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Implementing the Main Circular Economy Principles within the Concept of Sustainable Development in the Global and European economy, with Particular Emphasis on Central and Eastern Europe – the Case of Poland and the Region of Lodz

Abstract

The aim of the article is to present the effects of selected activities implemented at the global, European and regional levels within the idea of sustainable development. Of particular importance here is the presentation of activities undertaken at the level of the Lodz region (one of the central regions of Poland) in which among 6 regional specializations, particular attention was paid to innovative organic farming and to the textile industry based on modern fashion and innovative design. All 6 specializations in the Lodz region, including medicine, pharmacy and the cosmetics industry, advanced building materials, electricity generation (including renewable energy sources), IT and telecommunications were directed to the implementation of the overarching bio-economy program aiming at achieving the main assumptions of the circular economy based on the 3Rs, i.e., "reduce, reuse, and recycle."

***Keywords**: sustainable development, bio-economy, circular economy, region of Lodz.*

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1. Introduction

Sustainable development takes place when it is based on stable and sustainable economic growth in environmentally friendly sectors and when it reduces unemployment by using existing social resources in the labor market.

The aim of the paper is to present the effects of selected activities implemented not only at the global and European level, but also in one of the new members of the EU, Poland, and its most centrally located region, Lodz. This region was in the past the capital of the textile and clothing industry in Poland. Currently, production is focused more on innovative textiles, innovative agriculture and food production (including organic farming), but the main objective is to integrate all specializations in the region towards the bio-economy, including sectors such as medicine, the pharmaceutical and cosmetics industry, advanced building materials; power generation (including renewable energy sources), computer science and telecommunications.

2. European and global partnership for sustainable development

2.1. European Perspective

In May 2001, the European Union established the Sustainable Development Strategy. In order to support this strategy, the Gothenburg European Council stated the need to develop wider international cooperation to implement the concept of sustainable development and to emphasize the European Union's contribution to this process. This contribution was reflected in the position presented at the World Summit on Sustainable Development, which took place in Johannesburg in 2002. The main topics on the agenda were health, education and the environment. As is known, market forces contribute to the deepening of income inequalities. Globalization must go hand in hand with actions that will reduce these adverse effects, especially in the area of improving access to trade, finances, achieving better results in environmental protection management, reducing poverty and crime. Sustainable development is also a significant pillar of each of the subsequent development strategies of the European Union. The Europe 2020 strategy is the EU's agenda for growth and employment in the current decade. It emphasizes smart, sustainable and inclusive growth as a way to overcome the structural weaknesses in Europe's economy, improve its competitiveness and productivity and underpin a sustainable social market economy.[1]

[1] The main targets of this strategy are focused on: Employment (75% of people aged 20–64 to be in work); Research and development (R&D) (3% of the EU's GDP to be invested in R&D); Climate change and energy (greenhouse gas emissions 20% lower than 1990 levels, 20% of ener-

Europe is setting a course for a resource-efficient and sustainable economy. The goal is a more innovative and low-emissions economy, reconciling demand for sustainable agriculture and fisheries, food security, and the sustainable use of renewable biological resources for industrial purposes, while ensuring biodiversity and environmental protection.

The bio-economy encompasses the production of renewable biological resources and their conversion into food, feed, bio-based products and bioenergy via innovative and efficient technologies provided by industrial biotechnology. The bio-economy offers great opportunities and solutions to a growing number of major societal, environmental and economic challenges, including the mitigation of the negative climate change, energy and food security and resource efficiency. Today, the European bio-economy is already worth more than €2 trillion annually and employs over 22 million people, often in rural or coastal areas and in Small and Medium Sized Enterprises (SMEs).[2]

- To achieve this, the European Commission has set a bio-economy Strategy and action plan which focuses on three key aspects: developing new technologies and processes for the bio-economy;
- developing markets and competitiveness in bio-economy sectors;
- pushing policymakers and stakeholders to work more closely together.

Moreover, the Commission works on ensuring a coherent approach to the bio-economy through different programs and instruments, including the Common Agricultural Policy, the Common Fisheries Policy, Horizon 2020, European environmental initiatives, the Blue Growth initiative for the marine sector and the European Innovation Partnership on Sustainable Agriculture.[3]

The environmental goods and services sector in the EU

The EU has technologically advanced and world-class companies providing environmental goods and services. Between 2002 and 2011, jobs in the 'green sector' in the EU rose from 3 to 4.2 million full-time equivalents. Even during the recession years (2007–2011), employment grew by 20%. The EU is a world leader in the export and import of environmental goods, followed by China and other Asia-Pacific Economic Cooperation (APEC) countries. Although environmental goods are a relatively small part of EU trade, the sector is very dynamic. In 2013, EU exports

gy coming from renewables, 20% increase in energy efficiency); Education (rates of early school leavers below 10%, at least 40% of people aged 30–34 having completed higher education); Poverty and social exclusion (at least 20 million fewer people in – or at risk of – poverty/social exclusion), https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/eu-economic-governance-monitoring-prevention-correction/european-semester/framework/europe–2020-strategy_en

[2] https://ec.europa.eu/research/bioeconomy/index.cfm?pg=policy, [accessed: 15.03.2018].

