are insignificantly negative when we include no control variables in regression equation (column 1 in Table 3), but the estimated coefficient for $dt \times du$ is negative and statistically significant at the 5% statistical level with control variables included (column 2 in Table 3), however, when we further conduct regression with panel-corrected standard errors (PCSE) (columns (3) and (4) in Table 3), we also find that the estimated coefficients for $dt \times du$ are still negative but not significant, suggesting that WPPCL2008 have a negative effect on ROA of China's manufacturing industries,

although the effect shown above is not significant. The above results indicate that WPPCL2008 will reduce ROA of manufacturing industries and there is no possibility of the win-win situation in which both a better environmental quality and firm ROA can coexist.

Table 3. Effects of WPPCL2008 on EMPLOYMENT

Variable	Model 1(OLS)	Model 2(OLS)	Model 3 (PCSE)	Model 4 (PCSE)
$dt \times du$	-0.003 (0.773)	-0.013** (0.017)	-0.006 (0.512)	-0.002 (0.767)
dt	0.074*** (0.000)	0.121*** (0.000)	0.088*** (0.000)	0.118*** (0.000)
du	-0.020 (0.598)	-0.013 (0.601)	-0.015 (0.633)	-0.020*** (0.001)
$SIZE$		-0.023*** (0.001)		-0.023*** (0.000)
$GROWTH$		0.015 (0.252)		0.004 (0.863)
$COST$		0.665*** (0.000)		0.664*** (0.000)
C	0.116*** (0.000)	0.101*** (0.000)	0.117*** (0.000)	0.103*** (0.000)
Industry dummy	Yes	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes	Yes
R-square Industry	0.2599 37	0.7179 37	0.4017 37	0.5804 37
Observations	333	333	333	333

Note: Figure in parentheses are P-values.

* Significance at 10% levels; ** Significance at 5% levels;

***Significance at 1% levels.

Table 4 displays the estimates obtained using EMPLOYMENT as the dependent variable. Estimates in columns (1)-(2) in Table 3 are obtaining by OLS, showing that the estimated coefficient for $dt \times du$ are significantly negative when we include no control variables in regression equation (column 1 in Table 3), however the estimated coefficient for $dt \times du$ is insignificantly negative with control variables included (column 2 in Table 3). When we further utilize PCSE to correct the regression equation (columns (3) and (4) in Table 3), we also find that the estimated coefficients for $dt \times du$ are still negative but not significant, implying that WPPCL2008 has a negative effect on employment level of China's manufacturing industries, although the effect shown above is not significant. The estimate results suggest that WPPCL2008 can restrain employment of water pollution-intensive industries, although the effect is not significant.

Why does WPPCL2008 has a positive influence on total labor productivity rather than ROA for water pollution-intensive sectors in China? The intuitive explanation is that China's water pollution-intensive sectors do indeed engage in innovation-based solutions including both technological and organiza-

tional changes that increase a firm's resource efficiency to meet the requirements of environmental regulations, which in turn will improve the total labor productivity. On the other hand, stringent environmental regulations urge the firms to divert investment in profitable asset from productivity to abatement to achieve pollution reduction targets, which may lead to reduction for firm ROA. Furthermore, why does WPPCL2008 has an insignificant negative influence on employment level for water pollution-intensive sectors in China? The main reason is that new environmental legislation effectively restrains expansion of waste water intensive firms, resulting in the decline in the annual average number of employed personnel.

Table 4. Effects of WPPCL2008 on EMPLOYMENT

Variable	Model 1(OLS)	Model 2(OLS)	Model 4 (PCSE)	Model 3 (PCSE)
$dt \times du$	-0.057** (0.039)	-0.054 (0.216)	-0.026 (0.460)	-0.012 (0.831)
dt	0.642*** (0.000)	-0.224** (0.050)	0.637*** (0.000)	0.156*** (0.003)
du	-0.097 (0.765)	-0.078 (0.510)	-0.120 (0.294)	-0.089** (0.032)
$SIZE$		0.286*** (0.000)		1.311*** (0.000)
$GROWTH$		0.129** (0.015)		0.162 (0.054)
$COST$		-0.140 (0.442)		-0.650** (0.023)
C	4.106*** (0.000)	03.595*** (0.000)	4.090*** (0.000)	1.815*** (0.000)
Industry dummy	Yes	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes	Yes
R-square	0.7835	0.8148	0.9380	0.8967
industry	37	37	37	37
Observations	333	333	333	333

Note: Figure in parentheses are P-values.

* Significance at 10% levels; ** Significance at 5% levels;

***Significance at 1% levels.

The above results also imply that Chinese environmental legislations have significant influences on China's industrial performance. Although many papers prove the widespread under-enforcement of environmental regulations in China (Winalski, 2009; Beyer, 2006; Wang and Jin, 2007; Stokoe and Gasne, 2008), our study provides evidence on the effectiveness of the current environmental regulatory system in China, which contradicts existing views that China's current environmental legal system is not important (Allen et al., 2005).

5.2 Robustness Tests

In this subsection, we make comprehensive tests to check the robustness of our main results present in Table 2. Based on a differences-in-differences approach, we find WPPCL2008 has significantly im-

proved total labor productivity of China's manufacturing industries. However, a differences-in-differences approach is based on the following premise – if there is no influence of WPPCL2008, the growth trend of industrial performance between treatment group and control group will not be systematically different with time. In this section, we will utilize a counterfactual test to examine whether the above premise is valid. Specifically, because WPPCL2008 only create incentive and constraint for waste water emissions, but will not affect waste gas and solid wastes emissions, so we can test the robustness of above estimate results with a differences-in-differences approach by examining the impact of WPPCL2008 on total labor productivity of waste gas intensive sectors (WGIS) and solid wastes intensive sectors (SWIS). If WPPCL2008 has no significant impact on the industrial performance of WGIS and SWIS, we can conclude that the estimate results with a differences-in-differences approach are robust.

First, we regard the manufacturing industries of which waste gas emissions per unit of output value exceed the average of total manufacturing industries in 2008 as WGIS and treatment group, other industrial sectors are treated as control group. The estimate results of regression equation (column (1)-(2) in table 4) indicate that the estimated coefficient for $dt \times du$ is not significant.

Second, we regard the manufacturing industries of which solid wastes emissions per unit of output value exceed the average of total manufacturing industries in 2008 as SWIS and treatment group, other industrial sectors are treated as control group. The estimate results of regression equation (column (3)-(4) in table 4) indicate that the estimated coefficient for $dt \times du$ is not significant too. The above results suggest that difference will not exist for the growth of total labor productivity without the impact from WPPCL2008 with time, justifying the robustness of the above estimate results with a differences-in-differences approach.

6. Concluding Remarks and Policy Implications

Based on a natural experiment of the Water Pollution Prevention and Control Law's revision in 2008 (WPPCL2008), this study investigates the impact of environmental regulations on industrial performance in China by using manufacturing industries' data from 2003-2011, and we derive interesting and important findings. WPPCL2008 significantly increase the total labor productivity of the water pollution-intensive industries, suggesting that the possibility of the win-win situation in which both a better environmental quality and firm total labor productivity can coexist, providing evidence for the so-called Porter hypothesis. However, there is no evidence to support an ROA-inducement effect for industries brought about by WPPCL2008. It indicates that WPPCL2008 has different impact on China manufacturing industries' total labor productivity and

Table 5. Effects of WPPCL2008 on LABOR: Counter-factual Test

Variable	Treatment group: WGIS		Treatment group: SWIS	
	(1)	(2)	(3)	(4)
$du \times dt$	0.098	0.072	0.168	0.165
	0.396	0.573	0.183	0.185
du	0.355	0.335	-0.306	-0.174
	0.002	0.001	0.124	0.321
dt	1.159	1.1005	1.126	1.174
	0.000	0.000	0.000	0.000
Control variables	NO	YES	NO	YES
Industry dummy	YES	YES	YES	YES
Time dummy	YES	YES	YES	YES
R-square	0.9933	0.9659	0.9976	0.9946
Industry	37	37	37	37
Observations	333	333	333	333

Note: Same to Tables above.

ROA. A further examination of WPPCL2008 on employment level shows that new water pollution prevention and control law has an insignificant negative impact on the annual average number of employed personnel of water pollution-intensive industries. At the same time, this study provides evidence on the effectiveness of the current written environmental laws in China.

From the above analyses, this study derives two policy implications. First, environmental regulations have different impacts on various performance indices including ROA, total labor productivity and total employment. Thus, it is very necessary for the Chinese government to design differentiated and properly environmental regulation policies according to different performance indices of firms in Chinese industrial sectors. Second, the environmental written laws indeed are important in China. Therefore, the Chinese government should make the existing environmental laws to continue to play a positive role in preventing environmental pollution. Furthermore, the Chinese government should properly implement a series of major revisions to the various environmental laws in time according to environmental situation, giving firms more incentive to innovate to offset the costs of complying with environmental regulations and then lead to improved competitiveness.

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References

1. ALLEN F., QIAN J., QIAN M., 2005, Law, finance, and economic growth in China, in: *Journal of Financial Economics* 77, p. 57-116.

Appendix: Table 6. Composition of industry categories

SIC code	Two-digit category
06	Coal mining and dressing
07	Extraction of Petroleum and Natural gas
08	Ferrous metal mining & dressing
09	Non-ferrous metal ores mining and dressing
10	Mining and Processing of Nonmetal Ores
11	Mining of Other Ores
13	Agriculture and sideline foods processing
14	Food production
15	Beverage production
16	Tobacco products processing
17	Textile industry
18	Clothes, shoes and hat manufacture
19	Leather, furs, down and related products
20	Timber processing, bamboo, cane, palm fiber and straw products
21	Furniture manufacturing
22	Papermaking and paper products
23	Printing and record medium reproduction
24	Cultural, educational and sports articles production
25	Petroleum processing, coking and nuclear fuel processing
26	Raw chemical material and chemical products
27	Medical and pharmaceutical products
28	Chemical fiber
29	Rubber products
30	Plastic products
31	Nonmetal mineral products
32	Smelting & pressing of ferrous metals
33	Smelting & pressing of non-ferrous metals
34	Metal products
35	Ordinary machinery manufacturing
36	Specialty equipment manufacturing
37	Transport equipment and manufacturing
39	Electric machines and apparatuses manufacturing
40	Communication equipment, computers, and other electronic equipment
41	Instruments, meters, cultural and office machinery manufacture
42	Craftwork and other manufactures
43	Utilization of Waste Resources
44	Electricity and heating production and supply
45	Fuel gas production and supply
46	Water production and supply

Note: Industry *Mining of Other Ores* (SIC code 11) and *Utilization of Waste Resources* (SIC code 43) are omitted due to missing data.

2. ALLERS M.A., HOEBEN C., 2010, Effects of unit-based garbage pricing: a differences-in-differences approach, in: *Environmental and Resource Economics* 45, p. 405-428.
3. ALPAY E., BUCCOLA S., KERKVLIT J., 2002, Productivity growth and environmental regulation in Mexican and U.S. food manufacturing, in: *American Journal of Agricultural Economics* 84(4), p. 887-901.
4. BARBERA A.J., MCCONNEL V.D., 1990, The impact of environmental regulations on industry productivity, in: *Journal of Environmental Economics and Management* 18, p. 50-65.

5. BERMAN E., BUIL T. M., 2001, Environmental regulation and productivity: Evidence from oil refineries, in: *Review of Economics and Statistics* 83(3), p. 498-510.
6. BEYER S., 2006, Environmental law and policy in the People's Republic of China, in: *Chinese Journal of International Law* 5, P. 185-211.
7. BLOOM M., MILKOVICH G., 1998, Relationships among risk, incentive pay, and organizational performance, in: *Academy of Management Journal* 41(3), P. 283-297.
8. BODEN T., ANDRES J., MARLAND G., *Global, Regional, and National Fossil-Fuel CO₂ Emissions*, CDIACenter, Oak Ridge, 2013.
9. BRUNNERMEIER S. B., COHEN M. A., 2003, Determinants of environmental innovation in US manufacturing industries, in: *Journal of Environmental Economics and Management* 45, p. 278-293.
10. CLIFT R., WRIGHT L., 2000, Relationships between environmental impacts and added value along the supply chain, in: *Technological Forecasting & Social Change* 65, p. 281-295.
11. COLE M., ELLIOTT R., 2005, FDI and the capital intensity of dirty sectors, in: *Review of Development Economics* 9(4), p. 530-548.
12. FINKELSTEIN S., BOYD B. K., 1998, How much does the CEO matter? The role of managerial discretion in the setting of CEO compensation, in: *Academy of Management Journal* 41(2), p. 179-199.
13. GOLLOP F. M., ROBERTS M. J., 1983, Environmental regulations and productivity growth: The case of fossil-fuelled electric power generation, in: *Journal of Political Economy* 91(4), p. 654-74.
14. GRAY W. B., SHADBEGIAN R. J., 2003, Plant vintage, technology, and environmental regulation, in: *Journal of Environmental Economics and Management* 46(3), p. 384-40.
15. HAMAMOTO M., 2006, Environmental regulation and the productivity of Japanese manufacturing industries, in: *Resource and Energy Economics* 28, p. 299-312.
16. JAFFE A. B., PERTERSON S. R., PORTNEY P. R., STAVINS R. N., 1995, Environmental regulation and international competitiveness: What does the evidence tell us? in: *Journal of Economic Literature* 93, p. 132-63.
17. JENKINS R., *Environmental Regulation and International Competitiveness: A Review of Literature and Some European Evidence*, UN University Institute for New Technologies 1998.
18. LANOIE P., PATRY M., LAJEUNESSE R., 2008, Environmental regulation and productivity: new findings on the Porter hypothesis, in: *Journal of Productivity Analysis* 30(2), p. 121-128.
19. LUKEN R., 1997, The effect of environmental regulation on industrial competitiveness of selected industries in developing countries, in: *Greener Management International* 19, p. 67-78.
20. KELLER W., LEVINSON A., 2002, Pollution abatement costs and foreign direct investment inflows to US states, in: *Review of Economics and Statistics* 84 (4), P. 691-703.
21. MA Z., XUE B., GENG Y., REN W., FUJITA T., ZHANG Z., DE OLIVEIRA J. P., JACQUES D. A., XI F., 2013, Co-benefits analysis on climate change and environmental effects of wind-power: A case study from Xinjiang, China. In: *Renewable Energy* 57, p. 35-42.
22. MANAGI S., OPALUCH J., JIN D., GRIGALUNAS T., 2005, Environmental regulations and technological change in the offshore oil and gas industry, in: *Land Economics* 81, p. 303-319.
23. MEP., 2014, 2013, *Report on the State of the Environment in China*, http://news.xinhuanet.com/live/2014-06/04/c_1110980565.htm.
24. PORTER M., VAN DER LINDE C., 1995, Toward a new conception of the environment-competitiveness relationship, in: *Journal of Economic Perspective* 9(4), P. 97-118.
25. STOKOE S., GASNE S., *China's Environmental Law Framework*. Pacific Business Press 2008.
26. TENG M. J., WU S. Y., CH S. J. H., 2014, Environmental commitment and economic performance, in: *Environmental Policy and Governance* 24, p. 16-27.
27. TOSI H. L., WERNER S., KATZ J. P., GOMEZ-MEJIA L. R., 2000, How much does performance matter?, in: *Journal of Management* 26(2), p. 301-339.
28. WANG H., JIN Y., 2007, Industrial ownership and environmental performance: evidence from China, in: *Environmental and Resources Economics* 36(3), p. 255-273.
29. WINALSKI D., 2009, Cleaner water in China? The implications of amendments to China's law on the prevention and control of water pollution, in: *Journal of Environmental Law & Litigation* 24, p. 181-202.
30. XINHUANET, <http://news.xinhuanet.com/>
31. YANG C. H., TSENG Y. H., CHEN C. P., 2012, Environmental regulations, induced R&D, and productivity: evidence from Taiwan's manufacturing industries, in: *Resource and Energy Economics* 34(4), p. 514-532.

Sustainable Development as Seen by the Residents of Eastern and Western Europe on the Basis of ISSP Environment Data

Problematyka zrównoważonego rozwoju w opiniach mieszkańców Europy Wschodniej i Zachodniej na podstawie danych ISSP Environment

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Abstract

The ISSP Environment 2010 data (random sample including more than 18,000 respondents) were used to demonstrate differences in opinions concerning sustainable development between the residents of Eastern and Western European countries. If it is assumed that the concept of sustainable development involves a relative balance among the three pillars (social, economic and ecological), then opinions of the residents of Western Europe are more in line with this assumption. On the other hand, a disproportion can be observed in the case of Eastern Europe, where the environmental pillar is clearly underestimated and the social pillar is much weaker.

Key words: sustainable development, ISSP, Eastern Europe, Western Europe

Streszczenie

Wykorzystując dane ISSP Environment 2010 (próbę losową o wielkości ponad 18 000 respondentów) wykazano różnice dzielące kraje Europy Wschodniej i Zachodniej w zakresie opinii związanych ze zrównoważonym rozwojem. Jeżeli w koncepcji zrównoważonego rozwoju zakłada się równowagę pomiędzy jego trzema filarami (społecznym, ekonomicznym i ekologicznym), to bardziej z tym założeniem zgodne są opinie mieszkańców Europy Zachodniej. W przypadku Europy Wschodniej zauważalna jest dysproporcja – wyraźnie niedoceniany jest filar środowiskowy i znacznie słabszy filar społeczny.

Słowa kluczowe: rozwój zrównoważony, ISSP, Europa Wschodnia, Europa Zachodnia

Introduction

As any large region of the world, Europe has both conventional and unconventional geographical, political, economic, historical, ethnic, cultural, and religious borders. For the last few decades, Europe was simply and commonly divided into two parts: Eastern Europe and Western Europe. However, after 1989 and then following enlargement of the European Union, this division is no longer so clear-cut; in many respects, the border between Eastern and Western Europe is not linear, but constitutes more of a zone. On the other hand, the traditional division into eastern and western part seems to persist in the

political discourse as well as in the common consciousness. The article attempts to establish whether this division functions with regard to sustainable development, and particularly with regard to environmental protection. For this purpose, the ISSP Environment 2010 data were used.

Methodology

The ISSP (International Social Survey Program) is a long-term international research project carried out annually in participating countries. It was created to regularly measure variables covering a broad scope of social life. The ISSP surveys are repeated every

few years, which allows to observe changes in the measured phenomena. One of the ISSP modules is the ISSP Environment, which was implemented three times: in 1993 (with Poland's participation), and in 2000 and 2010 (without Poland). The ISSP employs a questionnaire method on random samples. The ISSP Environment III data were made available in 2010 and they included 30 countries. For the purpose of this analysis, the data for 17 countries were used. These were: Austria, Belgium, Norway, Denmark, Finland, Germany, Spain, Sweden, Switzerland, and the United Kingdom (Western European countries); and Latvia, Bulgaria, Russia, Slovakia, Slovenia, Croatia, and the Czech Republic (Eastern European countries). A randomly selected study sample included 8441 respondents from Eastern Europe and 9770 respondents from Western Europe.

The ISSP Environment III data were used to answer the following research questions: What is the hierarchy of the components of sustainable development according to the residents of Eastern and Western Europe? What are the differences between the eastern and western part of the continent with regard to the social component of sustainable development? What threats to the natural environment are considered to be the most important? What factors determine the degree of concern in environmental issues in Eastern and Western Europe?

The analysis was limited to Europe and focused on comparing two groups of European countries – those of Eastern and of Western Europe. The comparison is not complete as the research did not cover all European countries. However, on its basis it is possible to form an opinion about general trends that can be observed in the context of the issues discussed in the article.

Results

The answers to the question about the most important issue for the respondent's country of residence, were used as an indicator of how significant each component of sustainable development was for respondents.

The natural environment was indicated as a priority by 3.2% of respondents from Eastern Europe and 8.8% of respondents from Western Europe. Social issues were indicated by 66% and 63.9% of respondents respectively, and economic issues – by 30% and 26.2%, respectively. The hierarchy of issues is clearly visible with social issues at the top, followed by economic and finally environmental ones. While for Eastern Europeans, social and economic issues are slightly more important than for residents of Western Europe, in the case of environmental issues the difference is significant: environmental problems are mentioned as the most important almost 3 times more frequently in the western region of the continent in comparison with its eastern part.

Table 1. Most important issues by region of Europe

Most important issues		Region of Europe		Summary
		Eastern Europe	Western Europe	
Health care	n	2021	2612	4633
	%	24,0%	27,1%	25,7%
Education	n	542	1518	2060
	%	6,4%	15,7%	11,4%
Crime	n	994	607	1601
	%	11,8%	6,3%	8,9%
The environment	n	269	852	1121
	%	3,2%	8,8%	6,2%
Immigration	n	172	768	940
	%	2,0%	8,0%	5,2%
The economy	n	2520	2525	5045
	%	30,0%	26,2%	27,9%
Terrorism	n	101	123	224
	%	1,2%	1,3%	1,2%
Poverty	n	1733	528	2261
	%	20,6%	5,5%	12,5%
Other	n	53	116	169
	%	0,6%	1,2%	0,9%
Summary	n	8405	9649	18054
	%	100,0%	100,0%	100,0%

Pearson Chi-Square= 1903,6; $p < 0,0005$

The ISSP data set contains a variable (expressed by a question about trust in most people), which can be seen as an indicator of the social component of sustainable development: the amount of social trust, which is usually perceived as a vital component of social capital (Wise, 2005).

Social capital is understood here as generalized trust in other members of society that are strangers to us. This trust helps to build an imagined or ideological community based on the systems of contracts and wider social agreements (Hull, 2008). In the classical approach of Robert Putnam, *social capital refers directly to the connections between individuals – social networks and norms of reciprocity, and trust that arises from them* (Putnam, 1995). Consequently, social capital is viewed as a factor directly resulting from social interactions and as such facilitating cooperation; it is some good that generates networking and cooperation. High levels of social capital should reflect potential possibilities for obtaining certain economic benefits (Munda, 1997). Resources of social trust that some group is endowed with, may increase the productivity of other capitals: physical, material, etc. (Zarycki, 2004; Pawłowski, 2008). Thus, the level of social trust is connected not only with the social but also economic domain of society (Littig, Griesler, 2005; Harris et al., 2001).

The analysis has shown that the amount of declared social trust is significantly higher in Western Europe (the average of 3.18 on a five point scale) than in countries of Eastern Europe (the average of 2.39 on the same scale).

Consequently, in the western part of the continent, the potential of civic society and the social component of economic development are stronger than in the east.

With regard to various threats to the environment and how important they are for the respondent's country as a whole, the differences in opinions between the residents of Eastern and Western Europe are seen primarily in the attitude to air pollution (27.9% in Eastern Europe, 16.3% in Western Europe) and climate change (8.6 % in Eastern Europe and 23.2% in Western Europe). To a lesser extent, these differences concern water shortage (3.4% and 6.2%, respectively), using up natural resources (9.1% and 12.7%, respectively) and domestic waste disposal (12.6% and 4.2%, respectively).

Table 2. ANOVA, Descriptive statistics, Amount of trust in most people

Region of Europe	N	Mean	Std. Deviation
Eastern Europe	8441	2,39	1,150
Western Europe	9770	3,18	1,247
Total	18211	2,81	1,266

Table 3. ANOVA, Robust Tests of Equality of Means

	Statistic	df1	df2	Sig.
Welch	1984,337	1	18133,578	,000

Levene Statistic = 23,19; $p < 0,0005$

Table 4. Most important environmental problem for respondent's country by region of Europe

Most important problem		Region of Europe		Summary
		Eastern Europe	Western Europe	
Air pollution	n	2272	1540	3812
	%	27,9%	16,3%	21,7%
Chemicals and pesticides	n	925	937	1862
	%	11,4%	9,9%	10,6%
Water shortage	n	275	582	857
	%	3,4%	6,2%	4,9%
Water pollution	n	1006	1066	2072
	%	12,4%	11,3%	11,8%
Nuclear waste	n	486	916	1402
	%	6,0%	9,7%	8,0%
Domestic waste disposal	n	1024	398	1422
	%	12,6%	4,2%	8,1%
Climate change	n	698	2195	2893
	%	8,6%	23,2%	16,5%
Genetically modified food	n	579	477	1056
	%	7,1%	5,1%	6,0%
Using natural resources	n	744	1203	1947
	%	9,1%	12,7%	11,1%
Other	n	126	128	254
	%	1,5%	1,4%	1,4%
Summary	n	8135	9442	17577
	%	100,0%	100,0%	100,0%

Pearson Chi-Square= 1463,4; $p < 0,0005$

On the other hand, taking into account the most important threats to the environment affecting the respondent's family, the differences in opinions between the residents of Eastern Europe and Western Europe concern water pollution (13.2% in the east, 9% in the west), climate change (9.3% in the east and

15, 6% in the west), using up natural resources (5.6% and 8.4%, respectively) and domestic waste disposal (13.7% and 8.8%, respectively).

Table 5. Most important environmental problem which affects respondent and his/her family by region of Europe

Most important problem which affects respondent and his/her family		Region of Europe		Summary
		Eastern Europe	Western Europe	
Air pollution	n	1609	1744	3353
	%	20,1%	19,6%	19,8%
Chemicals and pesticides	n	850	920	1770
	%	10,6%	10,3%	10,5%
Water shortage	n	345	450	795
	%	4,3%	5,1%	4,7%
Water pollution	n	1056	800	1856
	%	13,2%	9,0%	11,0%
Nuclear waste	n	314	398	712
	%	3,9%	4,5%	4,2%
Domestic waste disposal	n	1095	788	1883
	%	13,7%	8,8%	11,1%
Climate change	n	741	1392	2133
	%	9,3%	15,6%	12,6%
Genetically modified food	n	846	814	1660
	%	10,6%	9,1%	9,8%
Using up natural resources	n	450	751	1201
	%	5,6%	8,4%	7,1%
Other	n	689	853	1542
	%	8,6%	9,6%	9,1%
Summary	n	7995	8910	16905
	%	100,0%	100,0%	100,0%

Pearson Chi-Square= 361,2; $p < 0,0005$

The analysis also compares the level of concern in environmental issues between the residents of Eastern and Western Europe. This concern is measured on a five point scale, where 1 denotes *no concern*, and 5 denotes *high-level concern*. The average for Eastern Europe is 3.4 whereas for Western Europe, it is 3.6. This difference is statistically significant (Welch = 131,5; $p < 0,0005$).

Table 6. ANOVA, Descriptive statistics: How concerned in environmental issues?

	N	Mean	Std. Deviation
Eastern Europe	8387	3,4135	1,16184
Western Europe	9731	3,6016	1,02539
Total	18118	3,5145	1,09467

Table 7. ANOVA, Robust Tests of Equality of Means, How concerned in environmental issues?

	Statistic	df1	df2	Sig.
Welch	131,512	1	16871,536	,000

Levene Statistic= 185,9; $p < 0,0005$

Additionally, the analysis aimed at identifying which factors affected the level of concern in environmental issues. Two regressions for categorical data were performed, each for Eastern and Western Europe.

The models show the approximate percentage of variance of the dependent variable (3% and 2.5%, respectively). The following independent variables: sex, age, education (measured by the number of years of schooling), and the size of the place of living were taken into account in the models.

Table 8. Categorical Regression Model Summary for Eastern Europe

Multiple R	R Square	Adjusted R Square	Apparent Prediction Error
,176	,031	,030	,969

Table 9. ANOVA: Categorical Regression Model for Western Europe

	Sum of Squares	df	Mean Square	F	Sig.
Regression	251,135	8	31,392	32,359	,000
Residual	7855,865	8098	,970		
Total	8107,000	8106			

Table 10. Categorical Regression Model for Eastern Europe: Coefficients

	Standardized Coefficients		df	F	Sig.
	Beta	Estimate of Std. Error			
Age	,093	,014	3	44,269	,000
Sex	,070	,011	2	41,393	,000
Place of living: urban - rural	-,035	,012	1	8,830	,003
Education: years of schooling	,158	,014	2	132,507	,000

Table 11. Categorical Regression Model Summary for Western Europe

Multiple R	R Square	Adjusted R Square	Apparent Prediction Error
,160	,026	,025	,974

Table 12. ANOVA: Regression Model for Western Europe

	Sum of Squares	df	Mean Square	F	Sig.
Regression	235,000	8	29,375	30,119	,000
Residual	8921,000	9147	,975		
Total	9156,000	9155			

In both models, all independent variables that were considered affect the level of concern in environmental issues. Moreover, their influence has a similar hierarchy. The difference concerns the influence of education and age: in Eastern Europe, the hierarchy is as follows (according to the Beta value): (1) education, (2) age, (3) sex, (4) size of the place of living. In Western Europe, on the other hand, the order is: (1) age, (2) education, (3) sex, (4) size of the place of living. Therefore, the only difference lies in the minimally higher importance of age in relation to

education. Regardless of where the study was conducted, the level of concern in environmental issues increased along with education, age, and size of the place of living; women were more concerned in environmental issues than men.

Table 13. Categorical Regression Model for Western Europe: Coefficients

	Standardized Coefficients		df	F	Sig.
	Beta	Estimate of Std. Error			
Age	,109	,019	1	34,350	,000
Sex	,088	,010	2	82,145	,000
Place of living: urban - rural	-,041	,012	3	11,909	,000
Education: years of schooling	,101	,021	2	23,385	,000

Summary

The issue of sustainability turns out to be vital for residents of Europe. Out of the three pillars of sustainable development, social issues are considered to be the most important both by Eastern and Western Europeans. Economic issues are viewed as slightly less important while environmental problems rank only in the third place. At the same time, the biggest differences between regions can be observed within this last category.

The residents of Western Europe give priority to environmental issues much more frequently than those of Eastern Europe but overall, these issues are not identified as the most important problems in Europe and lag far behind social and economic problems. Declared concern in environmental protection is higher in Western Europe than in Eastern Europe, but it is associated with the same socio-demographic characteristics and almost identical hierarchy of their influence.

Another noticeable difference between Eastern and Western Europe concerns the question of threats to the environment. Residents of Eastern Europe more often consider water pollution and problems connected with domestic waste disposal to be burdensome while for those living in Western Europe, these are climate change and using up natural resources.

Western Europe is characterized by a much higher level of social capital, which constitutes part of the social pillar of sustainable development, and the level of which is also linked to the economic potential.

In conclusion, if it is assumed that the concept of sustainable development involves a relative balance among the three pillars (social, economic and ecological), then opinions of the residents of Western Europe are more in line with this assumption. On the other hand, a disproportion can be observed in

the case of Eastern Europe, where the environmental pillar is clearly underestimated and the social pillar is much weaker.

References

1. HARRIS J.M., WISE T.A., GALLAGHER K.P., GOODWIN N.R. (eds.), 2001, *A Survey of Sustainable Development. Social and Economic Dimensions*, Island Press.
2. HULL Z., 2008, The Philosophical and Social Conditioning of Sustainable Development, in: *Problemy Ekorozwoju/Problems of Sustainable Development*, vol. 3, no 1, p. 27-31.
3. LITTIG B., GIESLERE., 2005, Social Sustainability: A Catchwork Between Political Pragmatism and Social Theory, in: *International Journal of Sustainable Development*, 1-2(8), p. 65-79.
4. MUNDA G., 1997, Environmental Economics, Ecological Economics and the Concept of Sustainable Development, in: *Environmental Values*, 6, p. 213-233.
5. PAWŁOWSKI A., 2008, How many dimensions does sustainable development have?, in: *Sustainable Development*, vol. 16 no 2, p. 81-90.
6. PUTNAM R., 1995, *Demokracja w działaniu. Tradycje obywatelskie we współczesnych Włoszech*, Znak, Kraków-Warszawa.
7. WCED, 1987, *Our Common Future*, Oxford University Press, New York.
8. WISE T.A., 2005, Economics and Sustainability: The Social Dimension, in: *Intern. Journal of Sustainable Development* 1-2(8), p. 50-51.
9. ZARYCKI T., 2004, Kapitał społeczny a trzy polskie drogi do nowoczesności, in: *Kultura i społeczeństwo*, No 2.

Biofuel's Sustainable Development under the Trilemma of Energy, Environment and Economy

Zrównoważoność biopaliw w kontekście triady energia, środowisko i ekonomia

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Abstract

Biofuel helps to overcome energy shortages, and to improve the environment, as well as to increase job opportunity. So, on the one hand, biofuel solves the above mentioned problems; on the other hand, it brings new challenges to the fields of energy, environment and economy. The development of biofuel not only needs technological support, but also needs policy guidance. The paper discusses government's policy to support biofuel's development in a sustainable way.

Key words: energy crops, environmental governance, industrial upgrades, sustainability, biofuel policy

Streszczenie

Biopaliwa pomagają przezwyciężyć niedobory energii, przyczyniają się do poprawy stanu środowiska, a także do zwiększenia możliwości podjęcia pracy. Tak więc z jednej strony biopaliwa przynoszą konkretne korzyści, z drugiej związane są nimi nowe problemy w kontekście energii, środowiska i ekonomii. Rozwój biopaliw potrzebuje nie tylko wsparcia technologicznego, ale także odpowiedniego zarządzania. W artykule omówiono w jaki sposób rządy mogą wspierać rozwój biopaliw w zrównoważony sposób.

Key words: rośliny energetyczne, zarządzanie środowiskowe, innowacje przemysłowe, zrównoważoność, polityka biopaliwowa

1. Introduction

Many factors caused the global food crisis from 2007 to 2008, which include the climate change and despises of agricultural development and the unfair international food trade, the manipulation of giant transnational food incorporations, as well as the worldwide development of biofuel. Due to this crisis, biofuel came into the public's sights and the future of biofuel falls into people's debate. Some people are pessimistic, while some people believe biofuel industry will have a bright future under the premise of a sustainable development. A sustainable development of biofuel must give response to the current trilemma of energy, environment and economy.

The first part of this paper will introduce the definition and classification as well as function of biofuel

and the biomass sources of biofuel in some typical regions. The second part will analyze three backgrounds of biofuel's appearance. And the third part analyzes in what extend biofuel solves the three predicaments of energy, environment and economy. The fourth part is the most important one of this paper which puts forward some ideas helpful for the sustainable development of biofuel.

2. A brief introduction of biofuel

The term of *Biofuel* was first used in 1970s (*Dictionary*, 2014). Biofuels are liquid, gaseous or solid hydro-carbon fuels derived from biomass. Biomass refers to any organic matter that is available on a renewable or recurring basis, including agricultural crops and trees, wood and wood wastes and residues, plants (including aquatic plants), grasses, residues,

fibers, and animal wastes, municipal wastes, and other waste materials. Biofuel can be used as fuel for automobiles, trains, ships and planes, as well as sources of heat and electricity. In current period, biofuel is mainly used as vehicle fuels. Biofuel mainly include bio-ethanol and biodiesel, biogas, etc. Bio-ethanol is made of plants containing much sugar or starch, such as sugarcane, sorghum, beetroot, yam and cassava. Biodiesel comes from animal fats such as fish oil or oil plants such as soybean oil, palm oil, sunflower seeds oil, coconut oil, jatropha seeds oil, pongamia, moringa oleifera seeds oil, castor seeds oil or waste oils. World agricultural product statistics will show the top producer of each kind of crops, esp. those can be made to biofuel, for instance, Malaysia and Indonesia produce a large quantity of palm oil and Philippines produce a large amount of coconut. In fact, developing countries in Asia, Africa and Latin America have a good biodiversity which supplies enough resources for biofuel production. For example, resin cheesewood (with its Latin name *Pittosporum resiniferum*) is a tree that grows in Philippine, particularly in the wilderness surrounding the Mayon Volcano. The tree has another easily remembered name, *petroleum nut*, because of the resemblance of the fruit's odor to petroleum-based fuels. The fruits of the tree can be burnt brightly when ignited, and can be used for illumination as torches or candles (Wikipedia, 2014). The octane value of it is higher than that of jatropha seeds and is thus of great potential for commercialization. American has brought in this kind of Philippine tree to plant in some regions of USA. The global South has a great future for developing biofuel. But the first thing of Global South is to offer enough food and to reduce poverty, and then improve the technology. In order not to snatch food from human beings, global biofuel has undergone four generations' development. The first generation biofuel comes from surplus food or vegetable oil; and the second generation biofuel comes from agricultural waste, forest residue, municipal solid waste, by-products of food industry, fast-growing wood and grass; the third generation biofuel comes from algae; the fourth generation biofuel is made from microorganism. Most countries are in the first stage of biofuel development.

3. Background of biofuel upsurge

3.1. Energy shortage and biofuel upsurge

Energy can be divided into fossil energy, renewable energy and fission energy. Fossil energy includes petroleum, coal, natural gases, etc. Before the wide use of petroleum, German engineer Rudolf Christian Karl Diesel used peanut oil as fuel in late 19th century; and Brazil began to use alcohol made from sugarcane in 1920s and Japanese army used *Indian jatropha curcus* seeds oil as airplane fuel in WW II, economy of developed countries was thrived with the support of petroleum, that is, the wide use of oil,

and thus petroleum as an important resource caused tense relations between western countries and OPEC member states in 1970s.

The pursuit of alternative energy sets a new agenda before scientists and politicians. In 1978, the magazine Science published an article articulating scientists' view that alcohol can be renewable and clear fuel used for transportation (da Silva et al., 1978). USA began a large scale of use of ethanol in Nebraska since 1970s. In the 1980s and 1990s oil crisis broke out twice and till now Middle East is still the turbulent region of world not only because of religious conflicts but also because of oil resources, at the same time South China Sea is attracting more attention of big powers for its rich marine oil. In the 21st century, energy shortage becomes more serious and King Hubbert's famous theory of *peak oil* that the speed of petroleum and gas production may increase to a summit and then decrease rapidly because of the exhaustion of storage adds people's worries. Besides the diplomacy carried by politicians to secure oil supply, alternative energy including biofuel is necessary for the reduction of oil dependency. Thus, the multi-national corporations chanted the slogan of *planting oil in the fields*.

3.2. Environmental degradation and biofuel upsurge

We not only need enough energy but also clear energy. With the rapid developments of industry, environmental degradation is serious. The use of traditional fuels, such as petroleum and coals, emits a lot of CO, CO₂, HC, benzene and particulates, etc. which have contaminated our air, water and even changed the climate, causing abnormal weather, drought, flood, and the disappearance of some islands. Since 1970s, international society is trying to cooperate to improve world environments in order to secure our basic rights to enjoy clear air as well as to get enough and secure water, which is still in the process of negotiation and cooperation. The planting of energy crops can absorb CO₂ through Photosynthesis, and the use of biofuel can reduce emission of harmful gases. Thus scientist will make comparative studies of each energy crops and find the most potential ones to spread.

Even some desert plants such as *Haloxylon ammodendron* (Chinese called *Suo suo*), *Korshinsk Peashrub*, *sweetvetch*, *Salix psammophila* etc. can prevent wind and fix sands as well as be used as materials of biofuel. Apart from the function of controlling deserts, some plants can prevent the soil erosion as well as be made into biofuel, such as Black Locust whose seeds can be pressed into oil and *Hippophae rhamnoides* Linn whose fruits can be converted into bio-ethanol. Some other plants can be planted on the abandoned mines or in the acid soil or on the polluted lands such as lands contaminated by heavy metals, and these plants can ameliorate soil and reduce local economical lose as well as supply materials for biofuel. Thailand has planted palm trees in the Rangsit

Site to change the soil acidity (Thailand..., 2008) and planted sugarcane in the cadmium-contaminated Mae Sot district of Tak (Thailand..., 2008). If the energy value of plants can be well combined with its environmental value, energy crops will have a bright future.

3.3. Economy depress and biofuel upsurge

The industrial upgrading also leads to the increase of biofuel production. Since the last half of the 20th century the social productivity has been greatly improved, but agricultural surplus caused the reduction of agricultural profits and hurts peasants. In this condition, Europe changed rapeseeds into biodiesel in 1980s and Philippine converted surplus sugarcane into bio-ethanol and Malaysia converted surplus palm oil into biodiesel. But in 21st century, to develop biofuel can extend the industrial chain and increase job opportunities, esp. when the finance crisis happened. This is why American president Barack Obama said in his inaugural speech: *We will harness the sun and the winds and the soil to fuel our cars and run our factories.*

Nowadays food industries such as palm oil factories or coconut factories not only produce food but also change byproducts of food into fuel. In the countries using Chinese herbal medicines, those enterprises processing herbal medicines can convert parts of the plants such as *Jatropha*, *Pongamia pinnata*, etc. into biofuel. In the developing countries, governments encourage peasants to plant energy crops so as to reduce poverty, for example, Prime Minister of India, V. P. Singh, considers biofuel development as a part of *Indian National Rural Employment Guarantee Scheme (NREGS)* and Indonesian President Susilo advocated biofuel to reduce poverty; and Thai former premier Thaksin supported biofuel as a part of his *Rural Development Plan*.

With the development of low carbon economy including the development of biofuel, a new term *Green Collar* comes into being. Peasants, researchers, processors, manager, etc. made up the stakeholders of biofuel industry. Except the preferential policies given to the peasants or biofuel processors, the funds put into the research of biofuel is increased. For example, in July 2008 the US Department of Energy offered six universities US \$4.4 million in biofuel research funding.

4. New problems biofuel development faces

Biofuel as a new source of renewable and clear energy also offers a new point of economic growth, so few countries are producing or planning to produce biofuel nowadays, which is different from what it is in the late 20th century. But as we all know, anything has two sides, and biofuel can in some extent, though not wholly, respond to the former mentioned three complaints. And in this part we will find in what extend biofuel can answer the three complaints,

which is an important factor for us to find a way out towards biofuel sustainability.

