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Czasopismo Polskiego Stowarzyszenia
Ekonomistów Środowiska i Zasobów Naturalnych

ENVIRONMENTAL POLICY AND MANAGEMENT

STUDIES AND MATERIALS

GENERAL ENVIRONMENTAL AND SOCIAL PROBLEMS

ENVIRONMENTAL POLICY AND MANAGEMENT

POLITYKA EKOLOGICZNA I ZARZĄDZANIE ŚRODOWISKIEM

Ewa JASTRZĘBSKA

PRO-CLIMATE INITIATIVES OF SELECTED ENTERPRISES IN POLAND

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ABSTRACT: Action aimed to combat climate change and its consequences is number 13 among the 17 Sustainable Development Goals (SDGs): an urgent call for action announced by the UN in 2015 and highlighting the fundamental challenges to be faced by the modern world over the next 15 years. The SDGs are arousing a keen interest of the business sector. This is true also in Poland. Climate action is taken not only by large multinationals, which have become aware that degradation of the environment is now hampering development, but also by startups that are exerting an increasingly positive social impact and whose number has been growing rapidly worldwide. The article intends to asses selected cases of climate action taken by businesses in Poland. For this purpose, three parallel studies will be carried out of economic establishments based on a critical web research analysis.

KEY WORDS: climate change, business, startup, strategy

Introduction

In the October 2018 special report by the IPCC, 91 scientists from 40 countries proposed to lower the safe limit for global warming from 2°C to 1.5°C based on more than 6,000 scientific publications. At the same time, they stressed that the increase in the global average temperature by the end of the century by 1.5°C above pre-industrial levels would have much graver consequences than originally expected. To limit global warming by 2050, humanity will have had to slash greenhouse gas emissions to net zero (compared with 2010), which means that transformative systemic change is mandatory on a large scale and in all areas of life (IPCC, 2018).

The conclusions from the report seem to be getting through to the society, especially to young people, as demonstrated by the School Strikes 4 Climate Action. Their climax was 15 March 2019 when 1.6 million teenagers in 133 countries decided to dodge classes and took to the streets with banners. The mastermind of Skolstrejk för klimatet, Greta Thunberg, said at the World Economic Forum in Davos in January 2019, "I don't want you to be hopeful. I want you to panic. I want you to feel the fear I feel every day. And then I want you to act. I want you to act as you would in a crisis. I want you to act as if our house is on fire. Because it is" (Thunberg, 2019).

"Take urgent action to combat climate change and its impacts" is no. 13 out of 17 Sustainable Development Goals (SDGs) contained in Agenda 2030 adopted by the United Nations in 2015. The same goal has been recognised by 454 experts from around the world assessing progress on the SDGs for GlobeScan and Sustainability (2019, p. 5, 15, 18) as requiring the most urgent action; what is more, compared with the previous study in 2017, the proportion of experts saying progress on Climate Action is poor has increased dramatically. Meanwhile, the private sector is seen by them as making the poorest contribution to the promotion of sustainable development.

The diversified private sector (from micro-enterprises through cooperatives to multinationals) was considered one of the partners to Agenda 2030. It was noted that the sector must act to reverse unsustainable consumption and production models, including in developing countries (UN, 2015, p. 9, 12, 14). Although it is the largest companies that are in a position to combat climate change in the first place (they also bear the greatest responsibility), ultimate success will not be possible without a strong contribution of MSMEs. Among micro-enterprises, there are also the so-called positive impact start-ups. Through their ICT-driven core business, they are contributing to resolving local and global problems and are creating the maximum positive impact on the implementation of sustainable development (Rok, 2019, p. 13, 17-20).

Business interest in the SDGs has grown quickly. A study by KPMG (2017, p. 30-31, 39, 49-50) covering 250 of Fortune 500 largest multinationals and 4,900 local companies from 49 countries earning the biggest revenue reveals that 43% of multinational and 39% of local companies refer to the SDGs in their non-financial reports. At the same time, however, 52% of multinationals and 72% of local companies fail to acknowledge climate risk in their annual reports. Although a growing number of corporations (58% in 2015 in 67% in 2017) sets and discloses targets to cut their carbon emissions (the same 50% of local companies), most of them do not relate their own reduction targets to the national, regional, or global climate goals. However, goal no. 13 is one of three SDGs that attracts the most companies' attention (prioritized by 55% or more companies) (KPMG, 2018, p. 6).

The article intends to assess the instances of climate action taken by selected businesses in Poland. The following research questions are posed:

- Do the largest companies and at the same time corporate social responsibility (CSR) leaders in Poland, having a major impact on their immediate setting, acknowledge the problem of climate change at the strategic corporate level?
- What climate action – best practice do Poland-based companies take?
- Do the Polish startups acknowledge the climate problem?

An overview of the literature

In Poland, studies on companies' initiatives in the area of CSR and sustainable development are conducted by both research centres and companies themselves (mainly ones offering consulting services), not infrequently as part of cross-sectoral cooperation. It is worth noting that, according to ISO 26000, social responsibility focuses on the organisation and its responsibility towards the society and the environment; the ultimate goal of the concept is to maximise the company's contribution to sustainable development (PKN, 2012, p. 21). In practice, both terms are often used interchangeably. For example, Rojek-Nowosielska (2017) investigated the degree of implementation of the idea of CSR in Poland-based enterprises. She pursued the CSR Continuum model and looked into such organisational areas as: employees, customers, suppliers, natural environment and local community. Also, Sikacz (2019) performed an assessment of the ESG factors (Environmental, Social Responsibility, Corporate Governance) of Central European companies listed in social responsibility indexes (including in the Polish Respect Index) based on data from the ASSET4 database. Bachnik (2017) looked into the implementation of sustainable development and CSR in SMEs, while Wysocki

(2019) focused on the matters of strategic ecologisation of manufacturing businesses.

The assessment of CSR is also carried out as part of various rankings. Since 2009, the Ranking of Responsible Companies (Pol. ROF) by Koźmiński Business Hub has been looking at companies in such categories as: responsible business management, sustainable development policy, positive impact management, selected responsibility indicators. However, the ranking does not offer detailed results in individual categories. Similarly, only aggregate results are published for the Listki CSR ranking held by the *Polityka* weekly (2019) since 2012. It assesses companies in such areas as: corporate governance, human rights, staff policies, environmental protection, customer care, business integrity, and community involvement. Since 2016, the best practice in the pursuit of the SDGs has also been rewarded. Still, no research is being conducted in Poland on whether and how businesses respond to the challenges posed by goal 13 of the SDGs.

Research methods

The assessment of pro-climate initiative by selected enterprises in Poland was carried out in May 2019 through three parallel studies.

First, corporate strategic documents were analysed of selected Poland-based enterprises in terms of addressing the challenges of climate change. The studied entities were categorised as "large companies" according to the Rzeczpospolita 500 ranking of 2018 and simultaneously ranked among CSR leaders according to the ROF (2018) (Koźmiński Business Hub, 2018). The analysis covered their business and functional strategies (i.e. CSR and sustainable development) published on their websites (polish websites, if possible, unless redirected to global services) or in non-financial reports (because often the information about strategies is included in such reports and not published on websites). The strategies were assessed for direct (literal) or indirect (by references to sustainable development) mentions of climate issues. For companies had found that incorporation of the relevant climate-sensitive content in their strategy papers allows them to coordinate their pro-climate action in a more effective manner (by enhancing the synergy effect) and integrate it better with the regular corporate operations. With strategies in place, pro-climate initiatives are not diffused, unscheduled or mutually exclusive and their effectiveness is improving. The study embraced 44 CSR leaders in Poland (out of 70 included in the ROF) that were also included in the Rzeczpospolita 500 list.

Second, a critical analysis was carried out of 115 best practices (from the record-breaking 1,549) submitted by companies to the Responsible Business Forum (Pol. FOB) report, Responsible Business in Poland. Best Practice 2018, under goal 13 of the SDGs regarding climate action (FOB, 2019), to identify what pro-climate action is taken by companies that is worth copying.

Third, the author attempted to identify Polish startups contributing to the combating of or adapting to climate change, based on the database of Polish positive impact startups collated by Koźmiński Business Hub and published in April 2019 (Koźmiński Business Hub, 2019) and a web research analysis. The study aimed to assess whether the climate change issue is acknowledged by Polish startups.

Results of the research

The analysis of business CSR and sustainable development strategies/policies of 44 largest companies and CSR leaders in Poland first demonstrated that companies still had a problem in communicating with stakeholders, which is surprising considering that transparency is one of the fundamental principles of the CSR concept. Among the studied companies, 12 did not disclose anything of their business strategy on their websites. At the same time, when presenting some company-relevant information, the analysed companies often assumed in advance who might be most interested in them (e.g. by publishing their business strategy in the Investor Relations section).

Out of 32 companies providing their business strategy online, 17 did not make any references to climate change in the document, and 14 did so but indirectly (by mentioning an objective/initiative to reduce CO_2 emissions, RES development or ecology). Only one company, BASF Polska, highlighted the challenges of climate change in its business strategy.

BASF, whose mission says, "We create chemistry for a sustainable future," considered sustainability as one of the six strategic action areas (BASF, 2019b). The essential part of their strategy is climate protection. The enterprise aspires to be CO_2-neutral by 2030 through effective carbon management and reducing emissions along the value chain (BASF, 2019a).

Among the 44 analysed companies, 29 made their social responsibility/sustainable development strategy/policy available on their website or in non-financial reports. In 15 of those documents, there were no mentions of climate change, and 11 alluded to the problem indirectly (mostly by including an objective/initiative to improve energy efficiency or reduce greenhouse

gas emissions). Only three companies acknowledged the combating of climate change as one of their key objectives.

At BNP Paribas (2019b), the natural environment is one of the four pillars of responsibility embedded in their CSR Strategy. In each of the three dimensions of its environmental responsibility, the bank defines commitments related to combating climate change, e.g. by adopting the objective of reducing CO_2 emissions (by 25% per employee before 2020) or by financing RES projects (Bank BNP Paribas, 2019a).

One of the priorities of the Corporate Social Responsibility Strategy of Santander Bank Polska 2019-2021 is to co-fund climate-oriented projects and initiatives (Santander Bank Polska, 2019b). Commitments to keep down the negative impact on the environment are found in the Santander Bank Polska's Policy on Sustainable Development (CSR), supplemented by the Santander Bank Polska's Policy on Climate Change, the latter of which puts forward actions and initiatives that are likely to alleviate the effects of climate change, such as, for example, the control of consumption of resources and emissions in all bank's facilities (Santander Bank Polska, 2019a).

Environmental responsibility of Żywiec Zdrój is aligned with the Natura strategy of the Danone Group; one of its five key objectives is the prevention of climate change, which Żywiec Zdrój (2012, p. 38) strives to achieve by reducing its carbon footprint.

The quantitative results of the first study are shown in figure 1.

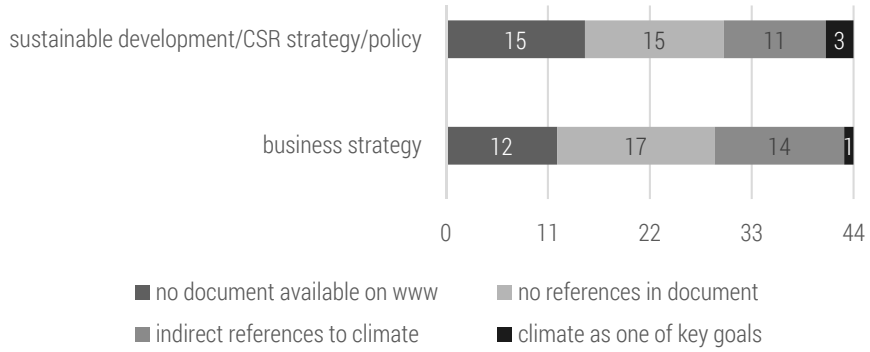

Figure 1. Strategic documents with climate action references of 44 largest CSR leaders in Poland

Source: author's own work based on completed research.

The second analysis covered 115 best climate practices submitted to the FOB report, Responsible Business in Poland. Best Practice 2018. The analysis exposed invariably low awareness of goal 13 of the SDGs. Although the num-

ber of practices related to climate change had increased (13 in 2016 and 41 in 2017), they made up no more than 7.4% of the total. Second, it was found that action taken by the studied companies in this area were quite similar. Most often companies become committed to combating climate change by educating their personnel (via websites, online portals, training or loyalty programmes promoting vehicle-free commuting by bicycle or public transport) and the general public (e.g. through classes and workshops for children, social campaigns, contests). Frequently, companies decided to plant trees, invest in RES, install solar or LED technology, maintain an eco-friendly or hybrid vehicle fleet and conduct training in eco-driving, collect e-waste and exhausted batteries, or implement green office initiatives. Among other examples of best practice, there were: the use of carpooling applications, the use of heat recovery devices, the purchase of green energy, customer service e-offices, including e-invoices (FOB, 2019).

In the third study, a critical analysis of 359 Polish positive impact startups revealed no more than 27 startups addressing climate change challenges. They were most often active in the ecological construction and green infrastructure segment, electromobility and car sharing but also providing services of air quality measurement and air pollution containment, air purification, small architecture (e.g. urban benches), green bus stops, or recycling. Some noteworthy startup initiatives are: DEGRUM designing bus stops with a green roof and walls and a filtered ventilation system; Earth Hearth designing and building wooden-frame houses filled with straw cubes and covered by clay plaster; SEEDIA designing and making benches with bicycle racks, with a solar charging functionality to offer mobile device charging and Wi-Fi connectivity; Ecobean making briquettes from coffee waste. An interesting startup is also Ronzo, which is not listed in the said database, making natural products from cricket meal.

Conclusions

When browsing non-financial reports and strategic documents of Poland-based enterprises, more and more references can be found not only to sustainable development but also directly to the SDGs. Businesses attempt to focus their activities around the implementation of specific SDGs that are aligned with their operations. Still, many companies seem to overlook this challenge and approach sustainable development as a functional strategy (programme, policy) and not as a way to reinvent their business. Meanwhile, by mere incorporation of climate change in the fundamental development strategy, a company can make sure that all its pro-climate effort will be uni-

form and will make the difference in the long run. Diffused and uncoordinated action is likely to lead to rebound effects that can even produce extremely undesirable effects (e.g. surging greenhouse emissions).

SDGs are intertwined: measures to combat or adapt to climate change can also be taken under goals 7 – to ensure access to affordable, reliable, sustainable and modern energy for all, goal 11 – to make cities and human settlements inclusive, safe, resilient and sustainable or goal 12 aimed to ensure sustainable consumption and production patterns. Climate change, however, is such a serious global threat that any action aimed to counter it should be anything but ad hoc or accidental.

The conducted studies have demonstrated that the analysed enterprises tend to go for isolated and non-recurrent climate initiatives rather than undertaking coordinated and comprehensive climate action, let alone embedding it into their regular business strategies. Among the studied companies, only one decided to include the issues of climate change in its corporate strategy, and only three made references to it in their Corporate Social Responsibility or sustainable development strategies/policies. The initiatives pursued by the studied businesses for the combating of or adaptation to climate change (mostly also the business models of the studied startups) were intended more as a way to evolve existing manufacturing and consumption models towards more sustainable ones rather than launching an in-depth transformation and systemic change, which the authors of the IPCC report had highlighted.

It is worth noting, however, that more and more initiatives are surfacing to galvanize businesses into implementing the SDGs. One of the most leading strategic tool is the SDG Compass, developed by GRI, the UN Global Compact and WBCSD to provide guidance for companies on how they can align their strategies as well as measuring and managing their contribution to the realisation of the SDGs (GRI et al., 2015). GRI and UN Global Compact (2018) drew up a practical guidance which outlines a three-step process to embed the SDGs in existing business and reporting processes. The WBCSD's SDG Business Hub platform presents best practice of the largest enterprises that lead the way in sustainable development and alignment of their business models with the SDGs. Through the ISAR group, UNCTAD (2018) proposed a list of a limited number of core SDG indicators for reporting entities. In Poland, the first set of SDGs indicators for business (named Impact Barometer) was being designed by CSR Consulting in liaison with the Central Statistical Office. It seems to be a promising strategy in helping enterprises understand the erroneous nature MacNamara's fallacy that what cannot be easily measured does not really exist.

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Wojciech **PIONTEK**

THE CIRCULAR PLASTICS ECONOMY AND THE INSTRUMENTS TO IMPLEMENT IT

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ABSTRACT: The purpose of this paper is the identification and analysis of the multidimensional consequences of implementing the concept of circular plastics economy in reality. The paper presents the concept of plastics and the history of development of the plastics industry. Selected negative environmental consequences of plastics consumption were indicated. This paper shows a rationale behind and key objectives of the Strategy for the plastics in a Circular Economy. It discusses the essence and scope of circular plastics economy. The proposed instruments for implementing the concept of circular plastics economy and the consequences of their application have been characterized in an integrated way. The paper attempts to answer the question whether and to what extent EU actions contribute to solving global environmental problems (oceans pollution, chemicals contaminations of waters and soils, destruction of ecosystems and landscapes). This paper is based on literature reviews and documents published by the European Commission.

KEY WORDS: circular economy, economic growth, single use products, plastics

Introduction

In 2018, the European Commission presented the concept of a circular plastics economy and initiated actions to reduce the use of plastics within the territory of the Community. The activities are to contribute to the development of circular economy and the reduction of environmental pollution by plastics. At the same time, they are completing the preference phase of the plastics industry, expressed both in preferential recycling rates and the unwritten principle of not raising the problem of differences and consequences of the use of particular materials. The implementation of new solutions will have significant economic consequences. The concept has a wide range of both supporters and opponents. There is strong opposition from plastics producers and businesses using plastic products. The aim of the paper is to identify and analyse the multidimensional consequences of the implementation of new solutions to the Polish legal and economic system.

Development and consequences of the use of plastics

Plastics are a group of several dozen materials created by synthetic polymers and modified natural polymers. The history of the emergence and development of the plastics industry is directly linked to the industrial revolution and technological progress. The first synthetic thermoplastic produced on an industrial scale was polyvinyl chloride (PVC). Vinyl chloride (monomer) was first obtained by H.V. Regnault in France in 1835, and polymerization was carried out in 1872 by E. Baumann. Pilot production installations were established in the 1930s in the USA and Germany. Mass production of plastics developed during World War II (Obłój-Muzaj et al., 1997).

Three plastics were invented in the 1930s. In 1930 DuPont produced polychloroprene, the first synthetic elastomer similar to industrially produced natural rubber. In 1898, H. Pechmann synthesized polyethylene. Industrial synthesis of polyethylene was developed by Imperial Chemical Industries Ltd. in 1933, and the process of repeated high-pressure synthesis introduced in 1935 made it possible to produce LDPE film. Low-pressure synthesis of polyethylene with the use of chromium oxide was invented in the 1950s (Trossarelli, Brunella, 2003). The introduction of the first synthetic fibre, nylon, by DuPont, was a significant milestone in the development of the plastics industry. The creation of this fibre is the result of research conducted by W. Carothers between 1930 and 1935. DuPont opened its first nylon factory in Seaford in 1939. Initially, nylon was used in the production of stock-

ings. During World War II, nylon was used to manufacture parachutes and tyres for B-29 aircrafts (DuPont).

In 1941, English chemists J.R. Whinfield and J.T. Dickson (Calico Printer's Association of Manchester) patented polyethylene terephthalate (PET) to initiate the development of polyesters. PET is used in the manufacture of precision instrument housings, bearings, drives, gearboxes, precision mechanics for the manufacture of small tolerance parts, plug housings, coil bodies, domestic appliances (reinforced with glass fibre), as well as kitchen utensils. In 1973, N. C. Wyeth patented the PET bottle, which is the primary packaging for liquid food in developed countries. Polyethylene terephthalate is also the basis for the production of polyester fibres such as polyester, dacron and terylene (Bellis, 2006).

Plastics are a highly differentiated group and as a result are classified according to many criteria, including: the origin of the primary ingredient (natural, synthetic), physicochemical properties, and use. The basic criterion of physicochemical properties allows the division of plastics into thermoplastics and thermosetting plastics. Within each category there are a dozen or so plastics (figure 1).

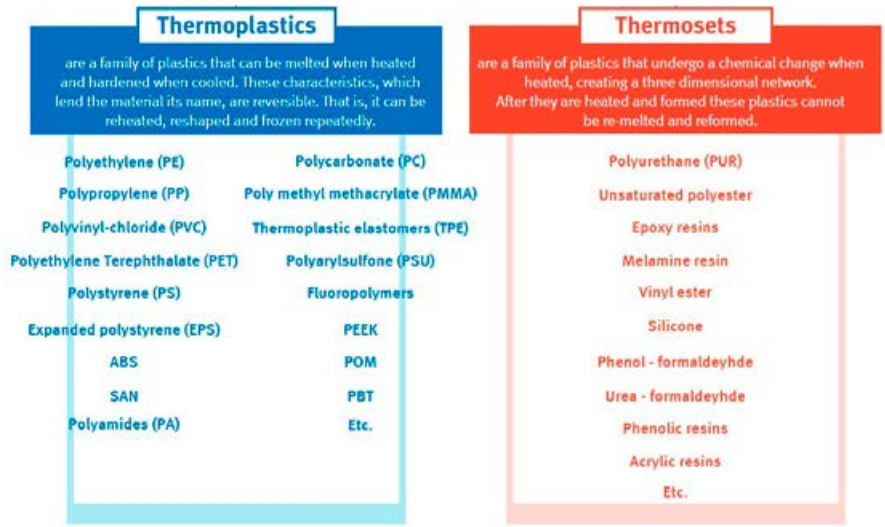

Figure 1. Categories of plastics

Source: Plastics – the Facts, 2018.

Plastics have found their application in all spheres of life. They are used in construction, medicine and cosmetics, electronics, automotive, energy, aviation industries, and many others. Combined with other materials, they cre-

ate particularly difficult to recycle multi-material plastics (combinations of different plastics, plastics with paper, aluminium, glass or rubber).

Notwithstanding numerous objective benefits (high functionality, low costs, low weight), the use of plastics has had negative health (conducted studies indicate that PET causes endocrine disruption and consequently its carcinogenic effect – see: L. Sax, Polyethylene Terephthalate May Yield Endocrine Disruptors in: Environmental Health Perspectives, http://ehp.niehs.nih.gov/0901253 [30-05-2019]), environmental and economic consequences (in sectors such as tourism, fisheries or shipping). The source of the negative environmental and economic consequences of using plastics include the following:

- generic change of the waste stream,
- creation of new categories of pollution.

The essence of the generic change of the waste stream is the appearance in the waste of substances not present in the natural environment, with a very long period of disintegration (even thousands of years depending on the conditions in which it takes place), during which numerous chemical substances are released into the environment, leading to secondary contamination. According to the available estimates, 8.3 billion tonnes of primary plastics have been produced worldwide since the 1950s, most of which have been deposited in landfills or released into the environment in an uncontrolled manner. In medium and highly developed countries, the share of plastics in municipal waste increased from less than 1% in 1960 to more than 10% in 2005 (Geyer, Jambeck, Law, 2017).

A generic change in the waste stream after World War II took place as a result of three processes:

- the development of disposable products,
- the use of materials other than natural materials in the manufacture of packaging,
- increasing use of packaging having marketing functions.

The category of single-use products comprises a wide variety of commonly used, rapidly disposable products that are discarded and become waste after a single use. These include packaging, disposable tableware, cosmetics, medical and hygiene products and disposable clothing. The widespread use of these products has made it possible to ensure the desired hygiene standards and reduce the number of various infections. At the same time, it caused a significant increase in the mass of waste generated.

Packaging waste is the dominant part of municipal waste. In highly developed countries, the share of packaging waste in the municipal waste stream is over 40%. In Poland in 2017, 11,969 million tonnes of municipal waste were generated, of which 5.7 million tonnes were packaging waste (47.62%).

The weight of plastic packaging introduced to the market amounted to 1.03 million tons, which constituted 8.6% of the total weight of municipal waste and 18% of the total weight of packaging waste. (Environment, 2018). Reducing the use of packaging is a prerequisite for addressing the problem of municipal waste. It is justified to create and disseminate solutions (by introducing legal regulations and conducting educational activities) for the sale of products without packaging in the case of which the consumer brings their own reusable containers to the store (an example of a store selling products without packaging is: Original-Unverpackt-Supermarkt, Wiener Straße 16, Berlin-Kreuzberg, also see: https://original-unverpackt.de/supermarkt/). A significant part of the mass of packaging placed on the market is not used to protect products, but is used in marketing functions. Such packaging is heavy and materially diverse, which makes it a difficult waste to recycle.

The pollution of the oceans and coasts should be mentioned among the types of pollution caused by the widespread use of plastics. It is estimated that every year a few percent of the world's plastics production reaches the oceans. The results available in this respect are characterised by significant differences. The comparative analysis of the available estimates clearly shows that the European Commission uses the estimates of the highest values biased and exaggerates the problem on a European scale in order to gain social acceptance for the introduced systemic changes. The estimate set by the European Commission in the *European Strategy for Plastics in a Circular Economy* estimates the weight of plastic waste reaching the oceans at 4.8 to 12.7 million tonnes per year, including 150,000 to 500,000 tonnes of EU waste (COM(2018)28 final; Jambeck et al., 2015). Alternative studies (Lebreton et al., 2017) estimate the mass of plastic waste flowing into the oceans by rivers at between 1.15 and 2.41 million tonnes per year. In addition, the authors of the study indicate that most of the 20 most polluted rivers, responsible for 67% of pollution, are located in Asian countries with rapid economic growth and poorly developed waste management systems.

Plastic waste shipped through ocean and sea currents forms "artificial islands" (figure 2). The largest of them is located between Hawaii and California. The Great Pacific Garbage Patch covers surface area of 1.6 million square kilometres and contains over 1,8 trillion pieces of plastic about weight 80.000–100.000 tones (Lebreton et al., 2018).

Ocean and sea pollution is classified according to the following criteria:

- the size of the waste: microplastics (0.05-0.5 cm), mesoplastics (0.5-5 cm), macroplastics (5-50 cm), megaplastics (anything above 50 cm),
- the type of plastic constituting the waste: type H (hard plastic, plastic sheet or film), type N (plastic lines, ropes and fishing nets), type P (preproduction plastics (cylinders, spheres or disks)), type F (fragments made of foamed materials) (Lebreton et al., 2018 and The Ocean Cleanup).

Figure 2. Areas of plastic accumulation in oceans
Source: The Ocean Cleanup.

Plastic microwaste constitutes a particular hazard. It is produced as a result of crushing larger waste and comes from microparticles added to products (e.g. cosmetics, detergents, paints), oxydegradable plastics, tyres, textiles or plastic granulates (COM(2018) 340 final). Such contaminants enter the bodies of marine animals and subsequently also to human bodies. As part of the work on the revision of the EU Directive on the quality of water intended for human consumption (*OJ L 330*), the introduction of mandatory monitoring of the presence of micro-plastics in drinking water is under consideration. The decision to establish the obligation is hampered by the lack of common methods of detecting pollution, as well as insufficient recognition of the different health consequences of human consumption of micro-plastics.

Plastics industry

The broadly treated plastics industry includes manufacturers of plastic raw materials, plastics processors, manufacturers of machines for plastics and their recycling and plastics recyclers. According to the data of PlasticsEurope AISBL, the world plastics production is estimated at 348 million tonnes (without PET, PA and polyacryl-fibers) in 2017. The biggest plastics producers are China – 29%, Europe – 18.5% and NAFTA countries – 17.5% of global production. In 2017, European producers produced 64.4 million tonnes of

plastics (without PET, PA and polyacryl-fibers). For comparison, in 2016 only 8.4 million tonnes of plastic waste were collected in order to be recycled inside and outside the EU, representing 2.48% of global and 18.5% of European plastics production. In Europe, the industry is made up of around 60,000 entities. The European plastics industry has an annual turnover of €350 billion and contributes €32.5 billion to Member States' budgets through public levies. The industry employs over 1.5 million people (Plastics – the Facts, 2018).

In 2017 in Poland, in the sector of rubber and plastic products production, 8,722 entities were conducting economic activity, including 2,361 entities employing more than 9 employees. The sector's production value amounted to PLN 94.2 billion and the added value to PLN 5.6 billion gross, which constituted 0.28% of the GDP. The sector employed 220 thousand people (Statistical Yearbook of Industry, 2018).

Instruments restricting the use of plastics

Responding to the risks posed by the widespread use of plastics and their uncontrolled release into the environment, the European Commission presented in January 2018 the *European Strategy for Plastics in a Circular Economy*, including the concept of building a circular plastics economy.

The Circular plastics economy is a development of the basic concept of circular economy defined in the Europe 2020 Strategy and the Closing the loop communication – An EU action plan for the circular economy (COM(2015) 614 final). The implemented measures and regulations are oriented towards products with a particularly negative impact on the natural environment (including water environment): single-use plastic products and fishing gears.