[3] Ibidem.

of the 54 APEC list products amounted to €71 billion, and imports to €34 billion. If we include an EU list of 165 green goods, exports rise to €146 billion (around 8% of the EU's total) and imports to €70 billion.[4]

In 2007[5], the European Commission launched new steps with respect to developing a new environmental policy aimed at accelerating the so-called 'climate package', taking into account changes in the 'old' energy sector based on nonrenewable energy resources, mainly fossil fuels (coal), and increasing the share of renewable energy sources in Europe. The EU's new environmental policy is founded on the assumptions of the Renewed Sustainable Development Strategy of the European Council prepared in June 2006, which integrated the main economic, social, and environmental aspects and identified seven priority aims and actions:

- climate change and clean energy,
- sustainable transport,
- sustainable production and consumption,
- conservation and management of natural resources,
- public health,
- social cohesion, demography, and migrations,
- global poverty and sustainable development challenges. (Wysokinska 2016, p. 58)

2.2. Global Perspective

As part of the global policy, it became necessary to include aspects of sustainable development in the policy towards international trade within the World Trade Organization (WTO) in order to:

- strengthen the integration of developing countries with the global economy;
- help developing countries obtain greater benefits from the global trading system;
- make changes to the Generalized System of Preferences (GSP), in the direction of including sustainable development in it integrate sustainable development into bilateral and regional agreements
- reduce the non-transparent operation of the international financial system and introduce more effective regulations;
- encourage European business to be socially responsible;
- promote cooperation between the WTO and environmental organizations (Wysokińska, Witkowska 2016).

[4] http://trade.ec.europa.eu/doclib/press/index.cfm?id=1116, [accessed: 26.02.2018].

[5] *2007 Environment policy review,* Communication from the Commission to the Council and the European Parliament of 2 July 2008 [COM(2008) 409 final – Not published in the Official Journal], https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52008DC0409, [accessed: 12.03.2018].

Environmental Goods Agreement (EGA) within the WTO

An important element of the WTO's contribution to sustainable development and protection of the environment comes in the form of furthering trade opening in goods and services to promote economic development, and by providing stable and predictable conditions that enhance the possibility of innovation. This promotes the efficient allocation of resources, economic growth and increased income levels that in turn provide additional possibilities for protecting the environment. The importance of trade's contribution to efforts on sustainable development and the environment has been recognized in such forums as the 1992 Rio Summit, the 2002 Johannesburg Summit and the 2005 UN World Summit (Wysokińska 2005)

Eighteen participants representing 46 WTO members are engaged in negotiations seeking to eliminate tariffs on a number of important environment-related products. These include products that can help achieve environmental and climate protection goals, such as generating clean and renewable energy, improving energy and resource efficiency, controlling air pollution, managing waste, treating wastewater, monitoring the quality of the environment, and combatting noise pollution. The participants in these negotiations account for the majority of global trade in environmental goods. The benefits of this new agreement will be extended to the entire WTO membership, meaning all WTO members will enjoy improved conditions in the markets of the participants in the EGA.[6]

Since July 8, 2014, the EU and 16 other members (see below)[7] of the World Trade Organization (WTO) have been negotiating an Environmental Goods Agreement (EGA) to remove barriers to trade in environmental or „green" goods that are crucial for environmental protection and climate change mitigation. The aim of this initiative is to facilitate the international trade in goods and technologies that contribute to the protection of the environment. In the course of negotiations, the Parties strive to abolish or reduce customs duties on goods that will be identified as crucial for environmental protection and, for example, for cleaning water and air, measuring pollution levels, generating energy from renewable sources, etc. However, as a result of the negative attitude of the US administration, negotiations are not currently being continued, and it is not known if or when the talks will resume.

Development Strategy at the global level

The **Millennium Development Goals (MDGs)** were the eight international development goals for the year 2015 that were established as a result of the Millennium Summit of the United Nations in 2000, following the adoption of the United Nations Declaration. All 191 United Nations members at that time, and at least 22 in-

[6] https://www.wto.org/english/tratop_e/envir_e/ega_e.htm, [accessed: 15.03.2018].