Firstly, in what extend biofuel can solve the energy needs. Supply of biofuel materials and level of biofuel technology and rules of biofuel trade will influence the biofuel production and supply. Therefore, some countries supply the materials but do not consume the biofuel or consume less than the developed countries such as EU member states, USA, Japan, etc. In the developing world, biofuel development has more economical meanings such as reducing poverty and increasing foreign exchange rather than solving its own energy needs. According to a statistics, global ethanol production reached nearly 20 billion gallons and global biodiesel production totaled 5.1 billion gallons in 2009 (Scarlet, Dallemund, 2011). But the poor technology and lack of compatible equipment reduced the local use of biofuel in developing countries and the trade barriers such as high tariff rates set by developed countries bring frictions between countries and are not favorable to developing countries. For instance, eight countries including Argentina, Brazil, Columbia, Indonesia, Malaysia, etc. wrote to EU, demanding EU cancel the negative clauses concerned with biofuel (Iago, 2008). Compared with biofuel production, many factors caused biofuel consumption to only take up a small portion of energy locally and globally.

Secondly, in what extend biofuel is green. Energy crops are helpful to increase carbon sink and reduce emission of harmful gasses or particulates. However, biofuel development is threatening environment in another way. The spread of some kinds of energy crops that can bring high yields will threaten biodiversity and destroy the ecosystem. Forests are destroyed to spare lands for planting energy crops, which cause the emission of CO₂ to increase, the amount of Indonesian CO₂ emission increased rapidly for this reason. Besides, in order to improve the production amount of energy crops, modified gene technology will be widely used, which will change the structure of species. More water is consumed when planting energy crops. During the processing of biofuel, untreated water will cause pollution. Mark A. Delucchi (2010), Galan-del-Castillo Elena (2010), Ray Huffaker (2010), Winnie Gerbens-Leenesa (2009), R. Dominguez-Faus (2009), Thomas W. Simpson (2008), Charlotte de Fraiture (2008), etc. discussed the water footprint in energy crops planting and biofuel refinery.

Thirdly, in what extend biofuel solves the economical predicament. Biofuel development offered new job positions, however food prices are going up and poor people need to cost much more in their daily life. To enjoy enough and secure food is also a basic human right and shall be secured. But lured by high profits, private companies or large transnational corporations will use good land but not marginal land to plant energy crops, which will effect the agricultural cultivation, esp. when there is a slow progress on the

technology of a new generation's biofuel. This economical enlargement of biofuel will finally affect the social justice.

5. Path to biofuel sustainable development

Biofuel production can cause positive as well as negative effects. The answer of future biofuel development is through sustainable ways. Energetical, environmental, economic as well as social factors shall be entirely evaluated when biofuel is developed. Although the standard of biofuel sustainability is not agreeable among countries, there lies some basic consensus.

The Dutch government claims that biofuel development shall consider six standards: (1). *Greenhouse gas balance*; (2). *Competition with food, local energy supply, medicines and building materials*; (3). *Biodiversity*; (4). *Economic prosperity*; (5). *Social well-being*; and (6). *Environment* (Piementel, 2008). In August 13th Roundtable on Sustainable Biofuels held by the United Nations Environment Programme (UNEP), EPFL, World Economic Forum, World Wide Fund For Nature, etc. passed an act to define and measure biofuel sustainable standard, and discussed the relation between biofuel development and land protection and labor rights, and biofuel's effect on biodiversity, soil pollution, water resources and food securities. In all, the sustainable biofuel development shall consider the agricultural, ecological, environmental, economic as well as social sustainability. In the local and global level, the sustainability is a principle, and we shall put it into practice.

First, we shall do much more scientific research. A nation shall be familiar with its potentials of biofuel development, and set the proper proportion of biofuel in its own energy plan, to develop step by step but not crazily. A nation shall set a scientific plan of biofuel development. At the same time we shall improve the planting technology of energy crops and biofuel processing technology and reduce biofuel's threat to food security and eco-security. If anyone or any economic actor disobeys the principle of sustainability, it will cause punishment.

Second, do not neglect the spread of knowledge of biofuel sustainability. In some countries, automobile drivers and ordinary citizens are well acknowledged of biofuel due to the good publicity. While in some countries very few people know the new things. If common people are well known about the biofuel, they will find some waste in daily life can be used to produce biofuel; and if officials are well known about it, they will support and oversee the sustainable way of biofuel developments. Funds shall be put into the information construction and proper promotion of biofuel.

At last, international society shall reinforce dialogues and co-operations concerned with biofuel developments until they can agree on the biofuel sustainable standard. Sustainable biofuel standard shall

be established on the base of interdisciplinary dialogues. The global world shall as possible as they can to share the experiences of biofuel development and technological advancements of biofuel for seek of sustainability. The global society shall push the fair trade of biofuel to avoid unsustainable development of biofuel in some regions. The publicity through various media such as Internet is important for the increasing of people's awareness of biofuel sustainability.

6. Conclusion

The foregoing examination has scrutinized the backgrounds of biofuel's arising, which include the energy shortages and environmental degradations and industrial upgrades. But biofuel can only in some extent solve the above predicaments. If biofuel can be developed in a sustainable way, it can be more helpful to solve those problems, and this is what the international society is committed to. Local government, private sectors and international organizations, etc. are putting up their standards of biofuel sustainability, which need time to practice, and to proof which standard is most feasible. And as from views of developing countries, the countries' guidance of biofuel development in a sustainable way is important and publicity of biofuel in a proper way is necessary and the participation of negotiation of biofuel trade rule and discussion of biofuel standard of sustainability is also important.

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References

1. DELUCCHI M.A., 2010, Impacts of biofuels on climate change, water use, and land use, in: *Annals Of The New York Academy Of Sciences*, vol. 1195, p. 28-45.
2. DICTIONARY Reference, <http://dictionary.reference.com/browse/biofuel>, thanks to Jim Lane, editor of Biofuel Digest (30.12.2014).
3. DOMINGUEZ-FAUS R., POWERS S., Joerg BYRKEN J., ALVAREZ P., 2008, The Water Footprint of Biofuels: A Drink or Drive Issue?, in: *Environ. Science Technol.* no. 43, p. 3005-3010.
4. FRAITURE CH., GIORDANO M., LIAO Y., 2008, Biofuels and implications for agricultural water use: blue impacts of green energy, in: *Water Policy*, Supplement 1, p.67-81.
5. GALAN-DEL-CASTILLO E., VELAZQUEZ E.V., 2010, From water to energy: The virtual water content and water foot print of biofuel consumption in Spain, in: *Energy Policy*, vol. 38, p. 134-1352.

6. GERBENS-LEENESA W., HOEKSTRAA A.Y., van der MEERB T.H., 2009, The water footprint of bioenergy, in: *PNAS*, vol. 106, no. 25, p.10219-10223.
7. HAUFFAKER R., 2010, Protecting water resources in biofuels production, in: *Water Policy*, vol.12, p.129-134.
8. IAGO D. ab, 2008, EU/Brazil: first ministerial dialogue to boost energy cooperation, in: *Euro-politics*, Nov. 25.
9. PIEMENTEL D., 2008, Biofuels, Solar and Wind as Renewable Energy Systems: Benefits and Risks, Springer.
10. SCARLET N., DALLEMAND J.-F., 2011, Recent developments of biofuels/bioenergy sustainability certification: A global overview, in: *Energy Policy*, vol. 39, p.1630-1646.
11. da SILVA J.G., SERRA G.E., José Roberto MOREIRA J.R., CONCALVES J.C., GOLDEMBERG J., 1978, Energy Balance for Ethyl Alcohol Production from Crops, in: *Science*, vol. 201, no. 4359, p. 903-906.
12. SIMPSON T.W., SHARPLEY A.N., HOWARTH R.W., PAERL H.W., MANKIN K.R., 2008, The New Gold Rush: Fueling Ethanol Production while Protecting Water Quality, in: *Journal of Environmental Quality*, vol. 37, p.318-324.
13. THAILAND Former Orchard in Rangsit Site of Pilot Project for Biodiesel Development, in: *Thai Press Reports*, May 19, 2008, Monday.
14. THAI Province to Promote Sugar Cane for Ethanol Production, in: *Asia Pulse*, May 15, 2006, Monday.
15. WIKIPEDIA, http://en.wikipedia.org/wiki/Pit-tosporum_resiniferum (30.12.2014).

Joseph Kozielecki's Concept of Transgressive Man and the Problems of Sustainable Development

Człowiek transgresyjny w ujęciu Józefa Kozieleckiego a problematyka zrównoważonego rozwoju

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Abstract

In this article the author notes, that the development according to Joseph Kozielecki depends on the fact, that man transcends natural, symbolic, social borders, associated with his own inner world, in order to satisfy own needs. He aims to improve the quality of life, and also tries to preserve the natural environment in possibly best condition. This understanding of the concept of development approaches psychologist's attitude to the idea of sustainable development, which rests on three pillars: environmental, economic and social. One of the most important categories for understanding development and sustainability issues is the value of life, which is endangered by destructive transgressions as destructive actions contributing to the destruction of natural phenomena, and also causing psychopatic changes in the human personality. Sofronic transgressions are designed, *inter alia*, to control actions (prudence, moderation, inner discipline, the ability to find a compromise). To be equal to the value of life a transgressive man must be aware of his own dignity.

Key words: value of dignity, transgression, hubristic need, know thyself, sustainable development

Streszczenie

W artykule autor zauważa, że rozwój w ujęciu Józefa Kozieleckiego polega na tym, iż człowiek przekracza granice naturalne, symboliczne, społeczne, związane z własnym wewnętrznym światem, w celu zaspokojenia potrzeb. Zmierza przez to do poprawy jakości życia, co dokonuje się także przy zachowaniu jak najlepszego stanu środowiska naturalnego. Tak rozumiane pojęcie rozwoju zbliża ujęcie psychologa do idei zrównoważonego rozwoju, który wspiera się na trzech filarach: ekologicznym, ekonomicznym i społecznym. Jedną z ważniejszych kategorii dla zrozumienia rozwoju w ujęciu Kozieleckiego i problematyki zrównoważonego rozwoju, jest wartość życia, którego zagrożenie wywołują transgresje destruktywne jako działania przyczyniające się do zniszczenia zjawisk przyrodniczych, powodując także zmiany psychopatyczne ludzkiej osobowości. Kontroli działań mają służyć między innymi transgresje sofrozyne (roztropność, umiarkowanie, dyscyplina wewnętrzna, umiejętność trzymania się drogi pośredniej). Aby sprostać wartości życia człowiek transgresyjny musi mieć świadomość własnej godności.

Słowa kluczowe: wartość godności, transgresja, potrzeba hubrystyczna, poznanie siebie, rozwój zrównoważony

Introduction

While reading the reflections of Joseph Kozielecki, a psychologist, author of the transgressive concept, we come across the notion of transgressive hubristic needs as the main factor stimulating human development. The intensification of the need indicates the

expansion of the boundaries, finding new, unforeseen possibilities for human development (Kozielecki, 1987). This need is the foundation for cognitive acts leading to the border crossing and may also evolve itself. This trend manifests itself in the forms of emerging new hubristic needs, ie. moving from its competitive form to the individual one: from placing

itself on the scale of social comparisons to evaluate itself through the prism of its own standards and own level of aspiration. These changes may correspond to the specific way of satisfying them through the so-called individualization. Cognitive acts are, apart from the hubristic needs, the foundation of the transgressive man acts. *Homo transgressivus* is disinterestedly and insistently seeking for the truth about the world and the truth about himself. It is impossible to understand the process of self-development without opening up to the truth (Kozielecki, 1995, p. 96). This opening is revealed in the free dialogue between the structures of his mind, and the external world: his constant feature seems to be the ability to adopt the views contrary to his own and the will to respect the facts incompatible with his knowledge, to confront theory with reality. This creates a pretext for an evolutionary understanding of science without claiming that theory, which a *homo transgressivus* laboriously formulates, explains the world. The man neither rejects everything that interferes with scientific progress nor closes himself to the irrational, accidental, even though he knows that it is difficult for science to cover all the unexplained and mysterious phenomena (Tański, 2008).

Analyzing the transgressive man it is hard not to mention the concept of sustainable development as that which satisfies the needs of the present without depriving future generations of possibility to meet their basic needs (WCED, 1987). The concept of sustainable development assumes the high quality of life with the possibility of meeting a variety of needs, which in turn constitutes anthropocentric values. And the high quality of life becomes achievable by preserving the best condition of the natural environment associated with the biocentric values (Skowronski, 2003, p. 32). Sustainable development was formulated in the name of reconciling the ecological, economic and social arguments based on the cultivation of certain values. Ecological values arise from the need to stop degradation of the environment. Economic values, on the other hand, determine the model of meeting the basic material needs of humanity by using techniques that do not violate the condition of the environment. Social values, in contrast, assume the entire spectrum of goods: minimum social security (the liquidation of hunger and poverty), health care, the development of the spiritual realm (culture), security and education (Skowronski, 2003,

p. 28-29). The transgressive man becomes, in the context of that development, a creator of values through the needs realization and overcoming difficulties, but also guarding the fundamental values (rudimentary) such as peace and freedom¹. These values not only protect human society, but also the environment from destructive transgressions arising from the hypertrophy of human forces, which threaten the instrumental transformation of nature. They cause, among others, that man becomes an instrument of his own tools, that is, their thoughtless extension (Kozielecki, 2004, p. 63).

Transgressive man and search for the truth about the world

The mind of the transgressive man seeking for the truth about the world wishes to be disciplined, shaped by experience, by practice, and certain rules of the game that require verification of experiences and observations, and at the same time, reaching for arguments, without stopping at the dogmatic axioms. *Homo transgressivus* in his openness to the truth in exploring the world does not understand science as a sequence of rational, orderly visions. Images with which various sciences try to present reality, are so different and so radically various that it becomes increasingly difficult to get a coherent vision of the world. It is proved by various cognitive paradigms within psychology and other social sciences. For a transgressive man these divergences, however, do not necessarily have to do harm to the process of learning, on the contrary, they can cause certain profit in the form of new knowledge, perhaps deepened by some previously unknown cognitive aspects. The real challenge of science is to create, develop and reproduce a coherent concept of man in the face of the multitude of facts and discoveries provided by the *labeled* science of man.

Thanks to the development of various disciplines and branches of science learning becomes more and more complex, engaging a variety of phenomena and processes. This model of man, due to the opening to science, approaches to the global understanding of reality, however it does not explain it completely. The modern world reminds megasystem, whose components are mutually and repeatedly linked (Kozielecki, 1995, p. 96-97). Hence, the feature of

¹ Leszek Gawor (Gawor, 2006, p. 94-99) in the context of sustainable development distinguishes different types of values: teleological values important to the community, the instrumental and basic values, which are intended to protect against the dangers of human civilization. One could mention another systematization of the world of values. It is namely the division into the absolute and relative (instrumental) values (see. Lipiec, 2000, p. 43-44). The first irreducible to usability, which right there would be over and above the sphere of utility, they bind the rudimentary and intentional values distinguished by Gawor.

Within the different division consistent with the axiology of sustainable development one can distinguish the autotelic and instrumental values, as a means to reach goal (Skowronski, 2003, p. 29-30). A more extensive systematization introduces Papużiński, distinguishing the ideal (constitutive) and practical, connecting with each other. Their discussion, and other systematics a reader will find in his work *Axiology of sustainable development: an attempt typology* (Papużiński, 2013, p. 9-12).

mind open to search for the truth is the ability to recognize phenomena in the holistic perspective, to search for weighty and important content, to the multifaceted cognition, based on the exploration of problems and phenomena from different points of view and positions (Bartoszewski, 2012, 43). It approaches Koziński's view to the idea of sustainable development for which important is an integral thinking based on holistic and systemic understanding of the biosphere and society through their mutual interaction and interdependence. This makes necessary to think global, universal, outgoing from the division of the world into independent parts, which is reflected in the rejection of various forms of nationalism and particularism (Hull, 2003, 19).

The mind of a transgressive man becomes a tool used by society in order to solve the current problems, bringing the vision of the future, much freed from fears and worries. It gives the same opportunity for the implementation of sustainable development favoring communication between people from different cultural backgrounds in terms of improving the current state of their natural environment (Papuziński, 2007, 30). The transgressive man desires to deal with content serving absolute purposes, associated with the truth as a value in itself, as an autotelic good.

Axiology of life, its threat and the idea of sustainable development

Getting to know thyself for this model of man, according to Koziński, is reduced to guide the action, which allows to become who you are (if it is knowledge not only about individual experiences, but also about a shaped form of your own life, expressed in the motifs of your actions), and the central element of these motifs is creating needs and humanistic values. Such a value is the phenomenon of life, about which says, *inter alia*, the *Rio Declaration*² and it is part of the development of a transgressive man, which is done in the name of harmony with oneself and with nature. The value of life supports the trend of development of such a man developing his character, dynamic behaviour, expanding his natural features. This happens not only because of the desire to maintain life, but also to give life sense what is the reason for daily effort, a sense of pride, integrity of the human spirit and body, communion with nature and transcendence, and interpersonal communication (see. Skowronski, 2003, p. 32). The extension of the axio-moral sphere to nature and its non-instrumental relation to man and society, as well as intergroup relations in terms of moral good and evil, is imposing on people responsibility for it, results from the cultivation of the value of life. Good

for sustainable development, but also for the transgressive man, appears as that which promotes life, as each form of life, not only human, is unique (see. Hull, 2003, p. 21). However, the phenomenon of life is endangered by these destructive transgressions, which are actions that are contributing to the destruction of a number of natural phenomena, but are also causing indelible psychopathic changes in human personality. They depend, *inter alia*, on the *destruction of the environment, the use of sophisticated means of violence, even in schools, implementation of anti-humanistic ideologies, such as: <Mein Kampf> or <the principles of Leninism>, <brainwashing> or inhuman methods of social engineering* (Koziński, 2004, p. 62). These are just a few examples of actions directed against man, against society, against environment. The basis of these acts, as Koziński notices, following Erich Fromm's reflection, is destructive aggression (malicious, striking at the very core of life). On the other hand, euthanasia, use of drugs or mutilation of one's body are called by the Polish psychologist self-destructive transgressions. Anxiety may be also raised by technical transgressions, disseminated at an unprecedented scale. The conflict between *hard* efficiency and *soft* ethics can be reduced to the fact that the instrumental transgressions, providing tools for more productive work, become the cause of violation of ethical principles and moral norms determining the source of humanity. Another danger is the nascent *technoelite and technopol, a technocracy, which tries to subordinate all forms of cultural life and spiritual rules to the rules of technique. Its symbol and metaphor has become a computer that brings all natural phenomena to the data files* (Koziński, 2004, p. 224). Technique, depending on usage, can be both ally and enemy, because in itself it is axiologically neutral. In this new, specific thicket of situations created by technique new creative forces certainly appeared and at the same time new dangers appeared which are sometimes difficult to realize.

Knowing thyself and sustainable development

If from axiological point of view, knowledge of the world that surrounds us turns out to be relevant, and the action taken in excess of the limits of the achievements appropriate, it opens up before a transgressive man possibility of becoming himself. This is an important moment in the modern man development according to Koziński's psychological concept. One could say that self-knowledge is ahead of any mature transgressive action directed towards the material social or symbolic world. In turn, the reverse way is possible: if the action is appropriate and proper it leads the man to being himself. More adequate way to being yourself, knowing your own

² The first rule of the preamble of the *Rio Declaration on Environment and Development* states: *Human beings are*

at the center of interest in the process of sustainable development. They have right to a healthy and productive life in harmony with nature (UN, 1992).

qualities and capabilities leads rather through the action appropriate to the situation and place (Węgrzecki, 2007, p. 15-16). This can happen but not by fluke or blind luck, which admittedly can happen, but it would mean that the transgressive man seems to be not the decision-maker, but a passive automaton in the hands of external forces. He would thus rely on blind fate, on what happens to him, sacrificing at the same time an active participation in what is happening within his life. Fate according, for example, a German philosopher Max Scheler, among other things, is *a series, swarm of <events> which, when made, we feel in a pretty special way as <belonging to our qualitative features> even though we were not <looking for> them, <not expecting>, <not choosing> which, taken as a whole show the uniqueness of the life course, as a holistic system, the mark of individuality of a person to whom this process belongs* (Scheler, 1986, p. 299). The category of fate does not determine the proper form of existence. The awareness of human dependence on fate becomes fundamental for the development. This fate shaping and co-shaping becomes essential for the sustainable development education, for which important is the overall balance of happiness in both the individual and social dimension, in order to radically change the situation of man in the world (Papuziński, 2006, p. 30). Man determines his fate not just alone, but also in collaboration with others, producing new goods, transforming and changing environment. Human communities are bonded by the principle of general human solidarity, which seems to follow the basic postulate of sustainable development³. In turn, the universal human solidarity would include a range of activities to the phenomena which neglected in one section may be not to catch up in another.

In the context of action based on the values associated with the cultivation of life and the ensuing knowledge, but also self-knowledge, you would say, therefore, about the ethics of sustainable development. Such an ethics must pave the way to the world of the universal values that are supported on three pillars: environmental, economic and social. Solidarity, exceeding particularistic comfort promotes, among other things: denuclearization, preventing famines, building a demographic balance, and removing threats of epidemic (Kozielecki, 1995, p. 97). Ethics of sustainable development would prepare the transgressive man to resolve fundamental conflicts characteristic of the *global village* in terms of Marshall McLuhan's concept. It would constitute a duty imperative, which would involve putting the blame on man for an existing, comprehensive global moral order. Development arising from such ethical imperatives is not possible to achieve using the ethical jump, which would repeal the importance of fundamental-humanistic values, defining the boundary

of knowledge and exploitation of the environment and society. This development – cultivating the transgressive model of man – could effectively bring humanity on a global scale to participate in broader communities, on the scale of a country or continent, which purpose is to implement the ideas and practices of sustainable development. This type of development provokes the search for positive values of solidarity and mobilizes to go beyond the ethics of small groups (Kozielecki, 2008, p. 47).

Being yourself results sometimes from the accordance of this action with the shaped form of life in which man becomes a transgressive sculptor of himself. It is therefore about the updating of the trends, which have been shaped as socially valuable. Overwhelmingly, however, for the transgressive man being himself means something you strive toward, as previous form of existence is unsatisfactory and treated as inauthentic (cf. Galdowa, 2000). There is need for change, transgression, which would remove the recognized lack or previously unrecognized negative value for the personal, but human development. Self-knowledge turns out to be something irreplaceable: being himself defines some important point of reference to the content of his life, which in his assessment becomes more self or foreign. Being yourself, recognized and accepted, however constantly shaping, provides psychological continuity determined by the biography of the individual.

Self-knowledge for a man according to Kozielecki is made in action, founded on the values and norms rooted in the time of Enlightenment (rationalism, disinterested truth, skepticism, freedom, brotherhood, respect, integrity, autonomy of the individual, individualism), emphasizing not only the rights of an adult, but also, as J. Locke claimed, children's rights, which at that time was a revolutionary concept (Kozielecki, 2008, p. 36). This understanding of cognition participates in something that is to emerge. The design phase of this activity is sometimes accompanied by reflection about the effects of the activity of a man trying to exceed the material, symbolic and social structures and about the direction in which the development will continue. If it was strengthened with the value experience, allowing to capture axiological nature of specific activities, trends that have appeared in man's life, maybe it would be possible to abandon some transgressive activities. Self-cognition present in the reflection concerning the future seems to anticipate what can happen when human action ends – Kozielecki emphasizes. The fact that this kind of knowledge appears in the life of a transgressive man is confirmed by some cases when the action is abandoned or its course, shape or form significantly modified. Modification of the course of action takes place due to this reflection, which can anticipate what would happen

³ We commit ourselves to act together, united by a common determination to save our planet, promote human develop-

ment and achieve universal prosperity and peace (Johannesburg Declaration on Sustainable Development, 2002, paragraph. 35).

if an action was continued unchanged. It fundamentally participates in what could be called guidance, persuading the man to continue of what has already occurred, or abandon a transgressive action, when its value interferes with typically human values.

The control of man's own actions should be supported by sofronic transgressions. They represent a collection of internal attributes (*Sophrosyne*), which were sought by educated Ancient Greeks. The author of the transgressive concept follows, therefore, the Ancients in his search for ethical reflection. These attributes include: prudence, moderation, internal discipline, the ability to find a middle path (Kozielecki 2001, p. 59). The struggle to maintain balance, and human concern for a certain order of things related to compliance with the proper measure, refer to the idea of sustainable development. Exceeding the measure proper to each individual contributes to the danger of life of an individual or community, it can also be dangerous to the tendency of self-preservation of the species. From the maxim *nothing beyond measure*, expressing the nature of the sofronic transgression, some scholars derive the Delphic maxim *Know thyself* (Dembińska-Siury, 1991, p. 41). Moderation as a value falling within the concept of sustainable development is essential in the socio-economic area. Failure to keep the maxim *nothing beyond measure* leads to the attitude of excessive consumerism, well visible in directing the process of production to satisfy the marketing generated needs. The value of moderation, however, should not be reduced to raw asceticism, but to the rationalization of consumer needs, which alien become a waste and extravagance (Gawor, 2006, p. 100).

Conclusion

Homo transgressivus, making acts of expanding the boundaries of his knowledge, becomes independent of the whims of public opinion, the requirements posed by his immediate environment, the instructions of the intellectual and administrative elite (Kozielecki 2001, p. 156). The question which therefore arises is whether a transgressive man is guided only by individualism, the desire to meet his own needs (especially related to the strengthening of self-esteem, that is *strengthening own ego*), where he becomes himself *his own rudder and the ship* or the spiritual values, such as dignity, responsibility, autonomy (freedom) help him to expand to the world? Are, therefore, the higher order values the foundation? Do the transgressive acts derive primarily from permanent efforts to confirm and increase self-esteem, or from such values as solidarity and dedication, friendship and brotherhood, help and emotional ties, the struggle with suffering and exploitation? The rich literature on transgressive man is not entirely clear, and does not always give a clear answer. Kozielecki's monograph *On Dignity* paints a picture of man, whose activity is by no means a tool for

achieving selfish ends related, *inter alia*, with the confirmation of self-esteem, but it comes from a sense of solidarity and willingness to help others. To be able to evolve, the man must be guided by the belief in his own dignity. Without this faith a transgressive man could not face adversity, would not be prepared for failure and existential shocks. Hence, in order to fight (to be resistant to stress that life brings), he must be aware of his own dignity, in defense of which the struggle inscribed into active participation in the vortex of everyday life goes on. One could define this *human dignity* as a value dominant above all goals. This value is important for the purpose of sustainable development, as Leszek Gawor states (Gawor, 2006, p. 95). Moreover, as an ideal it would have separate position and would be common, even fundamental, to the whole axiology of sustainability development (Papuziński, 2013, p. 10). At this point Kozielecki's approach would coincide with the axiology of sustainable development. When there is a lack of dignity, the processes of depersonalization appear; a man according to the psychologist becomes a sad puppet, controlled by the external forces which is no longer able to understand, and his life becomes colorless, which leads to a loss of the sense of existence. Depersonalization becomes visible also in the phenomenon of loss of self-esteem and a loss of self-will (May, 1978).

References

1. BARTOSZEWSKI J., 2012, *Człowiek XXI wieku. Recepcja kartezjańskiej filozofii przyrody*, WSHE Sieradz, Kraków.
2. DEMBIŃSKA-SIURY D., 1991, *Człowiek odkrywa człowieka. O początkach greckiej refleksji moralnej*, Wiedza Powszechna, Warszawa.
3. GAWOR L., 2006, Idea zrównoważonego rozwoju jako projekt nowej ogólnoludzkiej cywilizacji, in: *Diametros* vol. 9, p. 84-104.
4. GAŁDOWA A., 2000, *Powszechność i wyjątek, Rozwój osobowości człowieka dorosłego*, UJ, Kraków.
5. HULL Z., 2003, Filozofia zrównoważonego rozwoju, in: *Filozoficzne i społeczne uwarunkowania zrównoważonego rozwoju*, ed. Pawłowski A., Politechnika Lubelska, Lublin p. 15-27.
6. KOZIELECKI J., 1987, *Koncepcja transgresyjna człowieka. Analiza psychologiczna*, PWN, Warszawa.
7. KOZIELECKI J., 1995, *Koniec wieku nieodpowiedzialności*, Jacek Santorski & CO, Warszawa.
8. KOZIELECKI J., 2008, *Psycholog w wielkim świecie. Szkice o sprawach ludzkich*, Żak, Warszawa.
9. KOZIELECKI J., 1977, *O godności człowieka*, Czytelnik, Warszawa.

10. KOZIELCKI J., 2001, *Psychotransgresjonizm*, Wydawnictwo Akademickie „Żak”, Warszawa.
11. KOZIELECKI J., 2004, *Spółeczeństwo transgresyjne. Szansa i ryzyko*, Wydawnictwo Akademickie „Żak”, Warszawa.
12. LIPIEC J., 2001, *Świat wartości. Wprowadzenie do aksjologii*, Fall, Kraków.
13. MAY R., 1978, *Miłość i wola*, PIW, Warszawa.
14. PAPUZIŃSKI A., 2006, Filozoficzne aspekty zrównoważonego rozwoju, in: *Problemy Ekorozwoju/Problems of Sustainable Development*, vol. 1, no 2, p. 25-32.
15. PAPUZIŃSKI A., 2013, The Axiology of Sustainable Development: An Attempt at Typologization, in: *Problemy Ekorozwoju/Problems of Sustainable Development*, vol. 8, no 1, p. 5-25.
16. SKOWROŃSKI A., 2003, Wartości ekologiczne dla zrównoważonego rozwoju, in: *Filozoficzne i społeczne uwarunkowania zrównoważonego rozwoju*, ed. Pawłowski A., Politechnika Lubelska, Lublin, p. 27-41.
17. TAŃSKI M., 2008, O racjonalności i irracjonalności myślenia transgresyjnego, in: *Zagadnienia Naukoznawstwa*, 2008, vol. 3-4, p. 451-458.
18. WĘGRZECKI A., 2007, *Poznanie siebie a rozwój podmiotu osobowego* in: *Egzystencjalne i aksjologiczne wymiary prawdy, piękna, dobra*, eds. Gazda J., Moszczyński W., Księgarnia Akademicka, Kraków, p. 11-19.

A Process Model of Building Sustainable Competitive Advantage for Multinational Enterprises: An Empirical Case Study

Model procesu budowania zrównoważonej przewagi konkurencyjnej dla przedsiębiorstw międzynarodowych: studium przypadku

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Abstract

Multinational enterprises (MNEs) are the leading entities in the process of global economic integration, whose international expansion would be regulated and constrained by environmental issues. Drawing on theories of corporate social responsibility, corporate environmental behavior and legitimacy, this paper establishes a grounded process model that has both theoretical and practical significance. The model reveals that development of sustainable competitive advantage of MNEs is a gradual process that is dependent on the corporate environmental behavior and the legitimation of their behaviors. Via a real in-depth case study of Badische Anilin-Soda-Fabrik (BASF), one of the largest chemical companies in the world, the application and effectiveness of the proposed process model are demonstrated. Also, implications of this model and future directions for both research and practice are indicated.

Key words: multinational enterprises (MNEs), corporate social responsibility; corporate environmental behavior, corporate legitimacy, sustainable development

Streszczenie

Przedsiębiorstwa międzynarodowe stanowią wiodące podmioty w procesie globalnej integracji gospodarczej, których ekspansja międzynarodowa powinna uwzględniać regulacje i ograniczenia związane z ochroną środowiska. Niniejszy artykuł, opierając się na teorii społecznej odpowiedzialności biznesu, jego wpływowi na środowisko i legalności działania, przedstawia model istotny zarówno z poziomu teorii, jak i praktyki. Model ten pokazuje, że budowanie zrównoważonej przewagi konkurencyjnej przedsiębiorstw międzynarodowych jest procesem stopniowym, zależnym od podejścia do środowiska. Zastosowanie i skuteczność proponowanego modelu wykazano na

przykładzie jednego z największych zakładów chemicznych na świecie, którym jest Badische Anilin-Soda-Fabrik (BASF). Zaproponowano także przyszłe kierunki badań, tak w kontekście naukowym, jak i praktycznym.

Słowa kluczowe: przedsiębiorstwa międzynarodowe, społeczna odpowiedzialność biznesu, wpływ biznesu na środowisko, legalność biznesu, rozwój zrównoważony

1. Introduction

Global issues, such as climate change, global warming, poverty and biodiversity loss, increasingly impact our daily life. Nowadays environmental protection is a critical issue for firms throughout the world in the continuous pursuit of sustainable development in a long run. Confronted with increasing constraints of natural resources and the new situation of universal advocating low carbon economy, firms are required to comply with the global economic integration and sustainable development and to establish unique firm-specific advantages (Kolk and Pinkse, 2008). Sustainable development has twofold meanings. First, it applies to the firm level strategies. If a firm can strive to keep superior long-run business performance in the fierce marketplace with inimitable, durable and non-substitutable organization structure, strategies of the firm is sustainable (Oliver, 1997; Teece, 2007). On the worldwide level, sustainable development is equal to World Commission on Environment and Development's (WCED) definition, i.e., *development that meets the needs of the present without compromising the abilities of future generations to meet their own needs* (WCED, 1987). The objective of sustainable development is to improve the quality of life of ourselves and our offspring on a global scale (Wołczek, 2014).

Firms are required urgently to contribute to a sustainable development both on the firm and worldwide level, which applies most notably to multinational enterprises (MNEs), given their global production, resources exploitation, sophisticated technologies and thus their global influences to the world (Kolk and van Tulder, 2010). MNEs should respond to pressures for global integration and local responsiveness with respect to corporate social responsibility (CSR) issues, especially environmental issues in order to obtain local legitimacy in their internationalization process, which combines the global and local resources and capabilities for development. Environmental regulations from both home and host countries as well as consumers' demand, require MNEs to take appropriate response to environmental issues. MNEs are expected to not only take advantage of the local resources and opportunities, but also take the position of leading the world technological development by exporting to or spilling their technology ownership advantage over local firms to help in enhancing the local companies' capabilities in clear technologies. In order to manage the legitimacy in the host market while achieving better consequences of financial benefits and sustainable competitive advantage, alternative behaviors should be considered.

Although there is no consensus on the relationship between MNEs' expansion and the increasing environmental pollution, it is widely accepted that taking corporate social responsibility, including environmental responsibility, will help in keep corporate reputation, and support the sustainable development in the long run. Therefore, it is critical to identify the mechanism underlying the MNEs' environmental strategies and their sustainable development. The objective of this study is to build a general model of how to build sustainable competitive advantage in host countries through legitimacy for MNEs. Our research questions are why we need to pay special attention to the MNEs' social responsibility and how MNEs can establish its sustainable competitive advantage through taking CSR and obtaining legitimacy.

In this paper, we argue that as the leaders in the global economic integration process, MNEs are expected to take the most important role of leading the technological development of clear production, energy conservation and emission reduction and green management in the worldwide. Further, we argue that both home and host countries' environmental regulations and stakeholders' pressure as well as the chief executive officers' (CEO) personal belief would have enduring effects on MNEs' environmental behaviors. Through the positive effect on the firms' legitimacy, MNEs are more likely to build up their sustainable competitive advantage over the long term. In other words, the MNEs, which focus on the firms' strategic coevolution with natural environment and expressing their commitment to natural environment, will be considered more legitimate than those only focusing on financial benefits. Thus, the sustainable competitive advantage would be established consequentially.

The rest of this paper is organized as follows. Section 2 gives a brief review about the MNEs and the obligations of taking CSR in the global environments. The basic concepts of corporate environmental behaviors and its triple-dimensions as well as influencing factors are presented in section 3. The definition of corporate legitimacy and its discriminative three dimensions with typical examples of MNEs are recognized in section 4. In section 5, a process model of building sustainable competitive advantage for MNEs based on internal behavior and external legitimacy is developed. Finally, an illustrative case is given in section six to show the effectiveness of the proposed model and some conclusions and future research directions are provided in section 7.

2. MNEs' corporate social responsibility

2.1 Why MNEs?

Critics assert that globalization of MNEs harms the host countries as it allows re-location of polluting industries in host markets, especially emerging markets. on the contrary, it is also the case that globalization of MNEs increase the self-regulation pressures on firms in host countries with lower level of environmental regulations via global ties (e.g., Christmann and Taylor, 2001) and technological spillovers. Nevertheless, it is widely accepted that MNEs and their products are the enduring important sources for domestic firms to improve the efficiency and competitiveness in the global markets (Chen and Chung, 2014). Compared to traditional companies, MNEs own more sophisticated technology of energy conservation and emission reduction and environmental management systems, whose strong innovative capabilities can always distinguish them from others. Due to their ownership advantage, as argued in the Dunning's ownership-location-internalization (OLI) eclectic paradigm (Dunning, 2001), MNEs can transfer their innovative capabilities from parent companies to the foreign subsidiaries in the host markets. Thus, they would be able to continue their research and development activities and exploit their parent company's research and development (R&D) capabilities and management technology.

There are three remarkable reasons why MNEs should take certain environmental responsibilities in a worldwide are as follows. First, MNEs usually dominates the heavy pollution industries, such as chemicals, petroleum, biopharmaceuticals and other related manufacturing industries, which contaminate the environments heavily. Second, MNEs are usually involved in the institutionalization of international environmental initiatives and standards, like ISO 14001, and they are required to make greater commitment in the compliance with these policies and standards (e.g., Bansal and Hunter, 2003; Delmas, 2001). Finally, as the major actors in the process of global economic integration, MNEs are required to produce output of their key capabilities and also diffuse their advanced environmental practices to their production operations dispersed around the world, or even to local firms in host markets with spillover effects (Rugman and Verbeke, 1998a; Tian, 2007; Wei and Liu, 2006) in order to establish their sustainable competitive advantage for global expansion.

2.2 MNEs' corporate social responsibility

The consumers' increasing demand for environmental protection will inevitably increase the pressure for firms to corporate social responsibility (CSR) regarding to environmentally friendly production and service. In the welfare economics perspective, CSR is defined as the firm's obligation to respond to the externalities created by market action (Costa and Menichini, 2013). MNEs' CSR is highlighted to re-

flect the ever changing public attitudes about their social obligations (Luo, 2006), as they are considered as playing a specific role given their global influence and activities both in home and host countries (Kolk and van Tulder, 2010).

However, MNEs can be social responsible and irresponsible (Strike et al., 2006). There are two streams regarding to the relationship between MNE's international diversification and their social responsibility. Pessimists believe that MNEs are in the pursuit of lax social and environmental standards in foreign markets, especially in emerging markets (Low and Yeats, 1992). Global diversification allows location of polluting industries in countries with lower environmental regulations (Christmann and Taylor, 2001). Optimists argue that MNEs would transfer their best practice of clear production technology in energy conservation and emission reduction and environmental management across geographic boundaries (Bansal and Roth, 2000; Christmann, 2004), which helps in improving the local firms' environmental technology and management, as well as the environmental standards.

MNEs can get sufficient accesses to resources and markets via business expansion into foreign countries, including relatively lower cost labor, preferential policy from local government, and exploitation of natural resources in the host markets. However, values can be created only if MNEs' goods, service or their activities are able to provide extra benefits and contribute to the quality of life, knowledge, and safety of firm's stakeholder (Haksever et al., 2004) and the business returns from CSR depend heavily on how stakeholders perceive the company CSR commitment (Costa and Menichini, 2013).

It has been argued that MNEs have been pushed toward higher levels of CSR due to global and institutional pressures (Sharfman et al., 2004). Many researchers focus on the impacts of MNEs on the natural environment, as a lot of MNEs dominate pollution-intensive industries and they seek for the off-shore pollution havens which generate significant cost-related benefits (Rugman and Verbeke, 1998b). MNEs' environmental responsibilities are related to various factors, including host-county government regulations, peer monitoring, media attention and local consumers' preferences for environmentally friendly products.

3. Corporate environmental behavior and the influencing factors

3.1 Definition of corporate environmental behavior

Environmental behaviors apply to individual and corporate level separately. Yet, there is no consensus of the definition of corporate environmental behavior. For example, Sarkar (2008) defined corporate environmental behavior as *the set of strategies deployed by a firm to manage its business-environment interface, whether as a response to external pres-*

asures or as a proactive measure to mitigate its environmental impact. Pro-environmental behavior refers to behavior that harms the environment as little as possible, or even benefits the environment (Steg and Vlek, 2009, p. 309). The pro-environmental behavior of the individual level includes behaviors of *segregating waste, buying health food, avoiding buying certain products, reducing exhaust gas emission, saving energy and water* (Rydzewski, 2013, p. 130). Bansal (2005) defined corporate environmental management as *an effort by firms to reduce the size of their ecological footprint*. Among these previous literature, similar concepts like corporate environmental management, corporate environmental behavior, pro-environmental behavior or corporate green behavior appear to be the similar connotation. Therefore, in this paper, we adopt all these related concepts for corporate environmental behavior (CEB) and we will focus on the corporate level environmental behavior.

3.2 The triple-dimensions of CEB

There are various taxonomies developed to describe corporate environmental management, from the most reactive postures to the most proactive ones (Aragón-Correa, 1998). Similarly, CEB can be divided into different dimensions according to the firms' responsiveness. Aragón-Correa and Sharma (2003) and Moon (2008) argued that CEB has two distinguished responsive features, i.e., proactive or reactive. From coercive to proactive responsiveness, three dimensions of defensive, preventive and enthusiastic CEB are defined in Liu's (2009) study on the relationship between external environmental pressure on firms and their environmental behavior of 321 sample firms in the Yangtze River Delta of China.

In this study, we will follow Liu's methods in defining the triple-dimensions of CEB (see Figure 1). Defensive CEB refers to behaviors of abiding the coercive environmental regulations and policies. Without the external fines or penalties on environmental pollutions, firms will not go beyond the economic performance. Defensive CEB includes ignore environmental requirements of suppliers, purchase environmentally sensitive products, no special environmental department, no cleaner production auditing, waste disposal at a venture, or excessive use of natural resource.