The theoretical foundations of the economy with a closed plastic cycle are endogenous theories of economic growth, assuming economic growth achieved through the created innovativeness. The concept provides for three directions of action:

- shaping a smart, innovative and sustainable plastics sector where design and manufacturing take full account of re-use, repair and recycling needs, boost growth and employment in Europe and contribute to reducing GHG emissions and the EU's dependence on imported fossil fuels,
- shaping the support of citizens, public authorities and industry for sustainable and safe consumption and production patterns of plastics,
- abandonment or reduction of the use of plastics where this is technologically possible and economically feasible (see details: COM(2018) 340 final, p. 6-7 and next).

The package of measures adopted by the European Commission for the implementation of the concept of a circular plastic economy:

- increasing the minimum required recycling rates for packaging waste,
- reducing the environmental impact of certain plastic products,
- introducing new categories of own revenues of the EU budget discouraging the use of plastic packaging and motivating the development of recycling of plastic packaging.

Following the amendment of the Packaging Directive (OJ L 283, EU L 150/141) the minimum recycling targets for all packaging waste have been increased (table 1). For plastics, the increase in the minimum required recycling rate is 27.5% by 2025 and 32.5% by 2030. Despite a significant increase, the required minimum recycling rates for plastics are lower than those set for other categories of packaging waste.

Table 1. Minimum recycling targets for packaging waste

Material contained in packaging waste	minimum recycling targets		
	applicable	no later than 31 December 2025	no later than 31 December 2030
plastics	22.5	50	55
wood	15	25	30
ferrous metals	50	70	80
aluminium	50	50	60
glass	60	70	75
paper and cardboard	60	75	85

Source: OJ L 365 and OJ L 150/141.

The second element of the package is measures to reduce the environmental impact of certain plastic products. A catalogue of actions is set out in the Directive on the reduction of the environmental impact of certain plastic products (he so-called Single Use Plastic Directive (SUP)), (OJ L155/1). The Directive aims to prevent and reduce marine waste from disposable plastic products and fishing gear containing plastics by complementing the measures foreseen in the Plastics Strategy, addressing identified gaps in existing actions and legislation and ensuring that the EU's systemic approach to the problem is further strengthened. Action to prevent the generation of pollution covered by the Directive and to eliminate pollution from the environment is intended to contribute to the creation of new jobs, as well as to improve technical and scientific skills and the competitiveness of the industry. Fourteen categories of disposable products are covered by the regula-

tions (table 2). Using the criterion of product impact on the marine environment, they were divided into three categories and the applied instruments were differentiated:

- products for which sustainable alternatives are available – EU action aims to promote less harmful alternatives,
- products for which there are no sustainable alternatives available – EU action aims to reduce damage by better informing consumers and making producers financially responsible for environmental impacts,
- products that are already well captured – EU action aims to ensure that they are introduced into an existing (or planned) separate collection and recycling scheme (COM(2018) 340 final).

Table 2. Single-use items covered by the SUP Directive

Cam	Restriction of use	Market restrictions	Product design requirement	Labelling requirements	Extended producer responsibility	Purpose of separate collection	Knowledge dissemination measures
Food containers	x				x		x
Beverage cups	x				x		x
Cosmetic swabs		x					
Cutlery, plates, stirrers, straws		x					
Balloon sticks		x					
Balloons				x	x		x
Packaging and wrappings					x		x
Beverage containers and lids thereof			x		x		x
Beverage bottles			x		x	x	x
Tobacco product filters					x		x
Hygienic articles: wet wipes					x		x
Hygienic articles: sanitary towels							x
Lightweight plastic shopping bags					x		x
Fishing gear					x		x

Source: COM(2018) 340 final.

Seven instruments will be used to achieve the objectives of the SUP Directive:

- instruments directly interfering with the market mechanism: restrictions on use, market restrictions,
- instruments indirectly interfering with the market mechanism: design requirements, labelling requirements, extended producer responsibility, separate collection targets, and dissemination of knowledge.

The SUP Directive contains the following special measures:

- the mandatory level of separate collection of beverage bottles required under Article 9 from 2025 – 77% and since 2029 – 90%,
- in accordance with Article 6, with regard to beverage bottles, each Member State shall ensure that from 2025 beverage bottles which are manufactured from polyethylene terephthalate as the major component will contain at least 25% recycled plastic and from 2030 at least 30% recycled plastic (OJ L155/1).

As a consequence of the above legal regulation, beverage bottles with a capacity of up to three litres (including their caps and lids) made of PET and other plastics have obtained the status of a separate packaging category. In order to achieve that objective, Member States may establish deposit-refund schemes or separate collection targets for relevant extended producer responsibility schemes. The regulations relating to beverage bottles are to be seen as an attempt by the EC to offset the low recycling rates of plastic packaging waste.

Beverage containers with a capacity of up to three litres, glass or metal beverage containers, beverage containers intended and used for food for special medical purposes that have caps and lids made of plastic may be placed on the market only if the caps and lids remain attached to the containers during the products' intended use stage.

The third element of the package of measures to make the concept of a circular plastics economy a reality is the proposal to introduce new own resources of the EU budget since 1 January 2021, including:

- 20% share of revenues from the Emissions Trading Scheme,
- a collection rate of 3% applied to the new Common Consolidated Corporate Tax Base (CCCTB),
- own resources based on plastic packaging waste (COM(2018) 325 final).

Own resources based on plastic packaging waste will be a national contribution to the EU budget, calculated on the basis of the amount of plastic packaging waste not subjected to recycling. It is proposed to set a collection rate of €0.80 per kg of packaging waste. The actual collection rate may not exceed EUR 1,00 per kilogram.

This instrument will contribute to improving the cost-effectiveness of plastics recycling, reducing the plastic waste stream, enhancing the sustainability of plastics and stimulating innovation, competitiveness, and job cre-

ation. It is used to implement the concept of extended producer responsibility in the real world. In order to minimise the payment, it is expected that Member States will set the required recycling rates for packaging waste above the minimum levels required under Community law and that businesses will take action to maximise the recycled weight of waste.

The EU budget's own resource revenue based on non-recycled plastic packaging waste is projected to be between 2021 and 2027 with an average annual budget of €7 billion, representing 4% of the total EU budget. Member States will be entitled to 10% of the amount of revenue they receive to cover their collection costs (COM(2018) 325 final).

Consequences of the implementation of the concept of a circular plastics economy for Poland

The implementation of circular plastics economy will result in multidimensional positive and negative economic, social, environmental, and political impacts.

The application by the European Commission of restrictions on use and market restrictions constitutes a significant interference in the market mechanism and a departure from the free market economy. It should be expected that both in Poland and the rest of the Community it will result in the cessation of economic activity by a significant group of entrepreneurs manufacturing disposable plastic products. The continuation of economic activity by the indicated entities will be conditioned by the implementation of the technology of production of single-use products from materials other than plastics, which, due to their limited availability and necessary investment outlays, may be highly difficult.

Measures to reduce the use of plastics will have a direct impact on the functioning of the waste industry. The demand response for packaging waste recycling services will be determined by the interaction of the following factors: increasing recycling levels, the requirement to use recyclates for the production of new products, limiting the use of plastic packaging, and the amount of product fees. The relationships between variables are currently difficult to predict and require additional research.

The highly likely reduction in the use of plastic packaging will lead to significant problems in the functioning of plastics recyclers and a decrease in the efficiency of selective collection of plastics. The loss of competitiveness of plastics recyclers will be offset by the increase in demand for recyclers of other packaging materials. A widespread change in the packaging used in the initial period may cause difficulties in meeting the recycling obligation result-

ing from limited processing capacity and inappropriate separate collection systems. One should expect strong pressure exerted by entrepreneurs on communes to develop selective waste collection systems ensuring the availability of waste for recycling as well as high quality of secondary raw material.

Achieving the targets for selective collection of beverage bottles set out in the SUP Directive requires the introduction of new solutions to the waste collection system, including deposit systems. The estimates commissioned by the General Directorate for Environmental Protection indicate the cost of introducing a deposit system in Poland, covering beverage bottles, aluminium cans, glass bottles, multi-material packaging within the next 5 years at PLN 19-24 billion (the cost of collecting and transporting post-consumption waste) (Patorska, Paca, 2017).

Assuming that plastic packaging waste recycling is implemented at a minimum level resulting from directives and a constant 2% increase in the weight of packaging introduced to the market until 2030, the estimated Polish payment to the EU budget in 2021 will amount to PLN 2.98 billion (EUR 678 million) and by 2024 will increase to PLN 3.17 billion (EUR 720 million). As a result of the increase in the minimum level of recycling, the payment will be reduced from 2025 to PLN 2.11 billion (EUR 480 million) and from 2030 to PLN 2.10 billion (EUR 477 million). The projections do not take into account the abandonment of plastic packaging and the implementation by businesses of the recycling obligation both below and above the required minimum target level resulting from the Directive (figure 3).

The own resource contribution to the EU budget based on plastic packaging waste can be financed by the state budget or – what should be expected – transferred to producers of packaged products. The shifting of the burden to the introducing manufacturers requires modification of the algorithm for calculating the product charge in relation to plastic packaging. A new product fee will be charged for the weight of plastic packaging, which constitutes the difference between the weight of packaging placed on the market and the weight of recycled packaging. In situations where the producer does not reach the required minimum level of recycling, it seems justified to apply an additional penalty in the form of a surcharge added to the mass of packaging, for which the obligation has not been fulfilled. The product fee rate for plastic packaging should also be increased from PLN 2.70 per kilogram to not less than PLN 3.52 per kilogram (Piontek, Pokrywka, 2019).

In the technological dimension, it is possible to anticipate the manufacturers' resignation from plastic packaging in situations where their application is not necessary due to product parameters, and at the same time there

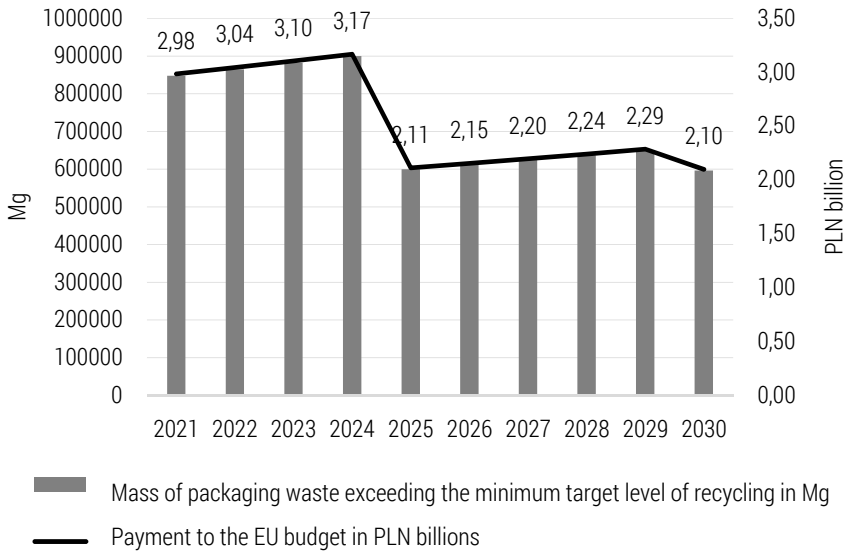

Figure 3. Projections of the Polish contribution to the EU budget from own resources based on plastic packaging waste for 2021-2030

Source: author's own work.

is a possibility of substitution with other plastic packaging. Increased recycling rates will contribute to the development of new packaging waste recycling technologies, allowing for recycling of secondary raw material with worse parameters.

Reducing plastic consumption will result in a significant reduction in the calorific value of municipal waste (calorific value of plastics ranges from 13.69 MJ/kg for PVC to 42 MJ/kg for polyethylene (Wasilewski, Siudyga, 2013)), which will have an impact on the efficiency and legitimacy of operation of thermal waste treatment installations. The recovery process is carried out only under autothermal conditions, and thermal processing of waste with insufficient calorific value requires the use of fossil fuels.

The expected political effect will be the unwillingness of the public (as shown by the practice supported by the media) to act in the future by government teams implementing EU regulations. Poles are in the vast majority in favour of membership in the European Union and, at the same time, are opposed to the costs necessary to be borne in connection with the implementation of Community environmental policy.

Conclusions

The measures taken by the European Commission to build a circular economy for plastics should be considered highly desirable and making a real contribution to solving the problem of waste in its current form. The aforementioned actions are one of the few undertaken by the EU that are directly aimed at shaping sustainable consumption. Sustainable plastics consumption in the EU will contribute in a limited extent to addressing the global problem of oceans pollution.

The analyses carried out allowed to identify opportunities and threats related to the implementation of the concept of circular plastics economy in Poland. These include:

- opportunities:
  - reduction of consumption of non-renewable raw materials (crude oil),
  - preserving the value of the raw material in use,
  - reduction of the environmental pressure of consumption processes resulting from depositing plastic waste into the environment (oceans pollution, chemicals contaminations of waters and soils, destruction of ecosystems and landscapes),
  - development of separate collection of waste and increase in recycling rates,
  - developing the processing capacity of non-plastic waste,
  - shaping positive attitudes of citizens towards the management of waste generated,
- threats:
  - significant interference of the state in the market mechanism,
  - change in the structure of the market for regulated products and the efficiency of entities operating on this market,
  - high costs of implementation and functioning of new solutions burdening the public sector, entrepreneurs and citizens,
  - new fiscal instruments,
  - social opposition to new regulations,
  - different treatment of entrepreneurs introducing disposable products made of different plastics with the potential to undermine the principles of competitiveness and equal treatment of entities,
  - necessity to adjust the processing potential of waste to new market conditions.

The implementation of EU legislation requires changes to the existing legislation as well as introducing completely new solutions. Regulations creating extended producer responsibility systems should occupy a special place among the new solutions. The achievement of the objectives set out in the concept of a circular plastics economy is conditioned by the fact that

Member States' governments do not give in to the law-making process, lobbying of plastic producers as well as those introducing products in plastic packaging.

Examples of lobbying organisations acting in support of industry include The New Plastics Economy Global Commitment (The New Plastics Economy Global Commitment, https://www.newplasticseconomy.org/projects/global-commitment [24-07-2019] and PlasticsEurope, https://www.plasticseurope.org [24-07-2019]). One of the forms of lobbying conducted by the indicated entities is dissemination of opinions indicating positive aspects of using plastic products and contesting the activities of the European Commission, as well as other entities for their reduction. Particular emphasis is placed on plastics' role in climate protection. It should be noted that the studies on the consequences of the use of plastics presented by lobbying organisations are not cost-benefit analyses. They are not used to verify, but to prove the hypotheses adopted. This is confirmed, among others, by the statement of the authors of the analysis disseminated by PlasticsEurope: *the study is not a full Life Cycle Assessment (LCA) by strict definition of ISO 14040 and 14044; however the principles of the standard have been followed and the data for comparison within the case studies are extracted from public LCA databases* (Plastics' contribution, p. 5) This detail is noticed only by observant readers.

It should be noted that disposable plastic products were widely promoted on the Polish market by international corporations in the 1990s and after the year 2000. Their use and consumption was presented as an expression of innovation and modernity. Despite the negative experiences of highly developed countries, these activities did not meet with the opposition of state authorities responsible for environmental protection and sustainable development.

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DIRECTIONS OF MANAGEMENT OF MUNICIPAL SEWAGE SLUDGE IN THE EUROPEAN UNION

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ABSTRACT: The purpose of this article is to compare sludge management trends between selected EU-15 and EU-12 countries on the basis of statistical data to determine trends and formulate conclusions for countries adopted after 2004. The analysis relied on the analysis of changes in legal regulations, international literature and the analysis of statistical data from EUROSTAT. Unfortunately, incomplete statistical data limited the number of analyzed countries, however, it was possible to draw conclusions.

Sludge management is an extremely complex issue, affects not only water and sewage management and waste management, but also concerns the issues of agriculture (fertilizers) and energy. A very important part of the issues is technological progress, and therefore research and development. Improper management of sewage sludge will in the long run lead to increasing costs of wastewater treatment, while modern technologies allow for the recovery of both energy and raw materials. The law in principle ruled out the possibility of storage and limited the agricultural use of unprocessed sewage sludge, thus one should choose the optimal development directions of the sector. Possible areas of action are burning with recovery of energy and raw materials from ashes or organic recycling, i.e. composting with recovery of energy and heat and using the resulting fertilizer.

KEY WORDS: sewage sludge, wastewater treatment, sewage sludge management, sewage sludge regulations

Introduction

The basic EU regulation regarding sewage sludge and its use in agriculture was adopted over thirty years ago. Since then, knowledge about the environmental and health effects of natural use of sewage sludge has been improved, technologies for wastewater treatment have changed, as well as, thanks to technical progress, more effective methods of dealing with sewage sludge are available in terms of neutralizing dangerous substances and pathogens. The progress of knowledge indicates the need to take action in the field of monitoring and handling substances present in wastewater and sewage sludge, which have not been the subject of interest so far.

The implementation of sewage management requirements in the countries adopted after 2004 (EU-12) will affect the increase in sewage sludge production, and the cheapest methods of handling them – that is storage and agricultural and natural use – are currently banned or very limited. These countries face the challenge of choosing a strategy for dealing with sewage sludge. One can and should take a look at the directions chosen by the countries of the "Old Union" – that is, adopted until 1995 (EU-15) and on this basis build recommendations for EU-12 countries.

The aim of the article is to indicate possible directions for sewage sludge management in Poland and selected newest member countries on the basis of observed trends in management of sewage sludge selected in the countries of the "Old Union". The adopted research method is the analysis of source documents and statistical data of Eurostat.

Legal foundations defining the directions of sewage sludge management in the European Union – an overview of the literature

Waste management obligations arise, for example, from the Helsinki Convention (EU 1994:156) and recommendation "Sewage Sludge Handling" approved on 17 March, 2017 indicating in the scope of handling sewage sludge to the highest possible level of recycling and recovery of phosphorus, and for other methods absolute compliance with standards. ("HELCOM 38/1", 2017).

The issues of production and management of sewage sludge are regulated by numerous regulations in the field of waste management and sewage management. However, also acts from other seemingly distant areas have a significant impact on the way they are managed – such as the issue of bio-

mass and the recognition of it as a zero-emission energy source (the most important directives are included in table 1).

The most important and the oldest EU legal act in the field of sewage sludge is Directive 86/278/EEC concerning the agricultural use of sewage sludge. Its purpose is to regulate the use of sewage sludge in agriculture in such a way as to prevent its harmful effects on soil, vegetation, animals and people, while encouraging the correct use of sludge. However, it clearly indicates that different regulations in individual countries can not pose a threat to the common market. It points out that although sewage sludge can be a rich fertilizer for agriculture, it can also contain heavy metals and other dangerous pathogens (EU, 1986). The Directive introduces limit values of heavy metal concentrations in soil on which sewage sludge is distributed, in sewage sludges itself and annual maximum amounts of heavy metals that can be introduced into the soil intended for agricultural purposes. At the same time, it prohibits the use of sludge if the concentration of even one heavy metal is exceeded. It also introduces the need for monitoring and reporting obligations for Member States (EU, 1986, Article 4). In this way, the possibility of agricultural and natural use of sewage sludge was significantly reduced (Bień et al., 2014, p. 9). The subsequent directives influence the creation and treatment of sewage sludge, although they are not directly devoted to them. Directive 91/271/EEC, called the Urban Waste Water Treatment directive, which aims to reduce the pollution of surface waters with municipal sewage and some industrial wastes. Its proper implementation will affect the increase in the amount of generated sewage sludge. It is important that, according to the Commission communication on the list of wastes, sewage sludge is not classified as hazardous waste, which significantly affects the way it is handled (EU, 2001, Chapter 19-20). On the other hand, Directive 1999/31/EC on landfill restricts, and in principle prevents the disposal of sewage sludge in landfills, and Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources results in limited areas on which sewage sludge can be used for agricultural purposes. Table 1 indicates the most important directives and the scope of their possible impact on the management of sewage sludge. Particularly important in addition to the waste directive, establishing a hierarchy of waste management (EU, 1998b) are: Directive 2009/28/EC on the promotion of the use of energy from renewable sources and Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control). The first recognizes energy from biomass, gas from landfills and sewage treatment plants as a renewable energy source, and the second does not prohibit the incineration and co-combustion of sewage sludge, while naturally maintaining all environmental standards. Both of these directives together with the aforemen-

tioned ones, which limit the agricultural and natural use and storage of sewage sludge, determine the desirable directions of this waste.

Table 1. Selected directives affecting the management of sewage sludge

Type	Document name	The most important records
Regulations regarding waste management	Directive 86/278/EEC on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture	- definition of sewage sludge - limits of concentrations of heavy metals in sewage sludge - the concentrations of soils in soils - monitoring obligation - reporting obligations
	Directive 1999/31/EC on the landfill of waste	- limits the possibility of liquid waste storage - limits the possibility of storage of biodegradable waste - does not include the spreading of sewage sludge on the soil surface for fertilization or fertilization
	Directive 2008/98/EC on waste and repealing certain Directives	- hierarchy of dealing with waste - the production of waste is avoided - treatment of waste as a resource
Regulations regarding water management	Directive 2000/60/EC establishing a framework for Community action in the field of water policy	- qualify the entire territory of Poland for the sensitive area (limitation of P and N discharge and biodegradable compounds to waters) due to the eutrophication of the Baltic Sea
	Directive 91/271/EEC concerning urban waste water treatment	- indicates the need to reuse sewage sludge (recycling) - resignation from the discharge of sewage sludge to surface waters - the necessity to monitor the removal of sewage sludge - its implementation will increase the amount of sewage sludge
	Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources	- can limit the amount of land on which fertilizers can be used
	Directive2006/118/ EEC on the protection of groundwater against pollution and deterioration	- possible limitations of organic recycling
	Directive 2008/105/EC on environmental quality standards in the field of water policy	- environmental quality standards in the field of water policy
	Directive 2008/56/EC establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)	- as a result of implementation, it is possible to increase the amount of chemical deposits (phosphorus precipitation)
Regulations regarding renewable energy	Directive 2009/28/EC on the promotion of the use of energy from renewable sources	- energy for biomass, gas from landfills and sewage treatment plants and from biological sources for renewable energy sources - Biodegradable part of the biodegradable parts of industrial and municipal waste

Type	Document name	The most important records
Regulations regarding industrial emissions	Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control)	- disposal of sludge in any part of the water - not prohibit the combustion and co-incineration of sewage sludge - significantly reduces emissions from energy installations, including incineration and co-incineration of waste and sewage sludge)
	Directive 2004/35/CE on environmental liability with regard to the prevention and remedying of environmental damage	- responsibility for the environment - polluter pays

Source: authors own work based on Bień et al., 2014, p. 9-11; Radecki, 2016, p. 355-362; Górski, 2018, p. 393-484; Kelessidis, Stasinakis, 2012, p. 1187-1188.

Research methods

The research aimed at determining the directions of sewage sludge management in selected European Union countries in the context of legal changes being introduced, and comparing these changes with actions taken in countries admitted to the EU after 2004.

The conducted research was based on the analysis of source materials and statistical data published by Eurostat. The analyzes in the article are divided into two groups of countries. Three EU-15 countries (Germany, France and Austria) and five EU-12 countries were selected for analysis: three adopted in 2004 (Poland, the Czech Republic and Hungary) and two later (Bulgaria and Romania). The selection of these countries was determined both by their significance or representativeness, but also by the completeness of the available data, for example, data on composting for Spain, Sweden, Belgium and England are not available at a satisfactory level.

Since statistics on water and wastewater in Eurostat are published for the resident and not in terms of the equivalent number of inhabitants (PE) (Eurostat, 2018f), all data are reported and converted in such units. The analysis is made in 2018, the latest available data is from 2015 (Eurostat, 2018b), and for some specific data for 2013, nevertheless, interesting conclusions can be drawn. The 10-year period for this sector seems sufficient to capture certain regularities and, on this basis, formulate conclusions for other countries under the same legal regime.

Changes in the management of sewage sludge reflected in statistical data for selected European Union countries adopted before 1996

In the middle of the first decade of the 21st century, a significant review of waste policy directions was made, combining more closely with environmental and energy issues. As part of the conducted analyzes, which resulted in increased requirements, inter alia, in waste management issues, the sludge was also focused on.

At first glance, there is a huge disproportion in the amount of sewage sludge produced, firstly between the EU-15 and EU-12 countries, and secondly in the EU-12 countries surveyed. The volume of sewage produced in Germany is decreasing by 20%, in France by almost 12% and in Austria by over 20%, in EU-12 it is growing by 20% in Poland, by 17% in the Czech Republic and in Romania it has more than tripled, or maintains as in Hungary and Bulgaria – similar production levels are recorded (minimum drops) (table 2 and figure 1). The amount of generated sewage sludge is mainly affected by the amount of treated municipal sewage (the number of residents served, the amount of rainwater, the state of the sewage system – seepage of groundwater) and the technologies used for wastewater treatment. So let's look at these factors. One important point to pay attention to is the definition of sewage sludge in individual countries and when they become waste and when they lose their waste status. How are sludge treated in the sewage treatment plant classified, and how it is exported to other installations. This data may affect the generally reported amount of sewage sludge.

It should be noted that in Germany, 97% of residents were connected to sewage treatment plants, 100% in 2010, 95.8% and 100% in France, and 100% in Austria in 2004 (Eurostat, 2018b). Out of the EU-15 countries surveyed, only Germany suffered a decrease in the population (Eurostat, 2018a).

In the years 2004-2013, the number of sewage treatment plants decreased in Germany and France, with total capacity decreasing in Germany (expressed in BOD_5 [t. O_2/24h]), but for treatment plants with increased nutrient removal remained constant. It can be concluded that old sewage treatment plants with lower cleaning parameters were closed. In France, a colossal drop in the number of sewage treatment plants is noticeable with a significant increase in capacity, especially for treatment plants with increased biogen removal, which may inform about the liquidation of numerous small wastewater treatment plants with low technical parameters for modern large enterprises. In Austria, all the analyzed indicators increased (table 2), but the amount of generated sewage sludge decreased (table 4), which may inform about the growing technological potential.

Table 2. Change in the number of sewage treatment plants, their capacity in Germany, Austria and France in 2004 and 2013 [in pcs]

Country	Unit	Number of wastewater treatment plants			Including increased biogen removal		
		2004	2013	change	2004	2013	change
Germany	pcs	9 994	9 636	-358	5534	5180**	-354
Austria	pcs	1579	1841*	262	783	1049**	266
France	pcs	16889	3275	-13 614	2393	2605	212
		The capacity of the sewage treatment plant			Including increased biogen removal		
Germany	BOD5 [t. O2/24h]	9 283,7	9238,1	-449,6	9008,8	9003,9**	-4,9
Austria	BOD5 [t. O2/24h]	1 217,7	1 290,5*	72,8	1 156,6	1275,6**	119,0
France	BOD5 [t. O2/24h]	5 289,1	5 323	33,9	2 909	4 360	1 451,0
Germany	population equivalent (p.e.)	154 728 333	153 968 333	-7 493 333	150 146 667	150 065 000**	-81 667
Austria	population equivalent (p.e.)	20 295 000	21 508 333*	1 213 333	19 276 667	21 260 000**	1 983 333
France	population equivalent (p.e.)	88 151 667	88 716 667	565 000	48 483 333	72 666 667	24 183 333

* for 2006 ** for 2010

Source: author's own work based on Eurostat, 2018d; Eurostat, 2018c.

In nominal terms, Germany produces the most sewage sludge. The decrease in sewage sludge production between 2004-2015 is also the most visible in them (by 20%). It is caused by both a decrease in the number of inhabitants and technological factors in the form of abandoning the use of calcium / iron chloride in favor of polymers and the use of optimized processes during industrial wastewater treatment (Podewils, 2016). France produces on average half as much sewage sludge than Germany (table 3, figure 1). However, Austria has the highest production of sewage sludge per capita, followed by Germany. All three surveyed EU countries report a decrease in the volume of generated sewage sludge (Germany by almost 20%, France by 10%, and Austria by over 21%), as well as per capita, however Austria is the largest drop in this indicator in the period under study (figure 2). With a general decrease in the amount of generated sewage sludge in Germany, the amount of sludge burned increases from 711.2 to 1148.7 thousand tonnes of d.s. which is an increase from 36.2% to 63.7%. Storage was practically limited. The second most common way of utilizing sewage sludge is agricultural utilization with the share of nearly 24%.

In France, however, agricultural use dominates, but it remains at a similar level during the period under review with a downward trend of 420,000 t.d.s. today. The amount of sludge subjected to composting increased from 166.6 to 305.1 thousand t.d.s. together, composting and agricultural use gives almost 78% of the sludge used. The share and the amount of sludge stored fell. In Austria, both in 2004 and in 2014, combustion is dominating and almost half of sewage sludge is utilized in this method. The composting share increased from nearly 21% to 32.5%, but in nominal terms it increased from 63.4 to 77.7 t.d.s., as there is generally a significant decrease in the quantity of produced sewage sludge.