[7] Australia, Canada, China, Costa Rica, Chinese Taipei, the European Union, Hong Kong (China), Japan, Korea, New Zealand, Norway, Switzerland, Singapore, United States, Israel, Turkey and Iceland.

ternational organizations, committed to help achieve the following 8 Millennium Development Goals by 2015:

1. Eradicate extreme poverty and hunger;
2. Achieve universal primary education;
3. Promote gender equality and empower women;
4. Reduce child mortality;
5. Improve maternal health;
6. Combat HIV/AIDS, malaria, and other diseases;
7. Ensure environmental sustainability;
8. Develop a global partnership for development.

The final evaluation of the main results of implementing the 8 MDGs in the world economy can be summed up as follows: The MDGs have triggered unprecedented efforts worldwide in the fight against poverty, hunger, disease, and environmental destruction, but until now the effects, which have been related mainly to mitigating the negative and growing impacts of climate change, increasing global hunger, and the continuing fallout from the economic and financial crisis, are still not fully successful. Successful realization of the MDGs and the later SDGs depends, above all, on appropriate planning and successful financing efforts. The projects currently selected have greater chances than the projects undertaken in previous years, as the income and financing contributed by the richest countries is significantly greater than it was thirty years ago. The implementation of the MDGs was financed primarily from the Official Development Assistance (ODA), the contributions of which were relatively small compared to what was actually needed to reduce poverty in the world and find and implement solutions to the other pressing problems outlined in and addressed by the MDGs. The hopes for a more successful realization of the SDGs and greater achievements in comparison to the MDGs are based on the incorporation of the private business sector and NGOs, as well as public-private partnerships, into the implementation of development assistance programs. At the same time, the main achievements of the MDGs should be kept in mind, including the following:

- The number of people living on less than $1.25 a day has been reduced from 1.9 billion in 1990 to 836 million in 2015, although the target of halving the proportion of people suffering from hunger was narrowly missed. Primary school enrolment figures have shown an impressive rise, but the goal of achieving universal primary education has also been narrowly missed, with the net enrolment rate increasing from 83% to 91% in recent years.
- About two-thirds of developing countries have achieved gender parity in primary education.
- The child mortality rate has reduced by more than half over the past 25 years – falling from 90 to 43 deaths per 1,000 live births – but it has failed to meet the MDG target of a drop of two-thirds.

- The global maternal mortality ratio has fallen by nearly half – short of the two-thirds reduction the MDGs were aiming at.
- The target of halting and beginning to reverse the spread of HIV/Aids by 2015 has not been met, although the number of new HIV infections fell by around 40% between 2000 and 2013.
- Some 2.6 billion people have gained access to safer drinking water since 1990, so the target of halving the number of people without access to safe sources of water was achieved in 2010, five years ahead of schedule. However, 663 million people across the world still do not have access to safe drinking water.
- Between 2000 and 2014, overseas developmental assistance from rich nations to developing countries increased by 66% in real terms, and in 2013 reached the record figure of $134.8 bln. (£80.3 bln.). Global access to the internet increased from 6% to 43%.

The next period began with the adoption by the UN General Assembly of the new programs contained in the 17 Strategic Development Goals of Agenda 2030. It constitutes the next step forward in the global collective effort to attain tangible and measurable improvements in the quality of life of billions of persons in the world over the next fifteen years. In comparison to the previous MDGs, the new propositions contained in the SDGs add a series of additional elements to the main aspects of the sustainable development strategy, considered in its economic, environmental, and social aspects. These additional elements include the following:

- Sustainable development based on stable economic growth and making full and productive use of available human capital;
- Reduction of the growing inequality both within and between countries in terms of their economic development;
- Building an economic infrastructure and promoting industrialization based on accelerating innovation and sustainable models of production and consumption, as well as the sustainable development of cities;
- Developing a system for the sustainable management of water resources, including making better use of the resources of oceans, seas, and other marine areas;
- Developing a system for sustainable management of forests and preventing environmental degradation of the land and loss of biodiversity;
- Promoting peaceful and inclusive social development based on international partnerships and providing guarantees, to all inhabitants of the world, of access to institutions which will guard and protect their human and social rights and provide a stable social order (Wysokinska 2017).

The BioTrade global initiative

The BioTrade Initiative facilitates and supports national, regional and international BioTrade programs, partnerships and businesses that have contributed to fighting biodiversity loss while ensuring the sustainable use of biological resources and ecosystems. Activities are implemented in close cooperation with the secretariats of the Convention on Biological Diversity and the Convention on International Trade in Endangered Species of Wild Fauna and Flora on the development of regulatory and institutional frameworks to prevent illicit trade in natural species and to safeguard them.[8]

Building sustainable livelihoods, particularly for rural communities and marginalized groups, in biodiversity-rich developing countries is central to the conservation and sustainable use of nature's resources. Thus, at the moment it means UNCTAD collaborates with governments, the private sector and international organizations to promote Bio-trade programs and to promote businesses that adhere to sustainable development principles, ethical sourcing of biological resources, access to and sharing of benefits, the proper traceability of products derived from biodiversity and raising awareness of the value of nature. Improving income-earning earning opportunities for rural communities can also bring added dividends, such as consolidating peacebuilding in post-conflict areas.[9]

BioTrade covers the collection, production, transformation and commercialization of goods and services originating from native biodiversity (species and ecosystems) in accordance with the criteria of sustainable environmental, social and economic development.