Preventive CEB points to the firms' behavior that they seek to forecast the future environmental regulations and conduct internal detection and evaluation on their environmental effects in order to avoid environmental accidents. Preventive CEB can be exhibited as purchase environmental-friendly raw materials, achieved ISO 14000 authentication, established environmental management system, reduce emissions, meet environmental requirements of its suppliers, and recycle its byproduct.

Enthusiastic CEB suggests a strong linkage between the environmental protection and corporate competitive advantage. The firms taking enthusiastic CEB are in sake of ecological responsibility and will first adopt clear production technology and promote the philosophy of energy conservation and emission reduction in the industry. Enthusiastic CEB can be priority purchase environmental-friendly raw materials, provide environmental training to employees, have environmental protection devotion, environmental cooperation with its suppliers or conduct resource-saving technical innovations.

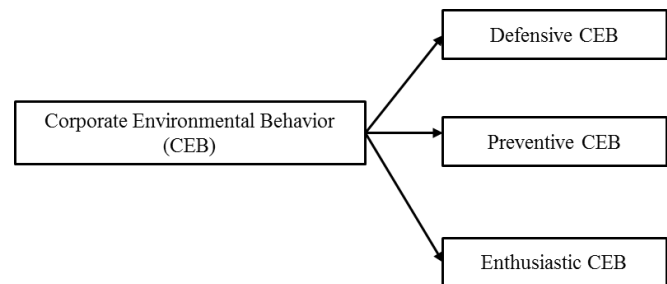


Figure 1. Triple-dimensions of corporate environmental behavior

3.3 Influencing factors of CEB

There are various factors influencing the firms' willingness to participate environmental programs voluntarily and driving the firms to take environmental behaviors. We classify the factors into external and internal (Claver et al., 2007). External drivers include environmental regulations and stakeholders' demands (we focus on the immediate consumers' demands) and internal factors include corporate strategy and CEO's personal belief (see Figure 2).

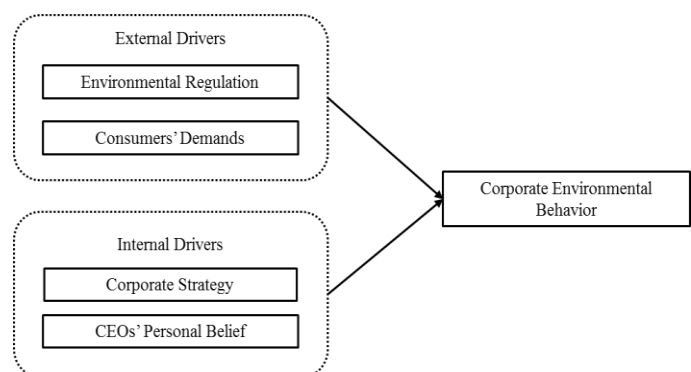


Figure 2. A preliminary model of influencing factors of CEB

External environmental regulations and corporate stakeholders' demands would affect the company's certain routine operations via formal norms and informal pressure. As the companies run in the real world with constant changing of customer needs, technologies and processes, a dynamic view of external factors should be adopted. It is suggested that properly designed environmental regulations can trigger innovative solutions to environmental issues

(e.g., Delmas et al., 2007; Lee et al., 2014; Porter and van der Linde, 1995) and unique organizational capabilities (Sharma and Vredenburg, 1998). For example, in order to comply with new regulations to reduce solvent emissions by 90 percent, 3M Corporation was forced to find a way to avoid the use of solvents altogether by coating products with safer, water-based solutions, and thus benefited in production efficiency (Porter and van der Linde, 1995; Shrivastava, 1995a).

Internal drivers of CEB are always related to the organizational and the managers' features. Some organizations are born to be environmentally responsible firms because of the founders' personal belief. This kind of firms can be called ethically motivated firms (Bansal and Roth, 2000). The founders' and top management teams' beliefs and corporate values are the key instruments in driving the firms to take appropriate corporate environmental behaviors.

Bansal (2005) pointed out that institutional theory is related to corporate sustainable development for three reasons. Firstly, an organization's commitment to sustainable development is judged on personal belief and value system, which impact the public's degree of acceptance and perception of legitimacy of the organization (Bansal and Roth, 2000). Secondly, participants of differentiate views of sustainable development will build norms and common beliefs. Finally, the components of sustainable development are institutionalized in the process of regulation and internationalization. MNEs are more likely to manage their environmental strategies and CSRs according to the institutional pressures rather than a strategic logic (Husted and Allen, 2006).

Among the previous literature on the sustainable development and competitive advantage, most of them either only take internal resources into consideration, or merely take institutional factors into account (Bansal, 2005; Oliver, 1997). There is a lacking of literature integrating both. Therefore, in the next section, we draw on the institutional theory, i.e., legitimacy, to argue about the formulation mechanism of MNEs' sustainable competitive advantage on the basis of their environmental strategies and corresponding environmental behaviors.

4. Legitimacy

4.1 Definition and dimensions of legitimacy

Past decades have witnessed increased interest in institutions (Kolk and van Tulder, 2010), such as an institution-based view of international business (IB) strategy (Peng et al., 2008), and the co-evolution of MNEs and the institutional environment (Cantwell et al., 2010). Institutional theory emphasizes the social environment where firms operate. A central concept in institutional theory is legitimacy (Peng and Beamish, 2007). From the perspective of institu-

tional theory, legitimacy is the organization's approach of obtaining and maintaining resources (Oliver, 1991), which is the objective behind the congruence of organizational and stakeholders' expectations (DiMaggio and Powell, 1983; Meyer and Rowan, 1977; Suchman, 1995).

There is no consensus about the definition of legitimacy in the academia. It is described by Dowling and Pfeffer as *a condition or status which exists when an entity's value system is congruent with the value system of a larger social system of which the entity is a part* (Dowling and Pfeffer, 1975, p. 122), where it highlights the cultural conformity between the organizations and social values. Kaplan and Ruland (1991) assigned legitimacy as a process of obtaining recognition of the community. Aldrich and Fiol (1994) argued about two types of legitimacy, i.e., cognitive and sociopolitical legitimacy confronted by entrepreneurs in emerging industries.

In this paper, we adopt the most acceptable definition of legitimacy proposed by Suchman (1995). It is defined as *a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions* (Suchman, 1995, p. 574).

4.2 Dimensions of legitimacy and MNEs

In Suchman's (1995) study, three types of legitimacy are recognized: pragmatic legitimacy, moral legitimacy, and cognitive legitimacy with a generalized assumption of this definition. In this section, we will dilate on the signification of three dimensions of legitimacy and provide examples of MNEs.

Pragmatic legitimacy points to the self-interested calculations of the most immediate audiences' preferences. Organizational activities affect the interest of the audiences, their choices and thus the organizational financial benefits. There exists exchange relationship between the organization and audiences. No matter the products or service is good or bad to the environment, audiences would provide support to MNEs as long as they are paid back with interest of themselves. MNEs are perceived as legitimate when the audiences' self-interests are satisfied via any kind of approach of MNEs. For example, in early 1990s, OJI Paper Co., Ltd, a Japanese papermaking company, entered Chinese markets and set up its own subsidiaries for manufacturing. At that time, the environmental pollution issue was not serious enough to get attention from the host governments, which emphasized economic development over everything. OJI's entrance enhanced the local production and GDP, and provided employment opportunities to the native labors, thus it was conferred pragmatic legitimacy and paid with great financial revenue without clear technologies being considered.

Moral legitimacy results from the audiences' normative evaluation or judgment of whether the company does a right thing in the local markets. Audiences'

evaluations of the consequences, procedures, structures and leaders' charisma comprise the four sub-dimensions of moral legitimacy (Suchman, 1995). In this regard, local consumers start to concern about the normative contributions of the firms and the firms' routine procedures are always criticized on their impacts to the environment. At the initial stage, MNEs' products are popular with the local customers, owing to their country of origin (Bilkey and Nes, 1982), which has a considerable influence on the quality perceptions of the technology or products (e.g., Ramachandran and Pant, 2010). However, with increasing consciousness of their own health and surrounding environment quality, local customers become nitpicking and tend to prefer green products and service that are friendly to the environment, not just so-called *foreign goods*. For example, British Petroleum (BP), a global MNE, makes clear the organization's responsibility to detect and respond effectively to local needs and its compliance with the local law and regulations: *We will respect the law in the countries and communities in which we operate. This will include competition and antitrust laws and the Foreign and Corrupt Practices Act. Where the law is unclear or conflicting, we will take expert advice and always seek to act in accordance with these communities* (Logsdon and Wood, 2005, p. 61).

Cognitive legitimacy is based on the audiences' cognition about the firms' behavior, with positive, negative or no evaluation, which is based on comprehensibility and taken-for-grantedness. Cognitive legitimacy suggests the coherence between organizational behavior of the firms with social culture and value system. Bansal and Roth (2000) argued that companies should not only comply with formal environmental regulations, but also with informal environmental regulations, like cultural regulations. For example, Dupont Corporation has always been considered as the leader of chemical industry by the local governments and environmental protection organizations in China. Its cognitive legitimacy lies in that it always incorporates the social culture and preferences into its strategies to formulate the industrial standards.

Actually, pragmatic, moral and cognitive legitimacy are not independent from each other but co-exist for most of the companies in real life. For a firms moving from pragmatic legitimacy to moral to cognitive legitimacy, it becomes more and more difficult to attain and maintain, and in return it's not easy for others to imitate (Suchman, 1995). Once cognitive legitimacy is obtained, the company is building up its unique core competence and competitive advantage (Prahalad and Hamel, 1990).

MNEs' worldwide operations are not only strategic but also institutional. By distinguishing global from local CSR, Husted and Allen (2006) suggested that MNEs are affected by institutional pressures for integration and responsiveness from their immediate

stakeholders to conduct their decision-making process with respect to CSR. Legitimacy arising from institutional theory provides a fresh perspective and insights into the MNEs' building sustainable competitive advantage.

Customers perceive MNEs with legitimate organizational behaviors as more worthy, meaningful, predictable and more trustworthy (Suchman, 1995), and in a long run, they would like to pay more for the responsible products and service, which are expected to be the standardized ones in the markets. Customers would prefer the certain product or service of this kind of legitimate MNEs, or even only buy the product or services designed in this way. Therefore, MNEs achieve their cognitive legitimacy among the customers, which is taken-for-granted, i.e., they are supposed to be the common standard.

5. A process model of sustainable development for MNEs

Traditional resource-based view (RBV) theory sees a corporate as a bundle of resources and capabilities (Barney, 1991; Fahy, 2002; Wernerfelt, 1984), but overlooks the capabilities required by the ever changing environment (Eisenhardt and Martin, 2000; Oliver, 1997; Teece et al., 1997). Firms cannot always expect rent-seeking by merely owning and controlling resources in the host markets. Dynamic capabilities approach is an extension of the RBV theory to explain how a firm can develop their distinctive capabilities to adapt to and even capitalize on the changing environment (Montealegre, 2002; Teece et al., 1997). MNEs should look at the impact of their business on the environment, societies and the economies where they operate. Host country environment constrains but also provides with opportunities for further development.

In this way, dynamic perspective suggests a sequential approach for establishing a process model of building up the sustainable competitive advantage. In this section, we propose a grounded process model of how MNEs establish their sustainable competitive advantage via legitimacy in the host countries. The process model can be divided into four phases, starting from the corporate strategy making, then focusing on implementing the strategy, institutionalizing the strategy, and finally obtaining their consequences of building sustainable competitive advantage as well as financial benefits (see Figure 3).

One thing should be noted that corporate environmental behaviors and the corporate legitimacy are changing over time to keep coherent with the host country surroundings. Therefore, flexible and dynamic resources and capabilities are premise and foundation during the whole process of achieving legitimacy and sustainable competitive advantage subsequently.

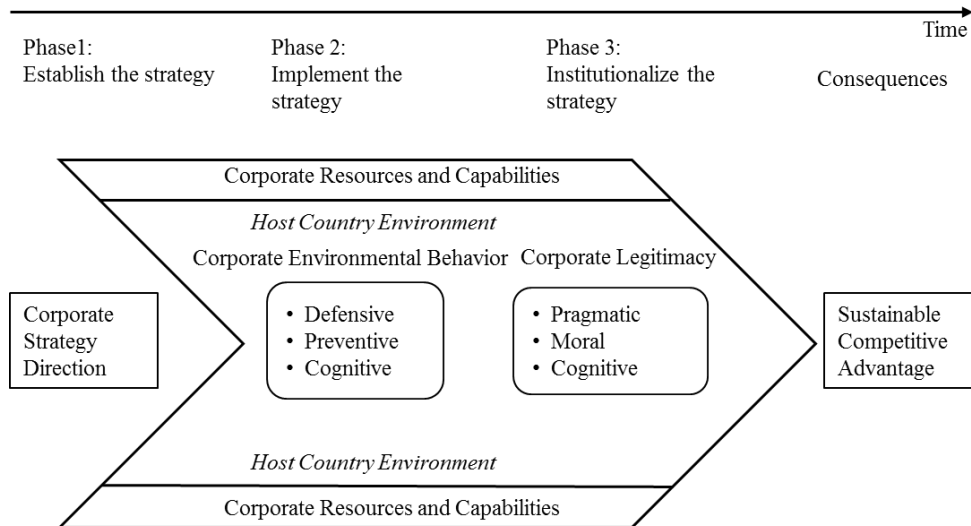


Figure 3. Process model of building sustainable competitive advantage for MNEs

5.1 Phase 1: Establishing the corporate strategy direction

MNEs expand their business all over the world with certain corporate objectives. Three basic types of motivation for ecological responsiveness are recognized, i.e., competitiveness, legitimation and ecological responsibility (Bansal and Roth, 2000). No matter for economic opportunities or just CEO's personal belief, corporate strategy direction is set first before any behavior or action could be taken further.

5.2 Phase 2: Implement the strategy

Given the corporate strategy direction, MNEs should implement the corporate strategy in this stage, taking defensive, preventive or cognitive environmental behaviors according to the strategy. Take ISO 14001 authentication for example, Delmas (2001) suggested that a firm's external stakeholders' involvement into the process of ISO 14001 standard will help in establishing a valuable organization capability. Moreover, ISO 14001 certification can be the best way of pursuing competitive advantage (Orsato, 2006), as it signals to the stakeholders of the organization's change in strategic positioning (Bansal and Hunter, 2003). It is found that firms of early adoption of ISO 14001 would have considerable environmental legitimacy (Bansal and Hunter, 2003).

5.3 Phase 3: Institutionalize the strategy

In this stage, on the basis of corporate environmental behaviors, the firms can obtain their pragmatic, moral, cognitive legitimacy or total. From the perspective of easiness of obtaining and maintaining, pragmatic legitimacy is considered the easiest to obtain and maintain, following moral and finally cognitive legitimacy, which is the most difficult level to obtain. MNEs satisfying the local market demands and preferences can own pragmatic legitimacy, whereas, it's not the case for moral and cognitive legitimacy as these two dimensions are more related to

cultural issues and local backgrounds (Suchman, 1995). For example, a firm obtains cognitive legitimacy as it is deeply familiar to and is accepted by the public audiences. Its product or service is the first thought of public audiences. However, this firm does not necessarily obtain moral legitimacy at the same time probably because the product or service it provides is not suitable for juveniles, such as alcohol. There are twofold benefits of achieve legitimacy for MNEs, i.e., strategic and institutional. Strategic legitimacy helps MNEs mobilize resources to garner societal support and hence increase the financial benefits. On the basis of strategic legitimacy, MNEs are supposed to be institutionally legitimate as their ownership advantage in environmental technology and management systems should be diffused beyond their own boundaries to the local firms in the host markets for maintaining social sustainable development. As the leading actors in the process of global economic integration, MNEs are the most financially beneficial owners and the contributors at the same time due to their ownership advantage according to Dunning's OLI paradigm. Institutionally legitimacy generates responsible sense of environmental pressure to take appropriate environmental behaviors. Their practices are more likely to become the first standard of the industry.

5.4 Phase 4: Consequences

Organizations that appear desirable, proper, or appropriate are most likely to be supplied with resources. Bansal and Clelland (2004) argued that environmentally legitimate firms are confronted with less risk in the stock market than illegitimate firms. When the firms' performance with respect to the natural environment conforms to the stakeholder's expectations, the firms would earn environmental legitimacy. In this stage, legitimacy can help MNEs to earn a *license to operate appropriately* (Parsons et al., 2014) in host markets. Thus, sustainable compet-

itive advantage in terms of enduring financial revenue, technological innovation, new products and services with local customers' demands incorporated is well established. MNEs benefit from ecological efficiencies by reducing cost of waste disposal, capturing the emerging green markets with first-mover advantage and improving the social image via better legitimacy obtained from the community (Shrivastava, 1995b).

Nonetheless, it does not mean that MNEs can rest on the final sustainable competitive advantage. The process would evolve to the next cycle of the companies, starting with establish a new corporate strategy and directions for future implementation in the ever changing host environments. What's more, the companies' strategies and level of legitimacy keep changing over time due to their involvement in environmental protection. With the dynamic evolution in local regulations, customers' preference and even technologies change, the sustainable competitive advantage of MNEs would not keep constant permanently. Then the process will evolve into a new cycle of achieving new sustainable competitive advantage. In the initial stage of expansion, consumers might be just curious about the new products or services provided by MNEs, which they have not encountered in the home country. With their consciousness changes, they are not happy with what they have already experienced, thus they desire for higher level of environmental responsibility for the MNEs.

6. Empirical case study

6.1 Overview of BASF

Given MNEs' global influences to the world and their dominate positions in the heavy industry, in this section, we will apply the proposed process model in previous part to the case of Badische Anilin-Soda-Fabrik (BASF), a Germany chemical company founded in 1865. Specifically, we focus on the evolution of the sustainable competitive advantages enjoyed by BASF in relation to corporate legitimacy, which was obtained via appropriate corporate environmental strategies and behaviors in China. China is the leading emerging economy, which desires for clear technology and mature green management practice spillover from MNEs of high sophisticated technologies. Moreover, Chinese government endeavors great effort in improving environmental quality and exerts strong regulations on industrial pollutions. In the context of China, BASF is confronted by both of home and host environmental constraints.

The information for this case study is all from company annual reports and documents, published descriptions of its environmental technologies, management system and programs, and any related things available from the company website. It should be pointed out that despite of the positive description

of BASF in this proposed process model, the company is by no means perfect on all environmental issues (Shrivastava, 1995a). Along with each stage production process, environmental burdens are certainly generated. Moreover, as the data sources are nearly all from the company's self-descriptions, we cannot guarantee the materials without bias due to self-evaluation problems. Yet, BASF is leading the environmental technologies and even visions in the domain of chemistry and other related and it has achieved competitive advantage in some degree.

BASF is the largest investing company of chemical industry in Greater China district. The cooperation between BASF and China should date back to the year of 1885, when BASF mainly sold textile dye in the cotton market. In the year of 2013, BASF had sales revenue amounting to EUR 74 billion and it had 112,206 employees all over the world, among which the Greater China market contributed by EUR 5.48 billion and 7,606 employees. Table 1 shows a 5-year summary of BASF's financial data.

Table 1. BASF's 5-year financial performance ^a

Year	Sales	EBIT	No. of Employees	R&D	EPS
2013	73.973	7.273	112,206	1.835	5.27
2012	78.729	8.976	113,262	1.732	5.31
2011	73.497	8.586	111,411	1.605	6.74
2010	63.873	7.761	109,140	1.492	4.96
2009	50.693	3.677	104,779	1.398	1.54

^a Sales, EBIT and R&D in billions of Euros; EBIT refers to earnings before interest and taxes; EPS refers to earnings per share in Euros.

6.2 BASF's CSR programs and CEBs

As a globally operating company, BASF is always confronted by different legal systems and cultural conditions in different host countries, which requires it to continuously comply with the local and global environmental regulations and norms. BASF's strategic rules include *leading the sustainable development solutions*. It is stated explicitly in its annual reports that *the fundamental requirement for the BASF organizational activities are in the sense of sustainable development*. In Dr. Kurt Bock's view, the Chairman of the Board of Executive Directors BASF, *sustainability means aligning economic success with environmental and social responsibility. This will ensure our long-term business success*.

BASF has a wide range of product portfolio, consisting of chemicals, functional materials and solution, agricultural solutions and oil and gas, etc. It invests heavily in R&D in environmental protection and clear production technologies. Investment in environmental protection is 325 million Euros and 268 million Euros in 2013 and 2012 separately. In the product diversification and environmental changes, continuous innovation development and adoption of new technologies are ongoing. R&D expenditure in

innovation in the past 5 years increased from 1.398 billion Euros to 1.835 billion Euros, with an average increase rate of 7.04 percent.

Compliance with all legislation to protect human beings and the environment is one of the company's basic obligations for both legal and ethical reasons. This applies to BASF products as well as to its processes. It declares that waste must be disposed of in accordance with legal requirements. It is clear in one of their behavior code that *all applicable laws and regulations on environmental protection or plant and industrial safety must be fully complied with.*

The philosophy of BASF operation is to create chemistry for a sustainable future. BASF insists that *economic considerations do not take priority over safety and health issues and environmental protection.* The company produces products that are safe to manufacture, use, recycle or dispose in order to minimize the impact on humankind and the environment during production, storage, transportation, sale, use and disposal of its products. What's more, BASF encourages its employees to hold a high level of awareness of safety, health and environmental issues and strive for continuous improvement through agreed-upon objectives. In this way, each employee shares in the responsibility to protect human beings and the environment in his or her area of work.

In 2006, BASF was the first one of China Business Council for Sustainable Development to initiate a 1+3 CSR program, which is comprised of one initiator together with three other actors – supplier, customer and logistic service provider. With the increasing environmental pressure, the firm has begun to consider an environmental issues and the measurement of their suppliers' environmental performance (Humphreys et al., 2003). This program aims to pass on the best practice of CSR through the supply chain and drive the sustainable development of the whole supply chain. The snow-ball effect of this 1+3 CSR program enables the diffusion among and participation of over 130 companies in China, and being listed in the United Nations Global Compact Yearbook in the year of 2007 and 2009 separately, which is shared as the best CSR practice case. Moreover, BASF was the first industrial company in the world-wide to appoint its Chief Climate Protection Officer, and the first one who release its carbon footprint report in 2008. It is said that *reporting of any environmental, health, or safety related problems is the responsibility of every employee and it is also in the interest of the company.*

Green supply chain management is a good extension to the supply chain, which indicates the internal and external organization environmental management practices through the supply chain (Lee et al., 2014). In 2012, BASF co-sponsored a chemical industrial sustainable supply chain proposal – *Together for Sustainability*, with another 5 international leading chemical companies, intending to imply green sup-

ply chain management and standardize the self-evaluation and self-audit process of the global chemical industry. The company supports the efforts of its customers and suppliers in the safe and environmentally sound handling of the products that they receive from BASF and those products that BASF receive from them.

6.3 BASF's legitimacy and sustainable competitive advantage

One of BASF's vision is *We strive for sustainable development.* With the practices of environmental protection, management and innovation, BASF has been included in the list of the Dow Jones Sustainability Indexes (DJSI) for the 13th consecutive year in 2013, and has also been listed in Carbon Disclosure Program (CDP) Leader Index Global 500 for 9 times in succession. As in previous years, BASF leads the CDP Leader Index in the materials field. Finally, BASF obtains its sustainable competitive advantage in various aspects in terms of balances (see Fig. 4).

7. Discussion and conclusions

In conclusion, this article has proposed that the sustainable competitive advantage of MNEs is not simply a function of economic rent-seeking actions in the host markets, but depends more on the social responsibility strategies, which should be justified by external stakeholders in the form of legitimacy. In support of this premise, this article has combined both internal corporate behavior and external legitimacy perspective to develop a process model of building sustainable competitive advantage for MNEs. A key implication of this paper is that MNEs can mobilize internal behavior and external institutional legitimacy for long-run sustainable competitive advantage. Future research can examine both potential effects of internal and external factors on the sustainable competitive advantage.

Nowadays, MNEs are facing unprecedented pressing threats in doing business in worldwide with increasingly prominent resources constrains and environmental issues. They start to realize the need to balance economic and environmental performance (Lee et al., 2014). In this paper, we argue that MNEs should be able to take the social responsibility of leading the initiatives of sustainable development of host markets, owing to their ownership advantage of technology and management suggested in OLI paradigm. Further, in the process model proposed, we argue that through taking appropriate CEBs and then obtaining corresponding legitimacy, MNEs would establish their sustainable competitive advantage with financial benefits and technological spillover to local firms, which is more likely to be accepted as the industrial common standard. Via an in-depth case study of BASF in China, we find supports for the process model.

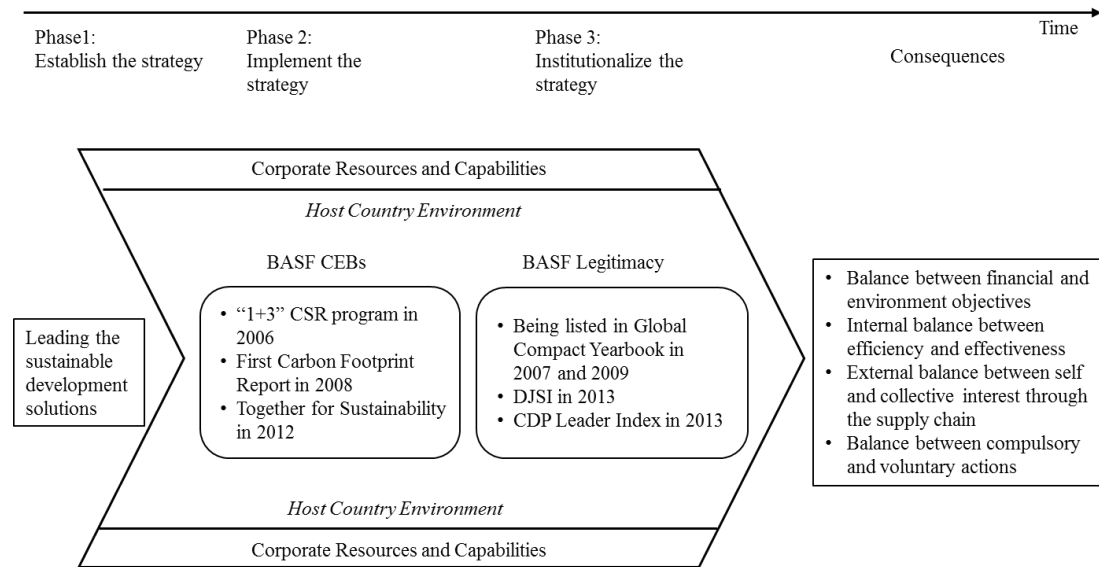


Figure 4. BASF's process of building sustainable competitive advantage

Fully successful implementation of MNEs' strategies are dependent on the resources, capabilities, consumers' demands and the overall societal preferences and evaluation or cognition. CSR represents a strategic opportunity as well as a set of obligations (Kolk and van Tulder, 2010) and MNEs are suggested to take advantage of their existing technology and management systems and explore new market strategies focusing on environmental protection. Other than meeting customers' demands, it is prevalent to create customers' demands via environmental strategy in the global process of achieving sustainable development.

This study contributes to the literature in threefold. First, it points to the important role that MNEs take in sustainable development due to their ownership advantage as suggested by the classical OLI paradigm. With disperse locations of their operations, MNEs have effects on the environmental issues both at home and abroad. The global nature of the environmental issue requires the MNEs take global CSR and local CSR into account (Husted and Allen, 2006). Second, building on the CEB conception, we define CEB into three dimensions, which shed light on the specific features of various motivations behind the CEB. Finally, legitimacy acts like a *license to operate* in host countries. In the MNEs' environmental campaign, strategic theory and institutional theory are combined together to provide insights into the formulation mechanism of MNEs' sustainable development and competitive advantage in the host countries.

We point to the generalization of the effects of MNEs' environmental behaviors on the legitimacy and finally the sustainable competitive advantage. Legitimacy is taken as mediation between corporate strategy and consequences in the process model, which can be assessed with empirical data in the future research agenda. Although we believe that our

conclusions can be generalized to other different types of organizations and various situations, future research can have a further exploration in different conditions. Empirical tests can also be conducted for the generalization and application of the proposed process model to other types of firms and situations in the future.

References

1. ALDRICH H. E., FIOLE C. M., 1994, Fools Rush In? The Institutional Context of Industry Creation, in: *Academy of Management Review*, vol. 19, no 4, p. 645-670.
2. ARAG N-CORREA J. A., 1998, Strategic Proactivity and Firm Approach to the Natural Environment, in: *Academy of Management Journal*, vol. 41, no 5, p. 556-567.
3. ARAGON-CORREA J. A., SHARMA S., 2003, A Contingent Resource-Based View of Proactive Corporate Environmental Strategy, in: *Academy of Management Review*, vol. 28, no 1, p. 71-88.
4. BANSAL P., 2005, Evolving Sustainably: A Longitudinal Study of Corporate Sustainable Development, in: *Strategic Management Journal*, vol. 26, no 3, p. 197-218.
5. BANSAL P., CLELLAND I., 2004, Talking Trash: Legitimacy, Impression Management, and Unsystematic Risk in the Context of the Natural Environment, in: *Academy of Management Journal*, vol. 47, no 1, p. 93-103.
6. BANSAL P., HUNTER T., 2003, Strategic Explanations for the Early Adoption of ISO 14001, in: *Journal of Business Ethics*, vol. 46, no 3, p. 289-299.
7. BANSAL P., ROTH K., 2000, Why Companies Go Green, in: *Academy of Management Journal*, vol. 43, no 4, p. 717-747.

8. BARNEY J., 1991, Firm Resources and Sustained Competitive Advantage, in: *Journal of Management*, vol. 17, no 1, p. 99-120.
9. BILKEY W. J., NES E., 1982, Country-of-Origin Effects on Product Evaluations, in: *Journal of International Business Studies*, vol. 13, no 1, p. 89-99.
10. CANTWELL J., DUNNING J. H., LUNDAN S. M., 2010, An Evolutionary Approach to Understanding International Business Activity in: *Journal of International Business Studies*, vol. 41, no 4, p. 567-586.
11. CHEN H.-C., CHUNG M.-F., 2014, How to Go Global with Differentiated Products, in: *Expert Systems with Applications*, vol. 41, no 7, p. 3484-3490.
12. CHRISTMANN P., 2004, Multinational Companies and the Natural Environment: Determinants of Global Environmental Policy, in: *Academy of Management Journal*, vol. 47, no 5, p. 747-760.
13. CHRISTMANN P., TAYLOR G., 2001, Globalization and the Environment: Determinants of Firm Self-Regulation in China, in: *Journal of International Business Studies*, vol. 32, no 3, p. 439-458.
14. CLAVER E., L PEZ M. D., MOLINA J. F., TAR J. J., 2007, Environmental Management and Firm Performance, in: *Journal of Environmental Management*, vol. 84, no 4, p. 606-619.
15. COSTA R., MENICHINI T., 2013, A Multidimensional Approach for CSR Assessment: The Importance of the Stakeholder Perception, in: *Expert Systems with Applications*, vol. 40, no 1, p. 150-161.
16. DELMAS M., 2001, Stakeholders and Competitive Advantage: The Case of ISO 14001, in: *Production and Operations Management*, vol. 10, no 3, p. 343-358.
17. DELMAS M., RUSSO M. V., MONTES-SANCHEO M. J., 2007, Deregulation and Environmental Differentiation in the Electric Utility Industry, in: *Strategic Management Journal*, vol. 28, no 2, p. 189-209.
18. DIMAGGIO P. J., POWELL W. W., 1983, The Iron Cage Revisited, in: *American Sociological Review*, vol. 48, no 2, p. 147-160.
19. DOWLING J., PFEFFER J., 1975, Organizational Legitimacy: Social Values and Organizational Behavior, in: *Pacific Sociological Review*, vol. 18, no 1, p. 122-136.
20. DUNNING J. H., 1980, Toward an Eclectic Theory of International Production: Some Empirical Tests, in: *Journal of International Business Studies*, vol. 11, no 1, p. 9-31.
21. DUNNING J. H., 1988, The Eclectic Paradigm of International Production: A Restatement and Some Possible Extensions, in: *Journal of International Business Studies*, vol. 19, no 1, p. 1-31.
22. DUNNING J. H., 2001, The Eclectic (OLI) Paradigm of International Production: Past, Present and Future, in: *International Journal of the Economics of Business*, vol. 8, no 2, p. 173-190.
23. EISENHARDT K. M., MARTIN J. A., 2000, Dynamic Capabilities: What Are They?, in: *Strategic Management Journal*, vol. 21, no 10-11, p. 1105-1121.
24. FAHY J., 2002, A Resource-Based Analysis of Sustainable Competitive Advantage in a Global Environment, in: *International Business Review*, vol. 11, no 1, p. 57-77.
25. HAKSEVER C., CHAGANTIR., COOK R. G., 2004, A Model of Value Creation: *Journal of Business Ethics*, vol. 49, no 3, p. 295-307.
26. HUMPHREYS P., MCIVOR R., CHAN F., 2003, Using Case-Based Reasoning to Evaluate Supplier Environmental Management Performance, in: *Expert Systems with Applications*, vol. 25, no 2, p. 141-153.
27. HUSTED B. W., ALLEN D. B., 2006, Corporate Social Responsibility in the Multinational Enterprise: Strategic and Institutional Approaches, in: *Journal of International Business Studies*, vol. 37, no 6, p. 838-849.
28. KAPLAN S. E., RULAND R. G., 1991, Positive Theory, Rationality and Accounting Regulation, in: *Critical Perspectives on Accounting*, vol. 2, no 4, p. 361-374.
29. KOLK A., PINKSE J., 2008, A Perspective on Multinational Enterprises and Climate Change: Learning from 'An Inconvenient Truth', in: *Journal of International Business Studies*, vol. 39, no 8, p. 1359-1378.
30. KOLK A., VAN TULDER R., 2010, International Business, Corporate Social Responsibility and Sustain. Develop., in: *International Business Review*, vol. 19, no 2, p. 119-125.
31. LEE V.-H., OOI K.-B., CHONG A. Y.-L., SEOW C., 2014, Creating Technological Innovation Via Green Supply Chain Management: An Empirical Analysis, in: *Expert Systems with Applications*, vol. 41, no 16, p. 6983-6994.
32. LIU Y., 2009, Investigating External Environmental Pressure on Firms and Their Behavior in Yangtze River Delta of China, in: *Journal of Cleaner Production*, vol. 17, no 16, p. 1480-1486.
33. LOGSDON J. M., WOOD D. J., 2005, Global Business Citizenship and Voluntary Codes of Ethical Conduct, in: *Journal of Business Ethics*, vol. 59, no 1-2, p. 55-67.
34. LOW P., YEATS A., 1992, Do 'Dirty' Industries Migrate? In: *International Trade and the Environment*, ed. Low P., WB, Washington.
35. LUO Y., 2006, Political Behavior, Social Responsibility, and Perceived Corruption: A Structuration Perspective, in: *Journal of International Business Studies*, vol. 37, no 6, p. 747-766.

36. MEYER J. W., ROWAN B., 1977, Institutionalized Organizations: Formal Structure as Myth and Ceremony, in: *American Journal of Sociology*, vol. 83, no 2, p. 340-363.
37. MONTEALEGRE R., 2002, A Process Model of Capability Development: Lessons from the Electronic Commerce Strategy at Bolsa De Valores De Guayaquil, in: *Organization Science*, vol. 13, no 5, p. 514-531.
38. MOON S. g., 2008, Corporate Environmental Behaviors in Voluntary Programs: Does Timing Matter?, in: *Social Science Quarterly*, vol. 89, no 5, p. 1102-1120.
39. OLIVER C., 1991, Strategic Responses to Institutional Processes, in: *The Academy of Management Review*, vol. 16, no 1, p. 145-179.
40. OLIVER C., 1997, Sustainable Competitive Advantage: Combining Institutional and Resource-Based Views, in: *Strategic Management Journal*, vol. 18, no 9, p. 697-713.
41. ORSATO R. J., 2006, Competitive Environmental Strategies: When Does It Pay to Be Green?, in: *California Management Review*, vol. 48, no 2, p. 127-143.
42. PARSONS R., LACEY J., MOFFAT K., 2014, Maintaining Legitimacy of a Contested Practice: How the Minerals Industry Understands Its 'Social Licence to Operate', in: *Resources Policy*, vol. 41, p. 83-90.
43. PENG G. Z., BEAMISH P. W., 2007, Evolving FDI Legitimacy and Strategic Choice of Japanese Subsidiaries in China, in: *Management and Organization Review*, vol. 3, no 3, p. 373-396.
44. PENG M. W., WANG D. Y., JIANG Y., 2008, An Institution-Based View of International Business Strategy: A Focus on Emerging Economies, in: *Journal of International Business Studies*, vol. 39, no 5, p. 920-936.
45. PORTER M. E., VAN DER LINDE C., 1995, Green and Competitive, in: *Harvard Business Review*, vol. 73, no 5, p. 120-134.
46. PRAHALAD C. K., HAMEL G., 1990, The Core Competence of the Corporation, in: *Harvard Business Review*, vol. 68, no 3, p. 79-91.
47. RAMACHANDRAN J., PANT A., 2010, The Liabilities of Origin: An Emerging Economy Perspective on the Costs of Doing Business Abroad, in: *Advances in International Management*, vol. 23, no, p. 231-265.
48. RUGMAN A. M., VERBEKE A., 1998a, Corporate Strategies and Environmental Regulations: An Organizing Framework, in: *Strategic Management Journal*, vol. 19, no 4, p. 363-375.
49. RUGMAN A. M., VERBEKE A., 1998b, Corporate Strategy and International Environmental Policy, in: *Journal of International Business Studies*, vol. 29, no 4, p. 819-833.
50. RYDZEWSKI P., 2013, The Implementation of Sustainable Development Vs. Environmental Attitudes in International Comparative Studies, in: *Problemy Ekorozwoju/Problems of Sustainable Development*, vol. 8, no 1, p. 125-137.
51. SARKAR R., 2008, Public Policy and Corporate Environmental Behaviour: A Broader View, in: *Corporate Social Responsibility and Environmental Management*, vol. 15, no 5, p. 281-297.
52. SHARFMAN M. P., SHAFT T. M., TIHANYI L., 2004, A Model of the Global and Institutional Antecedents of High-Level Corporate Environmental Performance, in: *Business & Society*, vol. 43, no 1, p. 6-36.
53. SHARMA S., VREDENBURG H., 1998, Proactive Corporate Environmental Strategy and the Development of Competitively Valuable Organizational Capabilities, in: *Strategic Management Journal*, vol. 19, no 8, p. 729-753.
54. SHRIVASTAVA P., 1995a, Environmental Technologies and Competitive Advantage, in: *Strategic Management Journal*, vol. 16, no, p. 183-200.
55. SHRIVASTAVA P., 1995b, The Role of Corporations in Achieving Ecological Sustainability, in: *The Academy of Management Review*, vol. 20, no 4, p. 936-960.
56. STEG L., VLEK C., 2009, Encouraging Pro-Environmental Behaviour: An Integrative Review and Research Agenda, in: *Journal of Environmental Psychology*, vol. 29, no 3, p. 309-317.
57. STRIKE V. M., GAO J., BANSAL P., 2006, Being Good While Being Bad: Social Responsibility and the International Diversification of Us Firms, in: *Journal of International Business Studies*, vol. 37, no 6, p. 850-862.
58. SUCHMAN M. C., 1995, Managing Legitimacy: Strategic and Institutional Approaches, in: *Academy of Management Review*, vol. 20, no 3, p. 571-610.
59. TEECE D. J., 2007, Explicating Dynamic Capabilities: The Nature and Microfoundations of (Sustainable) Enterprise Performance, in: *Strategic Management Journal*, vol. 28, no 13, p. 1319-1350.
60. TEECE D. J., PISANO G., SHUEN A., 1997, Dynamic Capabilities and Strategic Management, in: *Strategic Management Journal*, vol. 18, no 7, p. 509-533.
61. TIAN X., 2007, Accounting for Sources of Fdi Technology Spillovers: Evidence from China, in: *Journal of International Business Studies*, vol. 38, no 1, p. 147-159.
62. WCED, 1987, Our Common Future, Oxford University Press, New York.
63. WEI Y., LIU X., 2006, Productivity Spillovers from R&D, Exports and Fdi in China's Manufacturing Sector, in: *Journal of International Business Studies*, vol. 37, no 4, p. 544-557.
64. WERNERFELT B., 1984, A Resource-Based View of the Firm, in: *Strategic Management Journal*, vol. 5, no 2, p. 171-180.

The Development of Organic Food Market as an Element of Sustainable Development Concept Implementation

Rozwój rynku ekologicznych produktów żywnościowych jako element realizacji koncepcji zrównoważonego rozwoju

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Abstract

The development of organic food market constitutes an element of a far more complex phenomenon of ecological consumption and reinforcement of a new paradigm called green marketing.

Sustainable development strategies in the agri-food industry vary widely, ranging from mainstream agriculture becoming more ecological through the development of local production and consumption networks, organic farming to fair trade. We observe a dynamic growth in the value of organic food market in developed economies. From 2004 to 2012, the size of the European organic food market doubled. Further development of organic food market depends, *inter alia*, on the structure of distribution channels and pricing level, long-term trends in the national income growth and the development of ecological awareness of the society.

Key words : sustainable development, green marketing, ecological consumption, agri-food industry, organic food, Europe

Streszczenie

Rozwój rynku ekologicznych produktów żywnościowych stanowi element znacznie bardziej złożonego zjawiska ekologizacji konsumpcji i umacniania się nowego paradygmatu, zwanego zielonym marketingiem.