In the countries studied, we can see a decrease in the amount of generated sewage sludge, while in Austria and France the throughput increases. In Germany, the process of reducing it was visible, but the country registered a reduction in population, and the capacity of the treatment plant with the highest degree of treatment remained unchanged. In all countries operated by sewage treatment plants is the entire population. With the exception of Germany, the reason for the decrease in the amount of sewage sludge is not a reduction in the number of inhabitants, and possible reasons include: greater savings in water consumption, better sewage treatment technologies (smaller amount of excessive sludge) and in reducing the inflow of rainwater carrying significant amounts of sludge and other residuals. Following the industry literature, it can be confirmed that the development of modern technologies in wastewater management can contribute to reducing the amount of sewage sludge production (Makisha, 2016; Raghuvanshi et al., 2017; Grace, Clifford, Healy, 2016). Great technological progress is also observed in sewage sludge management methods, especially those related to energy recovery (Pająk, 2013; Fijałkowwski et al., 2017; Raheem et al., 2018; Kelessidis, Stasinakis, 2012).

The countries discussed have chosen different strategies for the management of sewage sludge. Both in Germany and Austria, its burning prevails, and in France, agricultural use, with the growing role of composting. In all the discussed countries, storage is disappearing, Austria has the most effective way to reduce it. It also confirms the effectiveness of the EU regulations that limit the possibility of sludge storage.

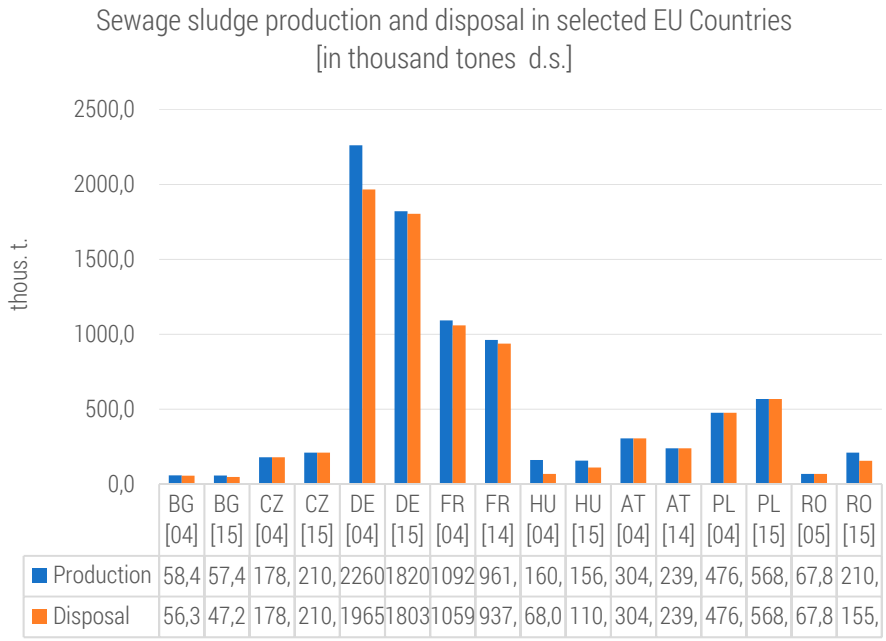


Figure 1. Sewage sludge production and disposal in selected EU Countries [in thousand tones d.s.]

Source: author's own work based on Eurostat, 2018b; Eurostat, 2018e.

Table 3. Production and use of sewage sludge in selected European Union countries in thous. tonnes of dry matter in 2004 and 2015

Country	Production	Disposal						Share of sludge used in total
		Total	In agri-culture	Com-posting	Landfill disposal	Com-bustion	Other	
Bulgaria [2004]	58.4	56.3	0.0	0.1	51.2	0.0	5.0	96.4
Bulgaria [2015]	57.4	47.2	30.4	3.4	8.5	0.0	4.8	82.2
Czech Republic [2004]	178.8	178.8	29.1	87.5	25.5	0.0	36.7	100.0
Czech Republic [2015]	210.2	210.2	101.6	72.9	21.5	14.2	16.6	100.0
Germany [2004]	2260.9	1965.9	628.0	547.7	79.1	711.2	79.1	87.0
Germany [2015]	1820.6	1803.1	427.7	223.7	0.0	1148.7	3.0	99.0
France [2004]	1059.2	1059.2	465.3	166.6	222.1	178.4	26.8	100.0
France [2014]	961.5	937.1	421.3	305.1	31.1	170.6	8.9	97.5

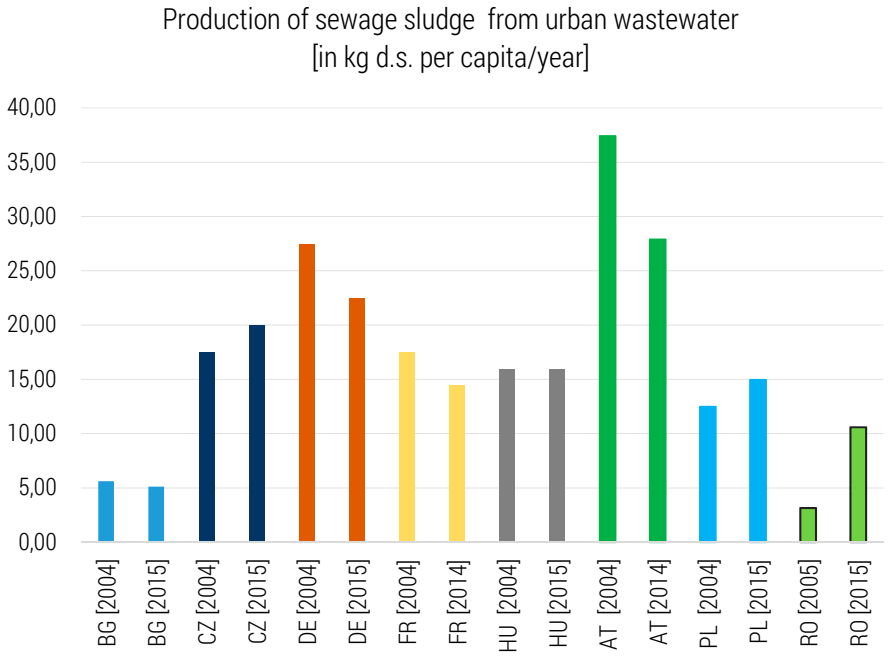
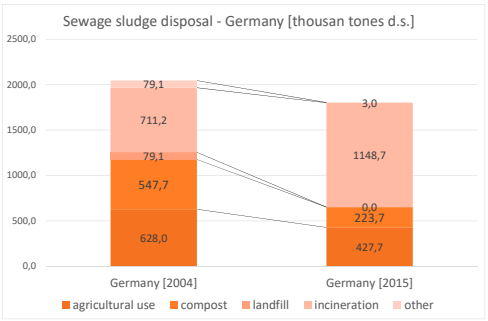


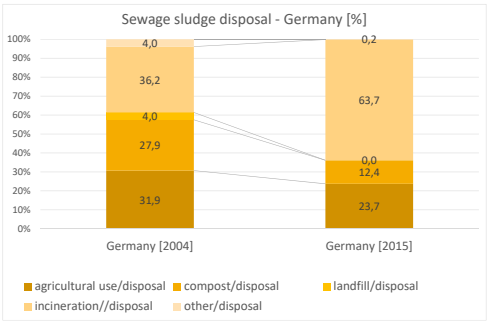
Figure 2. Sewage sludge production from urban wastewater per capita in selected EU Countries [in kg d.s. per capita/year]

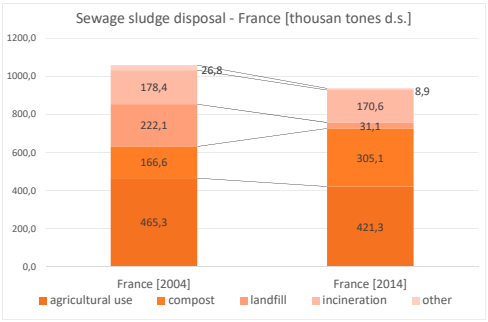
Source: author's own work based on Eurostat, 2018b; Eurostat, 2018e; Eurostat, 2018a.

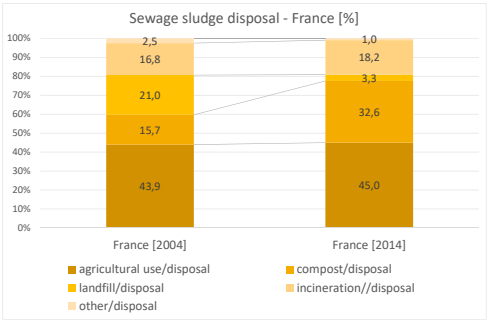
Hungary [2004]	160.9	68.0	33.2	8.7	19.3	4.4	2.5	42.3
Hungary [2015]	156.9	110.9	9.4	83.7	5.1	12.7	1.3	70.7
Austria [2004]	304.6	304.6	37.6	63.4	29.8	151.3	22.5	100.0
Austria [2014]	239.0	239.0	39.6	77.7	3.2	118.5	0.0	100.0
Poland [2004]	476.1	476.1	66.9	29.7	162.7	1.4	215.3	100.0
Poland [2015]	568.0	568.0	107.5	47.1	40.5	79.3	293.6	100.0
Romania [2005]	67.8	67.8	0.7	4.7	55.9	0.0	6.6	100.0
Romania [2015]	210.5	155.8	10.6	0.2	104.2	0.5	40.9	74.0

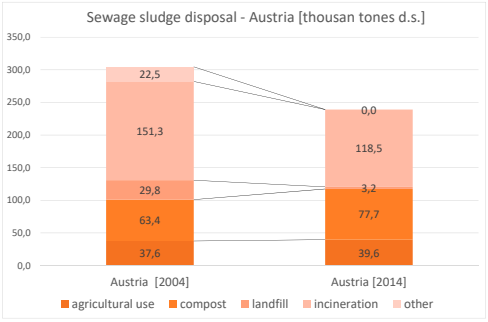
Source: author's own work based on Eurostat, 2018b; Eurostat, 2018e.











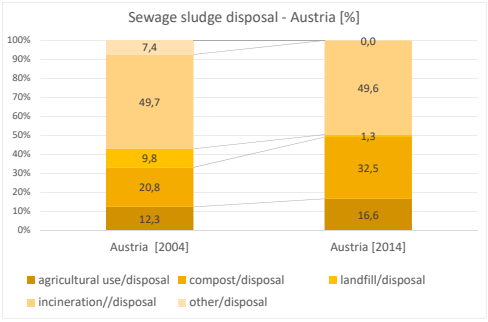
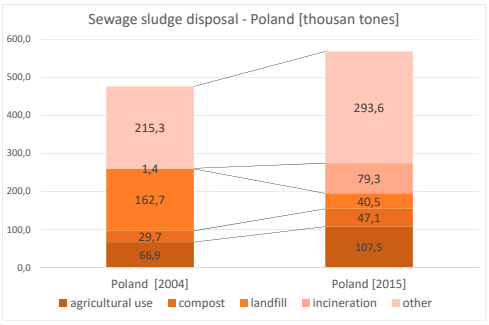
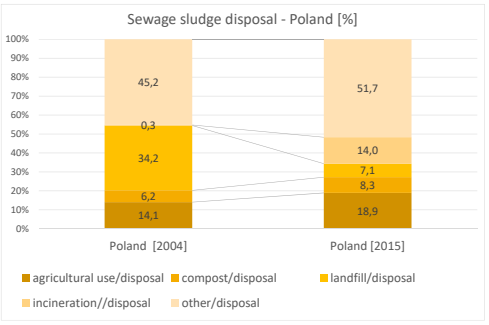
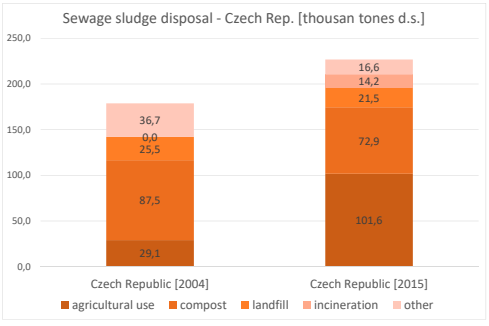


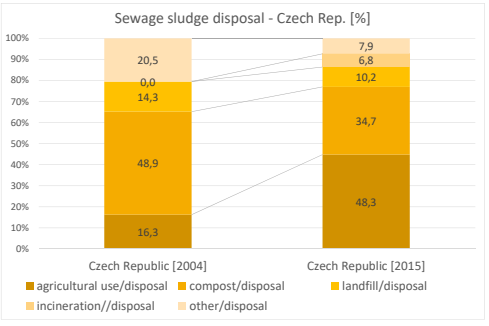
Figure 3. Sewage sludge disposal in selected EU-15 countries [in thousand thones d.s. and in percentage]

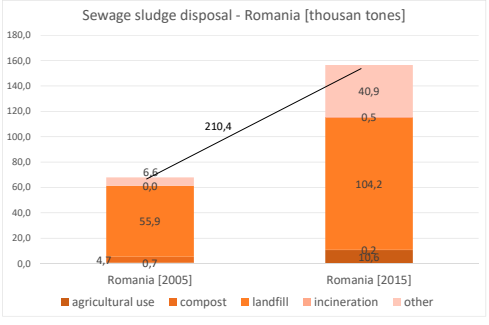
Source: author's own work based on Eurostat, 2018b; Eurostat, 2018e.











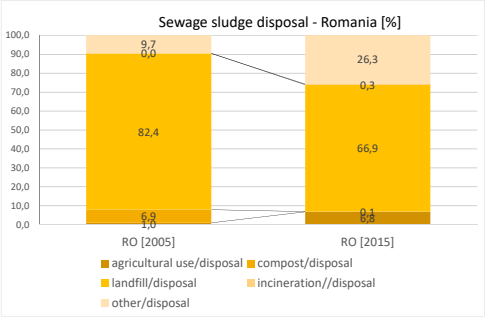


Figure 4/1. Sewage sludge disposal in selected EU-12 countries [in thousand thones d.s. and in percentage]

Source: author's own work based on Eurostat, 2018b; Eurostat, 2018e.

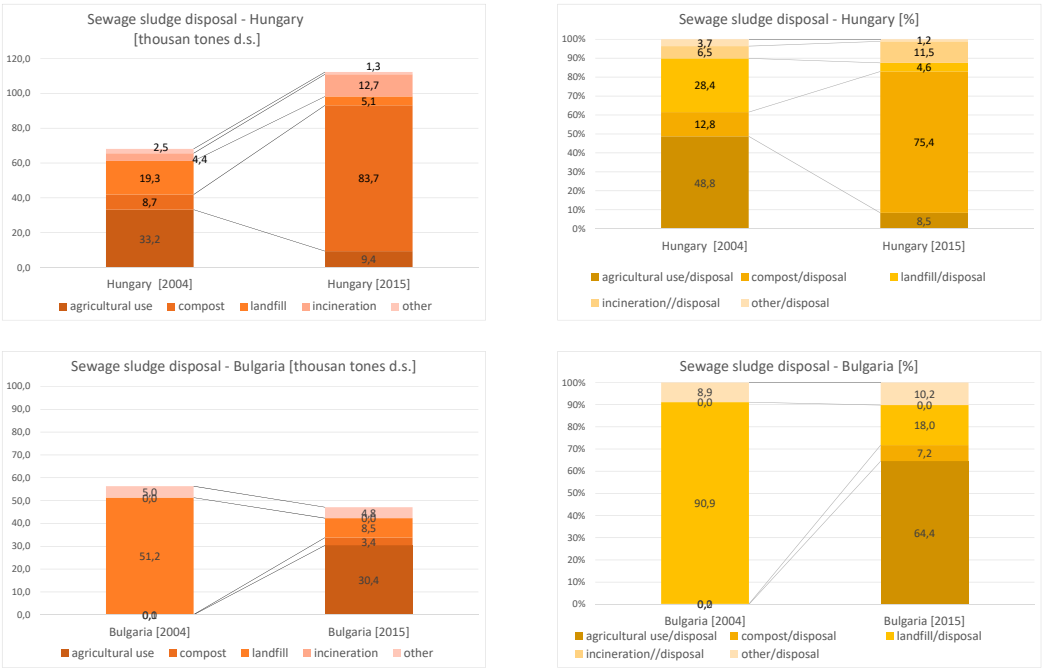


Figure 4/2. Sewage sludge disposal in selected EU-12 countries [in thousand thones d.s. and in percentage]

Source: author's own work based on Eurostat, 2018b; Eurostat, 2018e.

Directions for managing sewage sludge in selected countries admitted to the European Union after 2004

In the countries admitted to the EU after 2004, there is a completely different situation than in the EU-15 countries. The amount of produced sewage sludge is disproportionately smaller. In comparison to Germany, Poland produces only 30% of sewage sludge and Bulgaria 3%. Of the analyzed countries, only Hungary produces a comparable amount of sewage sludge as France (table 2, figure 1). In the studied EU-12 countries, the amount of generated sewage sludge increases due to the growing sewage treatment and increasing share of population with access to sewage treatment plants, improving the quality of treatment (table 4) and the growing share of residents with access to waterworks and lifestyle change resulting in increased consumption of tap water (increased water consumption is, however, hampered by rising water prices).

The number of people connected to sewage treatment plants is increasing, which increases the amount of sewage and sewage sludge produced. The share of people with access to sewage treatment plants increased: in Poland

from 84.5% in 2004 to 94.2% in 2015, in the Czech Republic from 73.5% to 81% respectively, and in Hungary from 72.1-76.8%. Even bigger changes occur in the countries adopted after 2007, and in Romania the increase of population connected to sewage treatment plants increased from 27.8 to 47.8%, in Bulgaria from 71.8 to 86.8% in 2004 and 2015 respectively (Eurostat, 2018b). It can be seen that especially in the last two countries there is still a large potential for growth in connecting residents to the sewerage system. At the same time, in all EU12 countries discussed, with the exception of the Czech Republic, there was a decrease in the number of inhabitants (Eurostat, 2018a).

In all EU-12 countries discussed, with the exception of Hungary, there was an increase in the number of sewage treatment plants, including increased biogen removal – table 4. This is clearly visible especially in Poland and the Czech Republic. In Poland, the capacity of sewage treatment plants increased by 11%, but in 2004, the purification plants with the highest degree of treatment constituted 58% of the available capacity, and in 2013 – already 82%. With the increase in the number of residents served, these are probably two main factors affecting the increase in the amount of sewage sludge (table 4, figure 4). Bulgaria and Romania are far behind although there has been a threefold increase in the production of sewage sludge in Romania during the period considered, Bulgaria and the Czech Republic can be compared due to a similar population (and these two countries have a population between 7-10 thousand inhabitants) and this shows how much still needs to be done in Bulgaria. The Czech Republic currently produces nearly four times more sewage sludge than Bulgaria.

In Hungary, the total number of sewage treatment plants decreased, but their throughput increased, and the number and capacity of the treatment plants with the highest degree of purification increased – resulting in an increase in sewage sludge (table 3 and table 4, figure 4). The number of sewage treatment plants in Poland increased, including the largest increase in the capacity of sewage treatment plants with increased biogen removal. Only in Bulgaria, the amount of generated sewage sludge and throughput decreased, despite the increase in the number of sewage treatment plants (table 5). It can be seen from the data that the processes of adaptation to the requirements of the Sewage Directive do not go as dynamically as in Romania. The total amount of generated sewage sludge in Bulgaria is only 10% of what is in Poland and slightly more than a quarter of what in the Czech Republic.

In Poland, the amount of generated sewage sludge increased from 476 to 568 thousand t.d.s. and the amount of managed sewage sludge has also increased. In Poland, the Czech Republic and Romania, the amount of gener-

Table 4. Change in the number of sewage treatment plants, their capacity in Bulgaria, the Czech Republic, Poland, Romania and Hungary in 2004 and 2013 [in pcs]

Specification	Unit	Number of wastewater treatment plants			Including with increased biogen removal		
		2004	2013	change	2004	2013	change
Bulgaria	pcs	56	90	34	0	26	26
Czech Republic	pcs	2006	2636	630	766	1272	506
Poland	pcs	2875	3264	389	689	820	131
Romania	pcs	467*	481**	14	:	74**	74
Hungary	pcs	864	739	-125	170	451	281
		The capacity of the sewage treatment plant			Including with increased biogen removal		
Bulgaria	BOD5 [t. O2/24h]	415.1*	464	48.9	:	223.7	223.7
Czech Republic	BOD5 [t. O2/24h]	862.2	981.7	119.5	705.2	864.7	159.5
Poland	BOD5 [t. O2/24h]	2 549.5	2 848.9	299.4	1 477.8	2 336.5	858.7
Romania	BOD5 [t. O2/24h]	793*	724.5	-68.5	:	293.4	293.4
Hungary	BOD5 [t. O2/24h]	661.9	946	284.1	240	692.6	452.6
Bulgaria	population equivalent (p.e.)	6 918 333	7 733 333	815 000	-	3 728 333	3 728 333
Czech Republic	population equivalent (p.e.)	14 370 000	16 361 667	1 991 667	11 753 333	14 411 667	2 658 333
Poland	population equivalent (p.e.)	42 491 667	47 481 667	4 990 000	24 630 000	38 941 667	14 311 667
Romania	population equivalent (p.e.)	13 216 667	12 075 000	-1 141 667	-	4 890 000	4 890 000
Hungary	population equivalent (p.e.)	11 031 667	15 766 667	4 735 000	4 000 000	11 543 333	7 543 333

* 2005 ** 2014

Source: author's own work based on Eurostat, 2018d; Eurostat, 2018c.

ated sewage sludge per capita is growing, in Hungary and Bulgaria it is stabilized or decreasing. However, it remains far lower than in Austria or Germany. Only France has a comparable production per capita as Poland or Hungary, and lower than the Czech Republic (figure 2).

The structure of utilization of sewage sludge is slowly changing in Poland. The share of incineration increased from a share of 0.3 to 14%. The share of the "other" category is very large. Of all the countries surveyed, the share of this category is the highest for Poland and growing. In response to the

Author's query to the CSO, an explanation was given that the category "other" includes:

- transfer of sludge to other authorized bodies for their development,
- the use of sludge for the cultivation of plants not intended for direct consumption,
- use of sludge in R3 processes, ie recycling or regeneration of organic substances that are not used as solvents (including composting and other biological transformation processes), R12 – replacement of waste for submission to any of the processes listed in item R1–R11 (Act on waste, 2013c, Annex 1, Indicative list of recovery processes).

One should consider the method of collecting statistical data, because in the present situation more than half of sewage sludge escapes public statistics on the ways of their management, and even if sewage sludge is transferred to another entity for development, it should be known how to deal with it and recorded statistical data. In the current situation, official statistics from Poland show a rather disturbing picture, especially against the background of EU-15 countries where the category "other". It practically disappears. It grows only in Romania from just under 10% to over 26%.

In Bulgaria, the use of farms from almost nil to almost 65% has significantly increased as a process replacing the storage dominating in 2005. The most diversified path of sewage sludge management, according to data, was adopted by the Czech Republic. In the years 2004-2014, agricultural use increased from about 16 to 48%, composting decreased from 50% to 35%, storage decreased from 14 to about 10% and combustion occurred – almost 7%. The category "other decreases from 20 to less than 8%. This is all with the growing total amount of sewage sludge (this means that despite the decrease in the composting share, the nominal decrease from 87.5 t.d.s. to 72.9 t.d.s., ie less than 17%).

In Hungary, with a significant increase in the volume of sewage sludge produced, the percentage of composting increased from almost 13% to over 75% and the decrease in storage from nearly 30% to less than 5% and decrease in agricultural use from nearly 50% to 8.5%

Conclusions and data for Central and Eastern European countries

Some conclusions can be drawn from the data presented. In the EU-15 countries, the amount of sewage sludge is decreasing due to the decreasing number of inhabitants, savings, limitation of inflow of rainwater to the network, but probably also due to technological changes in the treatment pro-

cess and their initial treatment. Depending on the country, the main strategy for their management is incineration (Austria, Germany) or composting and agricultural use (France). It goes away from the storage of sludge, which was enforced by regulations.

The storage constraint is also visible in the surveyed EU-12 countries. Moreover, as trends dominating in the decade under review, the following should be calculated: increase in the share of population with access to sewage system, increase in the amount of treated wastewater and improvement of the quality of the treatment process, which results in an increase in the amount of generated sewage sludge.

Is it possible to form unambiguous recommendations for the management of sewage sludge: Yes and No. Yes, as some generalizations can be drawn from the observed trends in other countries. No, because each decision should be made on the basis of a detailed analysis of costs and benefits. It is necessary to coordinate activities at the national level, support facilitating the transition in the desired direction, taking into account the legal and economic environment, in particular:

- quality and quantity of generated sewage sludge,
- restrictive legal requirements for agricultural use (which generates costs) and limitation of the possibility of storing sewage sludge,
- organizational and legal form of the conducted activity (whether at the sewage treatment plant or by specialized regional entities),
- existing infrastructure,
- a growing number of treatment plants with increased biogen removal, which contributes to the increase of sewage sludge,
- increasing saturation of the sewer trash (except for Bulgaria), which in a certain perspective will contribute to the stabilization of the amount of generated sewage sludge,
- limiting or stabilizing water consumption by households due to rising water prices and limiting the inflow of rainwater to the sewage system, which will contribute in the long run should lead to stabilization or even reduction of the amount of generated sewage sludge,
- increasing technological progress enabling the recovery of nitrogen phosphorus from deposits or ashes after their combustion,
- possibility of energy recovery from sewage sludge,
- restrictions on the possibility of transporting sewage sludge,
- mechanisms supporting RES and cogeneration,
- emerging markets for recovered raw materials.

On a national scale, it seems that the strategy that develops the main directions of development, that is composting with the recovery of energy and raw materials through their introduction into the soil and burning with

the recovery of energy and raw materials from ashes, seems to be the most flexible. Of course, the costs are also critical. Taking into account the costs (Milieu Ltd, WRc and RPA for the European Commission, DG Environment, 2010) and the fact that after reaching the maximum level of sewage sludge production, their number may stabilize or start to decline as in western countries, as well as the fact of dynamic technology progress Co-firing should be considered.

However, taking into account the impact on the environment and health of the population, the research conducted indicates that controlled composting (organic recycling) with recovery of energy and agricultural use of compost is a better destination (Wójtowicz et al., 2013, p. 427). In addition, research related to technologies related to the management of sewage sludge as well as the study of their impact on the environment should be supported. Thermal directions are usually recommended for large wastewater treatment plants whose catchments are threatened by excessive pollution of potentially toxic elements (e.g. heavy metals).

However, a number of local factors affect the decision on a particular solution. The direction of sewage sludge management depends, first of all, on the quality and quantity of sewage sludge and existing possibilities, e.g. the existing possibility of utilization in the vicinity of a mono-refinery or a restriction of the possibility of using certain criteria. In mountainous areas or near protected areas such possibilities will be limited, so one should consider another solution. Each time it translates into the costs of wastewater treatment.

Conclusions

Changes in legal regulations are one of the important elements affecting the management of sewage sludge (and general waste). Among the important factors affecting the selection of these trends should be distinguished:

- legal requirements (national and EU),
- the level of available technology (innovative technologies, improving existing ones),
- knowledge about the environmental effects of each method,
- possibilities of control and monitoring (quality of sludge, products from processes, soils and waters),
- financial abilities.

It should be noted that these factors influence each other. The extended knowledge about environmental and social effects as well as technological progress affects changes in the law and mobilization of financing sources, and changes in law in turn stimulate technological progress.

In EU-15 countries, the quantity of sewage sludge produced decreased, with a very high percentage of people connected to municipal sewage treatment plants. Production of sewage sludge from municipal wastewater treatment plants per capita is falling. Depending on the country, the dominant method of management is either agricultural utilization and composting (France) or combustion is prevalent (Austria and Germany). Storage virtually disappears.

In the countries adopted since 2004, the amount of produced sewage sludge is growing, but it is far less than in the surveyed EU-15 countries. The share of people connected to the sewage system and municipal sewage treatment plants is increasing (Poland, the Czech Republic, Hungary) and there is a large potential for growth of this indicator in Bulgaria and Romania. The number and capacity of sewage treatment plants with increased nutrient removal increase and the amount of produced sewage sludge per capita is increasing.

In the studied EU-12 countries, sewage sludge storage significantly decreases (too slow decline in Romania) for agricultural use (Bulgaria, the Czech Republic), composting (Hungary, the Czech Republic), the incidence of combustion per level is just over 10-15% (Poland, Hungary). In Poland, the category "Other" is a disturbingly large share, which includes the transfer of sludge to another use, which is an argument for the establishment of a national strategy for the management of sewage sludge.

Thus, in the surveyed EU-12 countries, the road of organic recycling is more often chosen, which should be a recommendation to focus efforts on developing the monitoring system and assessing environmental effects and supporting research and transfer of their results to the economy in these areas.

Looking at data from EU-15 countries, it should be pointed out that EU-12 countries should take into account – when building their sewage sludge management strategies – that currently the amount of sewage sludge is increasing, but in the future (rather further) it may stabilize or fall, and this will be favored by modern technologies used in wastewater treatment and primary treatment of sewage sludge. The possibility of their development should be taken into account, especially in the context of agricultural development and clauses limiting the transport of sludge. The provisions regarding the recognition of sewage sludge as a zero-emission energy source and provisions related to instruments supporting renewable energy sources and energy production in cogeneration may be of significant importance. Future priorities in financing investments in environmental protection from funds coming from the EU budget will also be important, especially if the possibilities of spending them on incinerators are limited. Probably the path chosen by Aus-

tria and Germany towards almost complete combustion of sludge for EU-12 countries is no longer available. Therefore one should create or verify quality standards, monitoring and certification programs.