The following sectors are involved in BioTrade activities: personal hygiene, pharmaceuticals/phyto-farm, food, fashion, the protection of flora and fauna, handicrafts, textiles and natural fibers, sustainable tourism, and forestry.

The main current BioTrade effects are noticed as follows:

- Sales in companies and associations of BioTrade beneficiaries achieved a level of EUR 4.3 billion, which was a significant increase from USD 40 million in 2003,
- The number of beneficiaries was around 5 million worldwide.
- 83% of consumers expect companies to have a supply policy that respects biodiversity.
- 12,000 companies in over 70 countries have applied for the UN Global Compact, committing themselves to greater responsibility for the environment (and biodiversity).

[8] 20 years of Bio-Trade, Connecting People, Planet and Markets, UNCTAD, Geneva, 2016/4, http://unctad.org/en/PublicationsLibrary/ditcted2016d4_en.pdf, chapter 1, [accessed: 17.04.2018].

[9] Ibidem.

- More and more companies report biodiversity in their annual reports – 36 out of the 100 largest cosmetics companies and 60 of the top 100 food companies take up business based on biodiversity.
- BioTrade has its share in almost all of the 17 Sustainable Development Goals – SDGs.[10]

Towards the Model of Circular Economy

The Circular Economy is an approach that would transform the function of resources in the economy. Waste from factories would become a valuable input to another process – and products could be repaired, reused or upgraded instead of thrown away. Therefore, it is why we all should be responsible and innovative from beginning to end / from the producer to the user and the user to the producer.

The contemporary economic model, based on continuous growth, may lead to the exhaustion of resources available at acceptable prices and destroy the biological foundations of life to such an extent that mankind will fight over drinking water and food, and will suffer from unpredictable, rapid climate changes. Many communities, enterprises, and local governments have launched actions designed to limit the consequences of such developments, which pose a threat to life and health on Earth. The time has come to seek products and services which are, beginning at the design stage, intended for the longest possible life-cycle; to engage in transformations and the recycling of natural resources; and to exclude toxic materials and processes which generate harmful emissions.

This entails striving to build a circular economy founded on the consumption of resources reduced to the necessary minimum; the use of renewable resources in a way that ensures their regeneration; eco-design and clean production; the consumption of renewable energy; instituting consumption patterns that respect the environment; using wastes as raw materials and processing them without negative external effects. All this means deep systemic changes – not only technological, organizational and social innovation, but changes in financing and new policy instruments.

The idea of a circular economy, which can also be called a 'closed-loop economy', i.e. one that produces minimum waste, and in which waste, if it is generated, becomes a raw material. The amount of real waste is constantly shrinking. **The waste on our planet can be minimized by implementation of responsible research to further the innovation principle, i.e., "reduce, reuse, and recycle." This means that each individual must reduce waste and, if he or she has generated any, reuse it or recycle it.**

[10] Ibidem, p. 10.

The circular economy is thus an economy in which production and consumption are organized in such a way that the value of products, components, materials, and resources is maintained within the value chain and products' life-cycles. Resource efficiency is maximized, while the extraction of raw materials and the production of wastes are minimized.

On December 2, 2015, the European Commission put forward a package to support the EU's transition to a circular economy. The circular economy package has created an important momentum to support the transition towards a more circular economy in the EU. This package included legislative proposals on waste, with long-term targets to reduce landfilling and increase recycling and reuse. In order to close the loop of product lifecycles, it also included an Action Plan to support the circular economy in each step of the value chain – from production to consumption, repair and manufacturing, waste management and the secondary raw materials that are fed back into the economy. The Commission committed to undertake a detailed list of actions within its current mandate.

The transition towards a more circular economy brings great opportunities for Europe and its citizens. It is an important part of our efforts to modernize and transform the European economy, shifting it towards a more sustainable direction. There is a strong business case behind it which enables companies to make substantial economic gains and become more competitive. It delivers important energy savings and environmental benefits. It creates local jobs and opportunities for social integration. It is closely interlinked with key EU priorities on jobs and growth, investments, the social agenda and industrial innovation.[11]

3. Sustainable Development Strategies in Poland – national and regional level

Studies and publications in Poland in the field of environmental protection in the context of the Strategy and recommendations for the EU environmental policy are presented below:

Two main national documents have been developed in Poland which set out the current development directions of the country in the field of sustainable development and environmental protection:

[11] Report from the Commission to the European Parliament, The Council, The European Economic and Social Committee and The Committee of Regions on the implementation of the Circular Economy Action Plan; Brussels, 26.01.2017 [COM(2017) 33 final], [accessed: 12.01.2018]. *Closing the loop-An EU action plan for the Circular Economy*, Communication From the Commission to the European Parliament, The Council, The European Economic and Social Committee and The Committee of Regions, European Commission, Brussels, 2.12.2015; [COM(2015) 614 final], [accessed: 7.03.2018].