Strategie zrównoważonego rozwoju w branży rolno-spożywczej mogą przybierać zróżnicowaną formę, począwszy od ekologizacji rolnictwa głównego nurtu poprzez rozwój sieci lokalnej produkcji i konsumpcji, rolnictwo ekologiczne, aż po uczciwy handel. Obserwujemy dynamiczny wzrost wartości rynku żywności ekologicznej w krajach wysoko rozwiniętych. W latach 2004-2012 wartość europejskiego rynku żywności ekologicznej się podwoiła. Dalszy rozwój rynku produktów ekologicznych zależy m.in. od struktury kanałów sprzedaży, wysokości cen, długofalowych trendów w zakresie wzrostu dochodów społeczeństwa i wzrostu świadomości ekologicznej.

Słowa kluczowe : zrównoważony rozwój, zielony marketing, ekologizacja konsumpcji, branża rolno-spożywcza, żywność ekologiczna, Europa

Introduction

In spite of a growing interest in sustainable development issues (Pawłowski, 2011), the implementation of this concept faces multiple obstacles, though it is stimulated by the processes of European integration and the absorption of European Union funds (Bryła, 2013a; Bryła, 2012a; Bryła, 2007). One of positive examples is the dynamic development of the organic food market (Bryła, 2013b). Food and its production

form the basis for our civilization existence. Tools used by man to sustain his existence affect the environmental conditions which, in turn, determine the production capacities and natural resource diversity. The economic development of rural areas guarantees professional stability of their inhabitants and determines environment protection investment decisions. These aims may be achieved via, *inter alia*, rural tourism and the production of healthy food.

The sustainable development concept influences the directions of marketing evolution (Zaremba-Warnke, 2014). Contemporary marketing may be oriented at the implementation of the sustainable development concept thanks to the adoption of ecological consumption paradigm both in relations to the model of managing an enterprise, but also changing values in consumer awareness and attitudes toward shaping the so-called eco-consumers. We observe a considerable rise in significance of certain types of products in food marketing. This long-term trend, albeit at a variable level of development depending on the market, applies to, *inter alia*, functional, health, origin, traditional and organic/ecological products (Domański and Bryła, 2013; Rudawska, 2014). The term *ecological* or *organic* reflects the product form, but also may be treated as a brand, because it differentiates the product on the market and fits the definition of a brand proposed by the American Marketing Association (Hall, 2008). The ecological character of the product constitutes one of competitiveness factors of a company offer, although it does not belong to the most important determinants of competitiveness of Polish food products, at least from the perspective of all producers. This factor was classified 17th on the domestic market and 12th in Polish food exports (Bryła, 2012b). Nevertheless, it is an important and systematically growing market segment in some product categories. For instance, we observe a growing importance of the segment of organic yoghurts, which constitutes an element of offer diversification (Domański and Bryła, 2012). This paper aims to present the new *green marketing* paradigm and ecological consumption. Moreover, we will mention sustainable development indicators adjusted to the specificity of the agro-food industry. Also the dynamic of growth in organic food market worth will be shown. The last section deals with selected statistical data on the organic food market in Europe.

Green marketing and ecological consumption

The development of organic food market constitutes an element of a far more complex phenomenon of consumption ecologisation and replacement of conventional marketing with a new paradigm – the so-called green marketing – table 1 (Ottman, 2011, p. 46).

Ecological marketing (ecomarketing, green marketing, environmental marketing, sustainability marketing) constitutes a reaction of businesses to the growing ecological awareness of their customers, that is a better understanding of our dependence on nature and of the human impact on the environment (Klimczyk-Bryk, 2000).

Table 1. The new paradigm of green marketing, source: Ottman, 2011, p. 46

Elements of the system	Conventional marketing	Green marketing
Consumers	Consumers with their life-styles	People with their lives
Products	<i>From cradle to grave</i> Products Global supply Standardisation	<i>From cradle to cradle</i> Services Local supply Regional adaptation
Marketing	Benefits Sales One-way communication Paid advertising	Values Education Building communities Word-of-mouth marketing
Company	Mysterious Reactive Independent and autonomic Competitive Structured Short-term orientation Profit maximisation	Transparent Proactive Interdependent, in Alliance with stakeholders Cooperative Holistic Long-term orientation A bundle of objectives ¹

Ecological consumption concerns: purchasing and consuming ecological products; a shift from ego-rationality to eco-rationality; economical, rational use of consumption goods; a reduction of or resignation from consuming products characterised by high intensity of non-renewable mineral resources; selecting products that do not generate a big amount of post-consumption waste; waste segregation and reuse; deepening one's knowledge in the field of protection of the natural environment; active participation of buyers in organizing cooperatives co-created by consumers and farmers; and engagement in activities of pro-ecological movements. This new consumer type has been named *Homo ecologicus* (Mazurek-Łopacińska and Sobocińska, 2010). Eco-consumers possess knowledge in the field of ecology, modify their lifestyle, and buy ecological products, which tend to be more expensive than conventional ones (Leśniak, 2001, p. 87). A clear differentiation of ecological products against competitive offerings with comparable utilitarian and functional parameters is crucial in green marketing. It can be achieved with eco-labelling (Czubala, 2010, p. 126). We can observe a growing role of sustainable marketing communication, which enables to shape both consumer attitudes and company image (Wilk, 2014).

¹ In English, there is a term *triple bottom line*, which refers to simultaneous meeting of economic, social, and ecological objectives (it is recommended not to perform below certain standards in each of these areas).

Table 2. The most important sustainable development indicators in the agri-food industry, source: (Fritz and Matopoulous, 2008)

Sustainable development dimension	Goals	Measurement criteria	Indicators
Economic	Economic growth	Productivity	Value added per employee, €
	Investments in labour qualifications	Trainings	Number of hours of employee training
	Open and competitive economy	Diversification and industry structure	Share of big enterprises, %
	Change in consumption patterns	Reduction of transport of imported goods	Dependence on imports, %
Social	Urban distribution	Traffic jams, noise, accidents	Number of kilometres necessary to supply all shops
		Journey time	Time on the roads % of delayed supplies
	Nutritional and health value	Labels	Number of products with labels
	Food safety	Contaminations	Number of incidents
	Improvement of working conditions	Equality	Employment of women, % Employment of ethnic minorities, % Employment of the disabled, %
		Work safety and hygiene	Accidents
		Employment size	Average number of employees
		Employment quality	Average salary, €
	Community	Support for the community	Subsidies (e.g. to build a school)
		Economic ties with the community	Local purchases and transactions, % value share Sales growth of local products, %
	Fair trade	Fair trade programmes	Share of fair trade products in the assortment, %
Ecological	Waste	Packaging	Amount of waste per basket of purchases Recyclable waste in the basket
	Air pollution	Emissions	Carbon dioxide emission Steam emission
	Water	Water consumption	Purchase of water for one's own consumption per enterprise, €
	Energy	Energy consumption	Purchase of energy for one's own consumption per enterprise, € Primary demand for energy, MJ/kg of the product
	Biodiversity	Impact on biodiversity	Share of local varieties of the product in total sales, % Share of local varieties of the product in crops, %
	Food transport	Transport means and tactics	Share of local purchases, % Share of products in air freight, % Share of direct supplies to retailers, %
		Fill of vehicles	% of use of available capacity regarding weight and volume % of empty kilometres Share of products transported in vehicles of different size, weight and cooling capacity
		Time use	Deviations from the plan Driver performance management Transport telematics
		Engine parameters	Share of alternative fuels, % Fuel consumption Carbon dioxide emission

The literature of the subject contains numerous attempts to discern the profiles of ecological product buyers (Witek, 2014). A survey among 41 923 people in 30 countries of the world allowed to assess the impact of selected socio-demographic variables on the willingness to sacrifice for the sake of natural environment conservation. Education had the highest impact, followed by professional status (employees, students, and trainees have a higher propensity compared to those who are unfit for work, the unemployed, old age pensioners and housewives), political orientation (leftist views correlate with a higher propensity), age (older subjects are ready for bigger sacrifice) and the place of residence (inhabitants of large cities and suburbs declare a higher willingness). International differentiation was noted as well. The highest propensity to undertake pro-ecological behaviour was declared by the Swiss, Koreans, and Danes, while the lowest – by Latvians, Croats and inhabitants of the Czech Republic (Rydzewski, 2013).

Sustainable development indicators in the agro-food industry

According to A. Graczyk and K. Mazurek-Lopacińska (2009), the development of ecological product market in Europe is stimulated by the adoption of the European Union sustainable development strategy, the implementation of which depends on cultural factors. Sustainable consumption indicators include: localisation, reduction of the *ecological footprint*, community building, acting in common and the creation of new socio-economic institutions (Seyfang, 2007). The determinants of sustainable consumption development should be perceived from the viewpoint of changes in attitudes, value hierarchies and lifestyles as well as cultural transformation of the society (Mazurek-Lopacińska and Sobocińska, 2014)

Fritz and Matopoulous (2008) classified the most important sustainability indicators in the agro-food industry within 3 fundamental dimensions of this concept: economic, social and environmental (table 2). It is a holistic approach to phenomena taking place in the whole market channel, starting from suppliers, through processors, distributors, to consumers.

Sustainable development strategies in the agri-food industry may take various shapes, starting from greening mainstream agriculture (lower use of pesticides, herbicides and fertilisers) through the development of local production and consumption networks, organic farming to fair trade (Tischner and Kjærnes, 2010, p. 39).

Geographical Indications contribute to the sustainable development of rural areas, because: they help producers get higher prices and guarantee safety and quality for consumers; improve the redistribution of value added in the supply chain; add value to the area

Table 3. Selected quality signs referring to sustainable development in Germany and Italy, source: Banterle et al., 2010

Sign	Social dimension	Ecological dimension
MSC (Marine Stewardship Council)	Protection of ichtyological heritage	Protection of the seas Fish diversity
Friend of the Sea	FAO code of conduct in the field of sustainable fishery	Impact on habitats Fish diversity Carbon dioxide emission (carbon footprint) Waste management
Dolphin Safe	Regulation of the method of tuna fishing	Sea biodiversity
Best Alliance	Work conditions	Climate protection Water consumption Carbon dioxide emission
Rainforest Alliance	Nature conservation Fair treatment Good working conditions Community relations	Ecosystem preservation Water protection Integrated crop management Integrated waste management
RSPO (Roundtable on Sustainable Palm Oil)	Social and human capital Local economy	Protection of tropical forests Biodiversity Saving water Energy resources
RTRS (Round Table on Responsible Soy)	Legal compliance Appropriate work conditions Appropriate community relations	Pollution minimisation Reduction of greenhouse gases Good agricultural practices Waste reduction Integrated crop management
UTZ Certified	Harvest management Labour law Food and agricultural safety Producer income	Biodiversity Protection of water resources Carbon dioxide emission Integrated management of crop protection chemicals
FAIRGLOBE	Better prices Fair working conditions	More respect for the environment
SAI (Sustainable Agriculture Initiative)	Lifestyle of farmers Community relations Agricultural income	Biodiversity Natural resources

of origin; lead to production growth, creation of new jobs and they prevent the exodus of population from rural areas; contribute to the protection of landscapes, traditional know-how and biodiversity (Williams, 2007, p. 10). Economic benefits stemming from the use of Geographical Indications also include the stimulation of innovations and entrepreneurship and their use in marketing. The list of social benefits may be supplemented with protection against unfair competition, assurance of market transparency for consumers and contribution to social cohesion. Within the ecological dimension, the reduction of the distance between supply and demand is crucial as well (Williams, 2007, p. 41-51). Thus the use of European quality signs appealing to the area of origin fits the concept of sustainable development.

Banterle et al. (2010) identified 10 quality signs referring to sustainable development in Germany and Italy (table 3).

Quality sign functions may be analysed from the perspective of particular stakeholder groups: producers (competitiveness growth, image effects, strategic considerations), consumers (information, ethics, loyalty, trust), authorities (care about economic interests of consumers with the reduction of information asymmetry, implementation of sustainable development policies, trade policy instrument), and non-governmental organisations (stimulating public discussion, opposition to consumerism) (Boer, 2003). The adoption of quality signs is treated as a chance to improve sales through offer differentiation, higher responsibility and extending consumer choice. However, in reality, labelling may lead to an overload of information in general and a shortage of independent, available and understandable information (Horne, 2009). In the opinion of A. Stanciani (2008), a lot of quality signs that are justified by the protection of consumer interests, aim to grant a group of producers a rent stemming from their position and institutional framework. Sometimes the signs serve to ensure loyal competition among producers.

Growth in organic food market value

The world organic food market value was estimated at 20 billion USD already in 2002 (Hughner et al., 2007). It showed a very dynamic from the level of 10 billion USD in 1997 (Łuczka-Bakuła, 2007, p. 76). In 2010, this value was estimated at 59.1 billion USD (Henryks et al., 2013, p. 20-42). The dynamics of growth was impressive. For example, in the UK, the sales of such products increased from 100 million GBP in 1994 to 605 million in 2000, the size of the American market soared from 78 million USD in 1980 to approximately 6 billion in 2000. The average annual growth of the market value in 1990s amounted to as much as 24% (Hughner et al., 2007). In 2006, organic food sales in the US reached 16.7 billion USD, which accounted for 3% of the entire

American food market (Adams and Salois, 2010). In 2003, the European organic food market constituted a half of the world market (Łuczka-Bakuła, 2007, p. 76). The area of organic crops in the European Union increased by 7.4% annually from 2000 to 2008 to reach 7.6 million ha cultivated by 197 thousand farms. Organic products accounted for 1.9% of total spending on food. In the period 2000-2009, the average annual growth in sales of organic food amounted to 8.7% in Italy, 14% in Germany and 18.1% in France (Tavella and Hjortsø, 2012). In 2003, in the European Union, the highest level of organic food spending per capita was observed in Denmark (51 EUR). Further positions were taken by: Sweden (47 EUR), Finland (41 EUR), Austria (40 EUR) and Germany (38 EUR) (Łuczka-Bakuła, 2007, p. 78), while the share of organic products in the food market ranged from 0.2% in Spain to 3% in Denmark (Motowidlak, 2007, p. 171). The organic food turnover in Germany increased from 3.9 billion EUR in 2005 to 6.6 billion in 2011 (Hasselbach and Roosen, 2013, p. 43-64). In 2010, the share of organic products in the German food market amounted to 3.9% (Gottschalk and Leistner, 2013). The share of organic products in the Danish food market grew very quickly during the second half of the first decade of the 21st century – from below 4% in 2005 to over 7% in 2009, though, naturally, is varied according to the product category e.g. 35% milk and 0.8% chicken (Smed et al., 2013). In 2006, the share of organic food in the particular product categories was as follows on the Danish market: oatmeal (27.0%), milk (24.7%), eggs (17.2%), carrots (16.2%), wheat flour (10.7%), yoghurt (7.7%), coffee (4.1%), potatoes (3.2%), rye bread (3.0%), beef (2.4%) and pork (0.7%) (Jørgensen, 2010, p. 93). The share of organic products in the American food market amounted to approximately 4% at the end of the first decade of the 21st century, while it was roughly 1% in Australia (Henryks et al., 2013, p. 20-42). In 2006, the Czech market of organic food was worth 760 million CZK, which meant a 58% increase during one year (!) (Doležalová et al., 2009).

According to American studies, the market of organic products is internally diverse. One can distinguish more and less orthodox forms (*deep organic* and *organic lite*). The matter is even more complex, as many consumers consider local products to be a more holistic and authentic substitute of organic products. Some of them claim that *food miles*, rather than organic labels, are an emanation of sustainability. Table 4 compares these 3 categories of food products. Interestingly the cited authors think that formal rules of labelling and certification concern the category of *organic lite* rather than *deep organic* (Adams and Salois, 2010). It may stem from the specificity of the American system of organic food certification, which differs from European Union regulations, as well as from the different model of agriculture in the United States (based on very

Table 4. A comparison of local and *deep* and *lite* organic products Source: (Adams and Salois, 2010)

Attributes	Local products	<i>Deep</i> organic products	Organic <i>lite</i> products
Production methods, inputs	Any	No pesticides and GMO, very environmentally friendly, biodynamic and sustainable	No pesticides and GMO
Product types	Big diversity, seasonality	Big diversity, seasonality	Traditional
Location	Local, but defined broadly	Local	Anywhere (even in China)
Certification	No formal standards	None	Rigorous standards
Labelling	No rules at the federal level, often at the state level	None	USDA organic labels
Relationship with consumers	Close	Close	Distant
Production scale	Small	Small	Typically very large
Market concentration	None	None	Domination of big producers and retailers
Distribution channel length	Short – direct sales	Short – direct sales	Long – includes wholesalers, transport companies, warehousing etc.
Impact on the environment	The same as in industrial agriculture, but at a lower scale	Environmentally friendly	Less pesticide pollution, but otherwise the same as in industrial farms
Impact on the local community, farm workers, animal welfare etc.	Favourable	Very favourable	The same as in industrial agriculture

large farms) compared to small and medium agricultural holdings in Europe. The development of the market of local products could be accelerated by a modification of public policies, for instance, a reduction of subsidies linked to market output size, strengthening competition policy in distribution channels, taxing mineral fuels (used in transport), elimination of food dumping and a reform of agricultural education (Halweil, 2002, p. 56).

The latest two decades brought about a tremendous growth in demand for organic food in the United Kingdom. This branch transformed from niche activity into one of the available mainstream options. The surface of organic crops has been increasing dramatically in that country – from 100 thousand ha in 1998 to 690 thousand in 2005. This production method is in greater harmony with the natural environment and local ecosystems. The second argument in favour of consuming such food is care for one's own health. Moreover, benefits for economy and employment resulting from organic agriculture development are mentioned. However, in the middle of the first decade of the 21st century, as much as 56% of organic food consumed in Great Britain originated from imports. The main distribution channel was supermarkets, where $\frac{3}{4}$ of the organic food was sold. Nevertheless, we may also observe a trend toward the development of local distribution channels. The *local* is defined in the UK as available in the radius of 30 miles or originating from the same country. Cutting *food miles* – important argument in favour of local supply chains. A reduction of the distance to move food from producers to consumers allows to curtail energy costs and transport-related pollution. Long-

distance transport may sometimes seem beneficial only because ecological and social externalities are not reflected in the price of fuel. We may observe growing sales of organic and local food products in alternative, direct distribution channels, including farmers' markets and home delivery. The Asda supermarket chain (which belongs to the greatest retailer worldwide: Wal-Mart) introduced a department for local products in 2001 and a few years later, it sold as many as 2.5 origin products from 300 local producers. Asda encourages local producers to supply their products directly to the retail outlets, because then they tend to be fresher, to have overcome a shorter distance and to have a longer *life* on the shelf. Such a policy served to promote freshness, taste, and perceived, local authenticity, for the destruction of which supermarkets were often criticised (Seyfang, 2007).

The development of the organic food market in Poland depends, *inter alia*, on the structure of distribution channels, level of prices, growth in the income of the society and its ecological awareness. Specialist shops with organic food have a large market share, but they face multiple difficulties, such as unfavourable location, low share of certified products in sales and high prices due to gross margins. The margins are high in Poland (even exceeding 100%) because of low supplies, high costs of distribution and a large share of imported goods. Sales in supermarkets also constitutes a serious challenge for the industry, as big distribution chains require a considerable amount of homogeneous products, supplied on time according to the schedule and supported by professional promotion activities.

Table 5. Organic crops and organic food producers in Europe, source: *The World...*, 2014, p. 204

Country	Area of organic crops (ha)	Share of organic crops in utilized agricultural area (%)	Number of organic food producers
Albania	515	0.0	46
Austria	533,230	19.7	21,843
Belgium	59,718	4.4	1,413
Bosnia and Herzegovina	343	0.0	25
Bulgaria	39,137	1.3	2,754
Croatia	31,903	2.4	1,528
Cyprus	3,923	2.7	719
Czech Republic	488,658	11.5	3,934
Denmark	194,706	7.4	2,651
Estonia	144,147	15.3	1,478
Finland	197,751	8.7	4,322
France	1,032,941	3.8	24,425
Germany	1,034,355	6.2	23,032
Greece	462,618	5.6	23,433
Hungary	130,609	3.1	1,560
Iceland	8,240	0.4	35
Ireland	54,122	1.3	1,400
Italy	1,167,362	9.1	43,852
Latvia	195,658	10.8	3,496
Liechtenstein	1,086	29.6	35
Lithuania	156,539	5.4	2,527
Luxembourg	3,924	3.0	102
Macedonia	12,731	1.2	555
Malta	26	0.2	9
Moldova	22,102	0.9	172
Montenegro	3,068	0.6	62
Netherlands	48,038	2.5	1,646
Norway	55,260	5.1	2,590
Poland	661,956	4.3	25,944
Portugal	200,151	6.0	2,603
Romania	288,261	2.1	15,315
Russia	146,251	0.1	60
Serbia	6,340	0.1	1,073
Slovakia	166,700	8.8	365
Slovenia	35,101	7.6	2,682
Spain	1,593,197	6.4	30,462
Sweden	477,685	15.6	5,601
Switzerland	125,961	12.0	6,173
Turkey	523,627	2.2	57,259
Ukraine	272,850	0.7	164
United Kingdom	590,009	3.4	4,281
Europe	11,171,413	2.3	321,630
including EU	9,992,425	5.6	253,377

Note: data for 2012 except for: Bosnia and Herzegovina, Ireland, Moldova, Montenegro and Portugal – 2011

Nevertheless, the future of this market seems to depend to the largest extent on big retail networks, because they are able to reduce costs and compete with lower prices for organic food (Żakowska-Biemans, 2011).

Table 6. Characteristics of the organic food market in Europe, source: *The World...*, 2014, p. 213-214

Country	Organic food retail sales (million EUR)	Organic food retail sales per capita (EUR)	Share of organic products in the food market (%)
Austria	1,065	127	6.5
Belgium	417	38	1.5
Croatia	104	25	2.2
Czech Republic	66	6	0.7
Denmark	887	159	7.6
Estonia	20	15	1.6
Finland	202	37	1.6
France	4,004	61	2.4
Germany	7,040	86	3.7
Greece	60	5	0.4
Hungary	25	2	0.3
Ireland	99	22	0.7
Italy	1,885	31	1.5
Latvia	4	2	0.2
Liechtenstein	5	129	no data
Lithuania	6	2	0.2
Luxembourg	75	143	3.1
Netherlands	791	47	2.3
Norway	209	42	1.2
Poland	120	3	0.2
Portugal	21	2	0.2
Romania	80	4	0.7
Russia	120	1	no data
Serbia	40	5	no data
Slovakia	4	1	0.2
Slovenia	44	22	1.5
Spain	998	21	1.0
Sweden	905	95	3.9
Switzerland	1,520	189	6.3
Turkey	4	0	0
Ukraine	5	0	0
United Kingdom	1,950	32	no data
Europe	22,795	35	no data
including EU	20,893	41	no data

Note: data for 2012 except for: Austria (2011), Czech Republic (2011), Estonia (2011), Greece (2010), Hungary (2009), Ireland (2011), Latvia (2011), Lithuania (2011), Poland (2011), Portugal (2011), Romania (2011), Serbia (2010), Slovakia (2010), and Turkey (2009)

Selected statistical data on the organic food market in Europe

In 2012, organic crops took 11.2 million ha on the European continent, which accounted for 2.2% of the utilised agricultural area – table 5 (for the sake of comparison, it was only 3.7 million ha in 1999). Spain, Italy, Germany and France had the biggest surface of organic crops. Poland had a high, fifth rank in Europe, ahead of the UK, Austria, and Turkey. The biggest share of organic crops in utilized agricultural area was observed in Liechtenstein, Austria, Sweden, and Estonia. Poland ranked the fourth in Europe regarding the number of farmers producing organic food – behind Turkey, Italy and Spain.

The worth of the European organic food market in 2012 was estimated at 22.8 billion EUR, including 20.9 billion of sales in the European Union – table 6. The value of the European organic food market doubled from 2004 to 2012. The highest absolute organic market value was observed in Germany. Further positions were taken by: France, UK, Italy and Switzerland. Switzerland had the highest consumption of organic food per capita, followed by: Denmark, Luxembourg, Liechtenstein and Austria. The highest share of organic products in the total food market was noted in Denmark, in front of Austria and Switzerland.

Conclusion

In the context of ecological consumption and the proliferation of the green marketing paradigm, we observe a dynamic growth in the market value of organic food in developed countries. The organic food market worth doubled in Europe from 2004 to 2012. This phenomenon is related to the concept of sustainable development.

In this context it is good to mention the example of Poland, so country still perceived as mostly agricultural. It ranks high, at the fifth position on the European continent in terms of the area of organic crops, and even higher (fourth) regarding the number of organic food producers. However, the national market value, the share of organic products in the food market and sales of organic food *per capita* continue to be relatively low. There are problems, *inter alia*, with distribution, high prices, but also with the level of ecological awareness of the society. So, even with good natural conditions (like in Poland), thinking about ecological farming we must not forget about economic and social issues, so discuss the full context of sustainable development.

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References

- ADAMS D., SALOIS M., 2010, Local versus organic: a turn in consumer preferences and willingness-to-pay, in: *Renewable Agriculture and Food Systems*, vol. 25, no 4, p. 331-341.
- BANTERLE A., FRITZ M., CEREDA E., 2010, *Labelling and environmental sustainability in food supply networks: an empirical analysis in Italy and Germany*, paper presented at 119 EAAE Seminar on Sustainability in the food sector: rethinking the relationship between the agro-food system and the natural, social, economic and institutional environments, Capri, Italy, 30 June – 2 July 2010.
- BOER J. DE, 2003, Sustainability labelling schemes: the logic of their claims and their functions for stakeholders, in: *Business Strategy and the Environment*, vol. 12, no. 4, p. 254-264.
- BRYŁA P., 2013a, Challenges for the Adoption of the Sustainable Development in Polish Evaluation Studies, in: *Problemy Ekorozwoju/Problems of Sustainable Development*, vol. 8, no. 1, p. 139-148.
- BRYŁA P., 2013b, Marketing ekologicznych produktów żywnościowych – wyniki badania wśród polskich przetwórców, in: *Rocznik Ochrona Środowiska*, vol. 15, p. 2899-2910.
- BRYŁA P., 2012a, The characteristics of farmers applying for the EU investment support in Poland, in: *Agricultural Economics – Czech*, vol. 58, no. 1, p. 21-33.
- BRYŁA P., 2012b, The impact of EU accession on the marketing strategies of Polish food companies, in: *British Food Journal*, vol. 114, no. 8, p. 1196-1209.
- BRYŁA P., 2007, The evaluative aspects of sustainability in rural development programmes in Poland, in: *Sustainable Development in Europe. Concepts, Evaluation and Applications*, eds. Schubert U., Störmer E., Edward Elgar, Cheltenham, p. 293-304.
- UBAŁA A., 2010, Społeczna odpowiedzialność w marketingu przedsiębiorstw. Teoria i praktyka eksporterów, in: *Strategie marketingowe eksporterów*, ed. Czubała A., Niestrój R., Wiktor J., Uniwersytet Ekonomiczny w Krakowie, Kraków.
- DOLEŽALOVÁ H., PÍCHA K., NAVRÁTIL J., 2009, Analysis of the organic food marketing – chain store companies (South Bohemia), in: *Agricultural Economics – Czech*, vol. 55, no. 9, p. 446-458.
- DOMAŃSKI T., BRYŁA P., 2013, *Marketing produktów regionalnych na europejskim rynku żywności*, Lodz University Press, Lodz.
- DOMAŃSKI T., BRYŁA P., 2012, The fragile strength of a leading Polish yoghurt company (case study of Bakoma), in: *British Food Journal*, vol. 114, no. 5, p. 618-635.
- FRITZ M., MATOPOULOUS A., 2008, *Sustainability in the agri-food industry: a literature review and overview of current trends*, 8th International Conference on Management in Agri-food Chains and Networks, Ede, Holland, 28-30 May 2008.
- GOTTSCHALK I., LEISTNER T., 2013, Consumer reactions to the availability of organic food in discount supermarkets, in: *International Journal of Consumer Studies*, vol. 37, p. 136-142.
- GRACZYK A., MAZUREK-ŁOPACIŃSKA K. (ed.), 2009, *Badanie rozwoju rynków pro-*

- duktów rolnictwa ekologicznego i żywności ekologicznej w Polsce, Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Wrocław.
16. HALL M., 2008, The marketing of organic products: an instrumental/symbolic perspective, in: *Journal of Food Products Marketing*, vol. 14, no 3, p. 1-11.
17. HALWEIL B., 2002, *Home grown. The case for local food in global market*, Worldwatch Institute, Danvers.
18. HASSELBACH J., ROOSEN J., 2013, Consumer heterogeneity in the willingness to pay for local and organic food, in: *International Food Marketing Research Symposium Conference Proceedings. Part 2*, ed. Stanton J., Lang M., Laszlo V., Budapest.
19. HENRYKS J., PEARSON D., ANISIMOVA T., SULTAN P., 2013, The labelling of organic food: understanding consumer perceptions, in: *International Food Marketing Research Symposium Conference Proceedings. Part 2*, ed. Stanton J., Lang M., Laszlo V., Budapest.
20. HORNE R., 2009, Limits to labels: the role of eco-labels in the assessment of product sustainability and routes to sustainable consumption, *International Journal of Consumer Studies*, vol. 33, p. 175-182.
21. HUGHNER R., MCDONAGH P., PROTHERO A., SHULTZ C., STANTON J., 2007, Who are organic food consumers? A compilation and review of why people purchase organic food, *Journal of Consumer Behaviour*, vol. 6, p. 94-110.
22. JØRGENSEN M., 2010, Transition towards sustainable consumption and production? *The case of organic food in Denmark*, in: *System innovation for sustainability. Case studies in sustainable consumption and production – food and agriculture*, ed. Tischner U., Stø E., Kjærnes U., Tukker A., Greenleaf Publishing, Sheffield
23. KLIMCZYK-BRYK M., 2000, Świadomość ekologiczna konsumentów i jej uwarunkowania, in: *Zeszyty Naukowe Akademii Ekonomicznej w Krakowie*, no 543, p. 95-104.
24. LEŚNIAK J., 2001, Rola instrumentów marketingu ekologicznego we wdrażaniu zrównoważonego rozwoju na przykładzie Szwecji, in: *Ekonomia a zrównoważony rozwój*, ed. Piontek F., Wydawnictwo Ekonomia i Środowisko, Białystok 2001.
25. ŁUCZKA-BAKUŁA W., 2007, *Rynek żywności ekologicznej. Wyznaczniki i uwarunkowania rozwoju*, Polskie Wydawnictwo Ekonomiczne, Warszawa.
26. MAZUREK-ŁOPACIŃSKA K., SOBOCIŃSKA M., 2014, Determinanty rozwoju zrównoważonej konsumpcji w Polsce – wybrane zagadnienia, in: *Zeszyty Naukowe Uniwersytetu Szczecińskiego. Problemy Zarządzania, Finansów i Marketingu*, no. 35, p. 169-179.
27. MAZUREK-ŁOPACIŃSKA K., SOBOCIŃSKA M., 2010, Ekologizacja konsumpcji i wynikające z niej konsekwencje dla zarządzania produktem, in: *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Poznaniu*, no 153, p. 109-118.
28. MEULEN H. VAN DER, 2007, A normative definition method for origin food products, in: *Anthropology of Food*, no. S2, <http://aof.revues.org>, (23.07.2007).
29. MOTOWIDŁAK U., 2007, *Ekonomiczne problemy rozwoju rolnictwa ekologicznego w Polsce*, Wydawnictwo Absolwent, Łódź.
30. OTTMAN J., 2011, *The new rules of green marketing. Strategies, tools, and inspiration for sustainable branding*, Greenleaf Publishing, Sheffield 2011.
31. PAWŁOWSKI A., 2011, *Sustainable development as a civilizational revolution: a multidisciplinary approach to the challenges of the 21st century*, CRC Press, Leiden.
32. RUDAWSKA E., 2014, Customer loyalty towards traditional products – Polish market experience, in: *British Food Journal*, vol. 116, no. 11.
33. RYDZEWSKI P., 2013, The implementation of sustainable development vs. environmental attitudes in international comparative studies, in: *Problemy Ekorozwoju/Problems of Sustainable Development*, vol. 8, no 1, p. 125-137.
34. SEYFANG G., 2007, Growing sustainable consumption communities. The case of local organic food networks, in: *International Journal of Sociology and Social Policy*, vol. 27, no 3-4, p. 120-134.
35. SMED S., ANDERSEN L., KÆRGÅRD N., DAUGBJERG C., 2013, *A matter of trust: how trust influences organic consumption*, 134th EAAE seminar, Paris, 21-22 March 2013.
36. STANCIANI A., 2008, La definition de la qualite des produits dans une economie de marche, *L'Économie politique*, no. 37, p. 95-112.
37. TAVELLA E., HJORTSØ C., 2012, Enhancing the design and management of local organic food supply chain with soft systems methodology, in: *International Food and Agribusiness Review*, vol. 15, no 2, p. 47-68.
38. TISCHNER U., KJÆRNES U., Sustainable consumption and production in the agriculture and food domain, in: *System innovation for sustainability. Case studies in sustainable consumption and production – food and agriculture*, ed. Tischner U., Stø E., Kjærnes U., Tukker A., Greenleaf Publishing, Sheffield.
39. *The World of Organic Agriculture. Statistics and Emerging Trends 2014*, 2014, FiBL and IFOAM, Frick-Bonn.

40. WILK I., 2014, Komunikacja z rynkiem docelowym w ramach marketingu zrównoważonego, in: *Zeszyty Naukowe Uniwersytetu Szczecińskiego. Problemy Zarządzania, Finansów i Marketingu*, no. 35, p. 199-207.
41. WILLIAMS R., 2007, *Do Geographical Indications promote sustainable rural development?*, Lincoln University, Lincoln.
42. WITEK L., Typologia konsumentów na rynku produktów ekologicznych, in: *Zeszyty Naukowe Uniwersytetu Szczecińskiego. Problemy Zarządzania, Finansów i Marketingu*, no. 35, p. 209-217.
43. ZAREMBA-WARNKE S., 2014, Koncepcja zrównoważonego rozwoju jako determinanta przeobrażeń marketing, in: *Z. Naukowe Uniwersytetu Szczecińskiego. Problemy Zarządzania, Finansów i Marketingu*, no. 35, p. 219-227.
44. ŻAKOWSKA-BIEMANS S., 2011, Polish consumer food choices and beliefs about organic food, *British Food Journal*, vol. 113, no. 1, p. 122-137.

Challenges to Sustainability of Resource-exhausted Cities: A Case Study of Lengshuijiang, China

Wyzwania dla zrównoważoności odnoszące się do miast pozbawionych surowców: przypadek Lengshuijiang w Chinach

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Abstract

Resource-based cities were once the backbone of Chinese economy for decades. When natural resources were depleted, however, these cities become *negative assets* of China and urgently need sustainable transition. Given the vast number of resource-exhausted cities in China, their success transitions not only mean much to themselves but also have great implications on China's sustainability. Taking Lengshuijiang, one of the 67 resource-exhausted cities of China, as a case, this article investigated sustainable transition of resource-exhausted cities in Chinese context. Firstly, we reviewed the development problems it faces in the past two decades. Secondly, we examined the countermeasures it took since 2009. Although this article mainly focuses on Lengshuijiang, the findings and discussion will provide insights for other resource-exhausted cities of China and other parts of the world in reviewing their development strategies as most of them are facing similar sustainable challenges.

Key words: sustainable development, resource-exhausted cities, China

Streszczenie

Miasta bazujące na surowcach stanowiły trzon chińskiej gospodarki od dziesięcioleci. Gdy zasoby naturalne zostały wyczerpane, miasta te stały się *ujemnymi aktywami* Chin i pilnie potrzebują zrównoważonych przekształceń. Biorąc pod uwagę dużą liczbę takich miast, ich sukces nie tylko będzie ważny dla nich samych, ale odegra również istotną rolę w zrównoważonym rozwoju całych Chin. Jako przykład wybrano Lengshuijiang, jedno z 67 miast, które dotknęło wyczerpanie zasobów, analizując zrównoważoność dokonanych tam przekształceń. Po pierwsze oceniono problemy rozwojowe występujące w ciągu ostatnich dwudziestu lat. Po drugie, zbadano skuteczność środków zaradczych, wprowadzonych w 2009 r. Przykład miasta Lengshuijiang stanowi punkt odniesienia dla strategii rozwojowych innych miast dotkniętych problemem wyczerpania surowców tak w Chinach, jak i w innych państwach świata, ponieważ większość z nich to staje w obliczu podobnych wyzwań.

Słowa kluczowe: rozwój zrównoważony, miasta dotknięte wyczerpaniem surowców, Chiny

1. Introduction

Since natural resources are the material foundation for human existence and development, harvesting natural resources is one of the most common human

activities. Some cities have been built up or developed mainly for resource-related activities, which are called resource-based cities. Sudbury in Canada, Mesabi in America and Fushun in China are all typical such cities (Yang et al., 2011). Because they dis-

play some distinctive characteristics, resource-based cities have drawn many researchers' interests. Following seminal work by Innis, researchers have studied a lot aspects of resource-based cities, including residents' sense of belonging (Marsh, 1987), social interaction (Gill, 1990), demographic characteristics (Bradbury, 1983), local labor market and employment structure (Peters et al., 1995; Halseth, 1999; Randall et al., 1996), globalization (Pani, 2009), women's rights (Dempsey, 1992), women's working conditions (Bates, 2006) and mental health (Sharma et al., 2007), and so on.

For a resource-based city, resource-related industries are often dominant in its urban economy, thus its development deeply depends on, therefore is also subject to, local resource reserves (Li et al., 2013). As most natural resources are nonrenewable, a resource-based city usually has a life-cycle of formation, growth, prosperity, recession or revival (Figure 1) (Bradbury, 1988; Wang et al. 2012). Sometimes natural resource is a *curse* rather than a *blessing* to a city (Papyrakis et al., 2007; Sachs et al., 2001). Due to over-dependence on local resources, resource-based cities often suffer from resource depletions, increasing mining costs and supply-demand change of resources (Shao et al., 2011), and their economies are inherently unsustainable (Walker et al., 2003). For these reasons, researchers pay many attentions to sustainable development of resource-based cities (for example, Azapagic, 2004; Hilson et al., 2000; Liu et al., 2011; Martinet et al., 2007; Pierce, 1992; Shen et al., 2005; Yu et al., 2008). Some of them argued that maybe long-distance commuting is a better approach to harvest natural resources than building resource-based city (Houghton, 1993; Jackson, 1987; Paker, 1988). However, when those existent resource-based cities enter their recession stages, economic reconstructing and transition are unavoidable (Barnes et al., 1990; Dong et al., 2007; Li et al., 2013).

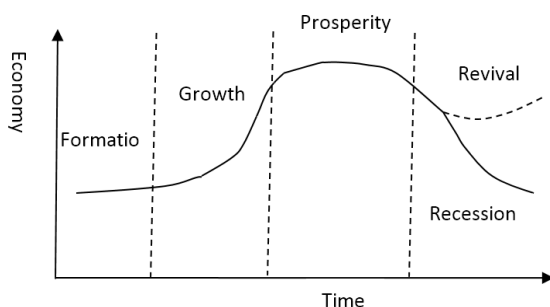


Figure 1. Life-cycle of resource-based cities

As a great nation strong in natural resources, China has built up many resource-based cities. Nowadays China has more than 600 cities, 262 of them are list as resource-based cities. Since new China was established in 1949, Chinese resource-based cities have produced 52.9 billion tons of raw coals, 5.5 billion tons of crude oils, 5.8 billion tons of iron ores and 2

billion cubic meters of timbers, thus have made enormous contributions to China's industrialization (State Council, 2013). Since the later 1980s, however, some of these cities started to confront all kinds of problems, including rapid resource depletion, difficulty in development of alternative industries, serious environmental pollutions, and coexistence of low income and high unemployment (Dong et al., 2007). Especially, those cities depleted more than 70% of their natural resource reserves, which are regarded as resource-exhausted cities in China, are struggling for survivals. These resource-exhausted cities were once known as *boiler room of the republic* and *raw materials storehouse of the republic*, and now are the *problem cities* of China. Since the mid-1990s, China's central government has made a lot of efforts to support resource-based cities' sustainability, such as special financial transfer payments to these cities, projects to expand employment, develop alternative industries and utilize energy and resources comprehensively in these cities (Li et al., 2013). One of the latest efforts is the plan for the sustainable development of the resource-based cities (2013-2020) formulated by State Council in 2013. This plan divides 262 resource-based cities into four categories according to their stages of life-cycle: 31 growth-type ones, 141 mature-type ones, 67 exhausted-type ones and 23 revival-type ones and tries to give them different supports. At the same time, local governments of some resources-exhausted cities start to actively take measures to meet their challenges.

In this article, we take Lengshuijiang as a case to investigate the sustainability challenges it faces and its responses to them. Lengshuijiang is selected as a case study because it is not only a typical resource-based city but also one of the 67 Chinese resource-exhausted cities. Given that the problems of Lengshuijiang are not uncommon in other resource-exhausted cities in China, the conceptual and analytical framework development in this article can provided reference for other resource-exhausted cities in coping with their own sustainability challenges. Insights gained from this research will shed some light on other similar cities.

2. Development problems of Lengshuijiang

Lengshuijiang is a county-level city, which covers an area of 439 square kilometers and has a population of 380 thousand. It located in the central of Hunan Province, which is a medium-sized province located in the south central China. Lengshuijiang possesses rich mineral resources. More than 40 kinds of mineral deposits were prospected, including antimony, iron, lead and other metals, and coal, graphite, silica, talc and other non-metallic minerals, in the territory of Lengshuijiang. It is known as the *world capital of antimony*, the *coal sea in Jiangnan*, and

the *home of non-ferrous metals* because of large reserves of antimony, coal and nonferrous metals. Although it is a smaller one in Hunan's 88 counties or county-level cities, Lengshuijiang has been an important energy and raw material base of Hunan Province for a long time. Lengshuijiang has seen impressive economic growth thanks to its rich mineral resources in the last thirty years. Its GDP amounted to 23.64 billion Yuan in 2013. It takes only about 0.2% of Hunan land and 0.5% of Hunan population, but creates 1% of Hunan GDP and contributes 0.7% of Hunan fiscal revenues. However, some problems have become increasingly prominent since the late 1980s. These problems have greatly threatened Lengshuijiang's sustainability.