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THE IMPACT OF THE ENERGY EFFICIENCY OF THE BUILDING TO ITS MARKET VALUE

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ABSTRACT: In the presented considerations, attention was focused primarily on signaling selected problem issues related to energy efficiency of buildings and its relation to the market value of a building property. The thesis was put forward that the improvement of energy efficiency, through the implementation of the directions of technological development in the building industry and the use of renewable energy sources significantly affects the value of building property. In Poland, more and more importance is attached to environmental protection and energy savings through thermal modernization of buildings in order to improve thermal insulation of walls, modernization of ventilation system, regular inspections and repairs of central heating boilers, modernization of hot water preparation systems, introduction of alternative energy sources, or the use of modern technologies in the building industry.

KEY WORDS: energy efficiency, buildings, energy demand, energy consumption, market value of building property

Introduction

In recent years, more and more attention has been paid to energy savings, which on the one hand results from the increase in demand for energy caused by the development of individual regions of the world, with the simultaneous depletion of non-renewable fuels and the search for sources to meet the growing energy needs, and on the other hand from the problems related to emissions to the atmosphere and their impact on climate change. These problems occur in many areas, and one of them is construction. For the purpose of these considerations, attention has been focused on housing.

Modern construction technologies more and more often take into account energy efficiency aspects. On the one hand, it is cost-intensive at the construction stage, but on the other hand, it brings a measurable profit in the process of exploitation and measurable effects related to

environmental protection. In the light of the problem under consideration, it is worth noting that the costs incurred to achieve the highest possible energy efficiency of residential buildings influence their market value.

Energy efficiency of a residential building in terms of energy demand

According to estimates, the demand for energy, along with the development of the world economy, is constantly increasing, and the rate of this growth is extremely fast. Analyses indicate that the largest energy consumption is in the residential sector. It is one of the following

emissions from the main energy consumers in the modern economies of developed countries and especially in the phase of operation of these facilities. Buildings account on average for about 41% of the total energy consumption in the European Union, which translates into the emission of about 842 million tons of CO_2 (Lis, Sekret, 2016).

The European Environment Agency in the European Union estimates that energy used for space heating accounts for 69% of total energy consumption in buildings (in Poland it is about 71%), 15% is used for hot water preparation, 11% for lighting and driving electric equipment and 5% for cooking (Lis, Sekret, 2016).

With reference to the above data, it should be stated that the biggest benefits would be the savings in the area of heating of buildings and here we should look for optimal solutions to this problem. Saving energy and thereby creating reserves of energy used during further development has introduced the necessity to consider the issues related to the so-called energy efficiency of buildings.

According to the Energy Efficiency Act of 20 May 2016 Energy efficiency is the ratio of the achieved amount of the utility effect of a given facility, technical equipment or installation, under typical conditions of use or operation, to the amount of energy consumed by that facility, technical equipment or installation, or as a result of a service rendered necessary to achieve that effect.

The energy efficiency value is therefore the ratio of the amount of energy used for heating prior to the modernization of a building to the amount of energy used after the modernization. It can therefore be concluded that energy efficiency determines how much energy can be saved by undertaking certain thermo-insulation measures, by increasing the efficiency of heating appliances or by simply reducing unnecessary consumption of electricity, gas and coal.

The energy efficiency of a building depends on many factors. Of course, the thermo-physical properties of the building material are most important. The key role is undoubtedly played by the roof and windows. Heating systems that can significantly reduce energy consumption are also very important. The best effects of measures to improve the energy efficiency of buildings are achieved by in a comprehensive approach – while sealing the building by improving thermal insulation and installing better heating equipment.

Measures to improve energy efficiency are not yet very popular, although they certainly guarantee real savings, even in the short term. When planning a thermomodernization, of course, it is worth taking a good look at the building itself first. A comprehensive solution is to conduct a full energy audit, combined with a thermal imaging camera. This allows you to determine exactly which way the heat escapes, which elements cause the greatest loss of energy, and which solutions will bring the best results.

Table 1. Energy standards of buildings in Poland since 1966

Year of construction of the building	Index of energy consumption for heating kWh/[m^2/year]
until 1966	240 – 350
1967 – 1985	240 – 280
1985 – 1992	160 – 200
1992 – 1997	120 – 160
from 1998	90 – 120
currently	50 – 80

Source: Kapuściński, Rodzoch, 2010.

An important issue in thermal upgrading is the age of the building, which is closely related to the technology used in residential construction and the current energy standards. According to Kapuściński and Rodzoch's (2010) analyses, unit heat demand of residential buildings in Poland changed with the period of their construction (table 1).

Unfortunately, in the case of about 90% of flats in Poland, the energy standard is lower than 240 kWh/(m^2/year). As can be seen, the area for the implementation of thermal upgrading processes in buildings, including their technical equipment, is very large.

Thermomodernization consists in introducing changes which aim at limiting heat loss and ensuring more economic and energy-efficient heating of interiors, as well as usable water. As already mentioned, the main reason for high consumption of heating energy is excessive heat loss from the house. It most often penetrates outside the building through inadequately insulated external walls and windows, roof and floor on the ground. For this reason, thermomodernization is most often performed:

- insulation of external walls of the building,
- replacement of windows and doors,
- roof or flat roof insulation,
- insulation of the ceiling above the unheated basement or insulation of the floor on the ground.

Thermomodernisation of a house also concerns its internal installations and consists, among other things, in:

- modernization or replacement of the heating system,
- starting to use RES (renewable energy sources) for heating purposes, e.g. through the installation of solar collectors or heat pumps,
- use of mechanical ventilation with heat recovery (recuperation),
- insulation of uncovered central heating and hot water pipes,
- Improvement of the hot water production system.

Investment outlays on this type of construction and energy technologies are quite significant. However, it is assumed that within a few years such investment should pay off, especially with financial support from the funds for the promotion of pro-environmental solutions. In the case of currently constructed buildings, the use of modern technologies aimed at obtaining low-energy buildings, which have an energy demand for heating in the range of 15-45 kWh/(m^2 a year) and passive buildings with a value of this ratio below 15 kWh/(m^2 a year), also generates high costs.

In conclusion, it can be expected that in the case of thermal upgrading of buildings as well as in the case of construction of new low-energy residential buildings, the costs incurred will translate into the market value of these building properties.

Low energy building properties and their market value

According to the Real Estate Management Act "the market value of a property is the estimated amount that can be obtained on the valuation date for a property in a sale transaction concluded on market terms between the buyer and the seller, who have a firm intention to enter into an agreement, act with discernment and prudence, and are not in a forced situation".

The market value of a property is affected by many different attributes, which are clearly classified in the literature. In the course of these considerations on the question of the impact of the energy efficiency of a building on its market value, the characteristics that affect its economic value, related not only to the cost of purchase or construction, but also to the costs of subsequent operation of the building, are particularly relevant.

A building property is a very specific good, whose market value is determined by certain features, such as:

- the surrounding area of the object,
- shape and size of the plot,
- the age of the building,
- quality of materials used in the construction of the facility,
- type of object and type of construction,
- quality of construction workmanship,
- operating conditions,
- design defects,
- the renovation economy carried out,
- security,
- microclimate,
- maintenance costs,
- demand and supply,
- energy intensity.

Among the factors influencing the market value of building properties, the technical condition of the building and its demand for energy for utility purposes, such as space heating and water heating, play an important role. These parameters naturally affect the costs associated with the use of the building.

Actions aimed at improving the technical characteristics of buildings, which result in a reduction in the demand for heat necessary for heating and hot water by eliminating heat losses, are the most important element of thermo-modernization measures.

The modernization of existing construction works should take into account the principles of sustainable development. The development of an integrated plan for the assessment, maintenance and management of the

works and the energy efficiency of the works are of particular importance in this respect and should take into account the following factors:

- reduction of energy consumption,
- use of renewable energy sources (solar collectors, heat pumps, domestic wind and hydroelectric power plants, biofuels),
- installation of modern measuring devices monitoring energy, gas and heat consumption in the facility,
- continuous analysis of the degree of consumption of energy carriers through the use of specialized IT tools.

The benefits of thermal upgrading include, first of all, a decrease in property maintenance costs, an increase in its value, as well as an improvement in the comfort of operation in a given facility. Generally, one can observe a desire to achieve results in terms of heat transfer coefficient through building envelope at a level lower than the limit values not provided for in the Act. This is advantageous due to the constantly changing legal regulations concerning the insulation requirements of buildings, and also economic profits, because with a small increase in investment costs it may cause a high decrease in the annual energy demand of the building.

Profits from thermomodernization procedures may turn out to be significant depending on the type of conducted procedures and the current condition of the building. The greatest benefits are usually obtained when insulating the buildings and modernizing the central heating system. However, it is beneficial to jointly modernize a wider range of building elements causing heat losses, which allows for synergy. The table 2 presents average changes in the scope of savings on heating of buildings in particular types of modernization.

Table 2. Estimated savings from thermal upgrading of the building

How to achieve savings	Reducing heat consumption
Thermal insulation of external building partitions (walls, roof, ceiling, cellar ceiling) – without windows	15-25%
Replacement of windows with airtight windows with a lower value of the permeation coefficient	10-15%
Introduction of improvements in the heat substation, including weather automatics and control equipment	5-15%
Comprehensive modernisation of the internal central heating system, including air-tightness of the system and insulation of pipes, hydraulic control and installation of thermostatic valves in all rooms	10-25%
Introduction of cost allocators	about 5%

Source: www.termomodernizacja.pl/strony/na-czym-polega-termomodernizacja [01-05-2019].

The thermal upgrading investments are aimed at achieving high energy efficiency based on energy savings. Thermomodernization of buildings is characterized by a relatively short payback period of 5-8 years. The rate of return on outlays in the analyzed investments ranges from 19-10%, which proves the following of their high economic efficiency. Usually, the value of savings from heating the property after a period of 10 years fully covers the amount of investment in this type of investment. It is estimated that this value is an approximate amount of the increase in the value of the property.

Conclusions

In the process of estimating the value of building properties, a number of attributes are taken into account. The set of features significantly affecting the value is not clearly defined, however, in the light of the applicable valuation standards, appraisers usually select a specific set of features matching it to the purpose of valuation and the type of property. In the case of residential properties, these are usually the location, the technical condition of the building, the area of the premises, the number of rooms, the location on the first floor or the communication accessibility. However, there are features that do not affect the value of such properties to a lesser extent, but are not taken into account in the valuation process, or are very rarely taken into account.

Taking into account the fact that residential buildings generate costs at the stage of purchase or construction, but also in their subsequent maintenance, the costs incurred for their thermal upgrading should be taken into account in the process of evaluation of their value, which in consequence will reduce the costs of building operation in later years. After such measures, buildings have a much lower heat demand in the form of primary energy, so that the investment is returned, which of course takes time. There is no doubt that the building after thermal upgrading has a higher market value.

Therefore, it should be postulated that property appraisers should develop a normative system for assessing the impact of the energy efficiency of a building on its market value.

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STUDIES AND MATERIALS

STUDIA I MATERIAŁY

Zdenka **KOVACOVA** • Stefan **DEMCAK** • Magdalena **BALINTOVA**

REMOVAL OF COPPER, ZINC AND IRON FROM WATER SOLUTIONS BY SPRUCE SAWDUST ADSORPTION

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ABSTRACT: The water pollution by toxic elements is one of the major problems threatening human health as well as the quality of the environment. Sorption is considered a cost-effective method that is able to effectively remove heavy metals. During past few years, researches have been researching usage of low-cost adsorbents like bark, lignin, chitosan peat moss and sawdust. This paper deals with the study of copper, zinc and iron adsorption by adsorption of spruce sawdust obtained as a by-product from locally used wood. Raw spruce sawdust was used to remove heavy metal ions from the model solutions with ion concentration of 10 mg/L during 24 hours or 5, 10, 15, 30, 45, 60, 120 min, respectively. Fourier-transform infrared spectroscopy was applied to determine functional groups of sawdust. Sorption efficiency was higher than 67% in short-time experiments and higher than 75% for one day experiments in all tested cations.

KEY WORDS: adsorption, model solutions, spruce sawdust, heavy metals

Introduction

The pollution of air, soil, and water is a result of people's efforts to improve their lives. The industrial activities together with technology development lead to a release of large quantities of contaminants to the water. Among a wide range of pollutants contained in wastewater, metals are one of the most toxic substances. They do not biodegrade and due to their presence in streams and lakes living organisms accumulate such substances, causing health problems in animals, plants and human beings – the overall negative impact on the whole environment. Inorganic pollutants most frequently presented in wastewaters are copper, nickel, zinc, lead, iron, chromium and cadmium. These heavy metals were intensively investigated from the point of view of persistence and toxicity (Abdel-Raouf, 2016; Larous, 2012; Gogoi, 2018; Simón, 2019).

Copper can be found in high concentration because it is usually used in many industrial sectors like metal finishing, electroplating, plastics and etching. Copper is actually one of the most frequently occurring heavy metal contaminants in the environment. Water contaminated with copper must be treated before it is discharged to the environment because of its toxic properties even at low doses. High concentrations of copper can cause serious toxicological concerns because it can affect the brain, skin, liver and pancreas. This can lead to nausea, vomiting, headache, diarrhea, respiratory difficulties, liver and kidney failure (Al-Saydeh, 2017; Ageena, 2010; Larous, 2012).

Zinc is widely used in electroplating, galvanized pipes, iron, alloy and brass production and paper production. At trace amounts, zinc is an essential nutrient for certain biochemical and physiological functions of the organism. At concentrations beyond the permissible level (2.00 mg/L), zinc can lead to a malfunction of various systems in the human body and it can cause nausea, vomiting, epigastric pain, lethargy, fatigue, a short-term illness called "metallic smoke fever» and restlessness. Zinc is also poisonous to plants at high concentrations and can be damaging in soils because of its high mobility (Simón, 2019; Udomkitthaweewat, 2019).

Contamination of water with iron can either be geogenic or caused by industrial effluents and domestic waste. Although iron is essential for human and lack of it may lead to anaemia and health problems, its high levels may cause severe health problems in human beings such as vomiting, liver cancer, diabetes, cirrhosis of liver, heart diseases, infertility etc. The higher concentration of iron in water corrodes water pipe lines, changes colour of water, its taste, odour and leaves stains on clothes (Al-Shahrani, 2013; Kumar, 2017).

Due to all these reasons, the proper treatment of the wastewaters before its discharging to the environment is needed.

There are several methods of removing heavy metals from wastewaters, for example:

- precipitation – a simple process based on the fact that some metal salts are insoluble in water,
- ion – exchange method uses ions to exchange with metal ions in the water solutions,
- reverse osmosis method utilizes high pressure to filter out the metal ions trough a membrane (Simón, 2019; Ageena, 2010).

Due to increased interest in using eco-friendly and economical materials, researchers are now searching for new adsorbents that can be used for this purpose. The adsorption process (figure 1) has been considered as one of the most efficient methods with many advantages: low costs, higher flexibility, high efficiency, good selectivity, simplicity of design, ease of operation, insensitivity to toxic pollutants, high quality purified products and recyclability (Elkady, 2017; Balintova, 2016; Demcak, 2019).

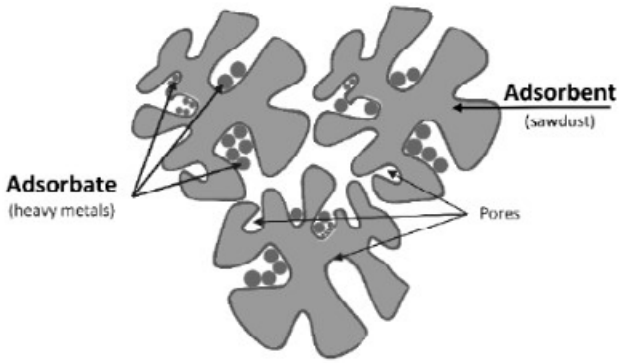

Figure 1. Realization of adsorption process using sawdust as adsorbent

Source: Ouafi, 2017, p. 117.

In recent years, extensive research has been done to identify new and cost-saving sorbents that could remove different heavy metal ions. The low-cost adsorbents including aquatic plants, waste tea leaves, bark, peat moss, lignin and sawdust have also been reported as efficient materials. Sawdust is one of the most appealing timber industry by-products that is available in large quantities, is cheap and easily regenerated after use (Memon, 2008; Thapak, 2015; Ince, 2017; El-Saied, 2017).

The aim of this research was to investigate application of spruce sawdust for Cu(II), Zn(II), and Fe(II) removal from aquatic solutions. Copper, zinc, and iron are metals found in nitrogen rich wastewaters (Zhang, 2019). Due to this reason these were selected as model ions to test spruce sawdust in the process of their removal from aquatic solutions. Spruce sawdust was also tested by FTIR method in order to determine the changes caused by adsorption/ion – exchange process.

Research methods

The spruce sawdust (particle size less than 2 mm) from local resources was used as a sorbent for the removal of selected heavy metals ions from aqueous solution without any pre-treatment. Wooden sawdust was analysed by FTIR on Bruker Alpha Platinum-ATR spectrometer (Bruker Optics, Ettingen, Germany). A total of 24 scans were carried out in the range of 4,000–400 cm^{-1}.

Dry spruce sawdust (1 g) was mixed with 100 mL of aquatic solutions. The water solutions with concentration 10 mg/L of Cu(II), Zn(II) and Fe(II) were prepared by dissolution of calculated amount of $CuSO_4.5H_2O$, $ZnSO_4.7H_2O$ and $FeSO_4.7H_2O$ in deionised water.

The first experiment focused on interaction between sorbent and sorbate during 24 hours. The sawdust was initially mixed with the model solution and left at the room temperature (20±1°C) for the duration of the experiment.

The next step of the research was the study of kinetics, the contact time between sorbent and sorbate was 5, 10, 15, 30, 45, 60 and 120 min. During this time spruce sawdust was intensively mixed in the model solution at the room temperature (20±1°C).

After the experiments, the concentration of heavy metals in the filtrates was determined by colorimetric method (Colorimeter DR890, Hach Lange, Germany) with appropriate reagent. Changes of pH were measured by pH meter (Mettler Toledo FG2, Schwerzenbach, Switzerland). The percentage efficiency was calculated by following equations:

$$\eta = \frac{(c_0 - c_e)}{c_0} \cdot 100, \quad (1)$$

where:
η – sorption efficiency [%],
c_o – the initial concentration of appropriate ions [mg/L],
c_e – equilibrium concentration of ions [mg/L].

Results of the research

Infrared sprectra

Metal adsorption capacity is influenced strongly by the surface structures of C–O and C–OH functional groups which are present in organic materials (Ricordel, 2001). FTIR method was used to determine active sites existing in the surface structure of sawdust (El-Saied, 2017). IR spectrum of spruce sawdust is shown in figure 2. The main components of sawdust are lignin, cellulose and hemicelluloses. A broad band of 3336 cm^{-1} represented presence of hydroxyl groups (–OH), the valence vibration related to aromatic C–H is shown on the spectrum at the 2883 cm^{-1}. The aromatic functions of lignin are characterized by infra-red absorption bands, which is characteristic of the C=C vibrations of the aromatic skeleton of lignin at the 1648 cm^{-1}. Another bands of lignin (carbonyls (C=O), alcohols and ethers) were observed at 1508, 1451, and at 1316 cm^{-1}. Wavenumbers at 1422, 1367, 1316, 1260, 1026 and 895 cm^{-1} belong to cellulose. The functional groups of aromatics were noticed at 895 cm^{-1} (Salamat, 2018; Schwanninger, 2004).

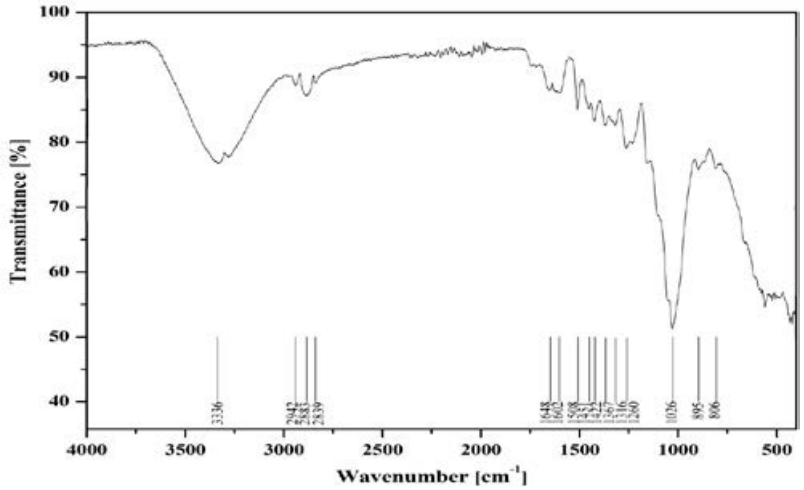

Figure 2. Infrared spectra of spruce wooden sawdust

Source: author's own work.

Sorption experiments – results of the 24 hours experiment

Results of the 24 hours experiment with initial concentration of cooper, zinc and iron ions 10 mg/L are shown in table 1. In all cases, the sorption efficiency reached more than 75%. The best removal efficiency was observed

in the case of copper ions (more than 85%). The pH of the aqueous solution is an important controlling parameter in the adsorption process and thus the effect of pH has been studied as well (Balintova, 2011). Initial pH of the solutions was influenced only the type of chemicals used, so adsorption process was carried out at different pH ranges. In all cases, pH decreased when compared to the initial value. The decrease in pH values could be caused by the fight for adsorption between metal ions and H^+ (Demcak, 2019).

Table 1. Results of the 24 hours experiments

Heavy metal ion	Input value		Output value		Sorption efficiency [%]
	c_o [mg/L]	pH	c_e [mg/L]	pH	
Cu(II)	10.00	6.3	1.48	5.3	85.2
Zn(II)	10.00	6.2	1.92	5.4	80.8
Fe(II)	10.00	5.9	2.49	5.2	75.1

Source: author's own work.

Sorption experiments – short-term results

Results of the short-term experiments of copper removal from aquatic solutions are shown in figure 3. Larous et al. (2005) state that copper adsorption on sawdust depends on the solution's pH, temperature, agitation speed, initial concentration, contact duration, liquid to solid ratio, and ionic strength. A significant increase in sorption was observed at 10 minutes, when efficiency achieved more than 80%, the rest of the time is characterized by slow changes in removal efficiency which can be evaluated as relatively constant. The highest efficiency of Cu(II) (≈ 90%) was reached after 60 min. Changes of pH, due to ion exchange between metal ions in model solutions and functional groups of spruce wood sawdust, are the major mechanism of retention of copper by sawdust.

Figure 4 shows the results of zinc removal during the experiment (from 5 to 120 min). In all experiments, removal efficiency was higher than 73%. The result indicates that zinc removal decreases pH of the solutions in the range from 6.2 to 5.7. The maximum efficiency removal of Zn(II) was about 82% at pH 5.7. Pragati et al. (2015) used the ground sawdust to remove zinc from aquatic solutions. They found that the maximum level of zinc iones removal (at pH 5, during 120 min of contact time, and adsorbent dose 0.5g/100 mL) is about 90%.

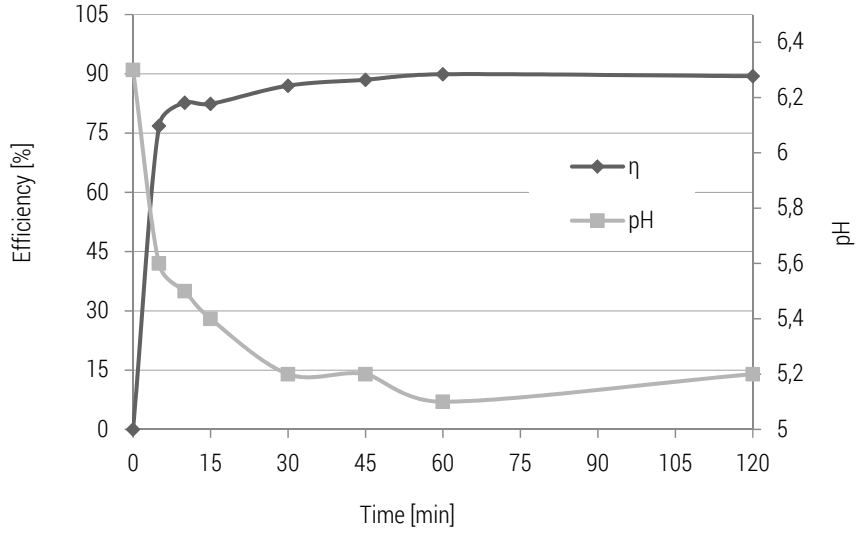

Figure 3. Dependence of sorption efficiency η and changes of pH over time when removing copper from aquatic solutions

Source: author's own work.

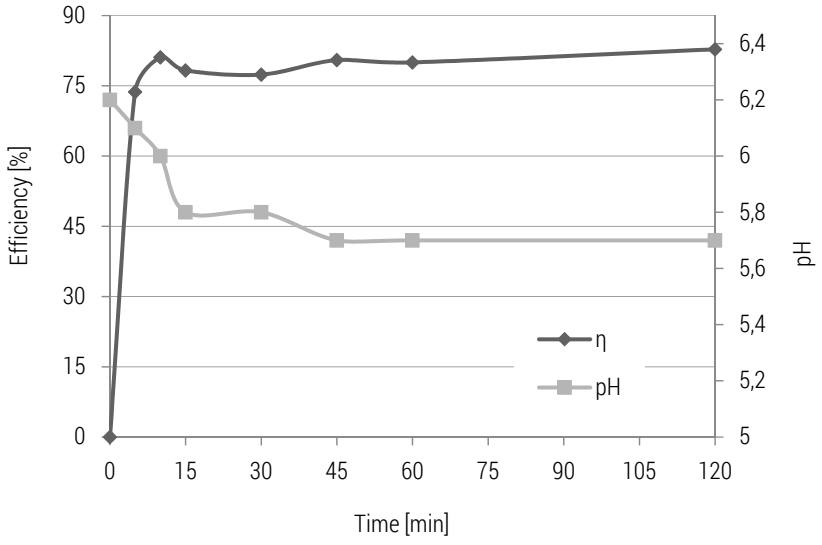

Figure 4. Dependence of sorption efficiency η and changes of pH on time during experiment on zinc removal from aquatic solutions

Source: author's own work.

The results of iron removal in short-term experiments indicated the removal efficiency higher than 67% (5 minutes), the highest efficiency was observed at 45 minutes at about 76% (figure 5). The value of pH was decreasing from 6.3 to 5.3 due to ion exchange. Senin et al. (2007) found that the maximum adsorption efficiency by sawdust was found to be 71.7% which corelates with the results of the experiment.

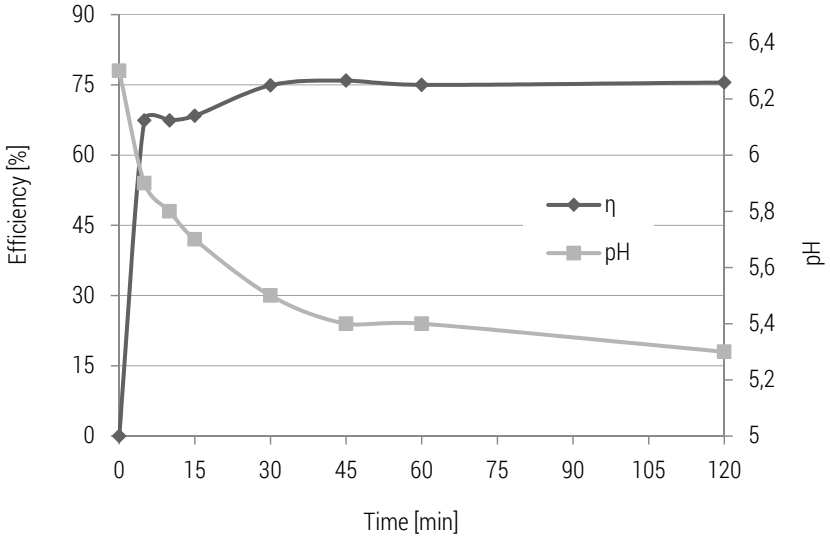

Figure 5. Dependence of sorption efficiency η and changes of pH on time during experiment on iron removal from aquatic solutions

Source: author's own work.

Conclusions

In terms of treatment of effluents, the current international tendency towards environmentally friendly standards and solutions favours cheap and harmless systems. Adsorption is one of the most effective techniques for removal of pollutants from aqueous solutions. Inexpensive and easily available materials like wood sawdust can be used as sorbent for purification of wastewaters.

The Fourier-transform infrared spectroscopy of spruce sawdust confirmed the presence of the functional groups that they are able to bind heavy metals ions.

Under the 24 hours experiments, the highest removal efficiency of ions was recorded for copper – more than 85%, and the lowest efficiency was recorded for iron ions – more than 75%.