1. The Strategy for Responsible Development until 2020 (with the perspective until 2030).
2. The National Waste Management Plan elaborated in 2014.

The Strategy for Responsible Development sets out one of the directions of Poland's development for the coming years, that is actions contributing to the sustainable development of the country, based on the individual endogenous potential of individual territories as well as actions promoting the Polish green technology sector and supporting the foreign expansion of Polish entrepreneurs in this sector with the use of new forms of climate finance (Green Climate Fund and Adaptation Fund).

The National Waste Management Plan covers the whole scope of tasks required to provide integrated waste management nationally in a manner that secures the protection of the environment, with regard to both the present and future economic opportunities and circumstances and the technology level of existing infrastructure. The Plan considers tendencies in the present economy worldwide as well as the national circumstances of economic development, and includes both a waste prevention scheme in relation to specific types of waste and a strategy for reducing biodegradable waste landfilling. The Waste Management Plan covers waste originated domestically, including, in particular, municipal waste, hazardous waste, packaging waste and sludge from urban wastewater treatment plants, and also waste imported into the national territory. The objectives and tasks presented in the Plan concern years 2011–2014 and the 2015–2022 outlook thereof.[12]

Scientific research in Poland in the area of sustainable development and environmental protection has developed particularly dynamically since Poland's accession to the EU, which was connected with implementing EU environmental policy directives and with the adaptations to subsequent EU strategic documents.

Initially, these were mainly publications related to the implementation of basic principles of the EU environmental policy instruments[13], but in the following years, the research covered some issues of sustainable development and the „green economy" in Poland, including mainly sustainable human resource management, natural resources, sustainable agriculture, effective water and wastewater management; international trade in environmental goods and services and counteracting

[12] The National Waste Management Plan 2014 in Poland.

[13] Fiedor, B. (ed.) (2002), *Podstawy ekonomii środowiska i zasobów naturalnych*, CH BECK Publishing House; Fiedor, B., Graczyk, A. (eds.), (2006), *Instrumenty ekonomiczne polityki ekologicznej*, Wydawnictwo Ekonomia i Środowisko, Białystok; Wysokińska, Z., Witkowska, J. (2004), *Integracja Europejska. Dostosowania w Polsce w dziedzinie polityk* [European Integration. Adaptation in Poland in the field of policies], PWE, Warszawa, Chapter 11 – Environmental policy; Poskrobko, B. (2007), *Environmental Management*, PWE, Warszawa; Wysokińska, Z. (2005), *Foreign Trade in Environmental Products; The WTO Regulation and Environmental Programs*, Global 'Economy Journal', Vol. 5, Issue 3, http://ec.europa.eu/programmes/horizon2020/sites/horizon2020/files/stratprog_overarching_version_for_publication.pdf, [accessed: 5.04.2018].

adverse effects of climate change, including Poland's involvement in the achievement of the UN Sustainable Development Goals.[14]

At present, there are plans and concrete actions taken both by the Ministry of Entrepreneurship and Technology and the Ministry of the Environment in order to develop a plan for the implementation of selected aspects of the circular economy at the national level in Poland. Both the theoretical and practical experience gained in this TWINNING project would be very helpful in developing appropriate materials for the purpose of the development of the circular economy in Poland based on the valuable experience of countries more advanced in this process at the European and global level.