2.1 Resource depletion

The most direct problem of Lengshuijiang is the resource depletion. Resource depletion is the inevitable fate of all resource-based cities because of the contradiction between limited supply and infinite demand of natural resources. But it was not a problem to Lengshuijiang before 1980. Lengshuijiang's mining scale was always not very large, although it has a mining history of more than one hundred years. However, the situation changed dramatically since China began the reform and opening-up policy in 1978. Hundreds of small mining enterprises were set up and the annual production volume surged. Furthermore, most of these enterprises used backward mining technology, and a large number of resources were destroyed and wasted. Predatory and destructive mining model accelerated the process of resource depletion badly. Resource depletion began to be a big problem in the early 1990s. In the 2000s, things have gone from bad to worse. Up to now, most of mineral resources in mining are on the verge of extinction. Iron ore resource has completely dried up. Antimony ore reserves has drop to 4.78 million tons, and it will be depleted in no more than 10 years at the current mining rate. Coal reserves has drop to half of the proved reserves, about 0.3 billion tons, and will be depleted in about 20 years according to current mining rate. Moreover, shallow coal seams have been completely exploited and only deep coal seams are left, so that the costs of coal mining are soaring. Other resources, such as graphite, lead, zinc and gypsum, have also been depleted or exhausted. As a result, the mining industries started to shrink. In the past ten years, 298 mining enterprises went out of business, including all four iron ore mining enterprises. Only 80 mining enterprises survived and the total production plummeted. Annual antimony production reduced to less than half of its peak, while annual coal production fell to 25% of its peak. Resource processing industry also experienced serious impacts. Antimony smelting enterprises had to cut production, some coal-washing enterprises went bankrupt, iron making enterprises had to look elsewhere for iron ore, coal chemical enterprises and

power enterprises had to acquire raw materials from other places, etc.

2.2. Uncoordinated economic and industrial structure

Lengshuijiang has experienced rapid economic development over thirty years through the successful utilization of mineral resources. However, its further growth may be subject to the constraints imposed by its existing economic structure, which has a strong bias towards secondary industry. As shown in Table 1, over the past ten years, the percentage of secondary industry in GDP increased significantly, while the percentage of primary industry decreased slightly and the percentage of primary industry decreased greatly. The imbalance between different economic sectors is getting worse and worse. This imbalance influences the development of Lengshuijiang in several ways. First, it brings a lot of inconveniences to the residents' livings. The residents in Lengshuijiang have to depend on the services (e.g., education, medical care, banking, and other urban services) provided in other cities. Second, it undermines investors' willingness to invest in Lengshuijiang. Insufficient provision of professional services such as accounting, banking, trading, and insurance makes some prospective investors turn to other cities. Third, it exacerbates the problems of migrant workers and left-behind children. About 40% Lengshuijiang residents live in rural areas. Declining primary industry and rising secondary industry drive more and more rural residents go to the downtown area for better jobs, leaving their children at home with the old peoples.

Table 1. Shares of primary, secondary and tertiary industries in Lengshuijiang's GDP, source: Hunan Statistical Bureau (2013)

Year	Primary industry (%)	Secondary industry (%)	Tertiary industry (%)	Total (%)
2003	4.78	57.67	37.55	100
2004	5.39	60.36	34.28	100
2005	4.53	65.08	30.38	100
2006	4.04	67.33	28.63	100
2007	4.85	67.95	27.20	100
2008	4.34	69.90	25.76	100
2009	3.87	67.92	28.21	100
2010	3.51	69.89	26.6	100
2011	3.88	70.79	25.33	100
2012	3.69	70.90	25.41	100

Resource-based cities usually developed their industries based mainly on local natural resource exploitation at their initial stages of urbanization and industrialization; this is a practical and rapid development pattern. However, most resource-based cities still deeply depend on resource-related industries in the subsequent course of development due to *path dependence* (Yang et al., 2011). Lengshuijiang is

such a prime example. It developed on the basis of the mining and now its industrial development is still driven by five pillar industries-mining, metallurgy, coal-fired power, coal chemical and building material industry, all related to local mineral resources. The output value of these five industries accounts for about 90% of the total industrial output value. Furthermore, most of the industrial enterprises are medium and small-sized. Lengshuijiang has about 1200 industrial enterprises, only about 100 of them are above designated size. Major industrial products of Lengshuijiang are low-tech primary products (see Table 2). This kind of industrial structure causes several problems. Firstly, it makes Lengshuijiang very vulnerable to market changes. For example, the weak coal market brought enormous difficulties to Lengshuijiang in latter 1990s. Secondly, local labor markets are full of low skilled workers. A low skilled worker is hard to find a new one when he loses his job, while a technology-intensive enterprise is difficult to find a needed worker in Lengshuijiang. Thus the efforts to establish technology-intensive industries and to change the industry structure encountered unimaginable difficulties. Thirdly, it leads to the inefficient utilization of resource and heavy environmental pollution. Five pillar industries mentioned above all belong to high pollution industries, and the fact that most small and medium-sized enterprises utilize resources inefficiently with backward technologies make things worse.

Table 2. Major industrial products of Lengshuijiang in 2013, source: Lengshuijiang Statistical Bureau

Product	Production	Growth rate
Raw coal	5096 thousand tons	-7.5%
Electric energy	8 billion KWh	14.0%
Crude steel	2410 thousand tons	-0.1%
Steel products	3550 thousand tons	2.7%
Soda ash	168 thousand tons	9.0%
Nitrogenous fertilizer (equivalent)	248 t housand tons	5.5%
Cement	407 thousand tons	8.6%
Antimony products	93 thousand tons	10.1%
Clothes	3710 thousand suits	-0.5%

2.3 Environmental destruction

Environmental costs of Lengshuijiang's economic development are extremely heavy. First of all, long term mining brought a large area of goaf. In mid-2013, Lengshuijiang's goaf area reached about 17400 hectares, accounting for 34% of its total area. Goaf led to about 4000 ground subsidence that

resulted in disastrous consequences. According to incomplete statistics, in the goaf areas of Lengshuijiang, 85% of reservoirs leak seriously, 66 thousand people lack adequate drinking water, 68% of farmlands were destroyed and a lot of them abandoned, 418.6 thousand square meters of buildings were badly damaged, more than 12900 houses were influenced to different degree, more than 2000 houses have collapsed or been uninhabitable, and the direct economic losses amounted to billions of Yuan. Secondly, a large amount of industrial solid wastes were accumulated. These industrial solid wastes include coal gangue, fly ash, antimony slag, iron slag, arsenic alkali residue and others. There is no accurate statistics about how many industrial solid wastes accumulated in Lengshuijiang. According to a conservative estimate, tens of millions of tons of industrial solid wastes were accumulated in the territory of Lengshuijiang over the past several decades, piling up haphazardly in more than one hundred places. Moreover, it is still growing at the rate of millions of tons annually. These industrial solid wastes not only take up a lot of fertile farmland, but also cause some other environment problems such as deterioration of groundwater, degradation of vegetation, destruction of arable lands because of toxic substances penetrating. Furthermore, industrial solid waste pile collapse frequently occurs, and become a local safety hazard. Thirdly, air and water pollution are serious. Lengshuijiang produces about 140 million tons of industrial waste water and 70 million standard cubic meters of industrial waste gas each year. The quality of water of Lengshuijiang's main river is lower than the national grade five standards because of ammonia, nitrite and other pollutants. The concentrations of atmospheric sulfur dioxide, nitrogen dioxide, and other inhalable particles are also very high. The average air quality of Lengshuijiang can only reach the national grade three standards. Environmental pollution has seriously threatened the health of the residents of Lengshuijiang that the rates of cancer, silicosis, and lithiasis in Lengshuijiang have been ranked highest in Hunan Province for a long time.

2.4 Poor infrastructure

Inadequate infrastructure is a long-standing problem of Lengshuijiang. Lengshuijiang city was built in 1960s. The original purpose to build it was to service the surrounding mines and factories. Although large sums have been invested in Lengshuijiang by the State and the Province over past several decades, most investments were used in construction of mines and factories. The construction of infrastructure has been left to the local government. Since the local government's financial resources are limited, poor infrastructure is inevitable. Up to now, 150 thousand people crowd in the central downtown of Lengshuijiang, which is only 10 square kilometers and almost half of it is occupied by several factories. In the cen-

tral downtown, streets are narrow, schools and hospitals are crowded, traffic congestion has reached a tipping point, and the daily life of the residents has been seriously affected by production activities due to intertwining of residential areas and industrial areas. The situations are even worse in areas outside the central downtown. In some mining communities, many residents live in cramped old houses built in 1950s or 1960s, without access to running water, paved roads, clean toilets and other basic services, not to mention recreational or other facilities. Children's education is also an annoying problem in these communities. Children have to go to school tens of kilometers away without school bus services or crowd in a local small shabby classroom with fifty or sixty classmates. Poor infrastructures plus dreadful environmental pollutions force some residents choose to leave or at least let their children leave Lengshuijiang.

2.5 Unemployment, inequality and social stability

Due to the recession of mining and related industries, unemployment of Lengshuijiang has retained at high level for the last decade. Making matters worse is that most unemployed workers are older than forty years. It is extremely difficult for a woman over forty years old or a man over fifty years old to get a job in China (This is called 40-50 problem). The local government has made a lot of efforts to solve this problem, but has only gotten marginal success.

Lengshuijiang is relatively economic developed in Hunan province. Its *per capita* GDP reached 61700 Yuan (about 10 thousand dollars) in 2013 and was among the top ten highest in Hunan's 88 counties or county-level cities (Hunan Statistical Bureau, 2014). However, income inequality is very serious. Vast resources make a small part of the residents be rich quickly; millionaires or billionaires are not uncommon in Lengshuijiang. On the other hand, many families are fighting for their survivals. In 2013, 12 thousand families and 27 thousand people were granted a minimum living guarantee by the government (Hunan Statistical Bureau, 2014). Income inequality between urban and rural residents is particularly serious. Among 380 thousand residents of Lengshuijiang, about 240 thousand live in the central downtown or other towns and other 140 thousand live in the rural areas. The per capita annual disposable income of urban residents was 23489 Yuan while that of rural residents was only 15407 Yuan in 2013 (Hunan Statistical Bureau, 2014). It aggravates this problem that social securities in rural areas are far below in urban areas.

Unemployment, inequality and other troubles make many people frustrated. Suicide, violence, drug and alcohol abuse, gambling, prostitution and other problems haunt on some communities. Some people vent their discontents through strikes, breaking the traffic, group petitions and other ways. Social stable prob-

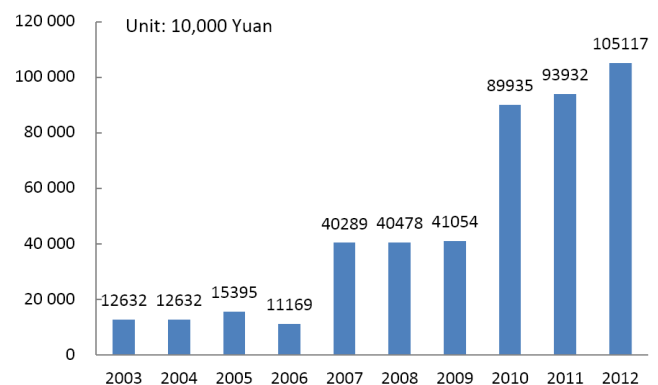
lem has also cast a shadow on the sustainable development of Lengshuijiang.

2.6 Low administrative status and fiscal deficit

China's administrative hierarchy consists of five levels. They are, in descending order, the top (State Council), province level, prefecture level, county level, and township level government. In China, a city with higher administrative status has more administrative power, autonomy and financial resources, and other privileges, so administrative status affects vastly a city's competitive advantages. Before 2000, Lengshuijiang and Loudi, another county-level city, had long been two well-matched competitors in the surrounding areas. Lengshuijiang even had some advantages over Loudi at that time. However, things reversed after Lengshuijiang failed in a competition for a prefecture-level-city position with Loudi in 1999. Now, Lengshuijiang is still a county-level city and administrated by Loudi which is already a prefecture-level city. In no more than ten years, Loudi has won overwhelming advantages over Lengshuijiang.

Lower administrative status brings some problems to Lengshuijiang. Firstly, it lowers Lengshuijiang municipal government's management authority. Lengshuijiang municipal government cannot effectively regulate some enterprises which are owned by governments at higher levels. For example, it cannot effectively deter their pollution behaviors and arbitrary mining behaviors. Secondly, it brings financial problems. Lower administrative status makes Lengshuijiang have to turn over a large portion of its revenues to governments at higher levels. In 2012, total revenue raised in Lengshuijiang amounted to 2.04 billion Yuan and almost 60% of it was turned over to governments at higher levels. Lower administrative status also makes Lengshuijiang at a disadvantage in obtaining subsidies and transfer payments from governments at higher levels. Thus Lengshuijiang has been plagued by fiscal deficit (see Figure 2), which greatly restricts Lengshuijiang's ability to deal with problems mentioned above.

Figure 2. Fiscal deficit of Lengshuijiang, source: Statistical Yearbook of Hunan Province (2004-2013).



3. CYSH: Lengshuijiang's responses to its development problems

Lengshuijiang took the problems of unemployment and social stability as its top priority before 2004, although all kinds of problems emerged in the late 1980s. It started to reconstruct its economy since 2004, but made less progress. The turning points emerged when Lengshuijiang was approved as a resource-exhausted city by State Council in 2009. That means huge sum of transfer payment from central government and series of preferential policies. Taking this opportunity, Lengshuijiang formulated a strategy (Called YiZhuan Sanhua, CYSH) to cope with its sustainability challenges systematically in 2009. CYSH has four main tasks: reconstructing economy, improving infrastructure, environmental protection and recovery, lessening income inequality between urban and rural residents.

3.1 Reconstructing economy

As mentioned above, low tech small and medium-sized enterprises of coal mining, metallurgy, coal-fired power, chemical and building material industries dominate in Lengshuijiang's economy. The first task of CYSH aims at this problem of reconstructing economy. It plans to take actions in both developing alternative industries and strengthening existing pillar industries.

3.1.1. Developing alternative industries

The first priority of reconstructing economy is to diversify economy. To do this, Lengshuijiang has actively developed following alternative industries.

(1) Hi-tech industries. Hi-tech industry is one of the main industrial developing orientations of Lengshuijiang. It set up a science park, built a center for entrepreneurship and an enterprise incubator to promote hi-tech industries. Taking two national high-tech industrialization demonstration projects, ceramic roller ring and Ganfule (a medicine), as a breakthrough, Lengshuijiang has initially established medicine industry and engineering ceramics industry. In medicine industry, absorbable protein suture, Ganfule and some traditional Chinese medicine products have been successfully marketed. Ceramics industry has also developed ceramic roller ring, ceramic drawing die, ceramic blade, and other products. There were 12 hi-tech enterprises above designated scale in Lengshuijiang in 2013, and the added value of these 12 enterprises reached 2.3 billion Yuan.

(2) Clothing and agricultural product processing industries. Due to pressure of employment, labor-intensive industries such as textile and food industries are also chose as alternative industries. A successful story is the Golden Eagle garment project invested by Golden Eagle group. Golden Eagle group's garment business not only provides about two thousand jobs but also rives related industries such as spinning,

weaving and garment accessories to boom in Lengshuijiang. To take advantage of rich agricultural resources of adjacent areas, Lengshuijiang also tries to develop agricultural product processing industries. A meat processing plant with annual production of 20 thousand tons and a red bayberry wine plant with annual production of 10 thousand tons have been built up.

(3) Tourist industry. Lengshuijiang boasts unique natural scenery. Boyue Cave had been developed into a well-known scenic spot in 1980s. In recent years, Daxiong Mountain, Zijiang River, and Zhadu have been developed successively. Xikuangshan, which was once the largest antimony mine in the world, will be turned into a mine sites park. Tourism industry is now a promising industry in Lengshuijiang.

(4) Other industries. Although, agriculture is not an important sector in Lengshuijiang economy, Lengshuijiang has made great efforts in it. Facility agriculture, animal husbandry, flower culture, and Chinese herbal medicine planting all have some progress. Other industries such as trade, logistic and neighborhood services also have developed quickly.

3.1.2. Strengthening pillar industries

Lengshuijiang desperately need to change its industrial structure. However, alternative industries cannot be developed in a short time. Lengshuijiang will depend on its five pillar industries in a long time. Thus, it has adopted a series of measures to strengthen its pillar industries.

(1) Mine purge and limiting production. Due to various reasons, mining industry has been in disorder in Lengshuijiang. Illegal mining is a serious problem. Since 2009, Lengshuijiang has made purges in mining industry. More than 100 coal mines and 75 antimony smelting enterprises were closed. To prolong the mining time limit, total annual production of coal is limited to about 5 million tons, while that of antimony is limited to about 100 thousand tons. Lengshuijiang antimony production cut was so large that world antimony price almost doubled (Financial Times, 2011).

(2) Scale economy and cluster development. Lengshuijiang encourages leading enterprises to merge small enterprises and orders that annual production of all coal mines cannot be less than 60 thousand tons. It also guides enterprises to cluster in Lengshuijiang economic development zone and Lengshuijiang industrial park. Clustering is helpful not only for enterprises growth but also for pollution control.

(3) Extending industry chains. Short value chain and low added value are striking characteristics of Lengshuijiang pillar industries. Therefore Lengshuijiang supports enterprises to extend their value chains. Antimony-related industry has initially formed a diversified development pattern of star metal, antimony trioxide, and dust-free antimony tri-

oxide. Coal-related industry is turning to coal mining, coal washing, coal preparation and coal blending from purely coal mining. Iron-related industry has formed a chain of iron, steel, stainless steel, and fasteners.

(4) Upgrading technology and eliminating outdated industrial capacity. Backward technology is another characteristic of Lengshuijiang pillar industries. Lengshuijiang actively guides and supports enterprises to upgrading technology. All the coal mines and antimony-related enterprises have upgraded their technologies in some extents. Lengshuijiang also eliminated some outdated industrial capacities such as small coal-fired power generating units, small blast furnace and converter.

3.2. Improving infrastructure

Poor infrastructure has hurt Lengshuijiang's competitiveness for a long time. So the second task of CYSH is to improve infrastructure. It plans to take three major actions.

3.2.1. Renewing the old urban center

Lengshuijiang has invested about 2 billion Yuan in renewing its old urban center since 2009. The most important measure is to move several large factories in downtown area out to suburbs. Thus there are more lands for infrastructures in the downtown area. East Jinzhu Road, North Tidu Road, North Huan-cheng Road and other main streets were upgraded. Binjiang Park, several parking lots and a comprehensive underground pipe network were constructed. A large number of residential areas were rebuilt. Water, electricity, gas, bus service and other facilities got a large improvement. Schools, hospitals, shopping centers were also improved dramatically. A new sewage treatment plant with a total capacity of 30 thousand tons a year was built. The living conditions in downtown area have changed considerably in just four years.

3.2.2 Building a new urban center

The old urban center of Lengshuijiang is already too crowded for existing 150 thousand people-not to mention to accommodate more people. So Lengshuijiang started to build a new urban center which is located about 5 kilometers east to the old urban center since July 2010. The new urban center will cover an area of 10 square kilometers. Unlike the old one, there will be no industrial enterprises in the new urban center. It is mainly for residence, administration, education, and medical care. In the past three years, the trunk road network has been finished, a new primary school, a new hospital and the new administrative center are put into use. Several residence communities has been completed, about 30 thousand people already live there. According to plans, there will be about 100 thousand people live in the new urban center by 2020.

3.2.3 Constructing a better transportation network

Lengshuijiang's transportation is poor. Its external traffic mainly depend on provincial highway 312 line and Xiangqian railway line. Neither of them is high grade. Its internal traffic is even much worse. Many people rely on dirt roads and need take several hours to the downtown which is only thirty or forty kilometers away. To change this situation, Lengshuijiang plans to build two traffic circles: one and a half hours communicational circle and half an hour fast commuter circle. The former is composed of super highway and high-speed railway and will be completed in 2015; it will make Lengshuijiang be within 1.5 hours drive eastward to Changsha, westward to Huaihua, northward to Yiyang and southward to Shaoyang. The latter is composed of improved existing and newly-built country roads, which will be finished in 2018; it will make people can reach the downtown area in half an hour from any location in the territory of Lengshuijiang.

3.3. Environmental protection and recovery

Environment destruction has been another threat to Lengshuijiang's sustainability. For a promising future, Lengshuijiang need to put environment destruction under control. This is the third task of CYSH.

3.3.1. Building an environment protection system of multi-level and all directions

Lengshuijiang pledges to become an ecological city by 2020 in CYSH. It tries to build Zijiang River, the mother river of Lengshuijiang, into a scenic belt, and establish two ecological protection zones. One is the core protection zone which takes the new urban areas as its center; the other is the suburban protection zone which locates in the outskirts. Improving the awareness of environmental protection among the public is also a very important part of its environment protection system. Although Lengshuijiang is in an extremely adverse environmental condition, most residents lack the awareness of environmental protection. To remedy this, Lengshuijiang carried out a series of environment publicity and education activities since 2009. It also launched a campaign for Provincial Hygienic City in 2010 and successfully got the title of Provincial Hygienic City in 2012.

3.3.2. Cutting emission and controlling new pollution sources

Economic growth was the first priority and environmental protection was almost ignored in Lengshuijiang in the past time. The latter got much higher priority since 2009. From then on, a large number of small enterprises such as coal mines and refineries were forced to close due to pollution. All large or medium enterprises were required to use new technology and install new equipment to reduce pollution within prescribed time limit. Any new enterprises will not be permit to open until it attains the

protecting environmental standard. Circular economy is encouraged, Lengshuijiang uses tax credit, fiscal subsidies and other preferential policies to stimulate the development of circular economy. Many enterprises are established to utilize industrial wastes of existing enterprises in recent years. Some enterprises such as gangue power plant, gangue brick factory, and slag cement factory have achieved considerable success.

3.3.3. *Reclaiming land and restoring ecology*

Mining caused a large area of subsidence, desertification and ecological damage in Lengshuijiang. Lengshuijiang started some projects of land reclamation and ecological restoration of mining areas since 2000. These projects included goaf backfilling, reforestation, water and soil conservation, resettlement, and reduction of heavy metal contents in water and soils. However, all of them were on small scales because of lacking money. After receiving 0.1 billion Yuan of special fund from central government in 2010 and being included in the key state project—the project of heavy metal pollution treatment of Xiangjiang River Basin in 2011, Lengshuijiang accelerated its projects of land reclamation and ecological restoration. Since then, Lengshuijiang has added 270 hectares of arable land and planted 4000 thousand trees.

3.4 *Lessening income disparity between urban and rural residents*

The fourth task of CYSH is to lessening income disparity between urban and rural residents. CYSH proposes two major measures.

3.4.1 *Household registration deregulation*

China implements the strictest household registration system in the world. Under this system, every Chinese citizen gets an urban or rural hukou (registered permanent residence) since birth according to his parents' hukou. Hukou transfer is rigorously controlled, especially from a rural to an urban address. Hukou decides a man enjoys what kinds of treatments in a place. A man with a rural hukou living in urban area is usually unevenly treated by local government. Lengshuijiang tries to break obstacles of the household registration system. It allows its residents relatively freely transfer their hukou in its administrative scope. It also cut down privileges binding to hukou. For example, since 2010, people with rural hukou living in Lengshuijiang can enjoy the same treatment as urban residents in employment, children's education, pension, medical care, minimum living security and social assistance, and people with urban hukou were permitted to build houses in rural areas and rent arable lands.

3.4.2 *Bettering public services in rural areas*

Before 2009, Lengshuijiang expended only 97 million Yuan in roads, medical services, water supply,

education, bus service, garbage dispose and other public services in rural areas each year. Since 2010, this expenditure increased to 200 million Yuan. Lengshuijiang launched a series projects to improve living conditions of rural residents. For example, it implemented a project call *three changes*. This project aimed to change the model of rural families' kitchen, bathroom, and raising livestock. It also began to plan new rural residential quarters with better public services and guide rural residents to build houses in these new residential quarters. For those rural residents who cannot afford to build new house but need it, local government supplies some subsidies. At the same time, endowment insurance, medical insurance, minimum living security and other social security policies gradually extend to cover rural residents.

4. **Conclusions**

In recent years, resources-exhausted cities in China face more and more sustainability challenges, which not only threaten the developments of these cities but also put enormous pressures on China's sustainability. One key theme that emerges from the above discussions concerns that how a resource-exhausted city to transfer to a more sustainable development trajectory in a shorter period of time.

As a typical resource-exhausted city, Lengshuijiang's development suffered from resource depletion, uncoordinated economic and industrial structure, environmental destruction, poor infrastructure, income inequality and fiscal deficit in the past two decades. Things turn out to be better after the CYSH strategy began to be implemented in 2009. Following years of transition and colossal efforts from local government and governments at higher levels, Lengshuijiang has made significant progress. Several alternative industrial have been initially developed, environmental picture has been better, infrastructure has been greatly improved, and the residents got a more suitable living condition. Furthermore, the public awareness of environmental protection and sustainable development has been promoted and the residents pay more attentions on these problems. This will greatly encourage and facilitate governments and enterprises behave more responsibly in economic activities and guarantee a more sustainable development. However, although Lengshuijiang has had some success in the past several years, there are more challenges remain ahead of it. Its environmental destruction is still serious, its natural resource reserves become much less while its pillar industries are still highly resource-intensive, its income inequality and fiscal deficit even get worse, and a large development gap between its urban and rural areas needs to narrow, and so on. Lengshuijiang still has a long way to go in its pursuit of sustainable development.

From the experience of Lengshuijiang, we consider that successful sustainable transition is absolutely a long and costly process. In Chinese context, it requires joint efforts of governments at all levels and local residents. First, it needs financial support from central government. China's tax system funnels most revenue to the central government, with the local authorities left to handle the bulk of spending on most public services. As a result, local governments have limited finances. Almost all of the resource-exhausted cities face huge fiscal deficits; they even cannot start a transition without help. Second, local government must suppress the impulse of increasing GDP. In the current regime, a Chinese mayor will be promoted to a higher position if his city has a faster economic growth. So many resource-exhausted cities ignore environmental pollutions in pursuit of economic development and results in further damage to their sustainability. Third, local residents should actively participate in the process of making local development policy. Chinese residents are usually excluded from the process of making policy, while local officials mainly are outsiders from other places. Under this condition, local policies usually pay more attention to the growth in short-term rather the sustainable development in long-term.

References

1. AZAPAGIC, A., 2004, Developing a framework for sustainable development indicators for the mining and minerals industry, in: *Journal of Cleaner Production*, vol. 12, no 6, p. 639-662.
2. BATES J., 2006, Gendered Space of Industrial Restructuring in Resource Peripheries: The case of Corner Brook Region, Newfoundland, in: *Journal of Economic Social Geography*, vol. 97, no 2, p. 126-137.
3. BRADBURY J.H., MARTIN S.T., 1983, Wind-ing down in a Quebec mining town: A case study of Schefferville, in: *Canadian Geogra-pher*, vol. 27, p. 128-144.
4. BRADBURY, J., 1988, Living with boom and bust cycles: new towns on the resource frontier in Canada, 1945-1986, in: *Resource Commu-nities: Settlement and Workforce Issues*, p. 3-20.
5. BARNES T., HAYTER R., GRASS E., 1990, MacMillan Bloedel: Corporate restructuring and community change in Chemainus, British Columbia, in: *Regional Studies*, vol. 26, p. 647-643.
6. DEMPSEY K., 1992, *A man's Town: Inequality between Women and Men in Rural Australia*, Oxford University Press, 290-315.
7. DONG S.C., LI Z.H., LI B., and XUE M., 2007, Problems and Strategies of Industrial Transfor-mation of China's Resource-based Cities, in: *China Population, Resources and Environment*, vol. 17, no 5, p. 12-17.
8. *Financial Times*,
<http://www.ft.com/cms/s/0/a66a2412-2264-11e0-b6a2-00144feab49a.html>, (17.01.2011).
9. GILL, A.M., 1990, Enhancing social interaction in new resource towns: planning perspectives, in: *Journal of Economic and Social Geography*, vol. 81, no 5, p. 348-363.
10. HALSETH, G., 1999, Resource town employ-ment: perceptions in small town British Colum-bia, in: *Tijdschrift Voor Economische en Sociale Geografie*, vol. 90, no 2, p. 196-210.
11. HILSON, G., MURCK, B., 2000, Sustainable development in the mining industry: clarifying the corporate perspective, in: *Resources Policy*, vol.26, no 4, p. 227-238.
12. HOUGHTON, D., 1993, Long-distance com-muting: a new approach to mining in Australia, in: *The Geographical Journal*, vol. 159, no 3, p. 281-290.
13. Hunan Statistical Bureau, 2014, Lengshui-jiang's economy and society developed statisti-cal bulletin in 2013.
http://www.hntj.gov.cn/tjgb/xqgb/ldgb/201404/t20140411_108825.htm. (16.06.2014)
14. JACKSON, R., 1987, Commuter mining and the Kidston gold mine: goodbye to mining town, in: *Geography*, vol. 243, no 72, p. 159-170.
15. LI H.J., LONG R.Y., CHEN H., 2013, Eco-nomic transition policies in Chinese resource-based cities: An overview of government ef-forts, in: *Energy Policy*, vol. 55, p. 251-260.
16. LIU, Y., YIN, G., MA, L.J.C., 2011, Local state and administrative urbanization in post reform China: a case study of Hebi City, Henan Prov-ince, in: *Cities*, vol. 29, no.2, p. 107-117.
17. MARTINET, V., DOYEN, L., 2007, Sustaina-bility of an economy with an exhaustible re-source: a viable control approach, in: *Resource and Energy Economics*, vol. 29, no 1, p. 17-39.
18. MARSH B., 1987, Continuity and Decline in the Anthracite Towns of Pennsylvania, in: *Annals of Association of America Geographers*, vol. 77, no 3, p. 337-352.
19. PANI, N., 2009, Resource cities across phases of globalization: evidence from Bangalore, in: *Habitat International*, vol. 33, no 1, p. 114-119.
20. PAPYRAKIS, E., GERLAGH, R., 2007, Re-source abundance and economic growth in the United States, in: *European Economic Review*, vol. 51, no 4, p. 1011-1039.
21. PAKER, P., 1988, *The cost of remote locations: Queensland coal towns. Resource Commu-nities: Settlement and Workforce Issues*, p. 79-95.
22. PETERS E., ROSENBERG M.W., 1995, Labor Force Attachment and Regional Development for Native Peoples: Theoretical and Methodo-logical Issues, in: *Canadian Journal of Regional Science*, vol. 18, p. 77-106.
23. PIERCE, J.T., 1992, Progress and the biosphere: the dialectics of sustainable development, in:

- Canadian Geographer*, vol. 36, no 4, p. 306-320.
24. RANDALL, J.E., IRONSIDE, R.G., 1996, Communities on the edge: an economic geography of resource-dependent communities in Canada, in: *Canadian Geographer*, vol. 40, no 1, p. 17-35.
 25. SACHS, J., WARNER, A., 2001, The curse of natural resources, in: *European Economic Review*, vol. 45, no 4-6, p. 827-838.
 26. SHAO J., ZHOU J.Q., 2011, Study on the influences of industry transformation on the sustainable development of resource-exhausted city space, in: *Procedia Engineering*, vol. 21, p. 421-427.
 27. SHARMA, S., REES, S., 2007, Consideration of the determinants of women's mental health in remote Australian mining towns, in: *Australian Journal of Rural Health*, vol. 15, no 1, p. 1-7.
 28. SHEN, L., CHENG, S., GUNSON, A.J., et al., 2005, Urbanization, sustainability and the utilization of energy and mineral resources in China, in: *Cities*, vol. 22, no 4, p. 287-302.
 29. STATE COUNCIL, 2013, *The plan for the sustainable development of the resource-based cities (2013-2020)*.
 30. WALKER M., JOURDAN P., P., 2003, Resource-based sustainable development: an alternative approach to industrialization in South Africa, in: *Minerals & Energy Raw Materials Report*, vol.18, no 3, p. 25-43.
 31. WANG S.Y., GUO S.Q, 2012, Study on Countermeasures for sustainable development of Resource-Exhausted Cities, in: *China Soft Science*, no 1, p. 1-13.
 32. YANG J.R., HUANG X., ZHANG S., 2011, RESOURCE-BASED CITIES' TRANSFORMATION: REVIVE, DILIMA AND ROUTE, in: *Economic Theory and Business Management*, no. 12, p.77-83.
 33. YU, J., ZHANG, Z., ZHOU, Y., 2008, The sustainability of China's major mining cities, in: *Resources Policy*, vol. 33, no 1, p. 12-22.

Application of Environmental and Social Sustainable Measures by Port of Koper: The Basis for the Regional Approach

Aplikacja środowiskowych i społecznych inicjatyw w porcie Koper: przykład podejścia regionalnego

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Abstract

This paper aims at identification of environmental initiatives and measures that affect maritime ports. The first part of the article describes the trend and drivers towards application of environmental measures in port sector. The second part describes the application of environmental measures and social elements at Port of Koper and analyses the main fields of environmental development. The Port of Koper can be used as the case platform for other similar and equally sized ports in the region, therefore a six pillar environmental with a social pillar platform is presented. The study results could help port management to define a scenario for a faster introduction of environmental and social objectives and measures in order to follow sustainable development and position itself in the future green and sustainable supply chains.

Key words: ports, environmental initiatives, social pillar of sustainable development, green policy

Streszczenie

Artykuł ma na celu identyfikację inicjatyw i działań, które mają wpływ na środowisko portów morskich. Pierwsza część artykułu opisuje trend i działania podejmowane w kierunku ochrony środowiska w sektorze portowym. Druga część opisuje przykład portu Koper, analizując wprowadzane rozwiązania odnoszące się do aspektów społecznych i środowiskowych. Koper stanowić może punkt odniesienia dla innych portów w regionie Adriatyku o porównywalnej wielkości, dlatego wyznaczono składający się z 6 elementów model środowiskowy, uwzględniając także uwarunkowania społeczne. Wyniki badań mogą pomóc w zarządzaniu portami, określając wzorcowy scenariusz dla szybszego wdrażania celów i działań tak środowiskowych, jak społecznych, zgodnych ze zrównoważonym rozwojem.

Słowa kluczowe: porty, inicjatywy środowiskowe, społeczny filar rozwoju zrównoważonego, zielona polityka

Introduction

The green logistics approach is more and more evident also in managing philosophies of ports. The management of the port must adopt new approaches in order to find measures against environmental impacts on the sea and land used by the system. Moreover, ports are important intermodal nodes for other transport modes and trades and as a result they have

to consider the impacts of climate change caused by their operations and create the necessary adaptation (Vidal, 2010).

Consequently, the environment issues are becoming one of the strategic pillars in port development, supported also by the entire industry. Namely, key executives in port and transport industry within Europe believe that the green strategy is an important element of a company's strategy (Eyefortransport,

2008). Climate change, CO₂ emissions, waste collecting, reprocessing and finally redistribution are significant factors in logistical decision-making (Murphy, 2000; de Bruto & Dekker, 2004; Darnall et al., 2008). At the same time the transport industry is still focused on economical delivery times and high safety standards. To some extent, such directions may contradict the green logistics approach (Mollenkopf, 2010).

Ports are under pressure to adopt green initiatives, which has forced some ports to implement green thinking in management's decisions and long-term development strategy. The process is mostly valid for port systems in Western economies. Emmett and Sood (2010) see benefits from such an approach, mostly in a reduced impact on the ecosystem and on wider environmental degradation, in the enhanced safety in the port and in overall better health environment. In order to encourage other ports Van de Voorde et al. (1998) claim that focused researches in port's responsibility regarding environment and maritime safety are needed. Kontovas and Psaraftis (2011) propose to include and combine analysis of the role of ships in the green port policy. According to Eden (2011) their GHG emissions, produced waste, noise pollution and energy consumptions affect ports significantly.

Koper port is one of the port systems that can be classified as one of the most advanced ports in green thinking and developing social sustainable environment. The port has already implemented various measures in different environmental and social areas, which makes it a model basis for other ports in the region or even globally. An in-deep analysis of past activities and the future orientation has been performed. The survey gives directions of further environmental improvements and important directions for social sustainable development of ports in the region. Port systems in South-East Europe will soon be forced to introduce green consciousness and invest in environment friendly technology (Beškovnik & Jakomin, 2010).

Environmental drivers and initiatives for ports **Understanding drivers and initiatives**

Green port initiative can be classified as a new approach versus traditional management philosophy of the 1990s. According to the port environmental review conducted by ESPO's EcoPorts (2009), the environmental goals were not listed in the top 10 developing priorities in mid-nineties of the last century. During the last two decades the environmental consciousness evolved and completely new drivers influence a port's development strategy. Results of the ESPO's survey expose that air quality, noise pollution, produced waste and energy consumption are among top goals in the managing port systems. The environmental drivers for ports vary between different ports according to their position, size and

layout of terminals, operational work, infrastructure and supra-structure in use, etc. All environmental drivers can have direct impacts on short-term economic operations, on costs effectiveness, on establishing new markets and alliances. The port can benefit from green measures, especially where the strong competition is present by the neighbouring ports. Nijkamp (1994) sees the environment friendly operations and transportation as drivers for a positive competition between ports. In regions with low competition the ports are more oriented towards higher performances and cost effectiveness resulting in a better financial outcome. Adams et al. (2009) expose that regulatory compliance and court-ordered activities might force such systems into carrying out the required environmental investments to follow legal recommendations. Since the top-down approach is not business friendly, the bottom-up approach where ports are interested in developing green measures is preferred by the entire port and shipping industry. Consequently, it proves beneficial for ports to understand, follow and gradually apply different environmental initiatives. Some of them can be easily adopted, whereas significant investments are requested for some of them. The initiatives can be divided into the following groups:

- Green shipping, with use of green ships,
- Energy consumption and recycling processes,
- Water and land quality,
- Sustainable and clean manipulation and internal transport,
- Sustainable hinterland transport,
- Sustainable accompanying actions in port development, dredging, maintenance, etc.
- Improvements in community and environmental involvement.

Following green port performances

The passive role of ports regarding environmental issues has gradually turned into an active one as ports follow green initiatives related to port communities Goulielmos (2000). The degree of green measures implementation is not equal in all ports, and essential differences exist among port systems. Therefore, states, governments and independent organizations establish an adequate model of monitoring and evaluating the port's environmental performance. Adams et al. (2009) point out the port's certification as a proper way with light top-down approach to stimulate ports in environmentally friendly thinking. The certification and assessment of environmental measures are made possible through Environmental Management Systems (EMS) at ports, including ISO 14001 and 14064 certificates, Environmental Management Handbook (EMH), Port Environmental Review System (PERS), and Eco-Management and Audit System (EMAS). The following measures which are of special importance are analysed:

- supporting green ships and ship/shore interface;
- traffic and transportation;
- clean air and Greenhouse Gas (GHG) emissions and reduced noise pollution;
- energy conservation and efficiency;
- water and land resources management, with purchasing and construction practices;
- waste and recycling management.

Goulielmos (2000) exposes the fact that introducing environmental measures in ports operation influences the economic and financial performance. Namely, environmental measures request investments in environmentally friendly technologies and sustainable development, with long-term benefits. Consequently, in a shorter period of time the investments might cause a lower profit, but in the future the port is expected to benefit from the increased new business generated by green logistics corridors and green supply chains respectively.

Social sustainable development of ports

According to Peris-Mora et al. (2005) the port management must develop not just environmental measures for sustainable development but social ones as well. The social perspective is an important sustainable pillar that complements economic and environmental sustainability. The concept of social sustainability that includes approaches towards social responsibility, liveability, community development, social support, worker's rights, cultural development and community resilience, spatial development, is more and more present in managing philosophies of port systems.

The social responsibility is particularly present in developed economies, with higher social awareness, higher quality of life and higher labour standards. This perspective was highlighted by western port communities during last ten years. Nowadays ports are more social oriented manifesting in higher concern for labour force and their health situation, extensive financial support of sport, cultural and humanitarian organizations, and by co-financing town infrastructural projects.

To some extent the social and environmental initiatives are complementary. Investing in environmental development the port at the same time develops social responsibility and in some cases *vice-versa*. As the port systems are still very dependent on labour they must strengthen their communication and cooperation through different pillars of social sustainable development. The same is valid for port-city relation, as both can benefit from a sustainable development (Daamen, 2007).

Application of environmental measures and social perspective at Koper port

The Port of Koper is a multipurpose port with 11 specialised terminals and an excellent location at the

head of the Adriatic Sea. The port throughput in 2013 exceeded 18 million tons of cargo, with a constant increase in the past years. Due to the port's complexity and throughput increase, the port management is under strong environmental pressure from the local community. The community supports the port's further development, but demands environmental considerations to be taken into account. Consequently, the port has to assume increasing responsibility in terms of environmental protection. The Port of Koper has already obtained important environmental certificates, which prove that the port already meets the requested environmental standards. The survey gives a view on the port's evolution towards the environment friendly maritime system. The port can be classified as one of the leading port systems in Europe in taking environmental actions and measures, and it can be used as a case model for other ports in the Adriatic area.