In all experiments Cu(II), Zn(II) and Fe(II) removal rate was more that 67%. In case of copper, zinc and iron the equilibrium concentration of ions was highest at 60 minutes (1.01 mg/L) for Cu(II), 120 min (1.72 mg/L) for Yn(II) and 45 min (2.41 mg/L) for Fe(II). Changes in pH values in the processes of adsorption and ion exchange in all experiments shown a decreasing tendency.

The sorption experiments showed the huge potential of the spruce sawdust in removing heavy metals ions from water solutions. The results of the experiments are promising in terms of using sawdust to reduce pollution by heavy metals.

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The contribution of the authors

Zdenka Kovacova – 40% (carried out the experiments and contributed to the final version of the manuscript).

Stefan Demcak – 30% (conceived and planned the experiments, carried out the experiments and contributed to the final version of the manuscript).

Magdalena Balintova – 30% (conceived and planned the experiments, supervised the paper).

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COST-EFFECTIVENESS ANALYSIS OF WASTEWATER TREATMENT BY THE ACTIVATED SLUDGE AND BIOFILTER METHODS

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ABSTRACT: The paper presents the methodology and results of cost-effectiveness analysis of selected methods of wastewater treatment: activated sludge and biofilter. The analysis concerns small municipal wastewater treatment plants with capacity of 10 to 500 m^3d^{-1} in Poland (~100 to 5000 PE). It is based on data on total investment outlays, annual operating costs and total average annual costs. It has been shown that, in the case of investment outlays, there are no statistically significant differences between technologies. However, the annual operating costs and the total average annual cost of wastewater treatment are the lowest when applying the biofilter technology. The models presented in the paper can be used for costs estimation at the initial stage of designing municipal wastewater treatment plants. The total average annual cost of wastewater treatment determines the charges for sewerage services. This charge, alongside technological and environmental factors, as well as local conditions, should be one of the criteria for choosing a method for wastewater treatment.

KEY WORDS: cost effectiveness analysis, investment outlays, operating costs, activated sludge method, biofilter method for wastewater treatment

Introduction

Initially, when undertaking an analysis of the costs of construction and operations of a wastewater treatment plant, its objectives should be defined. In general, wastewater treatment plants in large cities were built several dozen years ago. An analysis of their construction costs should take into account the investment outlays incurred on the construction and on subsequent upgrading, updated to the price level of the year of the analysis being carried out by applying conversion rates for construction and assembly prices of the Central Statistical Office. Conducting such research is justified within framework of brenchmarking of the water supply and sewerage sector. Due to the variety of solutions applied, their results have limited application when deciding on the construction of new or upgrading of existing facilities.

The situation is different in smaller towns. Many of them, as yet, do not have wastewater treatment plants or have facilities which require overall upgrading. What is even worse, often the local authorities do not have sufficient data to estimate the total average annual costs of wastewater treatment. The level of investment outlays is usually known after a cost estimate has been made. At this stage operating costs are omitted. There is a lack of an overview of the total costs of such commonly used technologies as activated sludge and biofilter, on the basis of which an initial selection could be made.

The problem of choosing the right solution occurs when legal requirements change and upgrading of the existing facilities is required. Local authorities should at least know the approximate total annual operating costs of the wastewater treatment plants.

Both the investment outlays and the operating costs affect the total average annual cost of wastewater treatment which subsequently determines the charges for sewerage services. This charge, alongside technological and environmental factors, as well as local conditions, should be one of the criteria for choosing technologies for wastewater disposal and treatment (Bakir, 2001; Engin, Demir, 2006; Molinos-Senante et al., 2010; Sala-Garrido et al., 2011). In many cases, it may be more beneficial to use household wastewater treatment plants.

Results of the cost-effectiveness analysis allow to compare different wastewater treatment technologies and in consequence, to select a technology with a minimal total annual cost. The choice is made by assuming the fixed performance effect, e.g. the volume of treated wastewater or the degree of its treatment. This analysis, however, does not take into account other investment results, including such environmental effects as protection of the environment from pollution, maintaining human health on an appropriate

level and creating conditions for the development of tourism (Karolinczak et al., 2015).

An overview of literature

The results of studies on the level of investment outlays incurred on construction of municipal wastewater treatment plants and on their annual operating costs, depending on the used technology, have not been published in the last few years. Previous research was conducted by Miłaszewski and Rauba and its results were published in 2008. Over the past 10 years this issue has not been examined. The results of research on the costs of construction and operating of the smallest facilities, where the problem is of the greatest significance, have also not been published.

The lack of systematic analysis of these issues which, in turn, is brought about by the difficulty of obtaining data. Only a few scientists are working on the economic aspects of the wastewater treatment process (Hernandez-Sancho et al., 2011). The EU Water Framework Directive assigns a very important role to economic analyses (Helming, Reinhard, 2009). Additionally, it introduces the need to conduct economic analysis in water management.

Research methods

Data examined in the paper comprise the year 2017 and were made available by municipal and public utilities authorities. The original construction investment outlays were converted to the 2017 price levels, using the price index of construction and assembly production provided by the Central Statistical Office in Poland. The analysis included the construction and operating costs of small wastewater treatment plants with a capacity of 10 to 500 m^3d^{-1}(~10 to 5000 PE), operating in activated sludge (technology I) and biofilter (technology II) technologies. The objective of the statistical analysis was to determine the significance of differences between these technologies, using regression analysis.

In order to examine the impact of technology and capacity (Q_{design}) on the investment outlays (I) a linear model (1) on logarithmic scale was developed. The model (1) utilizes independent variables used as a technology indicators (Ind_{bf} equals 1 for technology II) and their interactions with designed capacity (Q_{design}). As reference technology, technology I (activated sludge) was implemented.

$$ln\, I = A_2 + A_{2,bf} Ind_{bf} + b_2\, ln\, Q_{design} + b_{2,bf}\, ln\, Q_{design}\, Ind_{bf}. \quad (1)$$

On the linear scale it corresponds to the relationship:

$$I = e^{(A_2 + A_{2,bf} Ind_{bf})} + Q_{design}{}^{(b_2 + b_{2,bf} Ind_{bf})}, \quad (2)$$
$$I = \left(a_2 a_{2,bf}{}^{Ind_{bf}}\right) \times Q_{design}{}^{(b_{20} + b_{2,bf} Ind_{bf})}.$$

As above, in order to examine the impact of technology and volume of treated wastewater (Q_{real}) on the annual operating costs (excluding depreciation) (C_e) a linear model (3) on logarithmic scale was developed. The model (3) utilizes independent variables used as a technology indicators (Ind_{bf} equals 1 for technology II) and their interactions with volume of treated wastewater (Q_{real}). As reference technology, technology I (activated sludge) was implemented.

$$ln\, C_e = A_1 + A_{1,bf} Ind_{bf} + b_{10}\, ln\, Q_{real} + b_{1,bf}\, ln\, Q_{real}\, Ind_{bf}. \quad (3)$$

On the linear scale it corresponds to the relationship:

$$C_e = e^{(A_1 + A_{1,bf} Ind_{bf})} + Q_{real}{}^{(b_{10} + b_{1,bf} Ind_{bf})}, \quad (4)$$
$$C_e = \left(a_1 a_{1,bf}{}^{Ind_{bf}}\right) \times Q_{real}{}^{(b_{10} + b_{1,bf} Ind_{bf})}.$$

The total average annual cost C_a of wastewater treatment was calculated using the relationship (5) (Boruszko et al., 2013):

$$C_a = I \cdot (r + s) + C_e, \quad (5)$$

where:
C_a – total average cost of wastewater treatment [EUR year^{-1}],
I – investment outlays for construction of wastewater treatment plants [EUR],
r – discount rate [year^{-1}],
s – depreciation rate [year^{-1}],
C_e – the annual operating costs of wastewater treatment plants (excluding depreciation) [EUR year^{-1}].

In relationship (5), the depreciation rate (s) can be written as:

$$s = \frac{r}{(1+r)^n - 1} \tag{6}$$

where:
n – calculated operations time span [years].

After substituting data (6) to relationship (5) the result is:

$$C_a = I\left(r + \frac{r}{(1+r)^n - 1}\right) + C_e \tag{7}$$

After transformation, relationship (7) takes the form:

$$C_a = I\frac{r(1+r)^n}{(1+r)^n - 1} + C_e \tag{8}$$

After introducing into the equation (8) the capital recovery rate (α) (9),

$$\alpha = \frac{r(1+r)^n}{(1+r)^n - 1} \tag{9}$$

the relationship (8) is transformed into:

$$C_a = I \cdot \alpha + C_e. \tag{10}$$

In determining the total average annual cost of wastewater treatment the following values were assumed: discount rate $r = 0.05$, operations time span $n = 20$ years, average depreciation rate $s = 0.03$, therefore coefficient $\alpha = 0.08$.

In estimating the total average cost of treatment (C_a), depending on the capacity of the wastewater treatment plant (Q), the highest correlation is shown by the general exponential regression equation (Tyteca, 1981; Miłaszewski, 2003):

$$C_a = c + a \cdot Q^b, \tag{11}$$

where:
Q – plant capacity [m^3/year],
a, b, c – exponential regression coefficients [-].

To determine *a*, *b*, *c* values, coefficients of the linear regression equation obtained as the result of transformation of function (11) were delineated. For this purpose, assuming that $C_a > c$ and $a > 0$, the following substitutions were made:

$$ln(C_a - c) = Y, \tag{12}$$

$$ln\, Q = X, \tag{13}$$

$$ln\, a = A, \tag{14}$$

$$e^A = a. \tag{15}$$

In result of the transformations the following linear regression equation was derived:

$$Y = A + b \cdot X. \tag{16}$$

To determine A and b values of equation (16) the smallest square method was used. The coefficient b is the value of the projected exponent function (11), coefficient a was determined by the antilogarithm of the calculated value of A. The coefficient c was determined graphically. It is the coordinate of the intersection of streak empirical points, corresponding to the level of the average annual cost of wastewater treatment with the ordinate axis.

The value of coefficients a, b, c of function (11) was determined in accordance with the discussed algorithm, based on the actual data on investment outlays and the annual operating costs (excluding depreciation) of municipal wastewater treatment plants.

Results of the research

a) investment outlays

The regression analysis showed that the annual capacity of the plant (Q_{pro}) affects the level of investment outlays (I) in all the analyzed technologies. The effect of the technologies proved to be statistically insignificant. The relationship finally defined between the level of investment outlays (I) and the annual capacity of wastewater treatment plants (Q_{pro}) for both treatment technologies is as follows (price level 2017):

$$I = e^{4.83} \times {Q_{pro}}^{0.73} = 124.58 \times {Q_{pro}}^{0.73}\ \text{[EUR]}. \tag{17}$$

Coefficient of linear determination is high (0.95) and whole model is significant. Figure 1 shows the identified relationship and its diagnostic graphs.

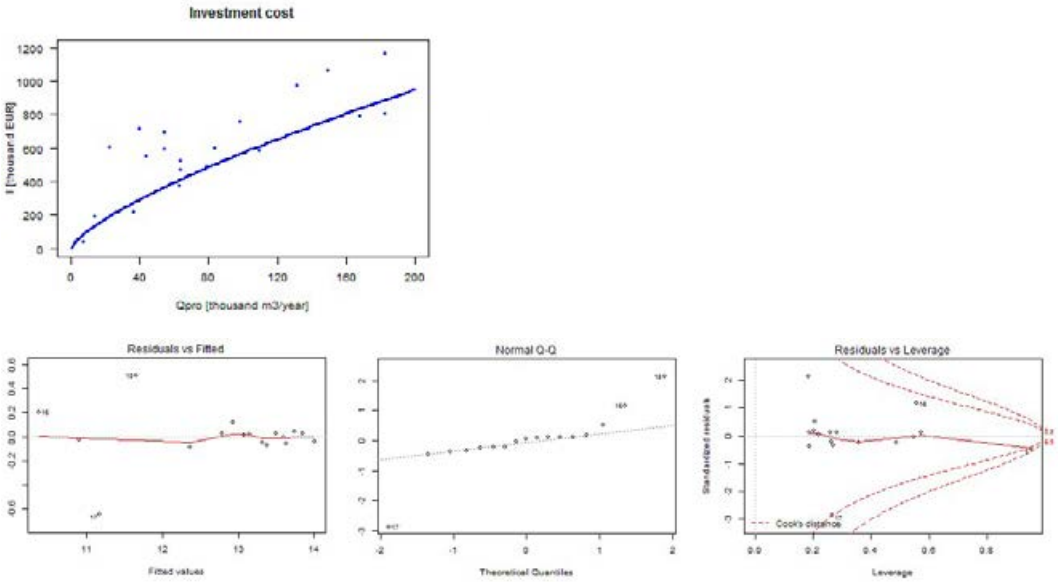

Figure 1. The relationship between the level of investment outlays incurred on the construction of small municipal wastewater treatment plants and their capacity and its diagnostic graphs

Source: author's own work.

The reviewed models illustrate that, in the analyzed capacity of small municipal wastewater treatment plants operating in the activated sludge and the biofilter technologies, there are no statistically significant differences in the level of investment outlays. For both technologies an increase of investment outlays has been observed together with an increase in their capacity.

The relationships of the impact of technologies on the investment outlays calculated in the paper comply with the conclusions of research conducted by Coleman (1997) and Kłoss-Trębaczkiewicz et al. (1998), Fraasa, Munley (1984) and Rauba (2008). The total investment outlays for construction of wastewater treatment plants grow with the increase of their capacity. In addition, with the increase of wastewater treatment capacity, there are more significant differences in the investment outlays in particular treatment technologies. The same conclusion were made by Muga, Mihelcic (2008). Moreover, they observed that investment outlays incurred on all kinds of mechanical-biological treatment plants are much greater than those incurred on

construction of the lagoon and land treatment systems. In the case of a large land reserve, when choosing wastewater treatment technology, constructed wetlands should also be taken into account.

b) operating cost (excluding depreciation)

The regression analysis showed that the annual volume of treated wastewater (Q_{real}) has impact on the final operating cost (K_e) in both technologies (p-value less than 0.0001). In addition, the effect of the biofilter technology, i.e. Ind_{bf} variable (p-value 0.02) and its interaction with the capacity (p-value 0.03) proved to be statistically significant. The ultimately identified relationship between the level of the annual operating costs (K_e) and the volume of annually treated wastewater (Q_{real}) is as follows (price level 2017):

- for technology I (activated sludge technologies):

$$K_e = e^{1.05} \times {Q_{real}}^{0.94} = 2.87 \times {Q_{real}}^{0.94} \text{ [EUR year}^{-1}\text{]}, \quad (18)$$

- for technology II (biolfilter):

$$K_e = e^{-3.26} \times {Q_{real}}^{1.31} = 0.04 \times {Q_{real}}^{1.31} \text{ [EUR year}^{-1}\text{]}. \quad (19)$$

Coefficient of linear determination was high (0.93) and whole model is significant (p-value for F test less than 0.0001). Figure 2 shows the identified relationship and its diagnostic graphs.

The annual operating treatment costs are lower in the biofilter technology. Augmented operating costs are observed when the volume of treated wastewater increases.

The level of the annual operating costs of wastewater treatment plants depends on the technology, capacity and effectiveness of the treatment plants and the composition of pollutants in wastewaters. The most difficult is to describe by means of statistical model the impact of treatment effectiveness and composition of the pollutants in wastewater on the treatment cost (Hernandez-Sancho et al., 2011; Muga, Mihelcic, 2008). The total operating costs increase together with an increasing volume of wastewaters treated. These costs are lower when the wastewater treatment technology uses biofilters. Currently, biofilters are used for wastewater treatment in rural wastewater treatment plants to 1,000 PE (Person Equivalent), and in Western Europe even up to 20,000 PE (Q ~5,000 m^3d^{-1}) (Ignatowicz, Puchlik, 2011).

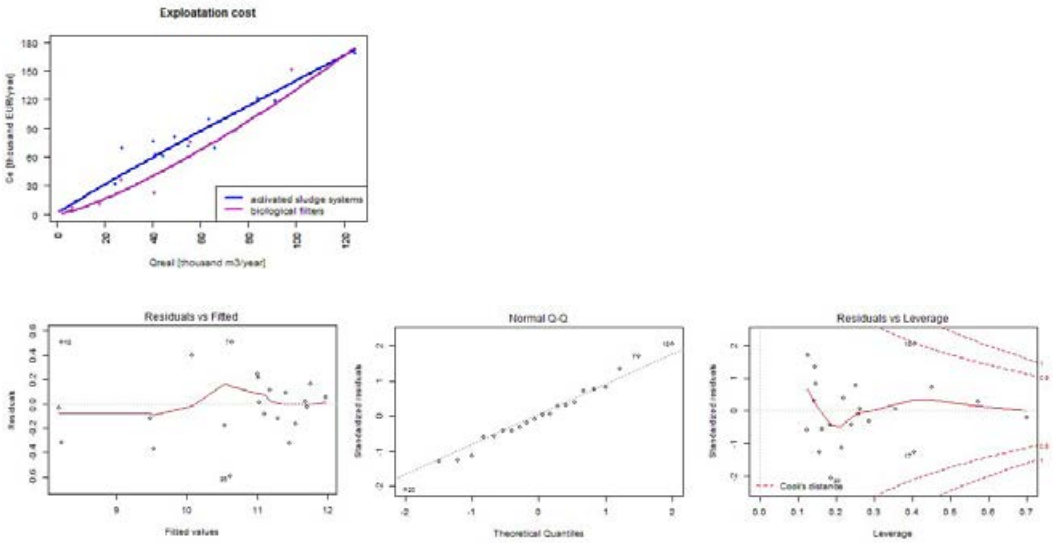

Figure 2. The relationship between the level of annual operating costs of small municipal wastewater treatment plants and volume of treated wastewater and its diagnostic graphs

Source: author's own work.

Research conducted by Muga and Mihelcic (2008) shows that the operating costs of the mechanical-biological wastewater treatment plants are significantly higher than those of the lagoon and land treatment systems. This is associated with increased energy consumption as well as with more highly mechanized equipment. In addition, Hernández-Sancho and Sala-Garrido (2009) showed that larger facilities are operated with greater technological and cost efficiency than smaller ones.

c) total average annual cost of wastewater treatment

Since the total average annual cost of wastewater treatment (C_a) depends on the level of investment outlays (I) and the operating costs (C_e), models (17), (18), (19) are transferred to the relationship (10). The capacity (Q_{pro}) and the volume of treated wastewater (Q_{real}) are the main factors which determine the total average annual cost of wastewater treatment (C_a). Biofilter technology (Ind_{bf}) has significant impact on the operating costs (K_e) and thus, indirectly, on the total average annual cost of wastewater treatment (C_a). Finally, the relationship between the total average annual cost of treatment (C_a), the capacity of the wastewater treatment plant (Q_{pro}) and the volume of treated wastewater (Q_{real}) takes the form (price level 2017):

- for technology I (activated sludge technologies):

$$C_a = 0.08 \times 124.58 \times {Q_{pro}}^{0.73} + 2.87 \times {Q_{real}}^{0.94} \text{ [EUR year}^{-1}\text{]}, \quad (20)$$

- for technology II (biofilter):

$$C_a = 0.08 \times 124.58 \times {Q_{pro}}^{0.73} + 0.04 \times {Q_{real}}^{1.31} \text{ [EUR year}^{-1}\text{]}. \quad (21)$$

Figure 3 shows the identified relationship.

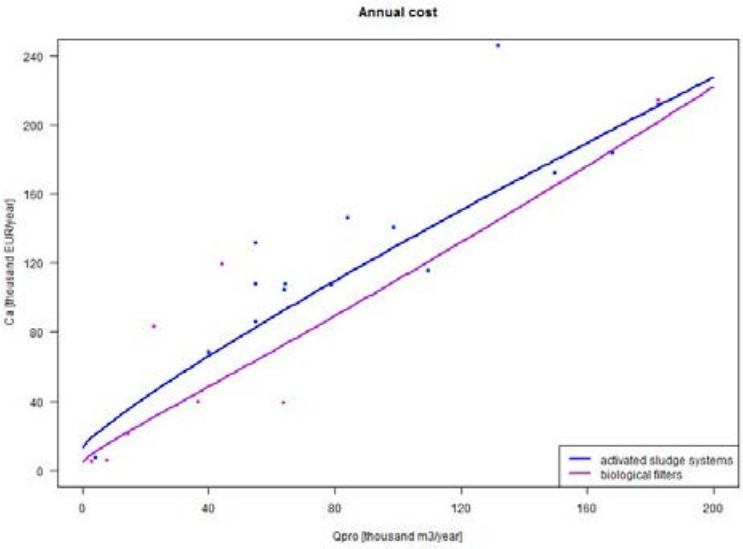

Figure 3. The relationship between the level of total average annual cost of wastewater treatment and their capacity

Source: author's own work.

The total average annual costs of wastewater treatment are lower in the biofilter technology. They increase with the growth of the wastewater treatment plant capacity.

Results of the research conducted by Sala-Garrido et al. (2011), based on data envelopment analysis (DEA), show a similar average technological and economic efficiency of systems such as activated sludge, aerated lagoon, trickling filter and rotating biological contactor. In this paper, in accordance

with the guidelines of cost-efficiency analysis, it was assumed that the technological efficiency of all the analyzed systems is the same. Taking into account the criterion of the lowest average annual cost of wastewater treatment, the biofilter technology proved to be the most effective in small plants.

Conclusions

The data presented in this study give a view on the possible impact of wastewater treatment technology, wastewater treatment plant capacity and volume of treated wastewater on the construction and operating costs of small municipal wastewater treatment plants. The resulting mathematical models can be used at the initial stage of designing municipal wastewater treatment plants. In the following years, they need to be updated using the price index of construction and assembly production.

The reviewed models illustrate that, in the analyzed capacity of small municipal wastewater treatment plants operating in the activated sludge and the biofilter technologies, there are no statistically significant differences in the level of investment outlays. However, the annual operating costs and total average annual cost of wastewater treatment are lower in the biofilter technology. For both technologies, an increase of investment outlays has been observed together with an increase in their capacity. Increased operating costs are observed when the volume of treated wastewater increases.

Data regarding construction and operating costs should be collected systematically, thus allowing to enhance the credibility and reliability of the developed cost models. This, as well, will allow for the application of the probabilistic approach to cost analysis.

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FAIR AND EFFECTIVE COMPENSATION OF LOSS IN RESTRICTED USE AREAS SURROUNDING AIRPORTS IN POLAND

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ABSTRACT: The intervention on the real estate market through a restricted use area (RUA) surrounding an airport changes the situation of the parties to the conflict and determines the manner of resolving the dispute, which is caused by noise externalities. The state, as a third party to the contract, influences the level of transaction costs on the real estate market. The aim of the publication is to present and compare the concepts of compensating loss relating to residential real estate located within RUAs surrounding airports according to the market value and fair value, as well as to present the methodology and estimates of social costs related to this kind of intervention. The methodological perspective is an effectiveness (market) based justification of the intervention derived from R. Coase's views, which are subject to critical assessment. Legal and economic deliberations are presented on the basis of studies, conducted in 2016-2018 for 5 largest Polish airports (according to the number of passengers), regarding the assessment of loss compensation in RUAs in the case of residential, single-family houses. The results of empirical research and the case study concern one airport, namely Poznań – Ławica. Theoretical considerations focus on comparing and searching for a legal, economic, and social justification of utilizing two bases of valuation, namely: market value and fair value. The methodology of research has been arranged with the use of R.A. Posner's approach. The discussion is divided into two parts: an analysis of the regulating element (the legal system) and the changes of the real estate market conditions from the point of view of price and cost levels after the implementation of a RUA.

KEY WORDS: compensation value, public intervention, transaction costs, negative externalities, airport noise

Introduction

The intervention on the real estate market through a restricted use area (RUA) surrounding an airport and established due to negative noise externalities changes the situation of the parties to the conflict and determines the manner, costs and time needed to resolve the property dispute. The activity of the State, which in the economic sense becomes the third party to contracts concluded on the real estate market, is justified by the expected, social result in the form of increased welfare caused by a decrease of social costs that accompany the transfer of real estate rights. The high, from a social point of view, costs of concluding contracts on a unique local market are substituted by assumingly lower costs of transferring entitlements, with the transfer following a normative model prescribed in legal regulations. In order to ensure the effectiveness of such targeted intervention into market relations, it is necessary to provide a rather complex set of formal tools and methods. In a hierarchical order, these include statutory legal provisions, local law, and appropriate regulations of real estate valuation methodology. The tools must be mutually consistent and suitable to achieve the purpose of valuation connected with a very particular intervention. Theoretical considerations in this paper focus on comparing and seeking a legal, economic and social justification for applying to the valuation of damage, two bases of valuation, namely: market value and fair value. The purpose of the publication is a critical analysis of the concept of compensating loss concerning residential real estate located within RUAs of Polish airports according to market value and fair value and to present the methodology of calculating as well as estimates of social costs connected with this type of intervention. Legal and economic deliberations are presented on the basis of studies conducted in 2016-2018 for 5 largest Polish airports (according to the number of passengers). On the basis of one of the Polish legal airports, an assessment of the compensation mechanism for damages regarding residential, single-family homes located within a RUA is made. The discussion focuses on finding a legally, economically and socially justifiable procedure and bases of valuing loss. The obtained results may be utilized in creating and amending legal regulations and the management of property entitlements by airports as well as by real estate valuers involved in valuations of real estate located in RUAs surrounding airports.

An overview of the literature

Views concerning private property are decisive when considering the admissibility of intervention, its forms and the criteria applied to assess its

effectiveness in the context of a selected concept of justice and effectiveness. This publication focuses on a particular methodological problem connected with the effectiveness of a specified intervention on the real estate market in the form of a RUA (Act 2001, of 27 April 2001, Law on the Protection of the Environment, art. 129, art. 135 and 136 s. 3, in short: POE). According to the neo-Austrian school, this intervention classifies as triangular (Rothbard 2008, p. 277; more on other types of intervention see: Habdas, Konowalczuk, 2018, p. 7) and for that reason abundant, foreign literature presenting well documented since the 1960's results of empirical research (Kopsch, 2016), in which the influence of externalities on residential real estate in the vicinity of airports is measured (compare an overview with a focus on a tool-based examination of analyses: Batóg et al., 2019, pp. 2-5), has limited applicability. National literature, for obvious reasons, deals with contemporary market research from the XXIst century (compare an overview of this research: Trojanek, Huderek-Glapska, 2018). There are no published results of studies that would be directly dedicated and connected with the particular and isolated intervention in the form of a RUA surrounding an airport (Habdas, Konowalczuk, 2019, p. 10). Solutions adopted in foreign countries (Pilsk, 2012; Goulbourne, 2002) demonstrate various approaches to compensating the effects of intervention, but imitating those solutions is not a viable option due to the differences in the legal systems of various countries and in the case of USA, even among different states (Migala, 2017; Bennett, 1982). In Polish literature, the issue of this particular kind of environmental compensation has not been discussed and this holds true also for a stronger intervention that occurs when a new airport is built (Kobryń, Bukanowicz, 2015, pp. 81-92).

The point of departure for discussing property (ownership) and its market context is the still relevant concept of justice as described by Aristotle (Arystoteles, 2017, 1132 b 21 et seq.). It is fundamental to ascertain whether compensation concerning RUAs should be based on distributive or remedial justice. In the situation under consideration there is no relation of the perpetrator (just punishment) and the victim (just compensation) which is characteristic of remedial justice. The intervention is a legal interference of a public authority (Habdas, Konowalczuk, 2018a, pp. 6, 10) in which the competence to specify details necessary to achieve proper compensation has been delegated to local governments at the highest tier (the voievodeship – POE, 2001, art. 135 s. 2). Consequently, we are dealing with distributive justice, connected with payments, that is with principles of shaping prices on the market and not with a penalty for the perpetrator and compensation for the victim.

Currently, the ownership of real estate is conceptualized not only in a utility context (e.g. a house as a place to live). A key aspect of ownership is connected with capital in the context of the potential for market exchange

(e.g. sale or lease). In common law, ownership (property) is a bundle of rights (Gray, Gray, 2009, p. 91; The Appraisal, 2013, s. 11 et seq.), which in Roman based, private law systems is associated with various entitlements of the owner (Gniewek, 2016, pp. 61-63; Stelmachowski, 2007, pp. 232-239; Murphy, Roberts, Flessas, 2004, pp. 60-68). Both of these concepts concentrate on the owner's prerogatives, neglecting a vital element of property, namely its object (Arnold, 2002, pp. 290-291). This denotes that in the case of real estate, its environmental context and the relation between a human and the environment is overlooked (Arnold, 2002, pp. 302-303). Simultaneously, it is this relation that must be taken into account when deciding on the scope of interference by the legislator into the owner's entitlements (Arnold, 2002, pp. 319-320). Historically, literature regarding intervention includes: A.C. Pigou's concept of taxation presented in the *Economics of welfare* (Żylicz, 2004, p. 68), a similar concept concerning common property in the Lockean proviso (Lock, 1992, p. 193) and his libertarian concepts forbidding interference into property which is the effect of an individual's labour (Lock, 1992, chapter 1, p. 42), a concept according to which externalities do not deserve correction and must be borne by the society (Mill, 1965, chapter 2, p. 6), Rawls's concept of background justice (Rawls, 1994, pp. 32 et seq.). Only libertarians do not accept any social dimension of property and even in cases of force or fraud suggest only a minimal interference of the state (Nozick, 1999, p. 5, 186).