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[14] Kowalski, Z., Kulczycka, J., Góralczyk, M. (2007), *Ecological Evaluation of LCA*, PWN, Warsaw; Kronenberg, J., Bergier, T. (2010), *Sustainable Development in Poland*, Godzimir Foundation, Cracow; Borys, T., (2013), *Nowe kierunki ekonomii środowiska i zasobów naturalnych w aspekcie nowej perspektywy finansowej Unii Europejskiej* [New Directions of Environmental Economics and Natural Resources in the New Financial Perspective of the European Union], 'Ekonomia i Środowisko' [Economy and Environment], 1/44; Burchard-Dziubińska, M. (ed.) (2015), *Towards a Green Economy. From ideas to practice*, Wydawnictwo Uniwersytetu Łódzkiego; Lipińska, D. (2016), *Podstawy inżynierii środowiska* [Fundamentals of Environmental Engineering], Wydawnictwo Uniwersytetu Łódzkiego, Łódź; Lipińska, D. (2016), *Gospodarka odpadowa i wodno-ściekowa* [Waste Management and Water and Wastewater Management], Wydawnictwo Uniwersytetu Łódzkiego, Łódź; Wysokińska, Z. (2016), *Zrównoważony rozwój. Wybrane aspekty makro i mikroekonomiczne* [Sustainable development. Selected macro and microeconomic aspects], Wydawnictwo Uniwersytetu Łódzkiego, Łódź; Wysokińska, Z. (2016), *The "New" Environmental Policy of the European Union: A Path to Development of a Circular Economy and Mitigation of the Negative Effects of Climate Change*, 'Comparative Economic Research. Central and Eastern Europe', Vol. 19, Issue 2, 57–73; Lipińska, D. (2015), *Zrównoważona gospodarka wodno-ściekowa jako element poprawy bezpieczeństwa ekologicznego* [Sustainable water and sewage management as an element of improvement of ecological safety], Marek, H., Zduniak, A. (eds.), *Bezpieczeństwo. Wielorakie perspektywy*, 265–278, Wyższa Szkoła Bezpieczeństwa, Poznań; Rydz-Żbikowska, A. (2015), *Wspólna polityka rolna i rolnictwo ekologiczne jako jedno z największych wyzwań w zakresie integracji państw członkowskich Unii Europejskiej* [Common Agricultural Policy and Organic Farming as one of the biggest challenges in the integration of the Member States of the European Union], Molendowski, E., Mroczek, A. (eds.), *Globalizacja i regionalizacja we współczesnym świecie. Wyzwania integracji i rozwoju*, SGH Warszawa; Grzesik, M., Romanowska-Duda, Z. (2015), *Ability of Cyanobacteria and green algae in improvement of metabolic activity and development of willow plants*, 'Polish Journal of Environmental Studies', Vol. 24, No. 3 (*IF. 0,600 MNiSzW 15 pt*), Badek, B., Romanowska-Duda, Z., Grzesik, M., Kuras, A. (2016), *Physiological markers for assessing germinability of Lycopersicon esculentum seeds primed by environment-friendly methods*, 'Polish Journal of Environmental Studies', Vol. 25, No 5. (in print) *(IF. 0,871, MNISZW 15 pt*); Grzesik, M., Górnik, K., Janas, R., Lewandowki, M., Romanowska-Duda, Z., van Duijn, B. (2017), *High efficiency stratification of apple cultivar Ligol seed dormancy by phytohormones, heat shock and pulsed radio frequency*, 'Journal of Plant Physiology', https://doi.org/10.1016/j.jplph.2017.09.007 (*IF.3,121; MNiSzW 35 pt)*; Wysokinska, Z. (2017), *Millennium Development Goals / UN Goals and Sustainable Development / UN as Instruments for Realizing Sustainable Development Concept in the Global Economy*, 'Comparative Economic Research', Central and Eastern Europe, Vol. 20, No. 1.

In the Region of Lodz, measures were taken to develop the bio-economy, which resulted in the International Bio-economy Congress in Lodz in October 2016.

This central region is one of the most prominent regions in Poland, promoting itself as a bioregion and supporting the development of the Polish bio-economy sector. On 27th August 2015, the regional parliament established the Region of Lodz as the first bioregion in Poland, meaning the establishment of a plan to transform this region into one of the most innovative regions in Poland, with a sustainable bio-economy **as a strategic and integrated approach**. The recognition of the Region of Lodz as a bioregion has also put the region **in the role of coordinator of all Polish bioregions**. This follows a long tradition of cooperation with other regions and actors from outside the region. Besides Lodz, the most important bio-regions in Poland include Lower Silesia, Lesser Poland, Greater Poland, Pomerania and Masovia.

Since 2015, the Marshal's Office in Lodz has created a discussion platform for the exchange of experiences in the construction of a bio-economy and is also the organizer of annual international Bio-economy Congresses, where representatives of the business sphere, universities, research institutes, officials from central and regional offices from Western and Eastern Europe, and representatives of non-governmental and social organizations can meet and work together.

Initiatives and projects in the Region of Lodz focus mainly on awareness-raising of the bio-economy opportunities and facilitating knowledge transfer between research and knowledge centers and the business sphere.

Instruments designed for implementing the bio-economy in the region:

- Regional Innovation Strategy (bio-economy specialization).
- Regional Bio-economy Development Strategy (to be developed).
- European Bio-economy Congress (large, annually organized, international conference).
- Bioregions Forum.

It also seems to be important to add that one of the most important policy efforts in recent times was focused on updating the existing regional innovation strategy, with the emphasis on the smart specialization issue and the development of monitoring instruments with the aim to reinforce targeted innovation policy interventions. The process was finished in May 2013, when the Strategy was officially adopted. The identified areas of smart specializations of the Region of Lodz include the following sectors of economic activity:

1. The modern textile and fashion industry;
2. Advanced building materials;
3. The medicine, pharmaceutical, and cosmetics industry;
4. Power generation (including Renewable Energy Sources);
5. Innovative agriculture and agricultural and food processing;
6. Computer science and telecommunication.