Introducing environmental initiatives

The Port of Koper strives to incorporate sustainable development and environmental protection into the system's environmental policy. In this way the port prescribes measurable goals in different environmental fields and performs regular inspections of the same. Activities within environmental policy can be divided into the following areas:

- Technology modernisation with energy-efficient machinery;
- Reduction of emissions and continuous monitoring processes on different points within port area;
- Prescribing preventive measures at workplaces;
- Following changes in environment management system and implementation of changes into the company's regulations;
- Building close partnership with companies working inside the port area and with local community.

The five orientations are the platform for a pallet of different actions within the following fields of environment protection: air pollution, noise pollution, waste management, illumination pollution, energy and fuel consumption; waste and potable water; safety of the sea and interventions in the local environment. In each field various environmental goals are defined, including measurable values that are in accordance with the environmental standards EMAS (Environmental Management and Audit Standards) and ISO 14001:2004 standard as presented in Table 1 (Luka Koper, 2012).

The environmental policy and orientation towards high environmentally standards are visible also through various certificates accredited to the port. The EMAS certificate confirms that the port adjusts its operations according to high standards. The port was also accredited with ISO 14001:2004 certificate,

Table 1. Environmental measures and objectives by Port of Koper

Environmental measure	Objective	Value of the objective	Achieving possibility
Air pollution	Decrease dust particle emissions from manipulation (mg/m ² /day) for each measurement	< 250 mg/m ² /day	Difficult
Air pollution	PM ₁₀ emissions across the entire port zone (µg/m ³)	< 30 µg/m ³	Moderate
Noise pollution	Night-time noise level in the direction of Koper city (dB)	48 dB	Moderate
Energy consumption	Energy consumption in the provision of port services (kWh/t cargo handled)	Decreasing by 3%	Moderate
Waste management	The percentage of separately collected waste (excl. waste from vessels)	> 84%	Moderate
Potable water consumption	Decrease potable water use in the provision of port services (l/t of cargo handled)	Decreasing by 3%	Difficult
Illumination pollution	Adjustment of illumination of facilities and operations to reduce light pollution	95%	Moderate

which confirms the environmental protection through ongoing modernization of supra-structure used by different terminals. Besides, the port obtained OHSAS 18001:2007 certification for occupational health and safety management system and HACCP ISO 22000:2005 certificate for a preventive management system. The latter confirms port's orientation in handling perishable goods that meets high standards posed by the certification process. Finally, the port was accredited with SEVESO II environmental certificate that is applied to the management of large quantities of dangerous substances in congruence with the Council of Europe Directive 96/82/EC.

Improving air quality

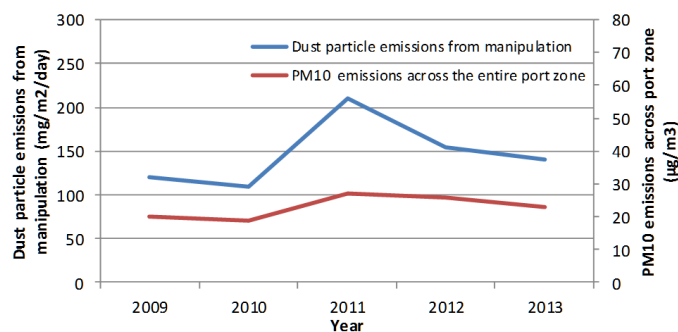
The port follows two measures related to quality of air in the port area and its surrounding. The first measure follows the concentration of dust particle emissions deriving from manipulation at ten points inside the port area. The objective posed at 250 mg/m²/day is much lower when compared to German guidelines with limit values of 350 mg/m²/day. The average result of one year was not overpassed in the last five years. The measurements performed in 2011 and 2012 show significant increase if compared to results from 2009 and 2010, but they do not reach the predefined frameworks. In 2013 the average result was at 140 mg/m²/day, which is close to the results from 2009 and 2010 (Figure 1).

The second measure follows the average annual emission of PM₁₀ particles (size of up to 10 µm). The annual results of measurements in the last five years do not reach the level as defined by the guidelines, which stands at 40 µg/m³. The port uses even a lower value at 30 µg/m³, which has been achieved from 2009 onwards. According to the port's report the measurements at three points in 2013 were in the range between 19 µg/m³ and 23 µg/m³ (Luka Koper, 2013). For comparison following green European ports obtain higher average results such as Antwerpen 34 µg/m³, Barcelona 33 µg/m³ and Valencia 26 µg/m³.

The principal activities bringing good results in the past years are mainly related to investments in new technologies and infrastructure on bulk and liquid terminals. The port invested in a retaining enclosure, which has been erected around the dry bulk cargo deposits. Moreover, water sprays were used to prevent dust generation and dust spreading, but later a protective paper sludge film on the coal depot was introduced. This technology shows better results in unfavourable weather conditions and in periods of strong winds.

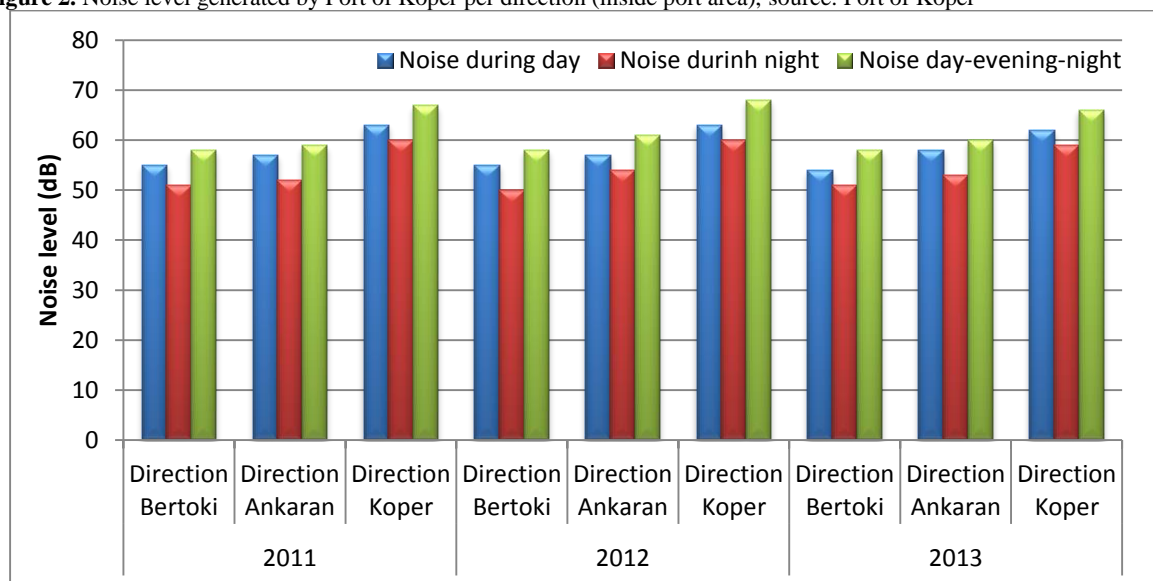
The port also invested in new filtering systems for handling cereals and in prevention of volatile liquids to evaporate in the air during the loading and unloading process.

Figure 1. Measures for air pollution from port activity
Source: Port of Koper



Reducing noise pollution

The Port of Koper is close to the city area. To the north it neighbours Ankaran and Koper to the south. In the west the town of Bertoki is expanding rapidly. Consequently, Port of Koper must pay attention to the noise pollution mainly generated by cargo handling operations, the use of machinery and vessel's generators during the stay at the port area. The port is ranked in group IV as industrial facility, where the maximum level of noise pollution must not exceed 63 dB. The areas close to the port zone are classified as type zones III, where the maximum noise is set at 48 dB.

Figure 2. Noise level generated by Port of Koper per direction (inside port area), source: Port of Koper

According to the results of monitoring for the years 2011, 2012 and 2013, the noise pollution is mainly generated by the container terminal and terminal for coal manipulation. The noise pollution affecting the city area of Koper is close to limit values, and results for 2013 are slightly lower when compared to those from 2012 (Figure 2). Based on reports by Port of Koper the noise pollution close to the port area did not exceed the defined max value of 48 dB in the last three years. Some other European ports achieve higher results. Namely port of Valencia registered noise pollution of 66 dB, Livorno 60 dB, Antwerpen 55 dB, Bremerhaven 50 dB.

The port has implemented various measures to keep noise pollution in the defined frameworks. Further reduction of noise pollution is possible by further relocation of noise-producing manipulations away from the city area but still within the port area, modernisation of handling and transport equipment, reducing speed limits, resurfacing manipulation area and roads close to the city area, and installation of visible warning devices instead of audible alarms for machinery operating during the night. With these activities the port shall keep noise pollution level below the defined maximum levels, despite the possible increase of throughput.

Illumination pollution

A maritime port uses artificial lights during the night, in order to perform handling operations in handling areas and transport routes in the third shift. With the port expansion in the last five years new storage areas and new transport routes were built. Consequently, the need for additional illumination has increased, which calls for two segments to be closely analysed. The first one embraces the standard of external illumination according to the legislative

requirements and the second one analyses the energy consumption for illumination.

According to the first package of activities till 2011, the port significantly invested in modernisation of lights which has resulted in approximately 80% of external illumination to be in compliance with the legislation, which is not due before 2016. Until 2013, the additional 5% of lights were replaced, so the port has already 85% of lights that are in line with higher environmental standards. In reference to the energy consumption the port has decreased the share of consumed energy for illumination to 15%. This percentage should be further reduced by new investments till 2016, as posed by the new legislation frameworks. The same is valid also for other European ports, in order to be in-line with new legislation.

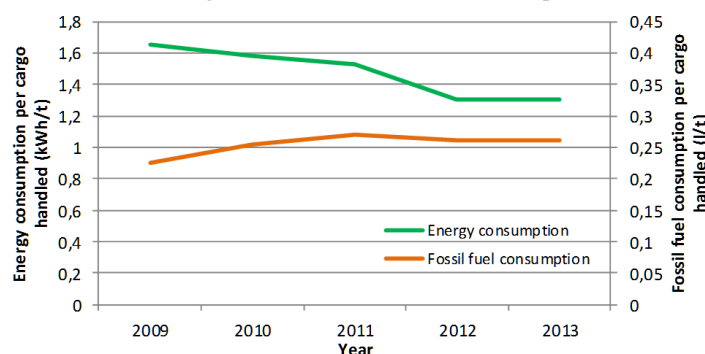
Following energy and fuel oil consumption

The green concept encourages the reduction of energy and fuel oil consumption as one of the crucial environmental issues. Ports shall reduce the consumption per ton of cargo handled. It is possible to achieve this goal by introduction of new technologies and modernisation of machinery in use. The Port of Koper has been decreasing consumption of energy per manipulated ton of cargo since 2009. Namely, in 2009 the consumption of energy was around 1.63 kWh/t of cargo and in years 2012 and 2013 decreased to the target level standing at 1.3 kWh/t of cargo handled (Figure 3). The reduction was possible through investment in new equipment on the container terminal that is the biggest consumer of energy in the port. One of the biggest energy consumers is also the Fruit Terminal that uses electricity for cooling processes in the specialised warehouses.

On the other hand, port handling and transportation processes consume a significant quantity of liquid

hydrocarbon fuels. The target value set at 0,2 l/t of handled cargo was set years ago when the port's throughput was 30% lower than the actual present result. In the last five years the port exceeded the target value. The higher consumption of fuel oil is primarily connected to port expansion, where storage areas are placed farther from the berth subsystem. The port will use the new methodology of collecting and analysing the fuel oil consumption, taking into consideration other external elements, such as the outside temperature, working hours, transported kilometres, etc.

Figure 3. Fossil fuel and energy consumption per ton of handled cargo (2007-2011), source: Port of Koper



Waste management

Waste management is one of the important fields in a port's environmental policy, because the port performs service also to the vessels calling the port. Collected waste from vessels is mainly qualified as hazardous waste including oil-contaminated materials and oil wastes, galley waste, ash and batteries. The port has established a Waste Management Centre (WMC) for the collection and sorting of refuses. Some waste materials are administered by the WMC, while some are dispatched to authorised agents for further processing. Wastes in the port area handled by WMC are classified in three main groups:

- Waste generated by port's operations, such as packaging wastes, metal scrap, cargo remnants, timber wastes, and regular municipal waste,
- Waste generated by other business entities in the port, and
- Waste from vessels berthing in the port as oil-contaminated water, waste waters, galley waste and regular municipal wastes.

According to the analysed data the port increased the quantity of collected waste from 2008 to 2011, whereas in the last two years the quantity of waste decreased to 4546 t.

In the period from 2009 to 2013 the increase at Koper port was of 10%, where the increase is mainly generated by the waste from the ships. In 2009 the port collected approx. 4050 t of waste and approx. 18% was contributed by waste from the ships. In 2013 the share of waste from the ships increased to

30%, totalling 1387 t. Over 86% of waste produced in the port is collected separately. Namely, sorted waste materials accounted for 2675 t, while 481 t are unsorted municipal wastes. The port wants to keep separately collected waste above 84%.

According to analyse of 40 European ports provided by EMSA (EMSA, 2012) Koper can be classified as one of the best ports in collecting and processing waste. Namely, the study shows that 92% of analyses ports accept sewage; 70% accept nox. liquid substances; 47% accept oily cargo residues, and 80% accept Annex V liquid cargo residues. The Koper port provides all services.

Waste and potable water

Port systems are important consumers of potable water as it is used for different operations such as timber processing, cooling foodstuffs, reducing dust from handling bulk cargo, washing vehicles handled by the car terminal and washing of machinery in use by the port. The Port of Koper reduces the use of potable water by building internal water networks that can be fed by water drawn from boreholes and collected rainwater. In the light of new technology introduced by the port, an objective to consume 5.8 litres of potable water per ton of cargo handled by the entire system was set. According to the results obtained for the last five years, the port consumed higher amount of potable water per ton of cargo handled in 2009 and 2010 when the consumption exceeded 8 l/t of cargo handled. In 2011 the consumption decreased to 4.8 l/t of cargo handled and in 2012 it increased to 6.36 l/t of cargo handled.

In 2013 the consumption exceeded the target value by 10%, which is mainly related to the infrastructure restoration inside the port area. Investments are planned also for the waste water system where cess-pits are going to be completely replaced by the port's own smaller sewage treatment plants and new buildings will be connected to the public network.

Social pillar of sustainability

The Port of Koper intensively develops social pillar of sustainability. The port is seeking a balance between economic, environmental and social considerations in system development. Under social responsibility the port is focused on following three segments:

- Employees,
- Community and environment,
- Sponsorship and donations.

Employee satisfaction is one of the crucial elements of system's excellence. The port motivates employees by rewarding innovation and useful suggestions, as well as the provision of in-house training and mentorship. Every year the port promotes five exemplary employees, one employee as the leader of the year, one innovator and one quality operative, that achieve above-average endeavours and affinity.

Moreover, the port supports their employees by paying between 70% and 90% of their supplementary pension insurance premium.

Workers are further supported with following social activities by the management:

- employees are informed with monthly in-house journal, where important news and other internal operations are published;
- education and training programmes are organized and funded;
- sporting activities through the Luka Koper Sports Club are encouraged;
- organises the annual Luka Koper Sport Games in which the seaport's sports-men and -women compete against one another;
- workers can benefit from subsidised holiday apartments.

The Port of Koper is well connected with the local community and supports various cultural activities, sport clubs and humanitarian organisations. Besides, the port is co-financing town infrastructure projects and is directly engaged in the preservation of natural heritage close to the port's eastern border. Every year the port is making donations in national areas of culture, public health, humanitarian aids and sport.

Six pillars of environmental measures and a social pillar for sustainable development

The application of environmental initiatives and measures by Port of Koper can be used as a case model for the same-size port systems or mid-size ports with different terminals and important national and regional position. To be specific, the complexity of port system, its role in international industry and globally might affect environmental measures and the set environmental objectives. Consequently, the six pillars of environmental policy in use by Port of Koper might be the platform for other similar port systems in the Adriatic Sea, where the environmental awareness is gradually developing but is still not at the same level. Namely, according to Ecoport study (Ecoport, 2013) of environmental measures in force in Southern Adriatic ports such as Durres, Bar, Bari, Patras etc. are in the initial phases and further development of environmental and sustainable initiatives are needed. Other ports like Ploče, Split and Rijeka can be added to this group of ports with just developing environmental and sustainable measures. The six pillar platform consists of six environmental fields important for a port's sustainable development and environmental approach. Each pillar has a measurable target value to be achieved by the port. The model uses target values defined by Port of Koper (Figure 4), but can be set at a different level, based on the port's objectives and posed standards:

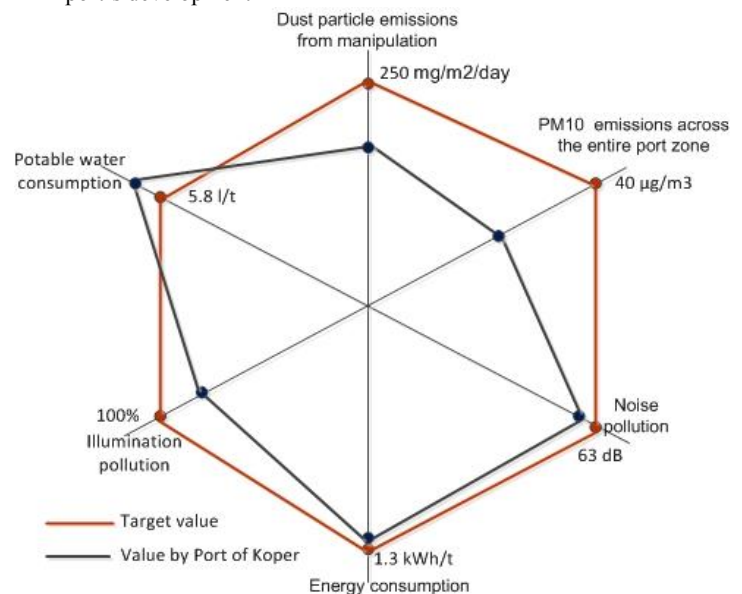
- dust particle emissions from manipulation ($\text{mg}/\text{m}^2/\text{day}$) less than $250 \text{ mg}/\text{m}^2/\text{day}$;
- annual average emission of PM_{10} particles (size of up to $10 \mu\text{m}$) less than $40 \mu\text{g}/\text{m}^3$;

- maximum allowed noise pollution up to 63 dB;
- 100% of external illumination in compliance with the EU legislation;
- Energy consumption up to $1.3 \text{ kWh}/\text{t}$ of cargo handled;
- Potable water consumption up to 5.8 litres per tonne of cargo handled.

Ports in the Adriatic Sea such as Rijeka, Split, Ploče, Bar and Durres might apply the defined six environmental pillars. The objectives can be achieved only by the long-term environmental policy. Firstly, an in-deep analysis of current situation is needed, and based on first measurements of the defined six pillars the target values should be defined by each port. Consequently, a range of different activities should be listed and later applied by the port management, in order to improve environmental results.

Meanwhile for the social pillar of sustainable development those systems have different attitudes and policy due to different organisation, economic performance and social situation in the local community. The example of Port of Koper can serve as the base for developing social responsibility. Consequently the six environmental pillars and a social pillar present the platform for sustainable port development. The entire region should benefit from port's sustainable development.

Figure 4. Six pillar environmental model for sustainable port's development



Conclusion

The role of a maritime port in a global green supply chain is becoming more important than ever. To be specific, environmental pressure on ports is becoming very strong, therefore port managements are forced to implement green policy in their long-term strategy. Ports have already taken important steps to-

wards environment friendly logistics and transportation operations. During last decade a social sustainable responsibility took an important role in port's sustainable development. The port has to be responsible not just to the owners through economic results, but also to the local community and environment. Some ports especially from the western economies already developed their sustainable platforms. One of such port systems is Port of Koper, where sustainable development and green policy has been one of the development focuses for over a decade. For this reason, Koper port is classified as one of the greenest ports in Europe, with important social responsibility. According to the analysed case of Koper port different environmental initiatives are followed by a number of measures. The main focus is on air pollution, noise pollution, energy consumption, waste treatment, illumination pollution and potable water consumption. A set of measurable values are defined for each environmental initiative, where the results are periodically observed and at least once per year published to the port community. Through a set of social sustainable responsibility the port supports three main segments such as employee's satisfaction and health condition, community and environment responsibility and financially supporting local community through sponsorship and donations. Based on the analysis and the results, achieved by the Port of Koper, it is possible to build a commonly used platform for a port's environmental and social sustainable development, even if a certain port has not been following the sustainable and environment friendly development so far. A six pillar environmental model, which can be used by ports in the region in setting-up their environmental measures, is introduced. The proposed value per each pillar is in accordance with high international environmental standards, therefore it can be modified according to a short-term policy. The model promotes also social sustainable approach as one of the most important pillar in sustainable development. With the right attitude ports might achieve important environmental results and sustainable development already by 2020.

References

- ADAMS M., QUINONEZ P., PALLIS A., WAKEMAN T., 2009, *Environmental Issues in Port Competitiveness. Research report*, Dalhousie University AGRI, Halifax.
- BEŠKOVNIK B., JAKOMIN, L., 2010, Challenges of green logistics in Southeast Europe, in: *Traffic & Transportation*, vol. 22, no. 2, p. 147-155.
- DAAMEN T.A., Sustainable development of the European port-city interface, in: *Sustainable urban areas conference*, Rotterdam, 2007.
- DARNALL N., JOLLEY G. J., FIELD R. H., 2008, Environmental Management Systems and Green Supply Chain Management, in: *Journal of Business Strategy and the Environment*, vol. 1, no. 8, p. 30-45.
- de BRUTO M. P., DEKKER R., 2004, *A framework for reverse logistics, Reverse logistics – Quantitative Models for Closed-Loop Supply Chains*, Springer, New York.
- ECOPORT, www.southeast-europe.net/document.cmt?id=229 (1.11.2014).
- EDEN I., 2011, Green ships and green ports, in: *Green port*, vol. 3, p. 30-32.
- EMMETT S., SOOD V., 2010, *Green Supply Chains: An Action Manifesto*, John Wiley.
- EMSA, 2012, EMSA study on the delivery of ship generated waste and cargo residues to port reception facilities in EU ports, Copenhagen.
- ESPO, 2009, *European Sea Ports Organization: EcoPorts port environmental review 2009*, Brussel European Sea Ports Org.
- Eyefortransport, Green transport and logistics – Survey report, www.greenlogisticsforum.com/2008/free_report.pdf, (10.6.2013).
- GOULIELMOS A. M., 2000, European policy on port environmental protection, in: *Global Nest*, vol. 2, no. 2, p. 189-197.
- KONTOVAS C., PSARAFTIS H. N., 2011, Reduction of emissions along the maritime intermodal container chain: operational models and policies, in: *Maritime Policy and Management*, vol. 38, no. 4, p. 451-469.
- LUKA KOPER, Environmental report for 2012 <http://ftp.luka-kp.si/> (15.8.2014).
- LUKA KOPER, Environmental report for 2013, <http://www.luka-kp.si/> (7.9.2014).
- MOLLENKOPF D., STOLZE H., TATE W.L., UELTSCHY M., 2010, Green, lean and global supply chains, in: *International Journal of Physical Distribution & Logistics Management*, vol. 40, no. 1, p. 14-41.
- MURPHY P. R., POIST R.F., 2000, Green Logistics Strategies, in: *Transportation Journal*, vol. 40, no. 2, p. 15-17.
- NIJKAMP P., 1994, Roads toward environmentally sustainable transport, in: *Transportation Research part A: Policy and Practice*, vol. 28, no. 4, p. 261-271.
- PERIS-MORA E., DIEZ OREJAS J.M., SUBIRATS A., IBANEZ S., ALVAREZ P., 2005, Development of a system of indicators for sustainable port management, in: *Marine Pollution Bulletin*, vol. 50, p. 1649-1660.
- VAN de VOORDE E., MEERSMAN H., STEENSSENS C., 1998, Safer and more Ecological Shipping: The impact on Port Competition, in *Quality Shipping*, ed. Haralambides H., Erasmus University Publications, Rotterdam.
- VIDAL J. H., 2010, *Environmental sustainability and climate change effects: an investigation into ports' response and readiness*, Doctoral dissertation, London.

The American Lawn Revisited: Awareness Education and Culture as Public Policies Toward Sustainable Lawn

Amerykańskie trawniki z bliska: świadomość, edukacja i kultura jako motywy polityki publicznej prowadzącej w kierunku zrównoważoności

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Abstract

Lawn has been used for landscaping, gardening, and beautification of homes and cities for a long time. The evolution of the lawn reflects important cultural and biophysical interactions between humans and nature. The American lawn, which was from Europe and has been a part of the American dream for home ownership and culture, has become an area going against nature for its extensively using chemicals and generated pollutions. Tracing how the lawn is becoming an important part of culture, this article focuses on more recent pollution and other environmental problems resulted from the lawn culture. It is argued, that awareness, education and changing culture of taste and preference can serve additional measures together with law and technological advancement toward sustainable lawn in the United States and the world.

Key words: grass, American culture, conspicuous consumption, industrialization, urbanization, pollution, aesthetics, landscaping

Streszczenie

Trawniki już od dawna były używane w kształtowaniu krajobrazu, ogrodnictwie i upiększaniu domów. Ewolucja trawników odzwierciedla istotne kulturowe i biofizyczne interakcje pomiędzy ludźmi i przyrodą. Trawniki trafiły do Ameryki z Europy i stały się częścią amerykańskiego snu o własności i kulturze domu. Później stał się on jednak obszarem przeciwstawiającym się naturze z uwagi na intensywnie stosowanie substancji chemicznych i generowanie zanieczyszczeń. Wykazując, w jaki sposób trawniki stają się ważną częścią kultury, ten artykuł skupia się na bardziej aktualnych kwestiach zanieczyszczeń i innych problemów środowiskowych. Wykształcenie świadomości, zmieniająca się kultura smaku i preferencji, łącznie z prawem i technologią, mogą stanowić dodatkowe środki prowadzące w kierunku zrównoważonego kształtowania trawników w Stanach Zjednoczonych i na świecie.

Słowa kluczowe: trawa, amerykańska kultura, demonstracyjna kultura, industrializacja, urbanizacja, zanieczyszczenie, estetyka, krajobraz

Introduction

Grass is considered to be one of the most successful plants on earth. Grasses are found in almost every habitat and they also dominate large areas of the planet. Their strong roots allow them to adapt to difficult conditions better than many other plant species. In human society, grasses have served mankind in many different ways. The cereal grasses were originally used as food for livestock and they aided in man's transition from nomad to farmer. In Egypt, grass was used to make paper. In some Asian countries (e.g., China, Japan), grasses are still the main materials for traditional handicraft products.

Ornamental grasses are always favored by gardeners to create harmonious depictions of their gardens and aesthetic nature. Gardeners use different combinations of shapes, textures, and colors in order to tell a story. On one hand, grasses can soften the whole design. On the other hand, grasses can make a picture sparkle.

In Europe, lawn was greatly appreciated, but the expansion was limited by space and management costs, and was not affordable by normal families. In Asia (particularly China and Japan), the high population densities could allow much land for lawn use, and the high maintaining costs were not affordable to most households. Instead, elements such as ponds, streams, islands, and hills to create miniature reproductions of natural scenery are more often used in Asia. Gardening has been limited to public parks and to some elites rather than to ordinary homes.

In North America, the European culture together with the abundant space and more-affordable land, and accompanied by car invention for long-distance transportation, and technological advancements in chemical and management equipment have made lawns of large sizes affordable to ordinary families, especially in the US. Consequently, lawns have been weaving into US culture to such a degree that the lawn is now a part of the *American dream* for home ownership and the month of April is known not only for containing Earth Day, but also for National Lawn Care Month.

Nowadays, turfgrass lawns are major components of urban landscapes and are highly valued for recreational, aesthetic, and environmental purposes (Beard and Green, 1994). They are dominant features of residential landscapes in North America (National Turfgrass Federation, 2003; Milesi et al., 2005). The aggregated estimates of lawn coverage in the United States fall between 10 and 16 million ha, surpassing those of some US food crops including barley (5 million ha), cotton (4.5 million ha), and rice (1.1 million ha) (Robbins and Birkenholtz, 2003). Millions of Americans love their home lawns and are satisfied

with the pure grasses for amenities as well as recreation facilities.

The increase in lawn coverage leads to increased use of synthetic inputs, including water-soluble fertilizers, herbicides, and insecticides (Bormann et al., 1993; Jenkins, 1994). The USEPA (1999) estimated that 36.3 million kg of pesticide-active ingredients are applied annually in domestic settings for the control of insects, invasive plants, weeds, and fungi in lawns and gardens within the US. With a large and increasing proportion of developed space given to the lawn, the problems of mono-cultural ecology and habitat fragmentation may become more acute. Pollution and environmental problems are associated with the American lawn from multi-dimensional causes. Lawns in our own backyards are so close to our living environment. But the problems are actually harder than we think.

Technologically, alternative lawn management, such as integrated pest management (IPM), organic and natural product applications, and an untreated lawn care program, is widely explored, few options successfully achieve aesthetic results better than the commercial management using significant chemicals (Alumai et al., 2009). Cultural management of weeds in turf grass such as mowing, fertilization, irrigation, cultivation, planting, and turf grass selection to affect weeds (Emmons and Thomas, 2007; Lush and Rogers, 1992); is not very effective, overall. In many part of the country, irrigation is needed to keep a healthy lawn. Irrigation can be a large portion of the domestic water use in the arid region.

Economically, pesticides and fertilizers are relatively less expensive in relation to the marginal utility of the inputs for both the lawn managers and homeowners and lawn managers do not directly accrue returns from lawn inputs like farmers do (Robbins and Birkenholtz, 2003). Few economic policy options exist. Although a tax to increase the prices of pesticides and fertilizers might reduce the usage, the increased cost is still minor compared to more fast increasing income. Robbins et al. (2002) found that income has a positive impact on the usage of chemicals to lawn management. Unlike crops, lawn grass is not cultivated for direct sale, but is consumed indirectly as aesthetic, personal, and property values. As more wealthy people live in suburban areas, more demand has been created for large lawns.

Political impetus and momentum for reformation of water pollution priorities and regulation remain far behind the needs for change (Robbins et al., 2002). The structure of water quality management committees remains heavily loaded with suburban development interests and traditional point-source industries eager to make agriculture *pay its fair share*, while paying less attention to other important non-point

sources. An immediate and proximate toxic risk is increasingly located in the under-examined areas around homes (Robbins et al., 2002). The deeply rooted notion of private property rights in residential land, moreover, makes restrictions and land use controls far more difficult in residential areas than it does on agricultural land (Feldman and Jonas, 2000). In this article, we aim to address the issues from awareness and cultural perspective. In order to address the issues, we need to trace the history. How lawn has become an American cultural artifact and how it goes *against nature* and a significant source of environmental problems will be reviewed, and why culture should be important part of the strategy will be discussed. We extend the argument that awareness and culture could be an alternative policies to problems resulted from the pollution. The insights and conclusions are not only limited to the American lawn and may also apply to other issues and other places.

Evolving American Home Lawn

According to the Oxford English Dictionary, the word *lawn* comes from the old English word *launde*, which means an open space or glade. The early lawns were usually related to pasture fields. With frequent rains and a moderate range of temperatures, turf grasses grew easily in the maritime Western Europe climate. In Tudor and Elizabethan times, lawns were widely used in gardens to create walkways and play areas. Gardens with lawns became places to be loved and admired.

In the early 17th century, the Jacobean epoch of gardening began. It was during this period that the closely cut English lawn was born. Since owning a residential lawn was a privilege of some wealthy people at that time, it represented high social status and the aesthetic sophistication of its owners. In English gardens, the flowers of grasses are widely used to bring drama and depth to the boundaries of the properties. Inspired by European landscape paintings, lawns became an essential element of English gardens.

In the 18th century, gardening fashion went through a further change. The landscape gardens of William Kent (1685-1748), one of the most important designers of English gardens, were inspired by ancient Greece and Rome as well as the paintings of Claude Lorraine, Gaspar Poussin, and Salvator Rosa (Johnson, 1999). The open *English* style of parkland was seen across Britain and Ireland. Lawns seemed to flow from the gardens into the outer landscapes.

Dean (1986) believed the American lawn was from England. In the 17th and 18th centuries, European immigrants in America brought with them English garden styles as well as an appreciation for lawns. However, it was not until after the Civil War that the lawn became popular in middle-class residences. Since then, the traditional residential yard of turf grass has

become an important and cherished image in American culture, and lawn-care has become a main topic in all types of gardening magazines. Unlike the traditional English garden, in which lawns usually served as a setting for lawn games and as a backdrop for flower beds and trees, the American lawn has become the dominant theme in American gardens.

The historical legacy of Europe, suburbanization driven by abundant space (cheaper land) and car transportation, and the function of lawns for homeowners and is often called *living green carpet* and an *extended living room*. Nowhere in the world are lawns as prized as they are in the US. They provide a tough yet soft surface for outdoor recreation and activities. Some common lawn games include field hockey, ring toss, volleyball, clock golf, lawn bowls, horseshoes, deck tennis, croquet, badminton, and archery as democratic games that could be played on a small lawn.

They are also the products of learned aesthetic tastes and cultural traits that have become popular over the past 120 years. North American lawn monoculture is derived from English gardens and the manor-house landscape fads of the 18th century, which was a product of Italian landscape paintings. North Americans learned the new English landscape fashion through paintings, books, and English gardeners. Some early wealthy Americans emulated English estates and integrated European garden styles into their New World environments (Jenkins, 1994).

Widespread pastures allowed the immigrant grass species from Africa, Asia, and Europe to flourish on the American continent. Grass was critically important to the survival of the earliest settlements because it was used to support livestock. At that time, lawns were managed very differently. Pasture land was usually maintained through grazing by sheep or other livestock. Most residential lawns belonged to wealthy people because maintaining a well-cut lawn involved a lot of labor. Thomas Jefferson, the third president of the United States, is thought to have owned the first American lawn (Bormann et al., 1993).

It is also widely accepted that Andrew Jackson Downing, Frank J. Scott, Frederick Law Olmsted, Sr., and Frank A. Waugh were the original creators of the ideal suburban landscape, which includes traditional turf grass lawns (Jackson, 1985). However, according to Charles Morrow Wilson, *lawn* did not become an everyday American word until after the Civil War. In 1868, Olmsted designed one of the first planned suburban communities in America – Riverside, just outside of Chicago, Illinois. Riverside provided the original layout of today's front lawn, in that *each house be set back thirty feet from the road, and it prohibited walls (...), each owner would maintain one or two trees and a lawn that would flow seamlessly into his neighbors, creating the impression that all lived together in a single park* (Pollan, 1989). Scott (1873) claimed that a lawn with a

closely cut smooth surface is by far the most essential element of beauty on the grounds of a suburban house.

Americans maintain gardens and lawns to provide additional beauty and to provide a natural look to their home. Lawns were initially used to create a park-like community and to beautify the housing landscape. Some researchers found that the key attractiveness of a piece of land to early arrivals in New England was its grassiness. More specifically, Balling and Falk (1982) found that people generally prefer a savanna-like environment. The universal appeal of lawns, with smooth topography and green color, is similar to the setting of the savanna (Balling and Falk, 1982).

Like any other gardening activities, maintaining a lawn can be fun and can give a person a sense of satisfaction. The physical exercise involved in working on the lawn benefits a person's physical health. Lawn mowing has been advertised to be a healthy exercise and hobby interest. Gardening provides an experience that also has a positive impact on a person's mental health (Gigliotti and Jarrott, 2005). To pursue a green lawn is part of the American dream. As a parcel of private property, a front lawn represents the Jeffersonian ideals of freedom, democracy, and opportunity, in addition to an outdoor expression of 1850s conformism.

From the 1880s through the 1920s, American culture was transformed from a producer society into a consumer society and conspicuous consumption was emerging (Veblen, 1899).

Many articles delivered the information to an expanding middle class on how to achieve the perfect lawn. Having a perfect green lawn has become a symbol of the wealth, power, and prestige of the upper class in society. Middle-class Americans have shown an unprecedented level of spending power during the economic boom in the late 20th century. They maintained perfect lawns to present their wealth and high status. *Darker lawns helped people to show off their wealth, under the assumption that the greener the grass, the greater the cost – theorem by Craig Edminster of International Seeds* (Steinberg, 2006, p.76).

In the 19th century, widespread car ownership combined with a government-subsidized road and housing boom caused people to begin moving to the suburbs. Suburban houses were furnished with front lawns in emulation of upper-class, park-like estates. In 1830, John Ferrabee and Edwin Budding invented the lawnmower, which greatly reduced the labor involved in gardening. Also, the increased availability of a public water supply and the importation of appropriate grasses brought the cost of maintaining a lawn within the reach of a growing middle class of homeowners (Bormann et al., 1993). By World War II, the pattern for suburban developments had become more or less fixed. Developers used grass to

surround houses and the families who purchased the houses were left to take care of these new lawns.

In the 19th century, suburbanization was accompanied by the rise of neighborhood associations. A neighborhood association provides a range of services to residents such as garbage collection, street maintenance, lawn mowing, and gardening. It controls not only the types of land use but also matters of aesthetics, including the color of the house paint, the placement of trees and shrubbery, and the size and location of fences (Nelson, 2002). In a word, the neighborhood association provides the community with the power to judge individual residents' behaviors.

In the process of perceptual formulation, the uniform appearance of front yards is deeply embedded in American culture. *If householders wished to be good Americans, they would maintain a respectable, open front yard with a grass lawn* (Weigert, 1994). Front lawns are a very public demonstration of personal values and can be a significant source of satisfaction and a connection to the community. American lawn was originally a symbol of high status. George Washington and Thomas Jefferson were two elite landowners who had enormous public and symbolic stature, and their designed images of their private properties have contributed to the status of the American lawn for the individual homeowner in the later period when people were more affordable (Harch, 1971; Manca, 2012).

A well-maintained lawn is seen as a symbol of conformity to social norms (Nassauer, 1988). Having and taking care of lawns is an American norm and an honorable obligation. Those who do not keep their front lawn clean and green are considered to be in violation of community standards and are not good citizens in the eyes of their neighborhoods. The attractiveness of front lawns comes from the expressed *care* in maintenance (Nassauer, 1995). In a lawn landscape, care is shown by neatness and uniformity of the overall lawn. A well-ordered and tidy lawn is expected to show conformity to the aesthetic standard of the community. The aesthetic of care is thought to be laden with good intentions and the social meaning of stewardship, work ethics, personal pride, and contributions to community.

People can judge a family by the lawn in front of their house. In the neighbors' eyes, a well-maintained lawn means that the owner is well-educated and has a job and a good family. Most homeowners have historically maintained their lawns in order to be good neighbors and to have a *proper* appearance. Those who did not maintain a lawn often come under extreme social pressure. Some residents even select plants that are already in the neighborhood to show a willingness to be part of the community. For example, Kaufman and Lohr (2002, p. 296) wrote, *the folks straight behind us obviously have a big vested interest in the way we keep our yard (...). Before we*

moved in, they asked our mutual friends – how well do they keep up their yard?

Thus, by demonstrating conformity with local norms and by encouraging community ties, lawn mowing reflects the individual's personal identity. It also represents the image of a harmonious family. On the other hand, those who maintain a messy front yard are often branded as being *selfish, unneighborly, unchristian* and *undemocratic* (Pollan, 1989). As a reflection of social status, lawn mowing can influence the economic value of property. For many homeowners, maintaining the front lawn is simply an investment in capital. Front lawns are semi-public spaces that impact the community. As a whole, they contribute to the overall image of the community. Yards that are allowed to run wild are considered to be detrimental to the value of the property and they affect the neighborhood's overall property value (Clayton, 2007).

Gardening in a publicly visible setting provides opportunities for social communication, like Steinberg said, *a neatly trimmed, perfectly green lawn that unfolded across the front yard like a living version of boardroom* (Steinberg, 2006, p.14). In the US, children learn how to mow the grass from their fathers when they are very young. It is a method for teaching children responsibility. Neighbors get to know each other when sharing information about lawn care experiences, including fertilizer and seed use and gardening practices (Lewis, 1990). The incentive to socialize is especially important at a time when Americans are increasingly isolated from others due to the privatization of house properties.

A homeowner's aesthetic standards are also affected by the public media and/or other people's opinions. To spur the widespread adoption of the residential lawn, popular magazines provided a new forum focused on the aesthetic appeal of the lawn. *'Lawns Beautiful' tells what many estate owners are doing to improve their lawns and proves it through interesting pictures* (Jenkins, 1994).

Businesses promote lawns and lawn care needs support businesses. Many businesses and industries provide equipment, services, and other products to homeowners. The invention of mower made to mow lawn much easier (Kennedy, 2000), and the fertilizer and pesticide chemical industry make weed control and greening manageable although it is not cheap.

Americans spend an estimated \$40 billion per year on lawns and acreage of turf is still growing quickly (Steinberg, 2006). The production, sales, and processing of home lawn products generates employment, economic activity, income, and tax revenue. The lawn-dependence industry is part of the life blood of the American economy. According to a survey of home lawns in Minnesota, the average lawn size was estimated to be 0.62 acres (0.25 ha), with an estimated 872,660 acres (353,427 ha) in home lawns and annual spending of \$200 per home and \$150 mil-

lion in total expenditures over the entire state (Meyer et al., 2001).

Advertisements have been selling an image to the public of the *beautiful scenery of the spacious, newly designed lawn and garden area surrounding a lovely house*. Many owners of small homes enjoy these pictures and try to fit their own properties into this picture of a green, velvety carpet of grass. The growing lawn industry together with the chemical industry used popular magazines to sell the image of a *good* or *perfect* lawn for middle class Americans. The ideal *industrial lawn* was thought to be *composed of grass species only; free of weeds and pests; continuously green; and kept at a low, even height* (Bormann et al., 1993, p. 62). The pursuit of a perfect lawn was reinforced by advertising and horticultural advice in popular magazines, in addition to advertisements promoting lawn standards in order to sell more lawn care products.