Currently it is accepted that the protection of property is relative and the dominating justification for intervention is its effectiveness. This justification is derived from a rather loosely and extensively interpreted (Fox, 2004, p. 2 et seq.) Coase's theory (Coase, 2013). As a result, the criterion of justice is abandoned and the perspective of effectiveness according to social utilitarianism is adopted. Previously, such an approach was present in economics only in the context of Bentham's individual criteria of utilitarianism (Skousen, 2012, p. 172). An analysis conducted, according to Coase's views, from the perspective of an equivalent situation for both parties of the conflict (mutual loss) is in fact a bilateral, effectiveness based approach to externalities (social costs), which justify intervention. The latter is performed in a market context.

In valuation methodology, the dominating, neoclassical models of the perfect, free or effective market basically have two dimensions concerning price and quantity. These models focus on the functioning of the market in the context of equilibrium and the shorter or longer periods it takes to achieve it (Marshall, 1925, p. 258, 268-277). Therefore, they do not include numerous, unique aspects of the real estate market, such as: transaction costs, low liquidity and low informational effectiveness (D'Arcy, Keogh, 1998).

Simultaneously, it is argued in writings that prices of real estate are not exclusively determined by and on the market (Evans, 1995). Other contemporary theories of the market (e.g. Nash-Cournot's non-collusive firm equilibrium, Arrow's risk aversion, Black's, Scholes's, and Marton's options, Markowitz's portfolio theory, supplemented by Sharpe's, Lintner's and Mossin's CAPM model, Fama's and Miller's informational effectiveness) are inadequate to explain the effects of state intervention and in practice are not relevant when solving disputes within RUAs. This is because they do not deal with real estate as objects, but rather with the reflection of real estate on financial markets (e.g. mortgages and other derivative instruments) which function in a parallel and peculiar reality (de Soto 2002, p. 25).

When assessing state intervention, a traditional, equilibrium model of the competitive market in the neoclassical perspective, based on full or sufficient information with no transaction costs is employed. This model has only two dimensions, i.e. price and quantity and it determines the dominant understanding of market value, thus shaping the manner in which valuations are performed (Act 1997 of 21 August 1997 – on the management of real property, consolidated version: Journal of Statutes 2018 item 121 as amended, art. 151; International Valuation Standards 2011, pp. 20-22; European Valuation Standards, 2016, pp. 18 et seq.). As a consequence, it also defines the principles of valuations for the purpose of awarding compensation payments and designates fair value as the basis of valuation for specified parties of the transaction (European Valuation Standards, 2016, pp. 38-39; International Valuation Standards, 2011, pp. 22-24; more: Konowalczuk, 2018). The application of a legally regulated market value as a basis of valuing real estate that has been subjected to a triangular intervention (the result of which is a change in the market equilibrium) results in an abstract valuation. This may cause the results of the valuation to be removed from reality or at least to inadequately reflect the economic reality, which creates the problem of the legal footprint (Konowalczuk, 2017), that is a situation in which the law obstructs reflecting economic relations. Meanwhile, capital in the form of real estate is treated on the market as a resource (and not dead-capital) (de Soto, 2002, p. 25), so all economic measurements are done only in the context of the relation between the market (capital) and property. One may therefore conclude that intervention is a normal, contemporary dimension of real estate ownership and only in exceptional circumstances, introducing restrictions or obligations or providing entitlements, will necessitate a duty to compensate the produced loss/damage or demand a payment in a private law (e.g. in cases of establishing a RUA) or a public law setting (e.g. planning burdens, see Act 2003, art. 36, or payments connected with the

division, division and consolidation of land or installation of utilities with the use of public money, see Act, 1997, art. 143 et seq.).

Research methods

Since Coase's theory requires loss to be mutual, then it must be assumed that intervention in the form of a RUA would be redundant only if transaction costs of market negotiations leading to the solution of disputes concerning airport noise externalities were low. In a system of statutory law, the intervention should be based on the premise that protection of interests is afforded to the party who will suffer the greater loss in a social dimension, according to the criteria of effectiveness, measured on the market. This sets out the general purpose of intervention, which is to increase welfare by lowering social costs. In the case of airports, identifying the scope and the form of intervention should take into account the public, or at least the quasi-public (Habdas, 2016), character of land and property designated as airports and utilized to fulfill public interests.

R.A. Posner's concept of analyzing the legal system (Posner, 2014) includes two types of activities, namely discovering and designing economic principles. On this basis he differentiates between positive analysis (economic rules on the basis of which the legal system functions) and normative analysis (economic rules on the basis of which the legal system should function). Consequently, the assessment of intervention in the form of RUA requires conducting a normative and a positive analysis, which in this publication have been considered in the following context:

- the regulated phenomenon, i.e. the functioning of the residential real estate market, which can change upon the introduction of restrictions on use, particular obligations or providing the owners with specified entitlements; the effect of the above may be a change in price or building costs; measuring the cause and effect relation of intervention is only possible after the establishment of a RUA,
- the regulating activity, i.e. the legal system, which pursuant to Williamson's model (Williamson, 1998, pp. 25-27) should be assessed on different levels (for more see: Habdas, Konowalczuk, 2018a, pp. 7-8):
  - the statute, which may restrict liability for damages or prescribe a particular form or procedure of intervention,
  - local law, which for real estate situated within a RUA may, in varying extent, restrict the use of land, place obligations on real estate owners or restrict other persons (e.g. local governments forbidding owners to utilize land for uses specified in local development plans),

– legal regulations on valuation of real estate applied by real estate appraisers which prescribe types of values, utilized in valuations for purposes connected with awarding compensation.

This paper focuses on intervention regarding single family houses, because number-wise they are the dominating type of real estate within RUAs surrounding airports and also account for the majority of filed compensation claims both in number and in value. It has been assumed that the main problem concerns claims for reimbursing money spent on acoustic improvements or paying for future, hypothetical costs of acoustic improvements and additional claims for compensating loss of value. The problem of loss connected with lost profits and forced acquisition of real estate is not considered in this paper, as in practice it is non-existent or negligible.

The tools of descriptive statistics utilized to present the results of research concern the size and the structure of claims and executed compensation payouts in the context of changes in real estate prices. Comparative research, applied when searching for a legally, economically and socially adequate basis of valuation, is based on deduction and a critical analysis of mainly foreign academic writings.

Results of research – a legal, social and environmental assessment of intervention in the form of a RUA surrounding an airport

The intervention in the form of a RUA, limited to real estate, is first and foremost aimed at protecting human health, because it should ensure effective, acoustic renovation of residential and other sensitive buildings (kindergartens, schools, homes for the elderly, hospitals, etc.). Acoustic improvements are to fulfill increased technical criteria which allow for a proper, acoustic climate within buildings. In addition, the intervention is aimed at properly shaping the principles of future land development in the airport's vicinity. The legislator has connected compensating real estate owners with the introduction of restrictions in the use of land (POE, 2001, art. 129 s. 1 and 2) and this is the core of the intervention in the form of a RUA. Specified restrictions in land use as well as obligations placed on real estate owners (concerning the acoustic standard of buildings) are implemented at the level of local law and their extent determines the strength and the character of intervention, thus prescribing the manner and scope of compensable loss. The latter does not exist if no restrictions or obligations apply to a particular real estate owner. This intervention does not allow for compensating loss of value resulting from the fact that a given piece of real estate is located in the

vicinity of an airport. This follows from the fact that the location of a given piece of real estate is not influenced by whether a RUA is implemented or not.

Statutory intervention is designed to expand or facilitate compensation by:

- confirming that all introduced restrictions in land use warrant compensation if they have caused a loss of real estate value,
- introducing the homeowner's right to request the reimbursement of costs incurred to perform acoustic improvements to the building and accepting that such costs classify as loss (POE, 2001, art. 136 s. 3).

Carrying out acoustic improvements of the building always increases the debt of the homeowner, however it would not classify as loss in cases where these improvements were done voluntarily, without an express obligation prescribed by law. In the case of RUAs, when requirements of acoustic building standards are introduced, but there is no obligation to acoustically upgrade buildings (in practice this concerns buildings already erected at the time the RUA is implemented), the intervention ensures that the costs of such upgrades are nevertheless classified as loss (POE, 2001, art. 136 s. 3).

An underappreciated aspect of the intervention is the fact that a precise area of restrictions and obligations is designated, which undeniably minimizes social costs. Before the intervention, these social costs hindered transactions, because they could only take place if measurements of noise levels were conducted by individual homeowners. This concerns both voluntary settlements as well as filing lawsuits. In the analyzed five airports, during the past dozen years, settlements concerning single family houses were concluded only incidentally (1-2 settlements in the case of two airports and no settlements in the case of the three remaining airports) and there was only one airport nuisance lawsuit brought in the entire country. The cost of such a measurement in the case of single family house typically is at the level of 10 000 PLN (for routine measurements). The approximate costs of these measurements/reports were calculated on the basis of current costs incurred by five analyzed airports and an assessment of a few dozen reports prepared by experts.

With an average of 500 single family houses within airports' RUAs, this amounts to social costs of 5 000 000 PLN, while the market cost of all specialized measurements/reports regarding all types of real estate required by an airport to implement a RUA does not exceed 1 000 000 PLN. Thus, the intervention with the use of a formal, "group" right to compensation is simply cheaper. Additionally, the advantage of such an intervention is its durability. Noise levels which determine the area of a RUA are calculated for a forecasted number of airport operations. Consequently, the intervention entails aspects of public activity, in which it is possible to create a plan for managing the

conflict situation. The adopted strategy is avoiding risk, taking into account not only the current state of the environment but also the future operations and the development of the airport while minimizing social costs and neighbour conflicts.

An important and socially effective aspect of the intervention would be reimbursing obligatory and non-obligatory (in practice buildings already erected at the time of implementing a RUA), but factually carried out acoustic improvements of buildings within a RUA. Advantages of such a solution (a properly implemented intervention), apart from improving homeowners' legal situation, are as follows (figure 1):

- limiting the formal extent of intervention, because in the RUA resolution it would not be necessary to specify detailed requirements for various types of buildings and administrative deadlines for performing improvements,
- making it possible to adjust the scope and type of improvements to differing needs of people in the context of the factual use of real estate,
- excluding or materially limiting unnecessary expenditures (vacant homes, homes used incidentally, utilized only in part, etc.),
- decreasing costs of determining reimbursement, because potential expert opinions/reports would only have to verify the type of installed improvements and their market cost,
- increasing informational effectiveness of the market by eliminating speculation that accompanies the alternative solution (future costs of improvements, as opposed to factual expenditures, are compensated) thus allowing the market to function based on free competition.

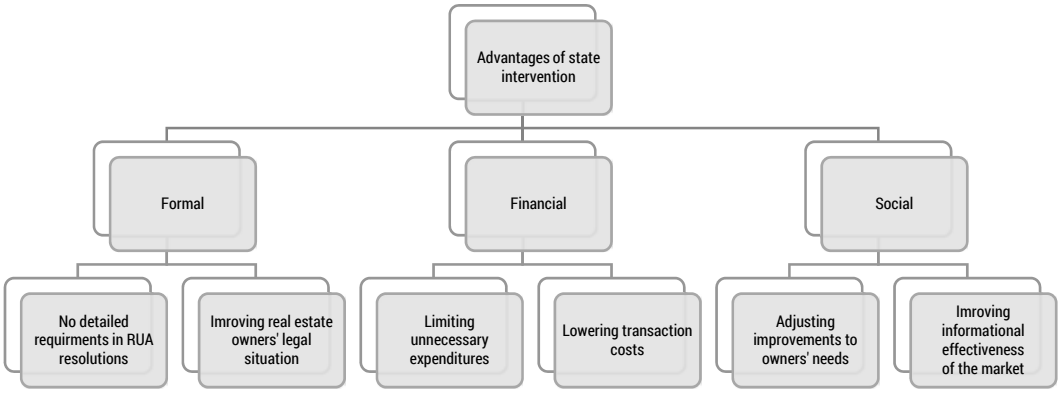

Figure 1. Advantages of an effective state intervention through a RUA

Source: author's own work.

In summary, the described advantages of intervention which provides the owners of real estate located within a RUA with a special right to request the reimbursement of money factually spent on necessary acoustic improvements, even if a particular owner is not obliged to carry them out, are derived from the fact that the intervention allows to fully imitate the market. This fulfills the criteria of Coase's effective intervention. No other solution will be more effective, because it will not decrease social costs.

The application of the intervention in a manner which allows to award compensation and conclude settlements with the airport regarding hypothetical (planned) costs of acoustic improvements that have not been carried out suffers from institutional flaws which lead to:

- compensation that does not take into account individual conditions (varying needs of persons and different manners of factually using the real estate in question),
- increasing the level of social costs – loss/damage is identified without the use of the differential method at a level of maximum, hypothetical acoustic improvements, thus encompasses unnecessary improvements, i.e. ones that no-one will utilize, or that will be utilized only incidentally; moreover, calculating the cost of these hypothetical improvements requires commissioning expensive expert reports,
- decreasing informational effectiveness of the market (speculative behaviour caused by no control over how awarded compensation for planned acoustic improvements is spent),
- not achieving the main purpose of the intervention, namely the protection of RUA inhabitants' health (no possibility to execute the performance of planned acoustic improvements for which monetary compensation was awarded).

It follows from the above that intervention in which compensation is paid for hypothetical (planned) costs of future acoustic improvements is flawed because it does not imitate the market.

From a methodological point of view, both compensation models (hypothetical costs or actual expenditures) bring about the increase of market value because the utility parameters of buildings are improved, including their energy efficiency (Kazak et al., 2018). Additional effects are also achieved, because the scope of acoustic improvements (outer layers of the building's elevation, windows and doors) lower the building's energy consumption and thus support sustainable development goals (Foryś et al., 2019).

The effects of intervention in the case of single family houses are different from situations when within a RUA, undeveloped land is subjected to restrictions, such as a ban on residential development, and is designated for open green space or agricultural use. Such an intervention unfavourably changes

the utility of undeveloped land and the equilibrium between two submarkets of land (by increasing the amount of "green" land and decreasing available residential land), even though it is beneficial from an environmental perspective (comp. the definitions and professional interpretation of the market for purposes of valuing according to the equilibrium model – International Valuation Standards, 2011, pp. 15-17). With respect to single family houses, for which the current use may be viewed as optimal, the intervention does not change utility or affect the market equilibrium, because it does not change the stock or supply of this type of real estate. As a result, there is no justification for measuring loss in the context of the balanced market model. The effects of such intervention may only be measured as a particular, external depreciation, which due to the intervention, has a guarantee of being fully compensated by the airport. This is environmental depreciation (comp. Standardy zawodowe, 2002, Standard III.4, point 4.3), which ignores the issue of intervention and shows environmental depreciation as a market variable.

From the homeowners' point of view there is no negative change, because their formal, negotiating position is improved. Only when assuming that a market transaction is effected (e.g. a sale) the intervention may be viewed as a deterioration of the market feature of the building's technical condition. Such an assumption may be justified methodologically only if the owner has not utilized (in full or in part) the claim for reimbursement of acoustic improvements. In such a situation the "market" loss may methodologically be only associated with differing prices due to a "deteriorated", price-influencing feature and not with the loss of value connected with the location of real estate within a RUA.

Results of the research – the proposed differential approach to the model of valuing loss within a RUA – case study

Whenever valuing real estate for the purpose of compensating loss, the differential method must be applied, according to the following formula:

$$MV_S = MV_0 - MV_1, \quad (1)$$

where:

MV_s – market value of loss concerning real estate (the difference between values – ΔMV_S),

MV_0 – value of real estate with no effects of intervention,

MV_1 – value of real estate with a depreciated use standard (to the owner) or market standard (to a hypothetical buyer) due to providing an effective claim for acoustic improvements.

In order to present the results of research concerning the assessment, on the level of valuation methodology, of the intervention's effectiveness, a model which compares the costs of improvements (without functional depreciation) for four single family houses in different (ceteris paribus) technical conditions at the date of intervention has been applied. The rules for applying the cost approach in Poland (see: Act, 1997, art. 151-153; Ordinance, 2004, § 20-23) are different from the current methodology used in mature markets (Bowes, 2011). The effects of intervention do not influence the value of land, because no changes are introduced regarding its possible use and development. The model is simplified by assuming that one is dealing with the same type of buildings, situated on similar parcels of land, located in similar neighbourhoods, with the only difference being the technical state of the building.

The first case (object 1) reflects the simplest, but also a realistic, methodological situation:

- before establishing a RUA, the building is new and in the process of construction (brick-built, multi-storied, the structure already erected and the roof covered – i.e. open building shell), the owner's expenditures (planned costs) for all work on thermal insulation will amount to 90 000 PLN – the thermal and acoustic insulation concerning double layered outer walls (including the structure and the insulation parts), typical for single family house construction, may be correlated only when proper technology is applied – see table 3,
- after establishing a RUA the building requires additional improvements as described in the chart (differences in construction materials), the owner's expenditures (planned costs) for all work on acoustic and thermal insulation will amount to 115 000 PLN.

Table 1. Value of construction materials for acoustic renovation, object 1 [thousand PLN]

Scope of work	Differences in construction materials	MV_0 – standard cost	MV_1 – increased cost	ΔMVS – difference
Outer windows and doors	Cost of triple, instead of double glazed windows, cost of acoustic instead of standard doors	35	46	-11
Insulation of top floor ceiling	Additional layer of acoustic insulation	10	15	-5
Insulation of outer walls	Additional layer of acoustic insulation	45	54	-9
Sum		90	115	-25

Source: author's own work.

The procedure of calculating loss through a differential model for incurred expenditures (increased costs of building works) is presented in table 1.

The real loss for object 1 is 25 000 PLN (mathematically it is shown with a minus sign, which reflects a financial debt) and is claimed pursuant to art. 136 s. 3 POE. After carrying out improvements, the building fulfills technical requirements and its market feature connected with the acoustic climate (technical feature) is not deteriorated. Consequently there are no formal reasons which would warrant a measurement of real loss perceived as loss of value, since there is no cause and effect relation between any (potential) loss of value and the introduced intervention.

The second case (object 2) reflects the following methodological situation:

- before establishing a RUA, the building has been in use for over 30 years – structural elements in good condition, remaining elements requiring overhaul or replacement, including a 100% physical depreciation of all elements relevant to the acoustic climate, i.e. outer doors, wooden, double glazed windows, top floor ceiling insulation (suprema) and insulation of outer wall (5 cm Styrofoam),
- after establishing a RUA, the building, requires additional improvements as described in the chart (differences in construction materials), the owner's expenditures for all, increased work on acoustic and thermal insulation will amount to 115 000 PLN.

The procedure of calculating loss through a differential model is presented in table 2.

Table 2. Value of construction materials for acoustic renovation, object 2 [thousand PLN]

Scope of work	Differences in construction materials	MV_0 – standard cost	MV_1 – increased cost	ΔMVS – difference
Outer windows and doors	Cost of triple, instead of double glazed windows, cost of acoustic instead of standard doors	35	46	-11
Insulation of top floor ceiling	Additional layer of acoustic insulation	10	15	-5
Insulation of outer walls	Additional layer of acoustic insulation	45	54	-9
Sum		90	115	-25

Source: author's own work.

The real loss according to the differential model amounts to 25 000 PLN. It is analogous to loss for object 1 only if compensation for loss of value is identified with planned (but not actually incurred) costs of acoustic improvements (pursuant to art. 129 s. 2 POE). However pursuant to art. 136 s. 3 POE the owner may claim the full costs factually incurred (115 000 PLN). The latter possibility may be questioned in the context of distributive justice (the basis of valuation is the actually incurred cost – this is a particular fair value regarding two specified parties of the transaction), because although it promotes protection of health, its "side-effect" is a considerable market value enrichment of the real estate owner.

The third case (object 3) reflects the following methodological situation:

- before establishing a RUA, the building has been in use for over 30 years – structural elements in good condition, outer doors and windows replaced shortly before the introduction of a RUA, however not with ones that meet technical requirements for the RUA, no insulation of the building's elevation and the top floor ceiling (methodologically this situation is analogous to object 2, no insulation is equivalent to 100% depreciation.),
- after establishing a RUA, the building, requires additional improvements as described in the chart (differences in construction materials), outer doors and windows have a 100% external (environmental) depreciation (value of depreciation 35 000 PLN *100% = 35 000 PLN), the owner's expenditures for all increased costs will amount to 115 000 PLN.

The procedure of calculating loss through a differential model is presented in table 3.

Table 3. Value of construction materials for acoustic renovation, object 3 [thousand PLN]

Scope of work	Differences in construction materials	MV_0 – standard cost	MV_1 – increased cost	ΔMVS – difference
Outer windows and doors	Cost of triple, instead of double glazed windows, cost of acoustic instead of standard doors	35 or with DE = 0	46	-46
Insulation of top floor ceiling	Additional layer of acoustic insulation	10	15	-5
Insulation of outer walls	Additional layer of acoustic insulation	45	54	9
Sum		55	115	-60

Source: author's own work.

The real loss claimed pursuant to art. 136 s. 3 POE is 60 000 PLN (this requires actually incurring the costs – standard doors and windows, a simpli-

fied assumption was adopted with a value of PLN) or may reflect the loss of market value claimed pursuant to art. 129 s. 2 POE. In the latter option, the maximum level of loss (in an active market with a high level of informational effectiveness) will not exceed 60 000 PLN, i.e. the amount required to improve the deteriorated market feature (technical state) regarding the building's acoustic climate. The remaining features are the same as in competing pieces of real estate offered in locations within and outside of the RUA.

The fourth case (object 4) reflects the following methodological situation:

- before establishing a RUA, the building has been in use for over 30 years with repairs/improvements carried out regularly, outer windows and doors have a standard physical depreciation of 40% (value of physical depreciation 35 000 PLN *40% = 14 000 PLN), insulation of the building's elevation – 10 cm Styrofoam with high quality plaster (however these materials impair the acoustic insulation of walls), physical depreciation 60% (value of physical depreciation 45 000 PLN *60% = 27 000 PLN), top floor ceiling with new, standard thermo-insulation – does not meet technical standards for the RUA,
- after establishing a RUA, the building, requires additional improvements as described in the chart (differences in construction materials), the owner's expenditures for this purpose amount to 60 000 PLN, replacement of the elevation's insulation with 100% of external (environmental) depreciation (value of external depreciation 45 000 PLN *100% = 45 000 PLN.), the same 100% external deprecation applies to outer doors and windows (value of external depreciation 35 000 PLN *100% = 35 000 PLN) – the scope of the paper does not allow for a full consideration of the issue of depreciation (see more: Źrobek, 2009). The concept of joint depreciation has been applied and in calculations, the highest level of the two analyzed types of depreciation was adopted.

The procedure of calculating loss through a differential model is presented in table 4.

The real loss claimed pursuant to art. 136 s. 3 POE is, without adjusting for physical depreciation, 110 000 PLN. This reflects the typical, market cost of increased, actually incurred or hypothetical costs of acoustic improvements. If physical depreciation is accounted for, the loss will be 64 000 PLN. If a claim for loss regarding acoustic improvements is not pursued, the loss may reflect a loss of value which may be claimed under art. 129 s. 2 POE. In the latter option, loss will not exceed 115 000 PLN and its market level will be equal to 64 000 PLN. The latter is a sum required by the market to improve the deteriorated market feature (technical state) regarding the building's acoustic climate. The remaining features are the same as in competing pieces of real estate offered in locations within and outside of the RUA.

Table 4. Values of tangible expenditure on acoustic revitalization, object 4 [thousand PLN]

Scope of work	Differences in construction meterials	MV_0 – standard cost	MV_1 – increased cost	ΔMVS – without physical depreciation ZF	Value of ZF	Value of external depreciation DE	ΔMVS – the difference taking into account DF	ΔMVS – the difference taking into account DF and DE
Outer windows and doors	As for object 3	35 or with DE = 0	46	-46	14	35	-32	-46
Insulation of top floor ceiling	As for objects 1 and 3	10	15	-5	0	5	-5	-5
Insulation of outer walls	As for object 3	45 lub z ZZ=0	54	-54	27	45	-27	-54
Sum		90	115	-110	41	85	-64	-110

Source: author's own work.

Legal provisions (Ordinance, 2004, § 35) require that single family houses be valued on the basis of market principles, which requires taking into account physical depreciation and a typical, market expenditure that is factually spent by buyers on additional acoustic improvements. This expenditure may be objectively and directly identified on the basis of prices of real estate (the difference between them) only if there is an active sales market of houses with previously carried out acoustic improvements. If no such market exists then the indirect method remains, pursuant to which a loss of value is calculated if acoustic improvements have not in fact been carried out. The method is based on the market cost of acoustic improvements, which is calculated taking into account physical deprivation – a requirement stipulated in the law (Ordinance, 2004, § 35).

A simulation of social costs based on the example of the Poznań – Ławica airport

The RUA for Poznań-Ławica airport came into force on 28 Feb. 2012 (Resolution, 2012), encompassing an area of 10,16 km^2 surrounding the airport. The area is divided into two zones: the inner zone (in the vicinity of the runway, indicated in figure 2 in blue colour, where new residential development is allowed under the condition that proper acoustic technologies are employed in rooms requiring acoustic insulation) and the outer zone (indicated in figure 2 in red colour, where there are no restrictions on residential development and there is no obligation to ensure additional acoustic insula-

tion of buildings). A part of this area overlaps with the RUA established for the military airport "Poznań Krzesiny" (Ordinance, 2007). The inner zone comprises approximately 1,1 thousand single family houses and the outer zone comprises around 1,5 thousand of such hoses and about 800 multi-apartment buildings. The whole restricted use area is inhabited by approximately 12 000 people.

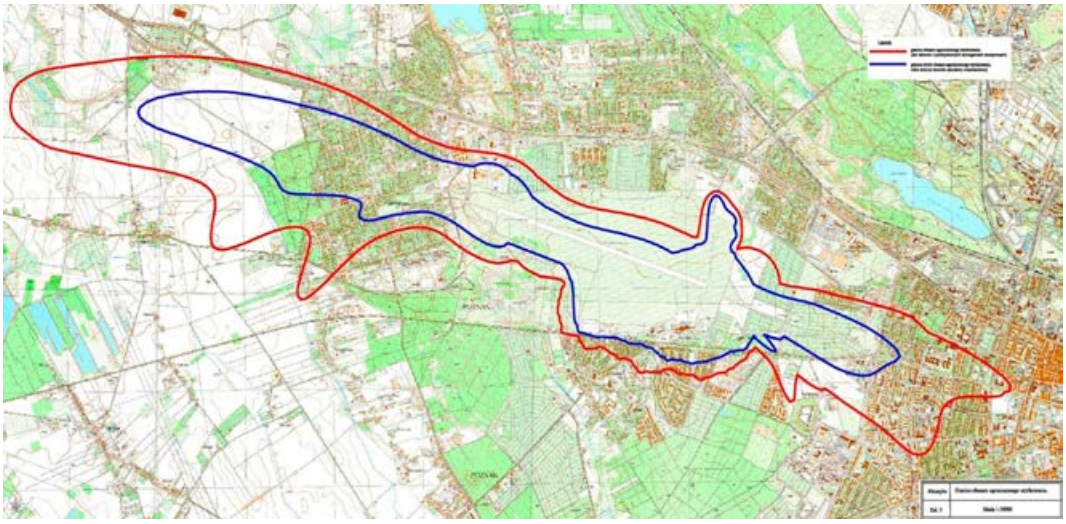

Figure 2. The location of RUA zones for Poznań – Ławica Airport

Source: PLL Ławica Poznań.

Out of RUA inhabitants, 1230 claims were filed (750 regarding the inner zone and 480 regarding the outer zone) for which no settlement was reached and the cases were submitted to court. RUA real estate owners had two years to notify their claims, after which time, the claims became time barred. It is important to note that the airport does not enter into settlements regarding loss of real estate value, but only regarding costs of acoustic improvements which fulfill current acoustic standards for airport RUAs. The airport, following a consistent line of judgements, does not account for physical depreciation (which would lead to lower payouts) and the fact that claims for loss of value and acoustic improvements overlap. This is because a different approach, in the light of court practice, would exclude the owners' willingness to conclude a settlement.

The sum of filed claims is approximately 125 million PLN, which denotes an average of 101,6 thousand PLN per house. With an estimated, average market price of a house equal to 600 thousand PLN, the owners have subjec-

tively valued their loss at about 15% of the property's market value. The results of analyzing the local market regarding average transaction prices obtained for similar single family houses located within and outside the RUA are presented in the table below. The RUA for Poznań – Ławica airport comprises parts of geodesic zones: (1) Poznań: Górczyn, Junikowo, Kotowo, Ławica, Łazarz and Plewiska from the Grunwald district; (2) Dębiec from the Wilda district of the city of Poznań; (3) Golęcin, Jeżyce, Krzyżowniki, Ławica II, Psarskie, Strzeszyn, Wielkie, Kiekrz from the Jeżyce district of the city of Poznań; (4) Przeźmierowo of the Tarnowo Podgórne commune. In the analyzed period and market there were 1371 transactions of single family houses, where 182 transactions took place within the Poznań – Ławica Airport RUA and 636 transactions took place within the Krzesiny military airport RUA (out of which 51 transactions were located within both, overlapping RUAs). 44% of all transactions took place outside RUA boundaries. This denotes that within the specified geodesic zones, in the market segment of single family houses, there are about 130 – 200 transactions, with the exception of 2009, when there were only 50 transactions.