This strategy was divided into three priorities, with the first one dedicated to the development of the areas defined as smart specializations. In this context, it has to be highlighted that areas of smart specializations such as the modern textile industry, building materials, cosmetics and agricultural and food processing are strongly focused on **manufacturing activities**. Consequently, development of the activities planned in the Strategy can be seen as the inclusion of the advanced manufacturing approach in the practices of the Region of Lodz. These activities include:

- Launching the 'programs of exchanges of personnel from the sectors of science and business';
- Implementing research and development projects in the field of regional specializations.

Agriculture and food processing – agricultural land accounts for more than 48% of the region's area and it plays a significant role in its economy. The region's main crops are rape, turnip, wheat, rye, sugar beets and potatoes. Chernozem (a black soil rich in humus) in the northern counties of Kutno, Łowicz and Łeczyca allows horticulture and market gardening to thrive. This, in turn, constitutes the basis for food processing, vegetable and meat canneries, and the production of concentrates, juices and beverages. This type of processing is also thriving in the county of Skierniewice, where it is effectively supported by the **famous Research Institute of Horticulture** in Skierniewice, founded by Professor Stefan A. Pieniążek (www.inhort.pl). The real leader of horseradish cultivation in Poland are the communities of Kiełczygłów, Siemkowice, Osjaków and Rusiec, which provide about 70% of the national production of this vegetable.

A number of agriculture producer groups operate in the region, thus providing high-quality organic food, with no artificial preservatives or food coloring. A case in point are Organizacja Producentów Owoców RAJPOL (RAJPOL Fruit Producers Organization), Zrzeszenie Plantatorów Owoców i Warzyw in Łowicz (Association of Fruit and Vegetable Growers in Łowicz), Malus Sp. z o.o. (Ltd), Kwiaty Polskie Grupa Producentów Sp. z o.o. (Polish Flower Producers Group Ltd), Elit, Sadex, Aplet, and Aura.

Scientific potential

"The circular economy needs more than traditional R&D or a piecemeal approach to different technologies: it needs changes in entire systems through the joint efforts of researchers, technology centers, industry, the primary sector, new entrepreneurs, users, governments and civil society."[15]

[15] Horizon 2020 work programme 2018–2020 – Strategic Programme Overarching Document, Brussels.

The region **has a very large scientific potential represented by universities and scientific organizations** that belong to a group of Poland's largest academic organizations. The main R&D institutions in the region are the University of Lodz, the Technical University of Lodz, the College of Computer Science in Lodz, and the Medical University in Lodz. Moreover, there is the Polish State Higher School of Film, Television and Theatre in Lodz, the largest of its kind. There are 30 higher education institutions in the region, of which two are technical universities. Moreover, the local branch of the Polish Academy of Sciences, which carries out intensive research in the area of natural sciences and the arts, maintains self-contained research institutes.

The University of Lodz (UL) is one of the leading institutions of higher education in Poland. It is also one of the strongest science and research centers in the country. For decades, it has also been one of the biggest and most popular Polish universities. The 12 faculties of the University provide programs in 40 fields of study and 170 specializations. As one of the biggest Universities in the country, UL plays an important role in increasing the economy's competitive edge, not only in the Region of Lodz but also on the national and international arenas. It has experience in research projects along the lines of the 6th and 7th EU Framework Programs as well as Horizon 2020 and many other research grants, conducting extensive research and actively participating in innovative development of the Region of Lodz, the entire country as well as the European Union.

The University of Lodz consist of numerous collaborating research teams from different Faculties (e.g. the Faculties of Management, Philosophy and History, Law and Administration, and Biology and Environmental Protection) as well as different Institutions (Technical University of Lodz: the Faculty of Material Technologies and Textile Design; The Institute of Biopolymers and Chemical Fibers, The Textile Research Institute), conducting extensive interdisciplinary research in such topic as Sustainable Development, Corporate Social Responsibility – CSR, Ethics, Globalization, RRI, Countries' adjustments to European Union policies, Economy, and the Green Economy. Hundreds of interdisciplinary scientific publications as well as extensive cooperation with non-academic sector (including NGO, SMEs, etc.) and with regional and national authorities made it a strong national science and research center with the ability to undertake most challenging scientific research.