Advertising sought to display a high-class image for their product and attract consumers to follow this trend. Maintaining a perfect lawn would indicate being good neighbor, a good citizen, and a good family man. The successful advertising images became cultural icons (Jenkins, 1994). That is, images of lawn mowing became icons of American culture. Homeowners were urged to buy new lawn care products and to spend hours every week on lawn maintenance. Industrially produced, this archaic landscape form was well-suited to post-World War II technology and management techniques (Jenkins, 1994). It demonstrates, moreover, the marketing of an ideal through media imagery that promotes lawn perfection as ordered monoculture (Bormann et al., 1993).

When Culture Going against Nature

The current extra amount of chemicals used on lawns is partly the result of lawn culture shaped from the history (see Figure 1): the homeowner's quest for a *perfect* lawn and low tolerance for weeds and insect pests is unusually predisposed to the romantic bucolic associated with rural landscape and imagery (Waldichuk, 1998). The culture of residential lawn as an ordered monoculture has proven nearly intractable to reform (Feagan and Ripmeester, 1999), and does not tolerate lawn heterogeneity (Bormann et al., 1993). The total annual input of yard insecticides represents a class of ecological policy problems previously unseen.

The economic growth is supporting the culture. The use of lawn care inputs, especially chemicals, has been shown to be positively associated with high levels of income and education and is disproportionately heavy amongst consumers who not only claim environmental concerns but who also acknowledge the negative effects of their actions (Robbins et al., 2002).

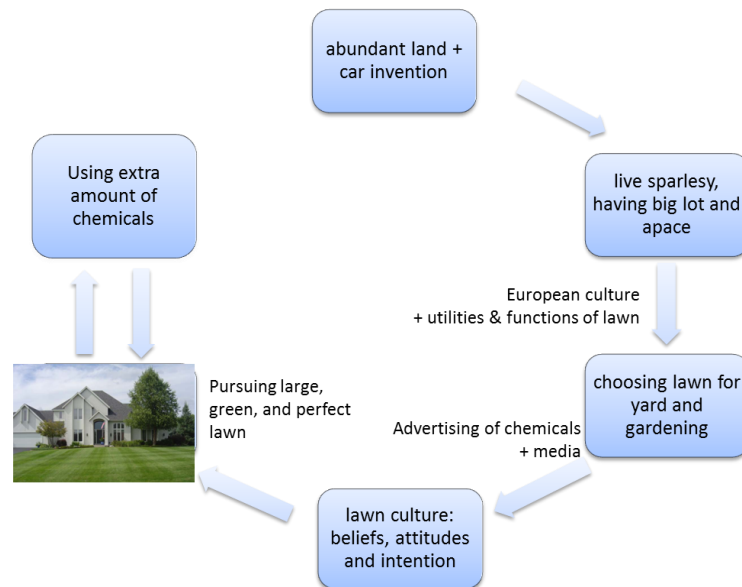


Figure 1. The American lawn culture and the pollution to the residential environment

People are placing too much attention and concern toward the green color of a lawn, even though a lighter green lawn represents better fertility, root development, and disease resistance. However, commercial advertisements try to convince homeowners that the greener the grass, the higher the aesthetic value. Advertisements describe a picture of a harmonious family – a rich green lawn sets off your house to its best aesthetic advantage and makes a wonderful area for children to play and for adults to sit and enjoy the finest scenery.

Deep green turfgrass usually involves more chemical use. It turns out that the much-touted deep-green lawn is not the healthiest turf. According to a study by the National Oceanic and Atmospheric Administration, only about half of the nitrogen and phosphorus in fertilizer is utilized by plants. The rest is dissolved in the groundwater and it causes tremendous growth in the number of bacteria, leading low oxygen into the water and the killing aquatic animals. Water consumption is also a problem (Shuman, 2002). The average lawn requires about 10,000 gallons of water over the course of a summer to keep it green (Melyayev, 2002). This is a tremendous amount if we consider that at least 40% of the world's population faces serious water-shortage problems.

The obsession with the ideal of having pure grass leads to the overuse of herbicides and pesticides. The home lawn landscape is considered to be part of nature, but it is also an extension of the home. Weeds are often viewed as unaesthetic in appearance and as uninvited trespassers. Insects are quite normal in nature, but they are also unwanted in a perfect lawn. Some lawn service companies, which rely heavily on quarterly or bi-monthly pesticide applications, leave the consumer with the perception that healthy, attractive lawns require frequent applications of assorted

chemicals. Most suburban households and lawn-care operators apply more herbicides and pesticides per acre on lawns than most farmers spread to grow crops in large fields (US Senate, 1991).

Although advertisements have routinely claimed that the use of fertilizers and pesticides is safe, the actual safety of these chemical applications has been brought into question by others who claim that they may be toxic or harmful to humans. Carson (1962) examined and demonstrated the chemical industry and her work eventually led to a ban on some chemicals for home use (e.g., DDT).

Even the pesticides that are still permitted by the EPA are often known toxic substances. Some chemicals commonly used on lawns and gardens have been associated with birth defects, mutations, adverse reproductive effects, to causing cancer in laboratory animals. Children, infants, and fetuses may be especially vulnerable to the health effects of pesticides (Landrigan and Garg, 2002). Grass is food for many animals such as geese, squirrels, prairie dogs, and rabbits living in suburban areas. Some pesticides are toxic for them. For example, the pesticide Diazinon was banned in 1986, because it caused the death of songbirds, waterfowl, eagles and other birds (Daniels, 1995).

The use of fertilizers, pesticides, and herbicides in lawn management contributes offsite water quality problems observed in American rivers. Most important water quality parameters such as sediment, nitrate, phosphorus are all related to lawns (Sun and Lockaby, 2012). Less recognized harm that lawns can cause to the environment is how lawns affect runoff and local climate. Lawns that were converted from forests can generate more storm flow than forest lands for two reasons: 1) soils are much compacted in lawns such rainfall cannot fully infiltrate; 2) grass intercept much less rainfall during storms

and uses less water than trees in the plant transpiration process thus the soils under the lawns have less available storage to absorb rainstorm. The end results contribute to frequent flush flows, deep cut of urban watersheds (thus river bank erosion), and general watershed degradation (Sun and Lockaby, 2012). In addition, it is well known that clearing forest vegetation in urban areas promotes *Urban heat island* (Konopacki and Akbari, 2002).

Awareness and Culture towards Sustainable Lawn

The lawn was created and developed by the consumption determined by the economic factors such as income, costs of land, labor, and fertilizers, but also promoted by culture and tastes (Larson et al., 2009). Lawn question can be seen as a subset of cultural and political ecology research problems, linking political economy, culture, and behavior to land cover change (Robins et al., 2002). To promote a sustainable lawn, we need to know not only the ecology but also the backyard culture and economy. Abundant evidence show culture should be included to address, not limited to lawns but also other environmental issues (e.g., Larson, 2009; Trigger et al., 2008; Domene and Sauri, 2007; Head and Muir, 2007; Luc 2014).

Culture is integrated system of learned behavior patterns which are characteristic of the members of a society and which are not a result of biological inheritance (Hoebel, 1966). Culture is related to ethics, habits, customs and value judgment. Broader economy mobilizes and produces *tastes* (Wilson, 1992). In recent decades, the tastes of nature or a *natural aesthetic* have been an increasing trend. Such a culture has resulted in problems as well as become barrier to collect the problem as illustrated in Figure 1. Towards sustainable lawn, we need to start from culture of individual attitudes and taste, which will lead to intentions to and acting on changing (See Figure 2). The intention will bring and seek new technologies, more acceptable weeds and not so green lawns and even replacing with more trees.

Awareness education is critical for the change as in many cases (e.g., Pawul and Sobczyk, 2011). Current education and extension are mostly limited to technology of lawn care, simply how to keep lawn green and pure. We should also promote and tell the public that the green lawn is not green, and the green and prefect lawn is not beauty. As Nassauer (1997a) indicated, *appreciation based on knowledge is the only way to avoid aesthetic omissions and deceptions*. Our culture should promote a new perception of beauty: only a healthy lawn can be aesthetic. Messy is acceptable and can also be beautiful (Nassauer, 1997b).

More ecologically landscaping is more socially desirable. Such an attitude should go beyond individual level into culture. Many people do realize that the

yard management generates pollution as wealthier people are using more pesticide and fertilizers (Robbins et al., 2002), but the society accept the pollution but not messy but environment friendly yard. New culture and norms of social goodness would induce homeowners to plant more trees, produce better habitats, and apply less water, pesticides and herbicides.

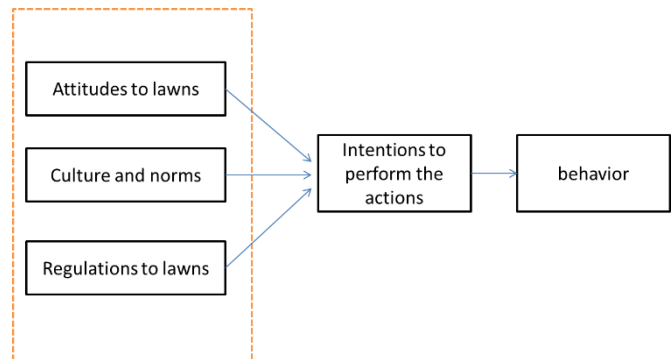


Figure 2. From attitudes, culture and regulation to lawn management

How to change public perceptions and attitudes, or broadly lawn culture? As Steinberg (2006) argued, the American obsessive quest for the perfect lawn has been largely promoted by individuals with commercial interests. However, governments and other non-commercial organizations can use the media to influence the public perception. The National Wildlife Federation offers certification of schoolyards and community areas. Community areas are certified when they accumulate a certain amount of points based on their population. In 2006, more than 74,000 yards, schools, and communities had been certified, including more than 12,000 in the last six months.

Working through various public media, education could help to shape public attitudes and perceptions about landscaping. It is especially important if members of younger generations form different attitudes regarding landscaping. Zheng et al. (2009) also found the impact of an educational background to the preference of landscaping. Based on a study on the public's attitude toward woodlot management in urban areas in Finland by Tahvanainen et al. (2001), it was found that the younger the person, the more positive their attitude toward the natural state of nature. Kays et al. (2006) is an excellent manual for reaching out to small woodland owners about managing their backyards. Messy is acceptable and environmentally beneficial. Annual awards to honor landscaping that meets a new, desired standard might help to promote awareness and adoption by homeowners.

Homeowner associations can also promote sustainable lawn and landscape management, promoting the notion that yards should have more trees and lawns should be smaller in order to limit the use of chemicals and reduce runoff. Trees should be used as an energy saver for urban homeowners. *Close-to-nature* concept should be promoted, especially in arid regions where lawns entirely depend on irrigation.

Further research is needed for investigation toward how we can reshape the existing culture, increasing the awareness.

References

1. ALUMAI A., SALMINEN S., RICHMOND D., CARDINA J., GREWAL P., 2009, Comparative evaluation of aesthetic, biological, and economic effectiveness of different lawn management programs, in: *Urban Ecosystem*, vol. 12, no 2, p. 127-144.
2. BALLING, J. D., AND FALK, J. H., 1982, Development of visual preference for natural environments, in: *Environment and Behavior*, vol. 14, p. 5-28.
3. BEARD J.B., GREEN R.L., 1994, The role of turfgrass in environmental protection and their benefit to humans, in: *Journal of Environmental Quality*, vol. 23, p. 452-460.
4. BORMANN F.H., DIANA B., GORDON T. G., 1993, *Redesigning the American lawn*, Yale University Press, New Haven.
5. CARSON R., 1962, *Silent Spring*, Houghton Mifflin.
6. CLAYTON S., 2007, Domesticated nature: Motivations for gardening and perceptions of environmental impact, in: *Journal of Environmental Psychology*, vol. 27, p. 215-224.
7. DANIELS S., 1995, *The green lawn handbook*, Macmillan, New York.
8. DEAN M., 1986, *In Search of the Perfect Lawn*, Black Moss Press, Windsor, ON, p. 37.
9. DOMENE E., SAURI D., 2007, Urbanization and class-produced natures: Vegetable gardens in the Barcelona Metropolitan Region, in: *Geoforum*, vol. 38, p. 287-298.
10. EMMONS R., and THOMAS R. D., 2007, Turfgrass Science and Management – Fourth Edition, in: *Delmar Learning*, (800) 354-9706, <http://www.delmarlearning.com>.
11. FEAGAN R B., RIPMEESTER M., 1999, Contesting naturalized lawns: a geography of private green space in the Niagra region, in: *Urban Geography*, vol. 20, no 7, p. 617-634.
12. FELDMAN T. D., JONAS A. E. G., 2000, Sage scrub revolution? Property rights, political fragmentation, and conservation planning in Southern California under the federal endangered species act, in: *Annals of the Association of American Geographers*, vol. 90, no 2, p. 256-292.
13. GIGLIOTTI C. M., JARROTT S. E., 2005, Effects of horticulture therapy on engagement and affect, in: *Canadian Journal on Aging*, vol. 24, p. 367-377.
14. HATCH P. J., 1971, *Thomas Jefferson's Flower Garden at Monticello*, University of Virginia Press; 3rd edition.
15. HEAD L., MUIR P., 2007, *Backyard: Nature and Culture in Suburban Australia*, University of Wollongong Press with Halstead Press.
16. HOEBEL A., 1996, *Anthropology: Study of Man*. McGraw-Hill, 3rd edition, New York.
17. JACKSON K. T., 1985, *Crabgrass Frontier-The Suburbanization of the United States*, Oxford University Press, New York.
18. JENKINS V. S., 1994, A green velvety carpet: The front lawn in America, in: *Journal of American Culture*, vol. 17, no 3, p. 43-47.
19. JENKINS V. S., 1994, *The Lawn: A History of an American Obsession*, Smithsonian Institution Press, Washington and London.
20. JOHNSON K., 1999, English landscape gardens in the 1700s: The history of English garden design from classical to natural style, in: *Garden Design*, July 1999.
21. KAUFMAN A. J., LOHR, V. I., 2002, Where the lawn mower stops: The social construction of alternative front yard ideologies, in C.A. Shoemaker (Ed.) *Interaction by design: bringing people and plants together for health and wellbeing*, Iowa State Press, Iowa.
22. KAYS et al., DROHAN J., DOWNING A., FINLEY, J., 2006, *The Woods in Your Backyard: Learning to Create and Enhance Natural Areas Around Your Home*, Ithaca, Natural Resource, Agriculture, and Engineering Service, New York.
23. KENNEDY M., 2000, The evolution of the lawn mower, in: *Grounds Maintenance*, vol. 35, no 5, p. 16-20.
24. KONOPACKI S., AKBARI H., 2002, *Energy Savings for Heat Island Reduction Strategies in Chicago and Houston (Including Updates for Baton Rouge, Sacramento, and Salt Lake City)*, Paper LBNL-49638. Lawrence Berkeley National Laboratory, Berkeley, CA.
25. LANDRIGAN P. J., GARG A., 2002, Chronic Effects of Toxic Environmental Exposures on Children's Health, in: *Journal of Toxicology – Clinical Toxicology*, vol. 40, no 4, p. 449-456.
26. LARSON K. L., CASAGRANDE D., HARLAN S. L., YABIKU S. T., 2009, Residents' Yard Choices and Rationales in a Desert City: Social Priorities, Ecological Impacts, and Decision Tradeoffs, in: *Environmental Management*, vol. 44, p. 921-937.
27. LEWIS C. A., Gardening as healing process, in M. Francis, and R. T. Hester Jr. (Eds.), 1990, *The meaning of gardens*, MIT Press, Cambridge, MA, p. 244-251.
28. LUC M., 2014, Placing the idea of sustainable landscape in ecophilosophy, in: *Problemy Ekorozwoju/Problems Of Sustainable Development*, vol. 9, no 1, p. 81-88.

29. LUSH W.M., ROGERS M.E., 1992, Cutting height and the biomass and tiller density of *Lolium perenne* amenity turfs, in: *Journal of Applied Ecology* 29:611–618.
30. PAWUL M., SOBCZYK W., 2011, Ecological Education in Waste Management as a Tool for The Implementation of Sustainable Development, in: *Problemy Ekorozwoju/Problems Of Sustainable Development*, vol. 6, no 1, p. 147-156.
31. MANCA J., 2012, *George Washington's Eye: Landscape, Architecture, and Design at Mount Vernon*, Johns Hopkins University Press.
32. MELYAYEV M., 2002, *The adverse effects of green lawns*, <http://83.149.74.79/refs/29/33443/1.html> (21.04.2009).
33. MEYER M., BEHE B., AND HEILIG J., 2001, The Environmental and Economic Impact of Home Lawns in Minnesota, in: *Horticulture Technology*, vol. 11, p. 585-590.
34. MILESI C, RUNNING S. W., ELVIDGE C. D., DIETZ J. B., TUTTLE B. T., NEMANI R. R., 2005, Mapping and modeling the biochemical cycling of turfgrass in the United States, in: *Environ Management*, vol. 36, p. 426-438.
35. NASSAUER J. I., 1997a, The beauty that requires health, in: Nassauer J.I. (Ed.): *Placing nature: Culture and landscape ecology*, Island Press, Washington, D. C., p.87-106.
36. NASSAUER J. I., 1997b, *Cultural sustainability: Aligning aesthetics and ecology*, Island Press, Washington, D. C.
37. NASSAUER J. I., 1995, Messy ecosystems, orderly frames, in: *Landscape Journal*, vol. 14, no 2, p. 161-170.
38. NASSAUER J. I., 1988, The aesthetics of horticulture: Neatness as a form of care, in: *HortScience*, vol. 23, no 6, p. 973-977.
39. National Turfgrass Federation, 2003, *The turfgrass industry – present and future*. The National Turfgrass Research Initiative. National Turfgrass Federation, Beltsville, Maryland, p. 5-7.
40. NELSON R. H., 2002, Privatizing the neighborhood: A proposal to replace zoning with private collective property rights to existing neighborhoods, in: Beito D. T., Gordon P. and Tabarrok A. (eds.), *The voluntary city: Choice, community, and civil society*, The University of Michigan Press, Michigan.
41. POLLAN M., 1989, Why mow? The case against lawns, in: *The New York Times Magazine*, vol. 28, May, p. 23-27.
42. ROBBINS P., BIRKENHOLTZ T., 2003, Turfgrass revolution: the ecology of urban sprawl, in: *Land Use Policy*, vol. 20, p. 181-194.
43. ROBBINS P., AND BIRKENHOLTZ T., 2003, Turfgrass revolution: Measuring the expansion of the American lawn, in: *Land Use Policy*, vol. 20, p. 181-194.
44. ROBBINS P., POLDERMAN A. M., BIRKENHOLTZ T., 2002, Lawns and toxins: an ecology of the city. , in: *Cities*, vol. 18, no 6, p. 369-380.
45. SCOTT F. J., 1873, *The Art of Beautifying Suburban Home Grounds of Small Extent*, New York, D. Appleton & Co.
46. SHUMAN L. M., 2002, Phosphorus and nitrate nitrogen in runoff following fertilizer application to turfgrass, in: *Journal of Environmental Quality*, vol. 31, no 5, p. 1710.
47. STEINBERG T., 2006, *American Green-The obsessive quest for the perfect lawn*. New York, W.W. Norton and Company.
48. SUN G. AND LOCKABY B. G., Chapter 3: Water quantity and quality at the urban-rural interface, in: Laband D. N., Lockaby B. G. and Zipperer W. (eds.): *Urban-Rural Interfaces: Linking People and Nature*, American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, Madison, WI 2012, p. 26-45.
49. TAHVANAINEN L., TYRVÄINEN L., IHALAINEN M., VUORELA N., KOLEHMAINEN O., 2001, Forest management and public perceptions – visual versus verbal information, in: *Landscape and Urban Planning*, vol. 53, p. 53-70.
50. TRIGGER D., MULCOCK J., GAYNOR A., TOUSSAINT Y., 2008, Ecological restoration, cultural preferences and the negotiation of 'nativeness' in Australia, in: *Geoforum*, vol. 39, p. 1273–1283.
51. US Senate, 1991, *The use and regulation of lawn care chemicals*, Hearing before the Subcommittee on Toxic Substances, Environmental Oversight, Research and Development, Senate Hearing 101-685, Washington, D.C.
52. USEPA (United States Environmental Protection Agency), 199, *Preliminary Data Summary of Urban Stormwater Best Management Practices*.
53. VEBLEN T., 1899, *The Theory of the Leisure Class*. Macmillan, New York.
54. WALDICHUK T., 1998, A comparison of Japanese and North American attitudes towards residential landscapes in the rural-urban fringe, in: *The Great Lakes Geographer*, vol. 5, no 1 and 2 p. 15–29.
55. WEIGERT A. J., 1994, Lawns of weeds: Status in opposition to life, in: *The American Sociologist*, vol. 84, no 1, p. 80-96.
56. WILSON A., 1992, *The culture of nature: North American Landscape from Disney to the Exxon Valdez*, Blackwell, Cambridge.
57. ZHENG B., ZHANG Y., CHEN J, 2011, Preferences to home landscape: wildness vs. neatness, in: *Landscape and Urban Planning*, vol. 99, p. 1-8.

Sustainable Mitigation of Methane Emission by Natural Processes

Zrównoważone ograniczanie emisji metanu z wykorzystaniem naturalnych procesów

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Abstract

It has been observed that employing the natural processes occurring in the Earth's ecosystem for mitigating the greenhouse gases emission is sustainable. One of the main sources of methane emission is agriculture (rice cultivation and livestock raising). Limiting the cultivation of rice would not be sustainable, as it is the basic source of alimentation for a large share of human population. On the other hand, introducing feed additives which limit the methane production in ruminants can be considered sustainable. Another significant source of methane emission are landfills. Utilizing this gas for energy purposes is the most sustainable solution. However, as only part of methane can be used as the source of energy, the natural process of methane oxidation by methanotrophic bacteria occurring in soil may contribute to sustainable reduction of its emissions from landfills.

Key words: green gases emissions, methane emission, sustainable development, reduction of green gases emissions

Streszczenie

W artykule zwrócono uwagę, że wykorzystanie naturalnych procesów istniejących w ekosystemie ziemi do zmniejszenia emisji gazów cieplarnianych jest zrównoważone. Jednym z głównych źródeł emisji metanu jest rolnictwo (uprawa ryżu i hodowla bydła). Ograniczenie upraw ryżu nie byłoby zrównoważone, ponieważ ryż jest głównym źródłem żywności dla dużej części populacji ludzkiej. Natomiast wprowadzenie suplementów do paszy bydła ograniczających tworzenie się metanu w żwaczach można uznać za działanie zgodne z zasadą zrównoważonego rozwoju. Innym znaczącym źródłem emisji metanu są składowiska odpadów. Najbardziej zgodne z zasadą zrównoważonego rozwoju jest wykorzystanie tego gazu do celów energetycznych. Ponieważ tylko część metanu daje się wykorzystać do celów energetycznych zwrócono uwagę, że zastosowanie naturalnego procesu zachodzącego w glebie, jakim jest utlenianie metanu przez bakterie metanotroficzne może przyczynić się do zrównoważonej redukcji emisji metanu ze składowisk odpadów.

Słowa kluczowe: emisja gazów cieplarnianych, emisja metanu, rozwój zrównoważony, redukcja emisji gazów cieplarnianych

Introduction

Sustainable development is development that meets the needs of the present without compromising the possibilities of meet their needs by future generations (WCED, 1987). This is related to ecological, economic and social issues.

Human beings are social people, however to expand their social behaviour, they need i.e. stable environment.

The most important challenge for the present state of the biosphere is connected with climate changes and anomalies. They are caused by huge logging of forests, especially tropical forests, and impressive emissions of different greenhouse gases.

Climatic changes foreseen by IPCC seem to be one of the greatest threats for the implementation of the basic sustainable development paradigm, which is preserving the environment for future generations. Remedial measures, especially in the European Union, focus on cutting the CO₂ emission from anthropogenic sources, particularly in the energy generation processes. Switching to so called low emission energy generation technologies is an extremely costly venture, which has a negative impact on the economic development and may significantly hinder the implementation of another important sustainable development paradigm, namely the intra-generational justice. On the other hand, other methods of mitigating CO₂ concentration in the atmosphere remain under-appreciated. While approximately 10 billion tons of CO₂ are emitted annually from anthropogenic sources, mainly fossil fuel combustion and cement production, roughly 120 billion tons of CO₂ are emitted simultaneously from the Earth's biosphere. If the emission from ecosystems were reduced by 10%, it would mitigate the total emission from anthropogenic sources. Similar situation occurs in the case of methane, which is another important greenhouse gas.

On Earth, methane exists in deposits. It was created through two kinds of processes:

- in thermal processes. Organic matter decomposed in elevated temperature, producing methane and higher hydrocarbons. It is believed that both shale gas and crude oil were created in thermal processes.
- in biological processes. Methanogenic bacteria process organic matter into methane in anaerobic conditions. Methane produced in this way is found in conventional gas deposits, clathrates, and arctic permafrost.

The most important parameter, when considering the impact on greenhouse effect, is the content of methane in the atmosphere, which is continuously on the rise since the onset of Industrial Revolution. Its concentration in the atmosphere equalled 700ppb prior to 1750, reached 1745ppb in 1998 and amounted to 1775ppb (IPCC, 2001) in 2014. Ac-

cording to Fung et al. (1991), Lelieveld et al. (2002), Sapart et al. (2012), methane is emitted into the atmosphere both from natural sources such as swamps (115-145 Mt/year), termites (10-20 Mt/year), seas and oceans (5-10 Mt/year), as well as from anthropogenic ones such as fuel industry emissions (75-100 Mt/year), municipal landfills emissions (40-70 Mt/year), or rice cultivation (60-200 Mt/year).

Rice paddy fields can be compared to man-made wetlands which are characterized by high moisture content and oxygen depletion. These factors combined with high content of biomass and nutrients, create conditions for methane formation. Production of 1 Mg of rice corresponds to the emission of 100 kg of methane. Other sources of methane emission include livestock raising (80-115 Mt/year), biomass combustion in domestic stoves (30-50 Mt/year) and municipal wastewater treatment plant (~10Mt/year). According to IPCC estimations (IPCC2013), total annual methane emission from all the sources adds up to 598 Mt.

Simultaneously, methane is removed from the atmosphere. The most important sources include: oxidation in the troposphere (~506Mt/year), oxidation in the stratosphere (~40 Mt/year), and oxidation by methanotrophic bacteria in soil (30Mt/year). According to these estimations, methane content in the atmosphere increases annually by ~20Mt. Climate stabilization mainly necessitates inhibition of increasing methane content in the atmosphere. Limiting its emission to the degree which causes a drop in its concentration in the atmosphere would be beneficial. Taking into account the paradigms of sustainable development, which prescribe both to neutralize impact of methane on the greenhouse effect and to minimize the influence of taken actions on food production, a critical evaluation of possible methane emission mitigation methods will be carried out.

Sources of methane emission

Methane is the product of anaerobic organic matter decomposition. One of the main sources of methane emission is ruminants raising, especially cattle. This emission could be limited by reducing the beef production and substituting it with poultry and pigs, which are more neutral for the environment. Rice cultivation is another important source of methane. However, limiting its production would be difficult, as it is one of the diet basic components for almost half of the human population. Certain amount of methane is emitted from industrial processes such as extraction and distribution of natural gas (IPCC, 2013; Osborn et al., 2011; Rahm et al., 2012; Rozel and Reaven, 2011; Vidic et al., 2013) as well as coal mining (EIA, 2013). Biomass combustion in domestic stoves, especially in households, is yet another significant source of methane emission. Additionally, a lot of methane is emitted from wastewater treatment

plants, especially the sewage discharged by growing cities, and from landfills. Emission from both sources is rapidly growing. Since the days of Industrial revolution, the concentration of methane in the atmosphere increases by 0.9% per year on average. In the Earth's ecosystem, there are various methane decomposing processes. One of the more important ones is methane oxidation in troposphere and stratosphere by OH[•] radicals. Methane absorbed by soil is also decomposed by methanotrophic bacteria. Therefore, it is advisable to seek natural methods for mitigating its concentration in the atmosphere.

Methods of mitigating methane emission

Mitigating methane emission from natural sources is relatively difficult. Practically, one should not interfere with the termite colonies existing in natural ecosystems. It is also hard to imagine any way of controlling the emission from seas and oceans. Theoretically, it would be possible to reduce methane emission from swamps by drying them. However, this is a significant interference in important natural earth ecosystems, which are habitats of many organisms. Drying swamps would decrease bio-diversity. Moreover, it leads to increased rate of organic matter mineralization, which in turn leads to the increase of another greenhouse gas – namely, carbon dioxide. Taking into account the above-mentioned consequences, the conclusion is that interfering with the natural methane-emitting processes would not conform to the principles of sustainable development. Let us evaluate the anthropogenic processes. Relatively lot of methane is emitted during the extraction and processing of fuels. Actions aiming at curbing the emission, mainly through improved leachate control and reducing the emissions from coal mines are encouraged. In the latter case, degassing coal deposits prior to extraction is desirable, as it leads to the utilization of methane as a source of energy and increases the safety in the process of mining coal as well.

Rice paddle fields, which are a vital source of food, especially in Asia, also significantly contribute to the emission of methane. Hence, limiting the cultivation of rice would be against the sustainable development principle of providing access to food. In the case of livestock raising, cattle is mainly responsible for methane emission. To a certain extent, the raising of cattle for slaughter could be limited by substituting beef with pork and poultry, as the emission of methane is low in that case in that process. However, it is difficult to alter the dietary patterns of a large and wealthier part of population, which puts the reduction of livestock for meat production into question. Approximately 3-12% of the energy consumed by cattle and sheep is converted to methane in the rumen and released to the atmosphere. This amount of energy is wasted and therefore is not used for growing of these animals. Therefore, minimization of the

methane generation in rumen will contribute to better utilization of forages by farmers.

However, limiting methane emission from livestock raising by means of feed additives that mitigate the methane production in rumens should be considered. RumensinTM is a product which significantly reduces this problem (Hook et al., 2010). Employing this additive would eliminate the negative impact of livestock raising on climatic changes and will improve utilization of feed in meat and milk production. Yet, this approach is not cost free. The production of this additive generates additional cost which should be balanced by an increase in forage utilization and decrease in the contribution of methane emission to greenhouse effect. Cutting the emission from cattle and sheep raising by 50% would inhibit the increasing methane concentration in the atmosphere. However, the problem consists in the lack of economic instruments which could be used to control the use of above-mentioned feed additives on a broader scale.

Landfills constitute another important source of methane emission to the atmosphere (Bogner and Spokas, 1993). Methane on landfills is created in the process of anaerobic organic matter decomposition by bacteria (methanogens). This process yield great amounts of methane (Hilpert et al., 2007; Fountoulakis et al., 2008; Hook et al., 2010; Wedlock et al., 2013) which is profitable in recovery and use for energy purposes.

Landfills are the third biggest anthropogenic source of methane, after rice cultivation and ruminants. 1200 Tg of waste is produced annually in the world, 70% of which is deposited on landfills. According to estimates 30-35 Tg CH₄/yr is emitted from landfills. It is projected that the amount of produced waste will increase twice till 2030. Therefore, cutting the emission from this source may significantly contribute to the mitigation of methane impact on the greenhouse effect.

In the USA alone, there are over 400 systems utilizing landfill gas, which are capable of generating more than 9 billion kWh of electricity. It is estimated that there are over 1000 such systems globally.

However, utilization of methane from landfills is possible when the production is intense, i.e. for a certain period. Attempts to intensify the methane production in order to utilize it for energy purposes are made (Pawłowska and Siepak, 2006), as they would allow for a more sustainable management of landfills. Nevertheless, methane will be produced on every landfill for decades, but after some time its concentration will be too low to be used as a source of energy. On the other hand, mitigating this emission is extremely important for preventing the global warming. While seeking the methods of mitigating methane emission, attention was drawn to methanotrophic bacteria living in soil, which are capable of oxidizing it.

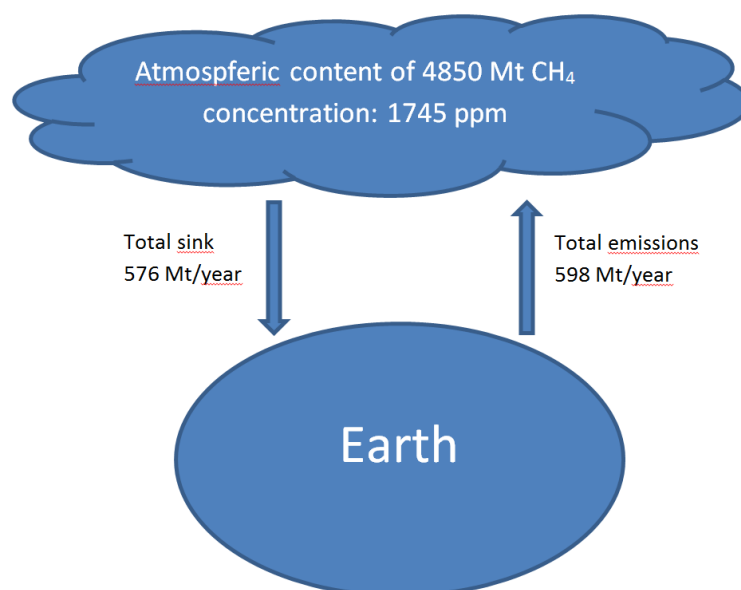


Figure 1. Simplified diagram of methane circulation in the Earth ecosystem (data based on direct flux measurements, IPCC 2007)

Methanotrophic bacteria are able to convert the methane to carbon dioxide, which has warming potential 25-times smaller than the methane.

Biofilters that employ these bacteria have been constructed (Pawłowska et al., 2011), and methods of creating landfill covers in which methanotrophic bacteria develop have been devised (Pawłowska et al., 2003; Pawłowska and Stepniowski, 2004, 2006; Czepiel et al., 1996; He et al. 2008; Chanton et al., 2011) (Fig. 1). In this way, methane emitted from landfills may be oxidized. Such biofilters and special covers allow for self-oxidation of methane and thus mitigate its emission.

Summary

There are two fields in which significant reduction of methane emission into atmosphere is possible. The first constitutes employing additives to the feed for cattle and sheep raising. This solution is beneficial from the point of view of sustainable development, as it leads to better fodder utilization, meaning that the same amount of feed would yield more milk and beef. However, it is difficult to convince the animal breeders to employ it. Although the reduction of methane emission from livestock raising through the addition of substances inhibiting the production of methane in rumens could relatively easily stop the increase of methane concentration in the atmosphere, no possibility of convincing the breeders to adopt this solution renders it practically non-viable. Methane emission to the atmosphere could also be inhibited through the reduction of the emission from landfills by using biofilters or bioactive biocovers. Bearing in mind that biofilters and biocover may virtually operate autonomously, employing this method of methane emission mitigation is easier. It would be

possible to introduce legal regulations enforcing the installation of biofilters or biocovers on landfills.

Employing the natural methods, such as methanotrophic bacteria, for the mitigation of methane emission from landfills is a good example of intensifying natural processes occurring in the environment to reduce the greenhouse gases emission. This is a classic example of a sustainable method.

References

1. BOGNER J., SPOKAS K., 1993, Landfill CH₄: Rates, fates and role in global carbon cycle, in: *Chemosphere*, 26 (1-4), 369-386.
2. BORJESSON G., SUNGH I., TUNLID A., SVENSSON B. H., 1998, Methane oxidation in landfill cover soils as revealed by potential oxidation measurements and phospholipid fatty acid analyses, in: *Soil Biology and Biochemistry*, 30 (10-11), p. 1423-1433.
3. CHANTON J., ABICHO T., LANGFORD C., SPOKAS K., HATER G., GREEN R., GOLDSMITH D., BARLAZ M.A., 2011, Observation on the methane oxidation capacity of landfill soils, in: *Waste Management*, 31 (5), p. 914-925.
4. CZEPIEL P.M., MOSHER B., CRILL P.M., HARRISS R.C., 1996, Quantifying the effect of oxidation on landfill methane emissions, in: *Journal of Geophysical Research*, 101 (D11), p. 16721-16729.
5. U.S. Energy Information Administration, Annual Energy Outlook 2013, [http://www.eia.gov/forecasts/\(2.01.2015\)](http://www.eia.gov/forecasts/(2.01.2015)).
6. FOUNTOULAKIS M.S., STAMATELATOU K., LYBERATOS G., 2008, The effects of pharmaceuticals on the kinetics of methanogenesis

- and acetogenesis, in: *Bioresource Technology*, 99, p. 7083-7090.
7. HE R., RUAN A., JIANG C., DONG-SHENG S., 2008, Responses of oxidation rate and microbial communities to methane in simulated landfill cover soil microcosms, in: *Bioresource Technology*, 99 (15), p. 7192-7199.
 8. HILPERT R., WINTER J., KANDLER O., 1984, Agricultural Feed Additives and Disinfectants as Inhibitory Factors in Anaerobic Digestion, in: *Agricultural Wastes*, 10, p. 103-116.
 9. HOOK S.E., WRIGHT D., McBRIDGE B.W., 2010, Methanogens: methane producers of the rumen and mitigation, in: *Archaea*, 2010:945785.
 10. IPCC AR5 WG1, 2013., *Climate change 2013: The Physical Science Basis – summary for Policymakers*, Cambridge University Press.
 11. IPCC, 2007, *Climate Change 2007: Working Group I: The Physical Science Basis. 7.4.1 Methane*.
 12. OSBORN S.G., VENGOSH A., WARNER N.R., JACKSON R.B., 2011, *Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing*, Proceedings of the National Academy of Sciences of the United States of America, 108, 8172.
 13. PAWŁOWSKA M., STĘPNIEWSKI W., 2004, The effect of oxygen concentration on the activity of methanotrophs in sand material, in: *Environment Protection Engineering*, 30, (3), p. 81-91.
 14. PAWŁOWSKA M., STĘPNIEWSKI W., 2006, Biochemical reduction of methane emission from landfills, in: *Environmental Engineering Science*, 23 (4), p. 666-672.
 15. PAWŁOWSKA M. SIEPAK J., 2006, Enhancement of methanogenesis at a municipal landfill site by addition of sewage sludge, in: *Environmental Engineering Science*, 23 (4), p. 673-679.
 16. PAWŁOWSKA M., 2007, Reduction of methane emission from landfills by its microbial oxidation in filter bed, in: Pawłowska M., Pawłowski L. (eds.), *Management of Pollutant Emission from Landfills and Sludge*, CRC Press.
 17. PAWŁOWSKA M., ROŻEJ A., STĘPNIEWSKI W., 2011, The effect of bed properties on methane removal in an aerated biofilter – Model studies, in: *Waste Management*, 31 (5), p. 903-913.
 18. RAHM B.G., RIHA S.J., 2012, Toward strategic management of shale gas development: Regional, collective impacts on water resources, in: *Environmental Science & Policy*, 17, p. 12.
 19. ROZELL D.J., REAVEN S.J., 2011, Water pollution risk associated with natural gas extraction from the Marcellus shale, in: *Risk Analysis*, p. 1-10.
 20. WEDLOCK D.N, JANSSEN P.H., LEAHY S.C., SHU D., BUDDLE B.M., 2013, Progress in the development of vaccines against rumen methanogens, in: *Animal*, 2, p. 244-252.
 21. VIDIC R.D., BRANTLEY S.L., VANDENBOSSCHE J.M., YOXTHEIMER D., ABAD J.D., 2013, Impact of shale gas development on regional water quality, in: *Science*, 340, p. 826-833.

Sustainable Bridge Design

Zrównoważone projektowanie mostów

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Abstract

The work consists of two interrelated parts. The first one presents general issues relating to sustainable development. There are examples of the road investments, in which the problems arising from the lack of a general approach to environmental principles and consequently sustainable construction occurred. In the second part, on the examples of culverts and bridges, selected technical cases are discussed.

The aim of the paper is to characterize the inconsistencies appearing during the bridge design process and maintenance in accordance to environmental categories. Several examples of the road-bridge investments carried out in the last decade have created the basis to formulate some opinions and questions.

The difference between the approach of bridge engineers and that of environmental ones to the concept of animal transition is shown on the grounds of implemented technical and environmental standards. The existing problems are of dual nature, the first group being very general aspects i.e. concerning the concept of ecology, while the other one involves detailed tasks, e.g. shaping the image of a bridge. Several questions of great significance have been formulated and addressed to ecologists. The answers are indispensable for bridge engineers to solve technical aspects of the proper, sustainable design of environment-friendly bridges.

Last but not least, the suggestion to use bridges as places for monitoring the environment in their surroundings is presented. This research work might be crucial for further good cooperation of bridge engineers and environmental ones.

Key words: sustainable development, bridges, environment

Streszczenie

Praca zawiera dwie powiązane ze sobą części. W pierwszej zaprezentowano ogólne zagadnienia z zakresu zrównoważonego rozwoju. Przywołano przykłady inwestycji drogowych, przy których wystąpiły problemy wynikające z braku zrozumienia uwarunkowań zrównoważonego rozwoju, co przełożyło się na problemy budowlane. W części drugiej, stosując przykłady z budownictwa mostowego, poddano dyskusji wybrane problemy techniczne.

Celem pracy jest omówienie nieścisłości w kategoriach środowiskowych, pojawiających się w trakcie projektowania mostów, rzutujących na ich utrzymanie. Kilka przykładów spośród prowadzonych w ostatniej dekadzie inwestycji drogowych stworzyło platformę do formułowania opinii i stawiania pytań.

Różnice między podejściami inżynierów mostowych a środowiskowych pojawiają się wyraziście przy projektowaniu przejść dla zwierząt. Przedstawiono je, wykorzystując stosowane standardy techniczne i postulaty ekologiczne.