Table 5. Average transaction prices of single family houses within and outside the RUA [in thousands PLN]

Location	2008	2011	2014	2017	2008-2017
Poznań – Grunwald	725.80	621.18	571.45	461.00	623.30
Poznań – Jeżyce	715.25	664.68	625.24	551.50	627.91
Poznań – Wilda	623.09	503.49	43208	467.50	488.31
gm. Tarnowo Podgórne	543.75	590.10	602.86	370.00	575.38

Source: author's own work.

The overall value of compensation payments currently (as of 28.02.2018) paid by the airport on the basis of court judgments is already 45,5 million PLN and regarded 584 filed claims. It should be noted that 83,5% adjudicated and executed compensation payments regarded the loss of value, seen as a result of introducing a RUA and only 16,43 % of compensation payments regarded planned (hypothetical) acoustic improvements (0,07% are claims for other types of loss). Consequently, only 7,48 million PLN has been dedicated to the protection of human health and the improvement of living conditions in accordance with the aims of environmental legislation and there are no tools to ensure that awarded money is spent for that purpose. Figure 3 presents the distribution of paid compensation awarded by the court (the OX axis – as % of the amount demanded by the owner, the OY axis the percentage

of cases adjudicated by the court). On average, the courts awarded compensation at 9% of the sum requested by the owner for loss of value.

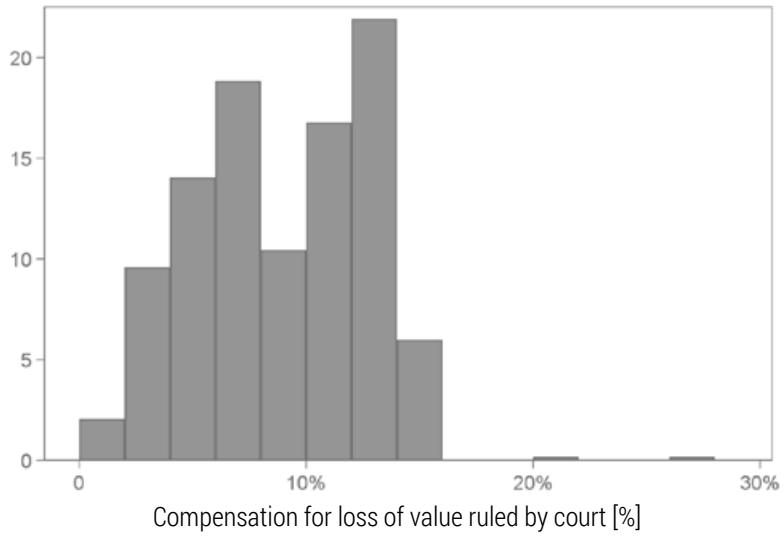

Figure 3. The distribution of executed compensation payments awarded by the court for loss of value, shown as a percentage of the demanded sum

Source: author's own work.

Similarly, the allocation of awarded compensation payments for loss of value between the inner (382 cases) and the outer (196 cases) zones allows to notice that on average, the awarded compensation in the inner zone was 10,9% of the demanded sum, while in the outer zone that percentage was 5,2% (figure 4).

A typical compensation case concerning a single family house located within a RUA (model property) may, for the purpose of constructing a model, be described in the following manner:

- market value is approximately 600 thousand PLN, with the cost of property replacement amounting to approximately 850 thousand (market price of land approx. 150 000 PLN and the buildings on land including other improvements approx. 700 000 PLN), with an average level of building depreciation (D_S) of about 34% (according to the calculation: D_S = {1- [700 000 PLN : (600 000 PLN –150 000 PLN)]}*100),
- the typical awarded loss of value compensation for the inner zone is 11%, that is 66 000 PLN, and 5% for the outer zone, that is 30 000 PLN,

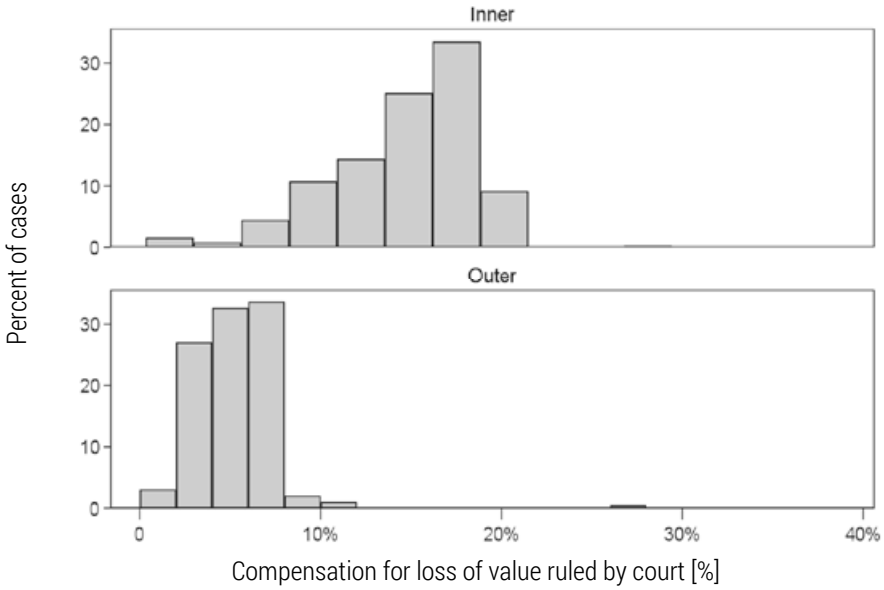

Figure 4. The distribution of executed compensation payments awarded by the court for loss of value, shown as a percentage of the demanded sum and with allocation between the inner and outer zones

Source: author's own work.

- the typical awarded costs of acoustic renovation (without taking into account the overlapping of claims and depreciation of outer windows, doors, ventilation, and top floor ceilings and roofs -without the building's elevation) is approximately 40 000 PLN,
- typical, superfluous costs of experts for the inner zone (reports on loss of value and costs of acoustic improvements) – 6 000 PLN, for the outer zone (report on loss of value) – 3 000 PLN,
- number of claims filed in court: 1230 out of which 750 concern the inner zone and 480 concern the outer zone.

The increased level of social costs for the model property located within the inner zone consists of:

- the full, typically awarded compensation for loss of value – 66 000 PLN,
- a part of the typically awarded costs of acoustic improvements, neglecting to account for the present technical state and depreciation (with depreciation of 34%), the assumed level is 40%, that is 16 000 PLN,
- the difference between typical, increased costs of expert opinions and the costs of such opinions in out of court settlements (6 000 PLN – 1,500 PLN) – 4,5 000 PLN,

- the difference between the typical, increased costs of legal representation and legal costs for out of court settlements (3 000 PLN – 500 PLN) – 2 500 PLN.

The increased social costs for the model property located in the RUA's inner zone are 89 000 PLN, which taking into account 750 filed claims amounts to 66 750 000 PLN.

The increased level of social costs for the model property located within the outer zone consists of:

- the full, typically awarded compensation for loss of value – 30 000 PLN,
- the typical, increased costs of expert opinions – 3 000 PLN,
- the difference between the typical, increased costs of legal representation and legal costs for out of court settlements (2 000 PLN – 500 PLN) – 1 500 PLN.

The increased social costs for the model property located in the RUA's outer zone are 34 500 PLN, which taking into account 480 filed claims amounts to 23 280 000 PLN.

Increased social costs in both RUA zones are equal to 90 030 000 PLN.

Conclusions

Achieving an effective, triangular intervention on the market of single family houses located in an airport's RUA requires utilizing a complex set of formal and methodological tools, which are very sensitive to mistakes regarding their proper application in market practice. This denotes that improper practice will obstruct achieving the purpose of the intervention, namely the protection of human health and of the capital (real estate) owned by the inhabitants of a RUA. The effectiveness of intervention is measured by the reduction of social costs.

The legal provisions in force should be assessed as correctly designed and as allowing to award compensation which is fair from an individual (real estate owner's) perspective, but is also effective in a market context and thus ensures that the intervention is effective, because social costs are lowered. Achieving this result requires a strict application and interpretation of art. 129 s. 2 and art. 136 s. 3 POE, which guarantees compensating the individual loss of a particular real estate owner. The indicated legal provisions also designate conditions for a fair differentiation of the amount of compensation, depending on the state of the owned property, which determines the extent of necessary acoustic improvements. It will, however lead to enrichment upon sale, because compensation paid for improvements is not adjusted for depreciation. The criterion of justice does not need to be further explained,

however when considering limiting the amount of speculative behavior it is worth considering, in the case of the subsequent sale of real estate, the introduction of provisions on the return of a part of compensation that was not adjusted for depreciation (a solution analogous to provisions on local development plans – Act, 2003, art. 36).

For just one of the airports considered in this paper (Poznań Ławica), 45,5 million PLN have already been paid in compensation (584 claims) and out of this sum only 7,48 million PLN were dedicated to the protection of health and the improvement of living conditions, however there are no mechanisms to ensure that money awarded for costs of hypothetical acoustic renovations will ever be spent for that purpose.

The provision of art. 136 s. 3 POE corresponds with local law (the resolution on establishing the RUA), which does not burden real estate owners with duties they do not consider as necessary. Local law, following the premise that law is not retroactive, does not require owners of houses already erected at the time a RUA is established to perform any acoustic improvements. However upon the introduction of a RUA, should they choose to do so (an option from the point of view of economics), they are provided with a claim to have all money factually spent on acoustic renovation of buildings reimbursed by the airport. Such a solution is based on the fair value of loss, which reflects the relation between two specified parties (in particular the situation of the homeowner as the weaker party is taken into account) and ensures the reimbursement of money actually spent on acoustic renovation, without subtracting for the depreciation of the building. This solution is market effective, because improvements are carried out voluntarily and only to the extent that fulfills the owner's individual needs. In addition, free market competition is respected, because the condition of imitating the market is met.

The lack of social effects of the intervention analyzed in this paper is caused by a faulty interpretation of the law by the courts, who should have relied on a strict and literal interpretation of the provisions in force. In the case of the Poznań-Ławica Airport the courts' opinion was supported by the opinions of a narrow group of expert witnesses, who indiscriminately accepted court requests for expert opinions. Unfortunately, the courts' requests were improperly drafted with regard to what the expert was to ascertain and the experts neglected to follow good practice rules known from similar purposes of valuation (e.g. for planning gains, see: Act, 2003, art. 36) and to apply professional norms (Guidebook, 2013, p. 15) that deal with the problem of valuing overlapping claims.

The main problem is identifying money actually spent on improvements with the hypothetical cost of potential improvements. This causes a further mistake allowing for double compensation of one loss. Money is awarded for

potential acoustic improvements (which is wrong also because the calculation does not include depreciation) and for loss of value, when the intervention does not restrict or change the use of land. The real estate in question is the same before and after the intervention, the latter only "implementing" environmental depreciation (by introducing acoustic standards for new buildings). The intervention does not introduce a new market variable and does not change the market equilibrium (the supply does not change). Therefore it may be associated only with the deterioration of a market feature (the technical state). A successful claim compensating acoustic improvements either "fixes" this market feature (from the market perspective of hypothetical buyers) or improves it for the current owner (in terms of use) and therefore there is no justification for attempts to calculate the loss of value of the property.

The social effect of a faulty interpretation of the law is visible in the overburdening of airports with compensation payments and negatively influencing their financial condition by forcing them to create financial reserves for potential (but unjustified) compensation payments for loss of real estate value. This may cause insolvency and always negatively impacts the financial standing of enterprises providing indispensable, public utility services. The potential, increased social costs for a model property in the RUA of Poznań – Ławica airport (taking into account the current number of claims – 1230) have been calculated at over 90 000 000 PLN, out of which 66 700 000 PLN concern buildings in the inner zone, and 23 300 000 PLN in the outer zone.

The financial dimension of the improper application of the law proves that the mistake is systemic. It is suitable to quote Bastiat who said "the intellect is (…) a useless encumbrance" (Bastiat, 2015, p. 33) since the analysis of the problem and the arising doubts have been limited to a very formalistic approach of considering the effects of awarded compensation only in in the context of each individual case. The missing element is a broader, market perspective on the purpose and conditions of the intervention. What was neglected are the effects experienced by airports of this formalistic understanding of the intervention. A formal analysis is always indispensable, however in the case at hand, it proved insufficient to comprehend the factual effects of the intervention. A systemic mistake is caused by an institutional loophole consisting of the lack of agreed and common for both law and economics methodological bases of analyzing new economic phenomena. Hayek identifies the roots of the above as the separation of disciplines, which in particular concerns two oldest branches of science, namely economics and law (Hayek, 1978, p. 4). Abandoning this division is a step towards integration necessary for the protection of the environment in the context of sciences such as economics, chemistry and technical studies (Famielec, Famiec, 2016,

pp. 24-38). It seems that only then will it be possible to perform complex economic analyses, which will allow to understand the activities of humans (Kostka, 2015, pp. 10-25), in this case on the real estate market. The latter must be viewed as a part of the environment.

Situations in which compensation exceeds justified social costs are analogous, when considering the reduction of social welfare, to arguments put forward by Bastiat in his essay on the baker's window broken by a hooligan (Bastiat, 2015a, p. 17). The position of the glass repairman who makes money on the baker's misfortune is assumed by households (which consume excessive compensation payments) and by lawyers, whose role in provoking the households is difficult to underestimate. In this context, the present publication is an attempt to solve the problem by applying a common methodology for law and for economics, which shifts deliberations in the direction of the economic analysis of the law.

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The contribution of the authors

Iwona Foryś – 33,33%
Magdalena Habdas – 33,33%
Jan Konowalczuk – 33,33%

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ECOSYSTEM SERVICES IN THE APPRAISAL OF THE ECONOMIC PERFORMANCE OF URBAN REGENERATION PROJECTS EXEMPLIFIED BY THE JESSICA INITIATIVE

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ABSTRACT: The purpose of this paper is to indicate the valuation importance of externalities derived from the urban ecosystem services (UES) in terms of their applicability in the appraisal process of urban regeneration projects co-financed from European funds. Specifically, it examines the impact of UES on the project's economic performance, and thereby on human quality of life. Using the discounted cash flow method, this paper estimates the project's economic performance indicators including the identified UES upon their prior valuation. The valuation was carried out on the basis of the benefit analysis, contingent valuation method – "willingness to pay" – and benefit transfer method, as recommended by Bernaciak, Wojcieszak (2014) and Zawojska et al. (2016). Results show that urban projects including UES are characterised by the higher values of the economic performance indicators and they should be assessed higher than projects with little or no UES because of their stronger contribution to the sustainable development of urban areas. In spite of the fact that there are limitations due to the UES valuation techniques used in the study, the presented approach could be an important tool for the project's appraisal.

KEY WORDS: urban ecosystem services, environmental externalities, economic performance, urban regeneration, JESSICA initiative

Introduction

Many Polish cities have faced economic hardships in recent years, mainly due to structural changes in the national economy. The most common problem is the relatively high levels of socio-economic disparities, which are proving to be a major challenge in urban areas. The existing inequalities, arising from the progressive degradation of the material substance as well as adverse demographic changes, have had a negative impact on the local labour market and discourage businesses from investing (OECD, 2011). In order to counteract this tendency, a considerable number of regeneration projects have been implemented aimed at supporting sustainable urban development through an integrated approach that takes up the social, economic, demographic and environmental challenges of urban areas.

Dealing with multiple aspects of sustainable development, all urban projects need to face the challenge of protecting the environment and promoting a more efficient and responsible use of natural resources. It means that individual projects should pursue operations to upgrade the physical environment on the one hand, but, on the other, they may also use the components of nature in a safe and responsible manner to improve resilience and quality of life in cities. All kinds of benefits that derive from the environment through natural processes, commonly known as ecosystem services (ES), should be taken into account when planning urban regeneration activities (Markandya, 2016). However, each project is subject to specific rules and assessment procedures to make sure that it is in line with general environmental objectives and provides the expected economic and social benefits. For instance, all the projects co-financed from European funds are assessed in the view of both the financial profitability and the economic performance. This entails, in turn, quantifying all possible ES and expressing their value in purely monetary terms, so that they could be included in the economic performance indicators.

A limited amount of available financial resources, combined with the relatively large-scale needs in urban areas, resulted in creating a new instrument, i.e. the JESSICA initiative (Joint European Support for Sustainable Investment in City Areas). JESSICA, contrary to traditional grants, consists of the use of revolving instruments (loans, guarantees) that allow for achieving a multiplier effect of the actions implemented (Musiałkowska, Idczak, 2018a). The JESSICA regulations indeed provide that the projects should not only ensure financial viability, but should in particular achieve socio-economic and environmental returns. Put simply, the projects should contribute substantially to the quality of life by generating broadly defined benefits that

enrich communities as a whole. In this sense, ES may be considered as a special type of externalities that spill over from the regeneration projects and affect the society at large. Thus, the main aim of the study is to demonstrate the valuation importance of externalities derived from the urban ecosystem services (UES) in terms of their applicability in the appraisal process of urban regeneration projects. In order to achieve this aim, we will focus on identifying those urban ES which can be recognized, with regard to regeneration projects, as appropriate for enhancing people's living conditions in cities. Subsequently, the identified ES will be valued. As a next step, with the use of the cost-benefit analysis indicators, the ES impact on the economic performance of regeneration projects will be assessed. The study builds on the data in principle on all projects implemented within the framework of the JESSICA initiative in Poland during the 2007–2015 period. However, the research sample covers five projects, one from each region implementing the JESSICA.

This study contributes to the debate on UES and, by showing their complex and valuable nature, highlights that they should be an area of particular interest for policy-makers, especially in the fields of sustainable urban development.

An overview of the literature – ES as urban environmental externalities

Ecosystems provide a great variety of basic functions that are essential for the sustainable use of the natural resources and thus serve the purpose of safeguarding the earth's capacity to sustain life in all kinds of its diversity. It seems intuitive to start by defining ES. De Groot, Wilson, Boumans (2002, p. 394) argue that ecosystem functions are the results of natural processes and components which provide goods and services that, in turn, satisfy human needs, directly or indirectly. Along their line of thought, these functions give rise to ES which subsequently may be utilised by human beings. Boyd, Banzhafa (2007, p. 619) consider ES as "components of nature, directly enjoyed, consumed, or used to yield human well-being". The major point here is that only the end-products of nature can be seen as ES and not intermediate services or goods. Fisher, Turner, Morling (2009, pp. 644-646) extend this concept and note that ES are all aspects of ecosystems which can be utilised in an active or passive manner by humans to produce their well-being. Hence, ES are, apart from goods, both functions and processes as well if there are humans that benefit from them. Many other researchers also refer to this approach and define ES in a wide sense as the overall benefits that people receive from ecosystems (Mizgajski, 2010; Mrozik, Idczak, 2017; Poskrobko,

2010; Solon et al., 2017; Żylicz, 2010). Thus, it is argued that ES are all those services which make humans beneficiaries of ecosystems.

When dealing with ES, a particular attention in the literature is drawn to urban ecosystem services. The functioning of cities depends to a large extent on a healthy natural environment that, on the one hand, still provides many benefits, i.e. ES, whilst – on the other hand – it determines their development by indicating the carrying capacity (more details on this topic can be found in for instance: Carey, 1993; Idczak, Mrozik, 2017). A central aspect of these writings is the emphasis on sustainable urban development because ES have a positive and lasting impact on human well-being and economic activities which, in principle, should be consistent with a sustainable social and physical environment (Lorek, 2015, pp. 102-103). Urban ecosystems are shaped mostly by the green and blue spaces that may be found in urban and peri-urban areas including parks, gardens and yards, cemeteries, business settings, urban allotments and forests, single trees, green roofs, wetlands, streams, rivers, lakes, ponds, etc. (EEA, 2011, pp. 30-36). In this respect it should be underlined that the quality of life in cities depends on urban ecosystem services (UES). They offer spaces for instance for social interactions and places for children's play in the neighbourhood. Moreover, they provide opportunities for stress recovery, physical activity and leisure time, and play an essential role in protecting health. In addition, UES contribute substantially to preventing flooding and reducing the urban heat island effect (EEA, 2011, pp. 40-47; Kronenberg, 2012, pp. 16-27). In sum, there is a rationale for UES as natural benefits that are economically viable and sustain human communities.

As regards urban ecosystems, there are strong arguments that they may be considered as positive environmental externalities. Laffont (2017) referring to the general equilibrium theory claimed that externalities are indirect effects of activities on "agents other than the originator of such activities which do not work through the price system". This means, in other words, that someone's performance (e.g. in production or services) depends on factors that are outside her or his control, but are determined by other producers or humans. What is more, the benefits or costs of these factors cannot be omitted from someone's activity (Krugman, Wells, 2012, pp. 765-798; Stiglitz, 2013, pp. 253-286). However, in contrast to many researchers (Capello, Faggian, 2002; Hołuj, 2018; Paradowska, 2006; Regnier, Legras, 2018; van den Bergh, 2010; Verhoef, Nijkamp, 2008) who explore environmental externalities mainly as negative effects arising from the ongoing increase in levels of urbanisation, urban ecosystems that go hand in hand with urban sustainable development may provide a range of benefits for city's residents. This, in turn, suggests that the provider of these benefits cannot receive any compen-

sation, that is, they are non-market benefits. Nevertheless, these benefits can occur as direct or indirect outcomes of measures or concrete projects implemented in urban areas, and consequently can be used for the appraisal of their total welfare effects on society (Fiedor, 1990). Thus, the positive environmental externalities (benefits provided by UES within the framework of urban projects may induce positive side-effects not only on the environment but also on society. These are then known as positive social externalities. In this study, however, we do not split the positive externalities into these two categories) provided by UES can be applied in the assessment of the economic efficiency of urban projects in which the environmental aspects have an important relevance (Máñez, Cerdà, 2014, pp. 19-22). It should be added that they are often neglected in the assessment analysis because they are difficult to measure and, more importantly, often difficult to value.

The JESSICA initiative to support sustainable urban development

The JESSICA initiative was introduced to the EU Cohesion Policy by the European Commission, the European Investment Bank (EIB)and the Council of Europe Development Bank in order to increase the amount of funds for the sustainable development of urban areas. The initiative is based on a revolving mechanism that employs the use of loans or guarantees under one of the structural funds – the European Regional Development Fund. It was an innovative and experimental approach to the planning of activities and projects by many entities, namely: regional authorities responsible for designing the scope of operational programmes (which are crucial documents for implementing the Cohesion Policy), EIB – being a so-called holding fund for the JESSICA allocations, Urban Development Funds (mainly private or semi-public institutions such as banks or development banks, e.g. Bank Ochrony Środowiska, Bank Zachodni WBK S.A., Bank Gospodarstwa Krajowego) that together with EIB introduce the elements of risk assessment and the market approach to the public intervention projects, and local authorities that are in charge of the delimitation of regeneration areas in the cities and are main stakeholder interested in solving the problems on degraded urban areas. It aimed at starting the multiplier effect, financial leverage, catalyzing public-private partnerships and the exchange of know-how between private and public partners (see figure 1) (Memorandum of Understanding, 2006). In Poland, the JESSICA initiative has been implemented since the very beginning – the 2007-2013 EU financial perspective. Five Polish regions: Mazowieckie, Pomorskie, Śląskie, Wielkopolskie, and Zachodniopomorskie

decided to include the initiative into their regional operational programmes. The scope of projects eligible for obtaining a loan was very broad and included e.g.: urban infrastructure (including for transport, water and sewage systems or power), heritage or places relevant to the culture (contributing to the development of tourism or other permanent use), development of brownfield sites (including cleaning and decontamination of the areas), creation of new commercial premises for small and medium-sized enterprises, development of information technology and research and development works, expansion of university buildings, and improving the energy efficiency (European Commission, 2013).

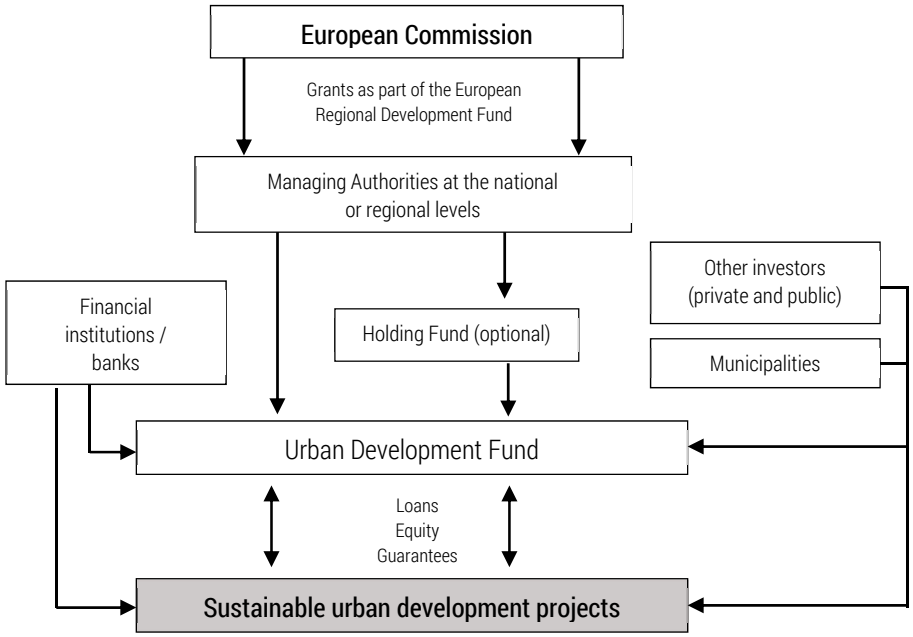

Figure 1. JESSICA implementation system

Source: Dąbrowski, 2014.

JESSICA had to be implemented through an integrated approach, which meant that "the measures concerning physical urban renewal should be combined with measures promoting education, economic development, social inclusion and environmental protection" (European Commission, 2014b). The urban projects executed within the framework of JESSICA were expected to render positive externalities for urban inhabitants, particularly in areas having substantial needs for a long period (reducing of negatives states, and increase in the quality of the life and work of citizens). The JESSICA projects

should incorporate all the driving factors considered as important for determining sustainable urban development and take into account urban problems in a coordinated way so as to be sustainable for themselves and for the entire city (Nadler, Nadler, 2018). Thus, each project required a comprehensive approach i.e. one tailored to the local needs, combining various aspects on a case-by-case basis: economic development, social integration, education culture, environmental issues, spatial planning, etc. (Musiałkowska, Idczak, 2018b). Only such projects have the potential to achieve results with regard to sustainable urban development and deliver a real added value.

Assessment of the economic performance

JESSICA projects must demonstrate not only a financial profitability that shows a project's ability to generate profits from its operations and determines return on investment (Musiałkowska, Idczak, 2018a), but also an economic efficiency that points out the project's contribution to welfare. Hence, the economic performance provides information to what extent a particular project, through its economic, social and environmental aspects, will contribute to the creation of social well-being. It covers as far as possible all the social and environmental externalities generated by the projects. This is possible because an economic analysis is made on behalf of the whole of society instead of just the project owners, as in the financial analysis (European Commission, 2014a, pp. 61-65). Economic analysis is one of the steps of the cost-benefit analysis (CBA) that provides the methods to be used to value all the benefits against all the costs created by the project and thereby constitutes an effective instrument for decision making on the co-financing of projects from public funds (including European funds). The CBA techniques are also recommended as useful tools to assess projects or policies aimed at improving the natural environment or other actions that affect certainly the environment as an indirect consequence (Atkinson et al., 2018, pp. 32-36; Kryk, 2003, pp. 71-108). In this sense, the importance of including ecosystem service values in the assessment analysis of projects or policies is significant and conducive to making decisions of greater benefits to society (Markandya, 2016).

CBA takes into account the advantages or disadvantages of an investment including tangible and non-tangible benefits (or costs) which cannot be valued in monetary terms in order to assess the project's economic performance (Kryk, 2013). These benefits can also generate positive non-market impacts and this is the reason why they, in the context of CBA, need special attention to be covered by the assessment. The impacts defined here as UES that spills

over from the project towards society must be expressed in measurable terms. The most common way to do this is to monetise the benefits and, by doing so, to obtain comparable financial values. Following this, these monetised benefits are used at the stage of the economic analysis to correct the financial cash flows by inserting their values to the cash flow statement. As a result, it is possible to measure the economic efficiency by calculating the economic performance indicators (for more, see next section). A project that is characterised by higher values of economic performance indicators, i.e. shows higher economic profitability, is more desirable because it provides goods or service, including also UES, which are more relevant for society.

Research methods

This section of the study seeks to examine empirically the importance and impact of UES in the appraisal of urban regeneration projects co-financed from European funds. This section outlines in particular the methods used to assess the impact of UES on the economic performance of this kind of projects. The research design is guided by the existing literature exploring links between ES and the urban perspective which was discussed in the previous sections. The empirical framework configured here consists of four stages that are discussed below.