Education: Economics-Eco-business – the program of modern education – bachelor and master's studies

The studies in Economics-Eco-business at the University of Lodz are intended to answer the demand put forward by entrepreneurs, searching for specialists in environmental protection economics. The specialists in this field should demonstrate broad theoretical knowledge, as well as,- practical skills and competences required

in the modern economy, oriented towards, among others, sustainable development, the implementation of environmental management systems, and innovative environmental technologies, in particular in the sustainable agriculture, sustainable textiles, and renewable energy sectors.

The second-cycle studies in Economics-Eco-business come forward to address the needs resulting from the implementation of the principles of sustainable development, which promotes reform programs for the global financial, fiscal and energy systems; investments that aim at stimulating the world economy and minimizing its dependence on non-renewable resources; counteracting climate change and the creation of new 'green' jobs.

4. Conclusion

Threats that cause adverse climate changes on our planet represent enormous policy challenges at the global and European levels to undertake effective joint actions to counteract their effects.

Due to the high costs of the measures taken, solidarity-based assistance for rich countries is necessary for the poorer countries, which are also the most exposed to the effects of adverse climatic events, mainly drought and floods, earthquakes, typhoons and tsunamis.

The activities of transnational organizations with a global reach are necessary and desirable, but often not very effective, due to the prolonged periods of negotiations and low efficiency in enforcing the decisions taken.

The most effective support instruments seem to be financial resources (penalties) and incentives (subventions) for undertaking pro-environmental activities, eliminating harmful activities resulting from adverse climate changes (promoting afforestation, using waste land for biofuel production, and biomass in agriculture here, promoting ecological agriculture and sustainable models of more sustainable production and patterns of prudent sustainable consumption.

It is also effective to raise awareness of the use of new pro-ecological solutions for cleaner air, water and soil, and to promote and support financial research and the implementation of low-carbon technologies and energy-saving technologies.

The market for environmental technologies and goods and services is among the potentially faster developing markets in the modern global economy, especially on the area of the European Union. It also allows the creation of new jobs in the bio-economy and creates opportunities to maintain the growing GDP rate. The high rate of its development is also marked, especially in countries of systemic transformation and in developing countries, which, although they currently have a relatively small share in the dynamically developing market, the pace of changes

in this area observed in these countries in recent years makes it possible to place them among potential growing participants.

A modern economic model based on a steady growth can lead to the exhaustion of available resources at an acceptable price and destroy the biological foundations of life to the extent that humanity will be condemned to wars for drinking water or food, as well as unpredictable, rapid climate change. Many communities, enterprises and local governments have started to take action to reduce the effects of such a model on health and life on Earth

The circular economy is thus an economy in which production and consumption are organized in such a way that the value of products, components, materials and resources is maintained in the entire value and life chain of products. It maximizes resource efficiency and minimizes the extraction of resources and waste.

Poland and other countries of Central and Eastern Europe, as EU Member States, should actively participate (at both national and regional level) to build a circular economy model, investing in environmentally friendly and low-emission technologies, as well as in innovative solutions that allow both the reduction of waste and/or the re-use of raw materials in order to allow better environmental protection of our planet.

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Streszczenie

WDRAŻANIE GŁÓWNYCH ZASAD GOSPODARKI O OBIEGU ZAMKNIĘTYM W KONCEPCJI ZRÓWNOWAŻONEGO ROZWOJU W GOSPODARCE ŚWIATOWEJ I EUROPEJSKIEJ, ZE SZCZEGÓLNYM UWZGLĘDNIENIEM KRAJÓW EUROPY ŚRODKOWO-WSCHODNIEJ – PRZYPADEK POLSKI I REGIONU ŁÓDZKIEGO

Celem artykułu jest przedstawienie efektów wybranych działań realizowanych na poziomie globalnym, europejskim oraz regionalnym realizowanych w ramach idei zrównoważonego rozwoju. Szczególnie istotna jest tu prezentacja działań podejmowanych na szczeblu regionu łódzkiego (jednego z centralnych regionów Polski) w którym to regionie omówionych zostało 6 specjalizacji regionalnych ze szczególnym zwróceniem uwagi na innowacyjne rolnictwo ekologiczne oraz na przemysł tekstylny oparty na modzie i innowacyjnym wzornictwie. Wszystkie 6 specjalizacji w regionie łódzkim, w tym medycyna, farmacja i przemysł kosmetyczny, zaawansowane materiały budowlane; wytwarzanie energii elektrycznej (w tym odnawialne źródła energii), informatyka i telekomunikacja zostały ukierunkowane na realizację nadrzędnego programu bio-gospodarki zmierzającego w kierunku osiągnięcia głównych założeń gospodarki cyrkularnej opartej na zasadzie 3xr: reduce, reuse, recycle. Oznacza to zredukuj ilość odpadów a jeśli już je wyprodukowałeś, użyj ponownie lub oddaj do recyklingu.

***Słowa kluczowe**: zrównoważony rozwój, bio-gospodarka, gospodarka cyrkularna, region łódzki*