Istniejące sprzeczności są dwójakiego rodzaju. Z jednej strony obowiązują bardzo ogólne zasady ekologiczne, podczas gdy z drugiej występują elementarne zadania projektowe, czyli np. projektowanie geometrii lub szerzej – obrazu mostu. W tym szczegółowym zakresie sformułowano kilka ważnych pytań adresowanych do ekologów. Odpowiedzi na te pytania są kluczowe dla projektantów, po to by rozwiązywać problemy mostowe właściwie, tj. by projektować funkcjonalne, zrównoważone i przyjazne środowiskowo obiekty drogowe.

Na koniec poruszono problem monitorowania środowiska, z wykorzystaniem przepustów, mostów i wiaduktów. Powstałe zbiory danych mogą utworzyć bazę do prowadzenia badań o charakterze ilościowym, a takie wyniki będą owocować dobrą współpracą inżynierów środowiskowych i mostowych.

Słowa kluczowe: zrównoważony rozwój, mosty, środowisko

1. Introduction

Sustainable design and construction works are applications of the sustainable development concept. The Latin *sustentō* means sustain or endure. Now the term is more extended than the original Latin word meaning. In the case of construction – the contemporary understanding of the above is a sort of actions, which result in welfare of people and their surrounding (Kates, 2005; Quaddus, 2013). However, any development is the *unity* of adversities. On a very minor scale it could be observed when struggles between environmentalists opposing the expansion of a transportation net and civil engineers occur. The pure Kant *Praxis* category (Critchley, 2012), which is here only a technical tool, could be applied when estimating engineer processes. Building highway systems in the US and Germany in the 30s was a method against the economic crisis, which was manifested by high unemployment. This program changed the transportation systems revolutionarily and led to the industrial and economic growth. The same program was applied in Italy after World War II, where the results were the same and where the development was spectacular.

So, bearing in mind positives of creating highway systems, one should put the following question – what is an alternative choice? If, looking forward, the road system is not done, will this be a compromise for generation to come or not? The similar problem applies all around the world, while creating linear and spatial structures of a various type, built with cements as a binder in concrete. The use of cement is one of the main sources of atmosphere pollution. However, until now, there is no substitute to it. Without question, tunnels, roads or cities already built and those being built at present, could be treated as developments that will be positive for further progress of future generations (which is the basic principle of sustainable development). Nevertheless, the pollution impact is also unquestioned. Where is the balance or, more strongly, where is the impassable limit for concrete technology (Aitcin, 2000)?

An interesting concept is presented in the article *Sustainable Development Revolution* (Pawłowski, 2009) where the author analyzes sustain development taking Ethics into consideration. It is true, that any changes start from mental disintegration which leads to the higher level of new integration (Dąbrowski, 1964). It is worth to recall the Gutenberg print technique followed in mass releases of the Bible or the Briand-Kellogg treaty (Stimson, 1932). Those were the turning points in human mentality, especially in ethics. Ethics is highly anthropological while the nature is governed by very crude rules,

characterized by Darwin (1859). The everyday human life is full of behaviours, which could be treated as Darwin's type, being rather rare to ethics inherent to other religions. Therefore, Cuvier's concept (1825) that the nature could be divided into animals (humans are animals, too) and non animals is still valid. However, the ethical approach could be fruitful when the problem of natural catastrophes will be included into anthropological ethics. Natural catastrophes, e.g. a flow of the river high floodwater or volcano eruption though are independent, even if many barriers (warning systems, walls, etc.) are constructed to prevent them. In this perspective, on the time axis, the ethical approach will be a consideration valid locally only. Concluding, the ethical approach is consistent with the Hegel helix (Verene, 1998), additionally this approach fulfils all elements of Hegel's scheme¹.

Pure philosophy and the philosophy of nature become closer to engineering or, more precisely, to engineers. The philosophical considerations display their complexity when the designer starts to draw the axis of the future road. At this moment, the current problems between environmentalists and road engineers arise in respect of understanding sustainable development. This controversy will be discussed in the text below.

2. From the protests of young lions of ecology to the provisions of the European Union in the field of environmental protection

Protected natural areas are key places where some problems at the interface between the investment – protection of the environment frequently appear. In practice, the all EU countries are covered by the uniform legislation, which refers to the most valuable sites protected on account of their uniqueness of nature. For most European countries the development of transport net is now mainly associated with their maintenance and replenishment.

But there are countries, like Poland, where situation is different. Poland's transformation, which began in 1989, included a lot of political, economic and social changes. The first phase of the transformation required facing the lack of a modern transport net, as well as diagnosing current problems of sustainable development when the investment in infrastructure, mainly roads and railways, took place.

The initial attempts to solve these problems ended up, in the majority, in failures both due to the inconsistency of the national legislation with the EU's one, as well as poor understanding of the principles of a sustainable approach to transport investment problems, which should focus on the possible maximal number of sustainable development aspects.

¹ Die These-Antithese-Synthese, geistloses Schema.

The turning point was the so called Rospuda River case. In 2008 the road construction works were stopped because of the organized protest of the local ecological organizations. They wanted to protect the river and were suggesting the alternative route of the road. The protest had a form of blocking the road construction works. Since that time, the real, both technical and environmental, aspects have been applied in the design.

The Rospuda effect also caused the change in the law. Most of the legal acts modified the approach to the design solutions of future road and railway routes by the requirements of environmental and human protection. The costs of realizations of transport investments have increased, but in most cases they resulted in solutions fulfilling an important role associated with the development, while eliminating or strongly reducing the impact of transport facilities on the environment.

But there are cases, where any consensus is not achievable. The presentation of an example of the felling trees along the roads in Germany (Brandenburg, 2009) and Poland (Pomerania, 2010) may be indispensable. Supporters of the trees logging and a narrow road enlargement indicated a high risk for people using the road in the case of a vehicle collision with a tree. In contrast, proponents of leaving trees along indicated the need to preserve rare and, therefore, protected species inhabiting these trees (hermit beetle and bats). They proposed the introduction of traffic restrictions (mainly speed limit) to eliminate the risk of an accident. This example illustrates the similar approaches and understanding of protection. The difference relates to protecting various entities. The current rules in this case do not give a clear solution, despite the fact that in defence of man and nature an equally powerful pressure was applied.

The more spectacular action was conducted when the construction of a detour around the small town of Augustów (Poland) was commenced. In 1992 the decision on the design work of the circuit road was taken. Among dozens of bridges, overpasses and culverts there were also objects designed for small and big animals. All this, i.e. roads and bridges as project elements, was performed strictly according to the Polish and European standards on environmental conservation. On the road run was the nature reserve on the Rospuda River, which was intended to be exceeded by means of high road embankments and overpasses as well as bridges in the valley of the river.

It is necessary to emphasize that the life of citizens in Augustów reached the limit of uncomfortable conditions due to heavy transport traffic, high noise, difficulties for pedestrian and bicycle traffic and even dangerous accidents.

The road construction works started in 2007 but soon the works were blocked, due to an ecological action, which was supported by some TV channels. In 2008

the investment was stopped. Recently, after significant modifications of the project, the construction works were started again. Till now the Rospuda slogan is readable anywhere and anytime in Poland when one thinks of designing a road.

Here a question arises, why such a situation occurred (Directive, 1985; Directive, 1990; Directive, 2001). Firstly, there is an analogy to the case of the overpass highway of Pilzno, the Czech Republic. Also there, the young ecological movement blocked the road construction works, and also after ~10 years the construction was continued. Probably here and there appeared the same sociological mechanism. It is worth mentioning that those were the days when both Poland and the Czech Republic joined the European Union and when new circumstances provided a new range for independent critics and personal responsibility distrust to governmental decisions still existing. 10 years' time seems to be brought to gain the mature understanding of both road-bridge technical conditions and environmental requirements. This is the time, which allowed to avoid a really dramatic cost of struggle between the two sides of the investment process and to transform the two opposite sides into partners. However, civil engineers have been still waiting for more detailed and uniform rules related to the environmental requirements for design.

The above examples well illustrate the basic problems of the countries, in which the fast social and economic change have a very large impact on the problems of proper understanding of sustainable development and the rules directly and indirectly related Directive (Gałaś, 2013).

As it turns out, not only the countries that have recently become part of the EU, face such problems. In several countries the highly organized social groups and environmental organizations, with the help of appropriately shaped legislation packets, block many planned road projects. This applies mainly to the Natura 2000 sites, national parks and other particularly valuable natural areas.

The example worth looking at might be an attempt to build the Federal S18 road crossing national park Lauterbacher Ried (SAC – Special Area of Conservation) near Lake Constance on the Rhine at the northern foot of the Alps, where local and federal authorities recognized that there was no alternative option for the course of the road. The formal procedure of the S18 road course began in 1992.

The consultations regarding, *inter alia*, the course of the road began in 1994, and ended in 1997. In 1999 the procedures relating to the authorization of the construction of this road were initiated and ended in 2001. This decision appealed to the government of the Land of Vorarlberg in which the disputed areas of the national park are situated. At the same time, in 2001, there was a complaint brought to the European Commission. In 2002, the European Commission sent the Austrian Government a letter of formal notice. Nevertheless, the Austrian government upheld

the decision on the implementation of the road in 2003, but after half a year the execution of the decision was suspended due to the bringing of the action of the European Commission to the European Court of Justice. In March 2006, the Court of the European Commission pointed to the failure of the Austrian Government and the infringement of two *Birds and Habitats Directives*, (Directive, 1979; Directive, 1992) mainly for the protection of birds – especially the corncrake (Case No: C-209/04).

This type and similar cases also took place in other EU countries and ultimately were settled by the European Commission, and in some cases by the European Court of Justice. Let us recall here Italy (Case No: C 117/03), the Netherlands (Case No: C-127/02), Portugal (Case No: C-239/04, Case No: C-191/05), Spain (Case No: C-235/04), Germany (Case No: C-244/05).

The above examples show, how – in many cases – the problems associated with various aspects of sustainable development: environmental, social, economic, as well as political and legal interpenetrate. It seems that due to certain provisions of the EU issues (Directive, 1985; Convention, 1998) main areas and species specially protected, have been harmonized within the EU member states. Unfortunately, also in many cases, there are still differences in the approach to the issues of preparing the project – for example, the approach to skills investment from the point of view of their impact on the environment (COST, 2003; Gałaś, 2004). Even greater disparities between EU countries are at the technical level.

The examples described below are focusing on requirements for bridges and engineering facilities in Poland. Over the years, those environmental requirements, have become more difficult to meet and are sometimes economically unjustified.

3. Basic environmental requirements related to bridges – case study from Poland

There are no special technical standards to design bridge objects, regarding environmental needs. Instead of standards, there are paragraphs in the Polish Transport Regulations (Regulation, 2000) where such requirements are formulated in detail. Briefly, they go as follows:

For wild animals a non-collision path ought to be ensured to let them move from one side to the other of the higher class roads in the areas of the increased migration, in particular in larger forest complexes and areas of wetlands and other habitats of rare and endangered species, as indicated by the relevant government authorities or appropriate local government units. This ought to be done as:

- transition in tunnels across the body of the road of a width equal to min 10 m,
- viaducts over the road with the entrances equipped with a screening fence in the access passages to the facility, of an axis crossing at an

angle close to 60 deg, and connecting with the green filming on the site – in order to lead wild-life, fig. 1-2.

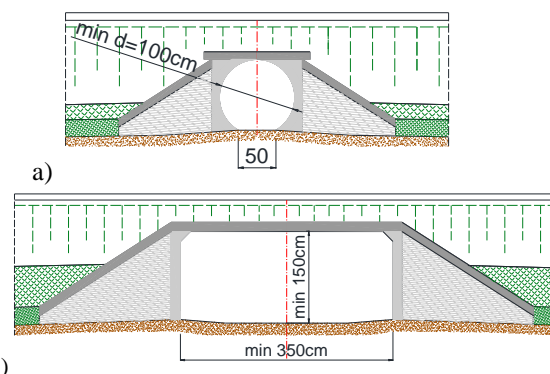


Figure 1. The clearance gauge a) for small animals b) medium-sized animals



Figure 2. Culverts for small animals – shapes of clearance gauge a) rectangular b) parabolic c) circular

In the case of large animals we practically have to deal with full-size viaducts. The rectangular clearance gauge under the viaduct is of a minimum height (H) of 4 m. The clearance width (B) is set by the following inequality:

$$B \geq \frac{N \cdot L}{H} = \frac{3}{2} \frac{L}{H} \quad (1)$$

where N is the measure of narrowness of min value $N = 1.5$; H – the height; L – the length of the passage. Another, more comfortable, parameters are proposed in COST (2003).

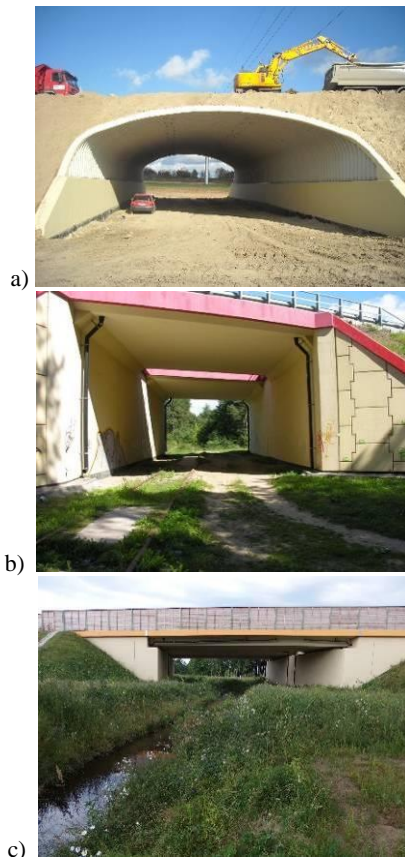


Figure 3. Animal transitions: a) for medium-sized animals b), c) for big animals

Basically the bridges were located over the rivers, while the viaducts over existing roads, agricultural fields or meadows. Such transition locations were the aim of environmental tracts (Karas, 2011).

There were three groups distinguished – small animals, medium-size and big ones respectively. In short – for small animals, like frogs or hares, for which it is necessary to build passes in form of circular tube culverts of the min. diameter of 100 cm (0.8 m^2) and walking paths of a min of 50 cm breadth, see fig. 3, culverts also leading along water-courses.

Outside of the culvert, the base of the passage should be designed according to the existing ground surface. In the case of water-courses some additional side benches running along the passage near the culvert walls should be constructed. The surface of the benches have to be placed above the average water level. To protect animal migration on the road, or train lanes, the appropriate fence system should be introduced to direct small animals to the safety zone where the culvert passage is located. The above mentioned fences could be made from different materials (steel shields) but in practice they are usually made of green colour plastics.

Finally, even though it is not written down in any technical or administrative document, the local stone, ground and vegetation are indicated to be used.



Figure 4. River culverts designed in accordance to old and new standards a) built in 2006 b) constructed in 2013

In fig. 4 the culverts present their beauty as elements of the river's landscape. Also the photos show differences occurring within the range of environmental approaches. In the first photo there are absences of side paths for small animals. In fig. 4b such a side bench was made. The scarp protection is made by use of openwork precast concrete heavy plates, which start being overgrown by grass. Technically, it is a typical and well verified solution, whereas the concrete stiff elements are extraneous in the natural river bed system.

Now, the dominating solution is to use more friendly gabion mattresses which are filled with crushed natural stones, appropriately to the mesh size, fig. 5. The gabion mattresses protection easily becomes overgrown by meadow grasses.

4. Long bridge – smaller environmental problem

A large river, or even a medium-sized river, always has a wide floodplain. Additionally, high water levels are significant because the height of the clearance gauge is large. Designing a long span bridge means to obey hydraulic and hydrologic criterions for the easy flow of high river water. This automatically fulfils the conditions for the minimum clearance gauge for big animals. Also, bigger distances from the carrying-deck to the ground level result in a more quiet solution considering road traffic but also, increasingly, for new rail bridges. For a long time this positive ecological impact was countered by extensive damage to the surrounding area caused during the construction of long bridges. Nowadays, however,

building technologies limit very strongly bad influence on bird habitats, especially during the breeding season (Rochelle, 1999; Garniel, 2010).



Figure 5. The bridge over the Lopa River in Lopiennik; transition for medium-sized animals a) in 2007 b) in 2009

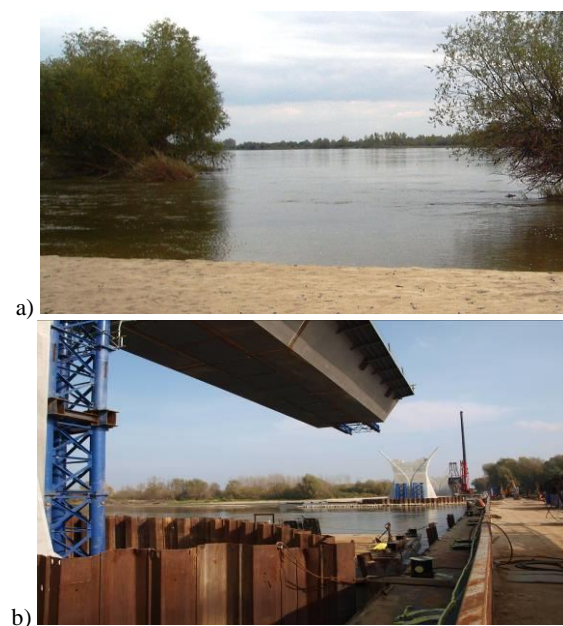


Figure 6. The bridge over the Vistula River in Kamień, a) view in 2012 b) under construction, 2014

The existence of biotope in the surrounding of long bridges is a challenge for both environmental and bridge engineers. Locally, during the bridge erection the previously existing biotope is destroyed (fig. 6). Figure 5a shows a change of vegetation occurring during the replacement of the existing old RC (reinforced concrete) bridge with a new composite of a steel-concrete. According to the environmental rules, the previous condition of vegetation should be

reconstructed in the coming 18 months after the construction works have been finished. As it is clearly visible, it is not possible in practice, as shown in figure 7.



Figure 7. The bridge in Neple over the Bug River a) an old one b) the new bridge

Also here, additional two views encounter. One of them, in a technical sense, the empty one i.e. a meadow clearance gauge, is perfect for the water flow. The other option is the clearance gauge, overgrown by bushes and trees. This is environmentally perfect solution. Here, bridge engineers are still waiting for the answer – which is better?

5. The attractiveness of environmental solutions for the people

While creating the environment surrounding for animals it was forgotten that the human, in a sense, is an animal too. Many rainwater reservoirs near the highways were practically immediately populated by amphibians, even when vegetation was not fully completed.

A water mirror, a green escarpment of highway embankments, an easy access i.e. in the vicinity of the city locations, all these were elements attracting people to camping, barbecue, fishing, bird-watching, in general, to relax, fig. 8. Let us notice that the noise of highway traffic at the foot of the road embankment is relatively low. All this provides the unity of nature and home for people around. Also, while building highways many secondary service roads were necessary. This service net discloses many interesting nature places. When one thinks *environment*, the human is excluded. This sounds like a very popular idea i.e. to separate nature from human activity or at least to limit the contact between them.



Figure 8. On the S17 road a) nature refuge b) place of recreation

This is the basic concept accompanying the foundation of national parks, for instance.

From the authors' point of view, the contact between man and nature is an elementary organic relation. It ought to be organized properly for both elements. To do this, the more commercial approach is necessary. At the design level the parking places must be taken into consideration. The administrator of such areas has to introduce clear rules of behaviour, such as entry fees, so, in short, all the elements which are in use in countries like Belgium or the Netherlands.

Here appears another mental barrier, which should be broken through. This one must be obvious for non-environmentalists and bring about some discussion among ecologists.

6. Questions that still need to be discussed and are waiting for answers

Building a bridge object proceeds according to proven, almost typical rules, which correspond to those given in the Eurocodes. The possible variation is only in term of details. Environmental engineers repeatedly questioned about the impact of the image on the behaviour of large animals, do not answer in a clearly way. Actually, there are two schools, not in congruence at all.

For example, the cones² of road embankments at bridge abutments may have at least two forms. The cone may be surface-enhanced by means of semi-rigid surfaces made of concrete blocks of the 15 cm thickness. The expression of such a solution is a strong colour image corresponding to the geological rock formation occurring in the rock mountains.

The other option is a solution used not so long ago, in which the cones of embankments were strengthened by laying turf. In this case, the image is characteristic of the lowland meadow views. Which is better? The thing is that one can get answer in two variants.

In terms of a bridge maintenance both of the discussed solutions are correct and equivalent. Therefore, arises the question mentioned above, which of these solutions is more pro-environment? There is also a twin question: how do large animals perceive the colour or the colour intensity? As far as colouring is concerned, bridges are designed only in the context of human acceptance.

Both questions are reasonable in a much broader context, namely: *what is the psychology of large animals* ? This question is so broad, that the problems of forming bridges constitute its small percentage.

Another issue is the cost of engineering and road bridges. It is estimated (Madaj, 2012), that the construction costs of passages for small, medium and large animals, noise screens, planting of trees and shrubs were from 10 to 20% of the total costs. This is a significant sum. What is the most expensive is upper transitions for large animals, which amounts to the cost of the normal typical overpass over the highway.

Another reasonable question arises concerning the effectiveness of these costs (Bohatkiewicz, 2014). Currently, the observations of the use of these objects by animals are commonly conducted. The answers are partial, but positive. The material collected from the observation includes animal trails and single images of animals passing, which indicates that animals use the constructed passages. However, so far no conclusions can be drawn in terms of statistics. Probably, animals need a generation or more to get used to the new situation. The answer to this question is very important, as cited, 10 to even 25% represent a significant compromise, involving the depletion of the possibility of achieving the objectives necessary to people (Karas, 2011).

Although the road-bridge standards in the field of ecology were formulated long ago and are precise and clear, the environmental criteria expressed in the relevant documents are not. In the field of environment there is an exponential growth in various regulations and instructions, which means that the goals are not clearly defined. Hence, their implementation may cause technical troubles. This is a major difficulty, which in the opinion of the authors, results from not enough professionalism of environmentalists.

Numerous mishaps show clearly, that this area requires a significant cognitive and technical discipline.

² Actually, in terms of geometry there are quadrants of a truncated cone.

As an example, the reference is made to a temporary break in the design and consequently the break in the building of an airport in Swidnik (eastern Poland). The area destined for the runway turned out to be inhabited by the spackled ground squirrel (*Spermophilus suslicus*), which is protected.

The problem has become popular because of its multiple presentations in the mass media.

After a thorough understanding of the situation, it turned out that the existing colony of the spackled ground squirrel was the result of artificial release of a few individuals from a breeding home. Due to unfavourable natural conditions, and degeneration within the group, this colony disappeared.

The above example shows that good intentions must be supported by solid research.

Here comes, therefore another question: how far is the recognition pure i.e. when is the recognition free from the anthropological point of view? The above question is related to yet another issue of nature – the problem of locally favoured conditions.

7. Nature v. nature

The symbol of the last international conference on environment and road construction³ was a stork preying at guiding fences. Another recorded instance was of a snake hunting along a guide fence. Hence comes a question – to what extent are human activities appropriate to protect nature and to what extent are the protecting processes leading to the imbalance of the whole system of fauna? Since nature is governed by the primary rule of survival, every convenience for some animals raises an increased risk for others. From the point of view of a road-bridge engineer this problem is of minor significance, but every road-bridge engineer is also an ordinary human for whom the idea of equality, justice, etc. is crucial.

As an example, for several years, beavers in Poland have been under strict protection. These animals are not very timid in the neighbourhood of man (Galaś, 2004). Their nature is to build systems of dams, using trees growing along the rivers. Following the introduction of protective provisions there was a significant growth of the population of beavers. Hence, there was clearly a greater range of their activities which was manifested by fallen trees (fig. 9) and significant consumption of fish in rivers (sometimes up to 100%). Here and there a new flood plain river areas occurred, with the surface close even to 5 hectares. There was a visible change of the image of woodlots after some poplars, ashes and alder trees had disappeared. There were problems with the availability of grassland, maintenance of riverbed profiles, uncontrolled damming the water. In the

case of bridges and culverts the problem strongly appeared during the high water flow, when the water carried logs of trees blocking the light of the bridges, causing additional stacking water and often blurring the bottoms of the rivers.

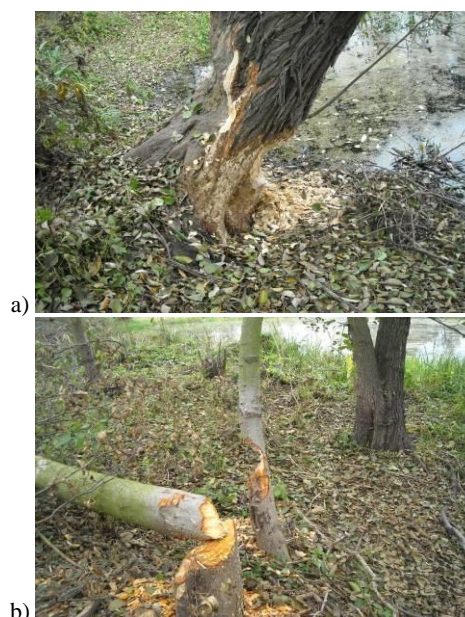


Figure 9. Effects of the beavers activity

Natural conditions such as extreme high water flows in culverts or under bridges after torrential rains cause havoc among birds during the breeding season, cause the destruction of nests and was the reason for the bird chicks deaths. The statistical distribution of such natural disasters means, that in large areas there is some averaging, which is depicted in a natural state.

If so, regarding to the environment, why road and bridge works are invasive like, why are perceived to be an attack on nature?

Let us emphasize the fact that a lot has been done to reduce the invasiveness to the minimum state, level which seems a safe one.

These questions are directed to environmental engineers. Questions need not be considered on the basis of the theoretical academic discussion. The form of response must be such, that their implementation in the process of construction will be possible. Lack of such responses could be a source of spontaneous public activity with a high emotional background, which is highly unrequired in construction works.

8. Conclusions

Achieving the full impact on sustainable development in investing activities, particularly in the field of linear structures, is currently a very difficult task.

³ 6th International Conference on Environment and Aesthetics in the Road Construction, which was held in Kazimierz Dolny, this year on 23-25 April; organized, among others, by the Road and Bridge Chair of Lublin

University of Technology, <http://wbia.pollub.pl/pl/owydziale/struktura-wydzialu/katedra-drog-i-mostow/konferencja-kazimierz-2014> (01.09.2014).

The road investments cover all elements of sustainable development: ethical, ecological, social, economic, technical, legal and political. Gaining an effect of the proper balance and ultimately of sustainable solutions can be extremely difficult and in some cases impossible. The reason is a varied level of understanding by many stakeholders of road investments. The hardest part is to understand the technical problems that are related to the economic and legal ones. The examples are culverts and bridges which in most cases, focus problems relating to the protection of nature and man. It is true, that animal migration corridors have been changed on a local and continental scale due to the building systems of highways.

Now there truly exists the consciousness of the must of protecting the environmental system which also requires additional work as a result of infrastructure development. This is the only way leading to the solution of the problem. It is necessary to conduct qualitative and quantitative research in accordance with the technical and environmental criteria.

Bridges are crossings of roads and railways on one side and of migration animal paths on the other. On this basis existing bridges should be supplemented by monitoring systems which will be able to record the continuous or selected events in the surrounding. Also, the distribution of temperature, moist, air pollution and a noise level have to be added to the recorded elements.

The monitoring of bridges, even if is not common, works in special cases. Lots of suspension or cable-stayed bridges are supplied with facilities to observe strain, stress or displacement processes. The archiving could be done on hard discs or in the cloud. The only action is to develop and unify the existing systems and adopt them to environmental needs. Having a good archive it will be easier and more reliable to formulate challenges for road-bridge solutions in sustainable design.

After ca 30 years of discussions on the sustainable development the *melting pot* still is observed. This is intellectually very attractive but for the civil engineers the results are still uncertain. Those engineers who create the current and future technical elements, still waits for clear and ordered recommendations, even instructions, which could be applicable in design and construction.

References

1. AIN P-C., 2000, Cements of yesterday and today. Concrete of tomorrow, in: *Cement and Cement Research*, no. 9, vol. 30, p. 1349-1359.
2. BOHATKIEWICZ J., GAŁAŚ S., 2014, The use of checklists in environmental studies in the field of road construction, in: *Construction and Architecture*, vol. 13, no. 1, p. 295-304.
3. COST 341. 2003. Habitat Fragmentation due to Transportation Infrastructure. Wildlife and Traffic. *A European Handbook for Identifying Conflicts and Designing Solutions*, http://www.iene.info/wp-content/uploads/COST341_Handbook.pdf, (03.09.2014).
4. CONVENTION, 1998, *on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters*. Århus, Fourth Ministerial Conference, Environment for Europe, <http://www.unece.org/fileadmin/DAM/env/pp/documents/cep43e.pdf> (04.09.2014).
5. CRITCHLEY P., 2012, *Kant's Natural Teleology and Moral Praxis*, <http://mmu.academia.edu/PeterCritchley/Books>, (12.10.2014).
6. CUVIER G., 1825, *Discours sur les révolutions de la surface du globe, et sur les changements qu'elles ont produits dans le règne animal*, G. Dufour et éd. d'Ocagne, Amsterdam, <http://visualiseur.bnf.fr/CadresFenetre?O=NUMM-110696&M=chemindefer> (3.10.2014).
7. DARWIN C., 1859, *The Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Live*, London, John Murray, http://darwin-online.org.uk/converted/pdf/1859_Origin_F373.pdf (7.10.2014).
8. DĄBROWSKI K., 1964, *Positive Disintegration*, Little Brown, Boston.
9. DIRECTIVE 1979/409/EC *on the conservation of the wild birds*, 2013, http://www.central2013.eu/fileadmin/user_upload/Downloads/Document_Centre/OP_Resources/Birds_directive.pdf, (03.10.2014).
10. DIRECTIVE 1985/337/EEC *on the assessment of the effects of certain public and private projects on the environment*, <http://www.energy-community.org/pls/portal/docs/36294.Pdf> (01.09.2014).
11. DIRECTIVE 1990/313/EEC *on public access to environmental information and repealing*, <http://www.elaw.org/system/files/EU.20034EC Directive.pdf> (02.09.2014).
12. DIRECTIVE 1992/43/EEC *on the conservation of natural habitats and of wild fauna and flora*, <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31992L0043> (02.10.2014).
13. DIRECTIVE 2000/60/EC *establishing a framework for Community action in the field of water policy*, <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32000L0060> (03.09.2014).
14. DIRECTIVE 2001/42/EC *on the assessment of the effects of certain plans and programmes on the environment*, <http://www.environ.ie/en/Legislation/DevelopmentandHousing/Planning/FileDownload,14420,en.pdf> (11.09.2014).

15. GAŁAŚ S., GAŁAŚ A., 2004, Evaluation of the environment from the point of view of optimal use of its potential, in: *Polish Journal of Environmental Studies*; vol. 13, suppl. 3, p. 255–258.
16. GAŁAŚ S., GAŁAŚ A., ZVIJÁKOVÁ L., ZELENÁKOVÁ M., FIALOVÁ J., KUBÍČKOVÁ H., ŠLEZINGR M., HÁZI J., PENKSZA K., 2013, Assessment of the quality of the environment in the V4 Countries, in: *Journal of Landscape Management*, vol. 4, no. 1, p. 12-18.
17. GARNIEL A., MIERWALD U., 2010, *Arbeitshilfe Vögel und Straßenverkehr*, https://mvi.baden-wuerttemberg.de/fileadmin/redaktion/m-vi/intern/dateien/PDF/Arbeitshilfe_Voegel_im_Strassenverkehr_BMVBS.pdf (01.09.2014).
18. KARAS S., LENIAK-TOMCZYK A., 2011, Roads and sustainable development (in Polish), in: Rawski W. (ed.), *Conference Proceedings of 6th International Conference on Environment Protection, Estheticks and road Infrastructure Development*, 25-26 May, Zamość, Poland. Lublin: Print for Association of Engineers and Technicians of Road Engineering, p. 149-161.
19. KATES R.W., PARRIS T.M., LEISEROWITZ A.A., 2005, *What is Sustainable Development? Goals, Indicators, Values, and Practice*, in: *Environment: Science and Policy for Sustainable Development*, vol. 47, 3, p. 8-21, http://www.hks.harvard.edu/sustsci/ists/docs/whatisSD_env_kates_0504.pdf (01.09.2014).
20. MADAH A. BEDNAREK B., 2012, Animal passages over the A2 motorway, Nowy Tomysl-Swiecko section, in Poland, in: *Archives of Institute of Civil Engineering*, Poznań, p. 167-174.
20. ROCHELLE J.A., LEHMANN L.A., WISNIEWSKI J., 1999. *Forest Fragmentation: Wildlife and Management Implications*, Brill, Leiden, Netherlands.
21. PAWŁOWSKI A., 2009, *The Sustainable Development Revolution*, Problemy Ekorozwoju/Problems of Sustainable Development, vol. 4, no 1, p. 65-76.
22. QUADDUS M. A., SIDDIQUE M.A.B., 2013, *Handbook Of Sustainable Development Planning Studies in Modelling and Decision Support*, Second Edition, Edward Elgar, USA.
23. REGULATION, 2000, of the Minister of Transport and Maritime *on the technical conditions to be met by traffic engineering objects and their location* (in Polish), Dz.U. nr 63 pos. 735, <http://www.abc.com.pl/du-akt/-/akt/dz-u-00-63-735> (07.09.2014).
24. STIMSON H. L., 1932, *The Pact of Paris: Three Years of Development*, New York, <http://eds.b.ebscohost.com/eds/pdfviewer/pdfviewer?sid=22fb4a67-4098-4878-96ac-49c3134508fb%40ses> (07.09.2014).
25. VERNE D.P., 1998, Hegel's nature, in: *Hegel and the Philosophy of Nature*, Houlgate S. (ed.), State University of New York, p. 209-227, <http://pl.scribd.com/doc/223557176/Hegel-and-the-Philosophy-of-Nature-Houlgate-ed#scribd> (01.10.2014).

BOOK REVIEW

RECENZJE

How to Teach on Sustainable Development Issues?

Jak uczyć o rozwoju zrównoważonym?

G Venkatesh, *Water For All and Other Poems*, Cyberwit.Net, 2014.

Water For All – yes, we all know this slogan, however rather from the world of media or scientific journals, than from the world of poetry.

And how to teach on sustainable development?

Well, there are a lot of educational programmes.

There are also many books and scientific journals (like *Problemy Ekorozwoju/Problems of Sustainable Development*).

Finally, don't forget about agreements, legislation, and many different initiatives on global, regional, and local level, introduced by UN or EU.

Is it enough?

The aim of sustainable development is make people AWARE, that something good may be done, and that WE may change for now, and for future generation's sake.

If we want to take any action, we must be however aware of existing problems. As we can read in the Preface to the book: *People kill each other over diamonds; countries go to war over oil. But the world's most expensive commodities are worth nothing in the absence of water. Fresh water is essential for life, with no substitute.*

It is true. And why poetry? Maybe because it can touch us from totally different perspective, than any article or movie. The author uses poetry to combine feeling and technology – and it works! What's more, between his poems you may find information and quotations presented here as *Points to ponder*, like: *In the developing world, 24 000 children under the age of five die every day from preventable causes like diarrhea contracted from unclean water.* This is one of the comments to the poem called:

The Christmas Gift

*I had fallen ill last Christmas,
and on the one before that too.
I remember mamma telling me
that this had with water to do.*

*My prayers this year,
have been heard by God,
who sent through Mamma
a small reward.*

*Come Chistmastime,
and I shall be fine,
with the water I drink
through this gift of mine.*

*I have seen little girls
with many a Barbie doll.
But what I have got from Mamma,
Is better than them all.*

My favorite poem is printed on the page 31 and is called:

Drop in the Ocean

*A drop in the ocean
what difference will it make?
You meter carefully what you use,
While neighbours drain up the lake.
Everything is evened out
You save for others to spill.
You concern is pointless,
when the majority lacks the will.
They wait for you to step back,
so they could have some more.
And when You see that happen,
You'd wish you'd known before.
Changes take some time, my friend,
And that is just a fond hope.
My desire is to change myself,
the rest is beyond the scope.
The small 'drop in the ocean',
is all that I can give,
as gratitude to the Almighty,
for as long as I have to live.*

Let's hope, that such reading may be the reason for some good behavioural change among readers. It may make them aware, and wanting to change. So, education with poetry? Why not?

P.S. The book is published for a charitable cause in India, the beneficiary of the royalties will be the Indian branch of Water For People Organisation. You may buy the book here:
<http://www.cyberwit.net/publications/738>

Artur Pawłowski

INSTRUCTIONS FOR AUTHORS

NOTA DO AUTORÓW

Problemy Ekorozwoju/Problems of Sustainable Development is a scientific journal published under the auspices of the European Academy of Science and Arts (Salzburg, Austria).

Annually two issues are published.

Scope of the journal:

- Ecophilosophy.
- Philosophical aspects of sustainable development.
- Social-political aspects of sustainable development.
- Ecological aspects of sustainable development.
- Earth resources management from the viewpoint of sustainable development.

The magazine publishes original papers not longer than 20 pages (40 000 characters) as well as reviews and letters no longer than 5 pages (10 000 characters).

Text pages should be of the A4 size, double line spacing, left and right margin of 2.5cm, 12-point *Times New Roman* font. The text should be organized as follows:

- Title of the article,
- Name and surname of the author(s),
- Address,
- e-mail,
- Abstract,
- Key words,
- Introduction,
- Text organized into paragraphs,
- References.

References quoted in the text should be given in parentheses and include the author's surname and the publication year e.g. (Tyburski, 2004).

The reference list should be given at the article end, arranged alphabetically by surnames of the first authors.

Reference should be listed as the following:

- Journal:
Surname and name initials of the author(s), year, article title, magazine title in italic, volume, issue, pages: from - to.
Example:
KOZŁOWSKI S., 2006, The Position of Poland in Europe, in: *Problemy Ekorozwoju/Problems of Sustainable Development*, vol. 1, no 2, p. 93-98.

Problemy Ekorozwoju/Problems of Sustainable Development są czasopismem naukowym publikowanym pod patronatem Europejskiej Akademii Nauki i Sztuki (Salzburg, Austria).

Rocznie publikowane są dwa zeszyty.

Zakres tematyczny czasopisma obejmuje:

- Ekofilozofię.
- Filozoficzne aspekty zrównoważonego rozwoju i ekofilozofii.
- Społeczno-polityczne aspekty zrównoważonego rozwoju.
- Ekologiczne aspekty zrównoważonego rozwoju.
- Uwarunkowania gospodarki zasobami Ziemi w aspekcie zrównoważonego rozwoju.

W czasopiśmie publikowane są prace oryginalne i artykuły przeglądowe o objętości ok. 20 stron (40 000 znaków) oraz recenzje i listy do redakcji o objętości do 5 stron (10 000 znaków).

Teksty należy przygotować w formacie A4 z podwójną interlinią, lewy i prawy margines 2,5 cm, czcionka *Times New Roman* 12 pkt., z zachowaniem następującego układu:

- tytuł w języku polski,
- tytuł w języku angielskim,
- imię i nazwisko,
- adres,
- e-mail,
- streszczenie (do 1 strony),
- słowa kluczowe,
- abstract (streszczenie w jęz. angielskim),
- key words (słowa kluczowe w jęz. angielskim),
- wstęp,
- treść artykułu,
- literatura.

Literatura w treści powinna być cytowana poprzez podanie w nawiasie nazwiska i roku publikowania pracy np. (Tyburski, 2004).

Zestawienie cytowanej literatury powinno być zamieszczone na końcu artykułu, uporządkowane alfabetycznie wg nazwiska pierwszego z autorów.

Wykaz literatury powinien zostać sporządzony według następujących zasad:

- Czasopismo:
Nazwisko i inicjały imion, rok, tytuł artykułu, nazwa czasopisma (kursywą), vol., numer, strony od-do. Przykład:
KOZŁOWSKI S., 2006, Miejsce Polski w Europie, in: *Problemy Ekorozwoju/Problems of Sustainable Development*, vol. 1, no 2, p. 93-98.

- **Book:**
Surname and name initials of the author(s), title in italic, publishers' name, publication year. Example:
KOZŁOWSKI S., 2005, *The Future of Sustainable Development*, KUL, Lublin.
- **Publication in collective works (monographs):** Surname and name initials of the author(s), article title, title of the monograph (in italic font), surname and name initials of the monograph editor, publisher's name, publication year. Example:
PAPUZIŃSKI A., 2004, Philosophical Aspects of Sustainable Development Principle, in: *Philosophical, Social and Economic Aspects of Sustainable Development*, ed. Pawłowski A., Lublin University of Technology, Lublin, p. 25-32.
- **Internet:**
Name of the web site, address, date of access. Example:
Problemy Ekorozwoju/Problems of Sustainable Development,
<http://ecodevelopment.pollub.pl>
(2.01.2014).
- **Książka:**
Nazwisko i inicjały imion autora, tytuł (kursywą), nazwa wydawnictwa, rok wydania. Przykład:
KOZŁOWSKI S., 2005, *Przyszłość ekorozwoju*, KUL, Lublin.
- **Prace wydane w monografiach zbiorowych:**
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PAPUZIŃSKI A., 2004, Filozoficzne aspekty zasady zrównoważonego rozwoju, in: *Filozoficzne, społeczne i ekonomiczne uwarunkowania zrównoważonego rozwoju*, ed. Pawłowski A., Politechnika Lubelska, Lublin, p. 25-32.
- **Źródła Internetowe:**
Nazwa strony, adres, czas dostępu. Przykład:
Problemy Ekorozwoju/Problems of Sustainable Development,
<http://ekorozwoj.pollub.pl> (2.01.2014).

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