1. *Identification of UES.* Firstly, we identified those urban ecosystem services which can arise along with implementing particular urban projects, and can be recognized, with regard to analysed projects, as appropriate for improving their economic efficiency through a positive effect on economic performance indicators. To do this we used in particular the concept of ecosystem services for Poland set out by Mizgajski and Stępniewska (2012, pp. 63-64).
2. *Valuation of UES*. This refers to putting a value on previously identified UES. As a result, the monetary valuation of UES provides evidence which can be incorporated into a project's financial accounts. Admittedly, in carrying out this ambitious task we confined our works to applying methods delivered by existing studies. More details on this will be given in the next section.
3. *Inclusion of UES in the project's cash flows*. This procedure aims at adding up the monetised UES to the economic cash flows. By doing so, we received economic performance indicators that include the impacts of UES on human quality of life. The economic analysis was made with the use of the discounted cash flow (DCF) method. The following rules were adopted (European Commission, 2014a):

- only cash inflows and outflows were considered,
- economic discount rate (EDR) – 5%,
- time horizon of the cash–flow forecasts covers 30 years,
- analysis carried out in constant (real) prices, i.e. fixed at a base–year,
- prices were net of VAT.

Economic performances were measured by two indicators – the Economic Net Present Value (ENPV) and the Economic Rate of Return (ERR) that are defined as follows:

$$ENPV = \sum_{t=0}^{n} a_t(S_t + UES_t^m) = \frac{(S_0+UES_0^m)}{(1+r)^0} +, \\ + \frac{(S_1+UES_1^m)}{(1+r)^1} + \cdots + \frac{(S_n+UES_n^m)}{(1+r)^n}, \tag{3}$$

$$ENPV = \sum_{t=0}^{n} \frac{(S_t+UES_t^m)}{(1+ERR)^t}, \tag{4}$$

where: S is the balance of cash flows at time t, and a_t is the economic discount factor chosen for discounting at time t. UES_t^m, in turn, denotes the monetised volume of the urban ecosystem services that were identified in urban projects at time t. Finally, r indicates the economic discount rate.

4. *Interpretation of the economic performance indicators*. The last step consists in comparing two options of results obtained from the use of the DCF method, where one option means "no UES in the cash flows", and another option involves adjusting the cash flows through the incorporation of UES. Projects including UES should indicate higher values on the economic performance indicator and thereby make a stronger contribution to the sustainable development of urban areas.

The empirical analysis presented in this study builds on a dataset containing details on all projects implemented within the framework of the JESSICA initiative in Poland during the 2007-2015 period. The data were provided by the Marshall Offices of all regions implementing the JESSICA initiative and also institutions acting as managers of the Urban Development Funds. The dataset was further completed with information derived from our own examination of other sources such as project descriptions, policy reports, official websites and field studies. All data on particular JESSICA projects stemming from various sources were merged for the purpose of this study and therefore enable studying the effect of UES on the project's economic efficiency.

Results of the research

The key empirical findings stemming from the study are summarised in table 1. However, before interpreting our results, we would just like to present in detail a few additional assumptions made during the research which underpin these findings. First of all, five projects were selected for the examination, that is, one from each of the regions in the analysis. The main criterion for the choice of projects for the purpose of this study was simple – those projects were taken which permitted the identification of UES in a clear and unambiguous manner. As a result, we have pointed to the two main groups of UES, where the first refers to the urban microclimatic regulation provided by trees and green areas, and the second covers the recreational (social) function. In order to estimate the economic value of the benefits, we used the minimum service value approach – which means that only those benefits are included in the valuation whose quantity and value can be calculated most precisely (Bernaciak, Wojcieszak, 2014, pp. 190-193). As for the benefits supplied by trees and green areas, we valued the absorption of carbon dioxide, oxygen production and water retention. To this end, we applied reliable techniques based on the recommendations of Bernaciak and Wojcieszak (Bernaciak, 2015; Bernaciak, Wojcieszak, 2014). When it comes to the valuation of the recreational (social) function, we used a similar procedure as described for instance by Lupa (2013); however, this was apart from the fact that the prices in the method (*Contingent Valuation Method – Willingness to Pay*) were taken from other studies, and do not result from the survey. This is since the procedure refers to the benefit transfer technique following the study of Zawojska et al. (2016) which provides a brief overview of how to extrapolate the results of other studies. It is also worth noting that the valuation of EUS as such was not the subject of the study but only a significant means to achieve the study objectives.

Returning to the findings, it is now possible to state that UES may have a significant impact on the given project's economic efficiency. The results displayed in table 1 confirm our expectations, and illustrate that the incorporation of the monetised UES into the given project's cash flows leads to an increase in the level of economic performance indicators – see the two last columns. A closer look at the values of these indicators reveals an evident increase of their value in all the projects analysed. However, what also clearly emerges from these columns are distinct differences in the level of the indicators between the first two projects and the other. The first two projects deal directly with the natural environment by creating the conditions conducive for people's physical activity and health, while preserving the natural resources and ensuring the need for their sustainable use. For instance, the

Table 1. JESSICA projects: the identified urban ecosystem services and their valuation

Region	Project's name	Project's value	CICES Section*	Ecosystem Services Class	Benefits**	Value of provided benefits a year	Increase of ENPV by PLN	Increase of EIRR by p.p.
Mazowieckie	Enhancing the quality of life of the inhabitants of the city of Legionowo through the construction of the "Health Park" in the urban regeneration area	2 941 176.47	Regulation and Maintenance	Urban microclimatic regulation	AofCD, OP and WR by trees and green areas	1220.52	576 009.84	3.18
			Cultural	Cultural landscapes	recreational (social) function	45 000.00		
Pomorskie	Land use at Sikorski street through the construction of the sports and recreational facilities in Pruszcz Gdański	1 742 484.87	Regulation and Maintenance	Urban microclimatic regulation	AofCD, OP and WR by trees and shrubs	18 732.86	345 612.73	4.97
			Cultural	Cultural landscapes	recreational (social) function	9000.00		
Śląskie	Providing new functions of the hospital and its green areas through the creation of a place for the leisure and relaxation facilities and the reconstruction of a part of the hospital's building aiming at the establishment of the dialysis clinic in Jastrzębie Zdrój	3 379 102.03	Regulation and Maintenance	Urban microclimatic regulation	AofCD, OP and WR by green areas	1453.00	74 187.54	0.38
			Cultural	Cultural landscapes	recreational (social) function	4500.00		
Wielkopolskie	Development of the Poznań Industry and Technology Park – stage II	30 360 000.00	Regulation and Maintenance	Urban microclimatic regulation	AofCD, OP and WR by trees and green areas	6384.41	79 563.80	0.04
Zachodnio-pomorskie	Reconstruction of the old "Goplana" cinema into the Cultural Centre in Połczyn Zdrój	5 567 205.98	Regulation and Maintenance	Urban microclimatic regulation	AofCD, OP and WR by trees	9037.47	174 937.93	0.54
			Cultural	Cultural landscapes	recreational (social) function	5000.00		

* CICES – The Common International Classification of Ecosystem Services

** AofCD – the absorption of carbon dioxide, OP – oxygen production, and WR – water retention by trees and green areas

Source: author's own work.

increase of EIRR amounted to 3.18 percentage points for the project implemented in the Mazowieckie region and 4.97 p.p.s for the project executed in the Pomorskie region. Conversely, the other projects covered investments in the infrastructure of buildings where the environmental components were used – in a way – as additional or supplemental elements of the whole, but required by general provisions and the law. These projects supported nature by establishing new green areas and/or providing some recreational opportunities for inhabitants. The increase of EIRR, however, does not exceed 1 p.p., and in the case of the project implemented in the Wielkopolska region, it amounted to only 0.04 p.p.s. This does not necessarily mean that this particular project provides only little UES. But one possible explanation for this is that the range of benefits provided by the project is disproportionate in view of its "infrastructural core". In this respect, it appears clear that projects which are more concerned with the natural environment, and thereby also provide much more benefits in terms of UES, will distinguish themselves with higher economic performance indicators.

Interesting insights come also from the analysis of the kind of UES identified in reference to projects included in the study. All the benefits were classified in two sections, e.g. Regulation and Maintenance, and Cultural. These findings indicate that urban projects can deliver benefits (non-material and non-consumed outputs of ecosystems) that affect the performance of people and their activities, and have a cultural or intellectual significance. This fact contributes, in turn, to explaining why the inclusion of UES for the appraisal of urban regeneration projects is so important. Urban projects providing UES regulate the widely defined physico-chemical and biological environment of people's life and constitute the basis for satisfying their spiritual, emotional and psychological needs. Thus, urban projects including UES, that is, characterised by a higher value of ENPV and EIRR, would be assessed higher than projects with little or no UES and, more importantly, they support a more sustainable pattern of urban development.

Conclusions

The analysis of the economic performance is an essential tool for the given project's appraisal in the light of the project's contribution towards achieving the significant objectives of urban policy. The EU Cohesion Policy stresses the urban dimension and provides that the urban development should be achieved through an integrated approach which meets the existing and new needs of urban areas. This implies that actions concerning physical urban renewal should be combined with measures promoting education,

economic development, social inclusion and environmental protection. It is, however, clear that such an objective can be achieved only by implementing comprehensive urban projects that are tailored to the local needs and bring together various aspects of urban life.

An important observation made during the analysis is that the UES generated by a particular project can be seen as positive environmental externalities and contribute to the creation of social well-being. More specifically, UES can be used in the assessment of the economic efficiency of urban projects, which illustrates the performance obtained without isolation from the environmental and social context. The economic performance indicators demonstrate, then, the given project's overall impact on human quality of life because they also take into account the value of UES, upon their prior quantification and monetisation. Thus, these indicators give a real indication of whether or how much benefits provided by projects involving UES outweigh the benefits provided by projects without UES. In this sense, the proposed approach provides a decision-making tool with a broad environmental and societal perspective. Tracking these indicators, in turn, appears to be especially valuable to policy makers, both in terms of assessing whether to intervene and what kind of intervention will be of greatest benefit to society. All in all, the economic performance indicators that take account of UES may serve, at the appraisal stage of the regeneration projects, as a baseline for prioritising investments (projects) in deprived urban areas by informing on their overall contribution towards the creation of wealth and growth. They can be not only an important tool for the given project's appraisal but also a stimulus for further sustainable urban development.

Finally, this study has hence several limitations that should be addressed in future studies. It analyses the impact of UES on the economic performance of the urban projects. However, it uses at the same time a loose approach to the quantification and monetisation of UES, drawing on attributes provided by the literature. Needless to say, measuring and valuing UES is a somewhat difficult and contentious undertaking. Future studies on this topic are therefore required in order to overcome these difficulties and to determine more objective and accurate procedures of UES valuation, which consequently make it possible to objectively compare in the appraisal the economic priority of different urban projects. Despite this, we believe our findings add to a growing body of knowledge of the ecosystem services and their application in decision-making.

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The contribution of the authors

Piotr Idczak – 50% (concept of the paper, literature review, data collection, data analysis and interpretation, drafting the text).

Ida Musiałkowska – 30% (concept of the paper, literature review, data collection, data analysis, drafting the text).

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Małgorzata CICHOŃ

VALUATION OF LAKE ECOSYSTEMS OF CENTRAL POMERANIA BY YOUNG PEOPLE USING THE CONTINGENT VALUATION METHOD

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ABSTRACT: The article presents the results of the survey using the Contingent Valuation Method. The aim of the research was to estimate the value of selected lake ecosystems of Central Pomerania by determining the willingness to pay for recreational use of the beach with the swimming area by people aged from 18 to 21 years. The research shows that 90% of the surveyed group declares their willingness to pay. The highest amounts are offered by young inhabitants of Szczecinek City and Szczecinek County. On the other hand, tourists resting in Central Pomerania value lake ecosystems most often on the basis of aesthetic values, without knowing the ecological condition of the lake. The average ticket price which the respondents are willing to pay is PLN 20.40 per day. The lower the ecological condition of the lake, the lower the willingness to pay, especially among the inhabitants of the region under study. The amounts declared constitute important information for lake managers who are able to compare the costs incurred so far with the potential profits from ticket sales. Moreover, thanks to the use of the Contingent Valuation Method, it is possible to determine which lakes have the highest value for recreationists and to manage them in such a way as to prevent their degradation in the future and, consequently, to prevent the deterioration of the value of ecosystem services.

KEY WORDS: ecosystem services, lakes, recreation, Contingent Valuation Method, Willingness To Pay

Introduction

The concept developed by Hardin (1968) called the tragedy of the common pasture shows that a common good may be destroyed if it is used by too many people. The lake ecosystems subjected to tourist use are a good example of goods affected by this social trap. Degraded ecosystems are losing value and the number and quality of services they provide is declining (Bernaciak, Cichoń, 2012). The problem of inappropriate lake management, especially in lake areas whose development depends on services provided primarily by lake ecosystems, is becoming more and more frequent. The inhabitants of these areas should be aware of this dependence, which should translate into willingness to take up costs. Young people should be particularly interested in the condition of lakes, as they make up 80% of all holidaymakers and, at the same time, will assume responsibility for their administration in a few years' time. It is difficult to determine what the management of lakes by the next generation will look like, because there is no research in this area, but the existing research indicates that young people opt for a consumer-oriented approach. This finding has been corroborated by the research carried out by, among others, Cichoń (2008). In her opinion, young people are guided by economic arguments, and in the hierarchy of values, biotic and abiotic elements of nature occupy the last place.

Therefore, the aim of the present study is to estimate the value of the ecosystems of coastal zones of lakes in Central Pomerania by young people in accordance with the assumptions of the Contingent Valuation Method. The Contingent Valuation Method is one of the commonly used methods of environmental valuation taking into account the degree of willingness to pay. According to Rauba (2016), it is based on surveys conducted among respondents interested in a given good or service. During the survey, respondents were asked how much they would be willing to pay for access to a given good or service (i.e. what is their Willingness To Pay – WTP). In the literature there are numerous publications in which the Contingent Valuation Method has been applied, for example in the works of Żylicz et al. (1995), Ligus (2008), and Wróblewska (2014).

In accordance with the assumptions of the Contingent Valuation Method, each respondent should declare their willingness to pay for one day of recreational use of a selected coastal zone (beach with a swimming area), knowing that the funds obtained from ticket sales would be spent on maintaining or improving the ecological condition of the coastal zone of the lake. In this context Directive 2000/60/EC of the European Parliament and of the Council of

23 October 2000 serves as the reference document defining the parameters of the ecological status of water.

Research area and methods

The survey and interviews were conducted in the years 2006-2017 on a group of over 1000 respondents living and resting in Central Pomerania (figure 1). The selection of respondents was random. The study conducted by the present author analyzed the results of questionnaires from 2014 and 2015 only.

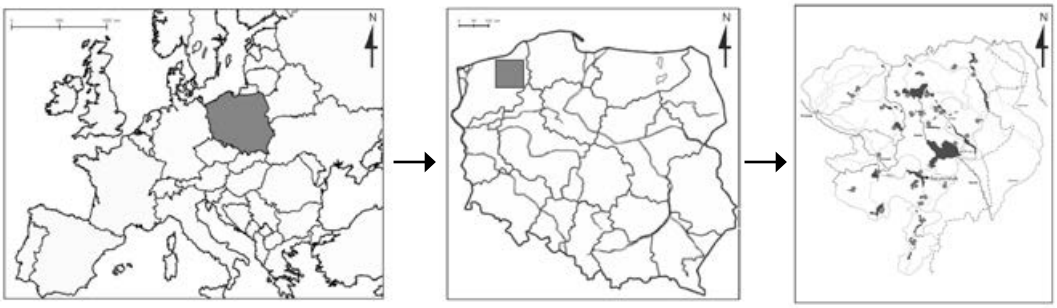

Figure 1. Location of the research area

Source: author's own work.

Two assumptions were made to corroborate the assumptions: the first one – respondents were aged from 18 to 21 years, and the second one – their place of residence was different. The respondents were divided into four groups: residents of the Szczecinek City, residents of the Szczecinek county, residents of the Western Pomeranian Region and respondents representing tourists from all over Poland. Each group was populated with 20 respondents. The detailed analyses included the results of 80 people in total. Due to the size of the sample, the present study is a pilot study, and it should serve as a departure platform for further research. In the research procedure, each of the 80 respondents were first asked to complete a questionnaire, where they determined, among other things, the frequency of rest at a given lake, factors determining the choice of beach and swimming area as a place for rest, beliefs and actions in the field of lake protection. The respondents were additionally asked to select the most beautiful beach and swimming area from among eleven shown to them in the photographs (two beaches and swimming areas, at Lake Wierzchowo and Lake Trzesiecko, were used twice), and subsequently they were asked to determine the amount that would be

willing to pay for one day of recreational use of the beach and swimming area of their choice, knowing that the funds obtained from ticket sales would be spent on maintaining or improving the ecological condition of the shore. Thanks to the metric included in the survey (gender, age, education, net monthly salary, place of residence) it was possible to analyze the results.

Results

Exactly 90% of young respondents declare their willingness to pay for the use of the beach and the swimming area. People living in Szczecinek and in the Szczecinek County are willing to pay PLN 24.90 and PLN 24.70, respectively, for rest on a selected beach, while residents of the region of Western Pomerania are willing to pay PLN 19.20 and tourists from other areas of Poland are willing to pay PLN 19.60.

Table 1. Average ticket price declared by four groups of residents for recreational use of a selected beach [person/day]

Photo	Lake	Residents of Szczecinek	Residents of the Szczecinek County	Residents of the Western Pomeranian Region	Residents of Poland
1	Lake Wierzchowo	15.0	0	0	4.0
2	Lake Czarne	25.0	0	0	0
3	Lake Sarcze	0	80.0	5.0	0
4	Lake Trzesiecko	0	0	0	10.0
5	Lake Białe	12.6	1.0	28.0	0
6	Lake Wielimie	10.0	5.0	3.0	13.8
7	Lake Radacz	0	45.0	0	60.0
8	Lake Wierzchowo	1.0	17.5	2.5	5.0
9	Lake Spore	40.0	0	0	5.0
10	Lake Łobez	26.0	38.8	22.5	21.6
11	Lake Trzesiecko	32.7	9.2	31.7	13.3

Source: author's own work.

In the opinion of almost 30% of the respondents the most beautiful beach is located in Szczecinek on Lake Trzesiecko (figure 2). This group included mainly tourists from various regions of Poland (7/20 persons), the Region of Western Pomerania (6/20 persons) and the Szczecinek county (6/20 per-

sons). The average ticket price is PLN 21.80 (figure 2) and PLN 10.00 (figure 3). The residents of the Region of Western Pomerania were willing to pay the highest price for the ticket to access the beach in Szczecinek shown in Photo 1 – PLN 31.70, whereas the inhabitants of the Szczecinek County were willing to pay the lowest price – PLN 9.20 (table 1). The willingness to pay the lowest price was motivated by the knowledge shared by the residents about the low quality of lake water (table 2) and numerous investments carried out in order to aerate the waters of Lake Trzesiecko (figure 3).

Figure 2. Beach in Szczecinek on Lake Trzesiecko

Source: author's own work.

Figure 3. Contaminated water of Lake Trzesiecko on the beach in Szczecinek

Source: author's own work.

The second beach, which enjoyed great interest, was the developed city beach and swimming area in Biały Bór on Lake Łobez (figure 4). Nearly 19% of the respondents, mainly from the Szczecinek County and the Region of Western Pomerania, voted for this artificial beach. The average price which they would be willing to pay was PLN 26.60 (table 2).

Figure 4. City beach in Biały Bór on Lake Łobez Figure 5. Beach in Spore by Spore Lake

Source: author's own work.

Figure 5. Beach in Spore by Spore Lake

Source: author's own work.

The most varied choices appeared among young residents of Szczecinek (tables 1 and 2). Apart from the two coastal zones mentioned above, they indicated the beach and the swimming area on Spore Lake (figure 5) in Spore (4 out of 20 people), and the average price they were willing to pay was PLN 40. Respondents also liked the beach on Lake Białe; they were willing to pay PLN 13 for its use. On the other hand, young residents of the Szczecinek County (4 out of 20 people) highly valued the beach and swimming area on Lake Wierzchowo (table 2) proposing to pay an average of PLN 17.50 per ticket and PLN 9.60. The beaches and swimming areas on Lake Białe and Lake Wierzchowo were among the most valuable ones according to the choice made by the residents of the Region of Western Pomerania. On the other hand, tourists representing all Poland also picked Lake Wielimie with the beach in Gwda Wielka, but the amount they were willing to pay was among the lowest ones, i.e. PLN 8.90. Taking into account all the values indicated in the case of this beach, they reduced the price of the ticket to PLN 9.60 (table 1). The relatively low value of this beach results from its poor accessibility, despite its very charming location and class II water purity.

Table 2. Willingness to pay for the use of the beach, average amount in PLN [person/day] taking into account the ecological condition of the lakes (Directive 2000/60/EC, 2000): I – very good, II – good, III – moderate, IV – poor, V – bad

Photo	Lake	Ecological condition of lake waters	Percentage of respondents interested in the coastal zone	Minimum ticket price	Maximum ticket price	Average ticket price
1	Lake Wierzchowo	II	3.8%	4	20	17.50
2	Lake Czarne	II	2.5%	20	30	25.00
3	Lake Sarcze	II	3.8%	0	80	30.00
4	Lake Trzesiecko	IV	1.2%	10	10	10.00
5	Lake Białe	II	8.8%	1	50	17.60
6	Lake Wielimie	V	10.0%	1	20	8.90
7	Lake Radacz	III	3.8%	40	60	30.00
8	Lake Wierzchowo	II	11.3%	0	50	9.60
9	Lake Spore	II	8%	0	100	27.50
10	Lake Łobez	II	18.8%	4	80	26.60
11	Lake Trzesiecko	IV	28.8%	0	100	21.80

Source: author's own work.

The above results confirm the practical approach of young respondents to choosing the beach as a place of rest. The better developed the beach, the greater the willingness to pay for the use of recreational services. The results confirm earlier studies that the individual assessment of the resting person is determined by the ability of the place to meet specific needs. If we take into account the needs of contemporary youth, including the availability of beaches and recreational infrastructure, urban beaches meet their expectations. However, if we compare the average ticket prices presented in this study (tables 1 and 2) to the average ticket prices declared by respondents from Central Pomerania aged 15 to 80 in 2011 (Bernaciak, Cichoń, 2013), we will notice that young people begin to appreciate the cleanliness of the beach and swimming area. For example, in 2011 the average ticket price for using the coastal zone of Lake Wierzchowo in one day was PLN 13.50, and in 2014-2015 – PLN 17.50 (table 2). Another example concerns Lake Spore – in 2011 the average ticket price was PLN 18.90, while in 2014-2015 – PLN 27.50 (table 2).

Table 3. Valuation of ecosystems in selected coastal zones of lakes (beaches and swimming areas) and the potential amount possible to obtain from ticket sales in the summer season

Photo	Lake	Average ticket price [PLN]	Average number of people per day	Average number of rest days	Revenue from ticket sales [PLN]
1	Lake Wierzchowo	17.50	55	40 days	38 500
2	Lake Czarne	25.00	15	20 days	7 500
3	Lake Sarcze	30.00	40	35 days	42 000
4	Lake Trzesiecko	10.00	30	10 days	3 000
5	Lake Białe	17.60	5	15 days	1 320
6	Lake Wielimie	8.90	75	50 days	33 375
7	Lake Radacz	30.00	20	30 days	18 000
8	Lake Wierzchowo	9.60	15	15 days	2 160
9	Lake Spore	27.50	30	35 days	28 875
10	Lake Łobez	26.60	65	40 days	69 160
11	Lake Trzesiecko	21.80	70	40 days	61 040
		20.40			304 930

Source: author's own work.

These examples show that despite difficulties in accessing the two lakes and travel costs incurred (about 15 km), young people choose to rest at a clean lake, often at the expense of infrastructure. According to Bernaciak and Cichoń (2013) lakes with a low level of pressure are perceived as worthy of higher expenditure.

To sum up, the willingness to pay for the use of a selected beach per day amounted on average to PLN 20.40 for all respondents. Assuming that mainly young people (80% of holidaymakers) will want to use paid beaches, lake shore zone managers will receive over PLN 300,000 in season tickets (table 3). For comparison, the cost of aeration and restocking Lake Trzesiecko is PLN 400,000 per year.

Conclusions

Studies on the valuation of lake ecosystems on the basis of photographs conducted among four groups of young people indicate differences in the valuation of ecosystem services. Young people, who do not live in Central Pomerania but only rest there, assessed the lakes from the aesthetic point of view, while the inhabitants of the region assessed them with regard to ecological condition and accessibility. Hence the differences in the declared ticket prices between the inhabitants of Szczecinek City and Szczecinek County and tourists from Poland and the region. It is difficult to determine the reliability of the declarations made by the surveyed youth, especially as the increase in willingness to pay does not correlate with age or income, but rather with the presence of tourist infrastructure and attachment to the place of residence. Nevertheless, the average ticket price of PLN 20.40 per day seems to indicate a high level of willingness to pay for the use of the beach and the swimming area. Comparing the amount of PLN 300,000 with the costs of maintaining the ecological condition of one lake, the value of selected lake ecosystems seems relatively low. For comparison, the total willingness to pay of the local population in Finland at Lake Pielinen amounts to about EUR 240,000 – 440,000 per year (Lehtoranta et al., 2013).

The results show that lakes, especially Lake Trzesiecko and Lake Łobez, are treated by young people as a common good that can be used for recreational purposes. Young people are aware of which economic operators are polluting the lakes, so when lakes are being degraded, they are more likely to spend money on travel and change their place of rest than to rehabilitate a reservoir. The solution, however, is not to look for another place to develop a new beach and a new swimming area, but to ensure that the recreational use of the lakes is evenly distributed. Thanks to appropriate environmental edu-

cation and social participation, young people should understand that lakes, together with resource, regulatory, supporting and cultural services, constitute a "natural capital" for the next generations of Central Pomerania.

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CHANGES IN THE BEHAVIOR OF ORGANIC FOOD CONSUMERS

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ABSTRACT: The purpose of this paper is to discuss the purchasing behavior of organic food consumers based on survey findings, and to identify the change patterns by comparing these findings with a 2010 study and selected conclusions from other research carried out in Poland. A PAPI survey was carried out in 2018 with 214 respondents who buy organic food in stores located in Poznań. The results were analyzed using descriptive statistics metrics. The survey revealed the growing importance of health and environmental concerns among the motives for buying organic food, as indicated by the consumers. Compared to findings from previous research, there are improvements in consumer awareness and a transition from an egoistic to an altruistic approach to how their purchasing decisions affect the natural environment. Positive developments also include the increase in the share of regular consumers who form the basic segment of the organic food market, and the fact that online sales are viewed as a prospective place of buying organic food.

KEY WORDS: consumer, purchasing behavior, market, organic food

Introduction

Modern science offers extensive empirical evidence that processes taking place in the food chain have many adverse environmental impacts (Stern et al., 1997). Therefore, measures taken to change these processes are of key importance to sustainable development efforts. Implementing the sustainable development concept requires a new approach to production, trade and consumption processes. In parallel, opposite processes take place which distort sustainable development, excessively burden the natural environment and are focused on short-term benefits. Today, consumers need to choose between consumerism and sustainable consumption; between generating excessive quantities of products, waste and environmental burden and a rational use of products focused on future consequences of their decisions; and between an egoistic and ethical consumption.

A positive development is the growth trend followed by environmentally-friendly attitudes and behaviors that are consistent with the sustainable consumption concept. Purchasing decisions are increasingly guided by the awareness of their long-term environmental and social consequences. The purchasing and consumption activities of an aware, environmentally responsible consumer have an effect on the sustainability, nature and extent of production processes and on the condition of natural resources and environmental burdens. Therefore, it is important to forge environmental awareness and attitudes among consumers to promote the principles of sustainable development and, more precisely, the principles of sustainable consumption. The cognitive component of consumer attitudes is based on knowledge and information which is delivered not only by traditional communication tools but also, increasingly often, by new digital media (Łaszkiewicz, 2017). This provides unprecedented opportunities for building the environmental and social component of consumer attitudes in a faster and more extensive way.

In the food economy sector, an important part of sustainable consumption is organic food produced based on natural production measures and low amounts of external inputs. The greater the consumption of organic food, the smaller the environmental burdens. Growing interest in and demand for organic food is an important change in the behavior of Polish consumers which has been observed in the last couple of years. Organic food consumers form a stable and distinctive market segment. Their attitudes and behaviors reflect the growing health and environmental awareness, the changing market and the availability and quality of products. However, these are the characteristics of a minor part of consumers. Hence, although consumer interest in organic products has been growing, organic product markets continue to be a niche (Vermeir, Verbeke, 2006).

An informed purchasing process becomes increasingly complex in the sense that it takes place in the context of a large excess of supply, excessive product quantities, strong advertising efforts, intensive marketing messages and growing market information. The growing interest in and demand for organic food may encourage the use of unfair and abusive practices by producers of fake organic food. This is why organic food consumers are expected to have certain knowledge of organic farming labeling. Lack of adequate knowledge makes decision-making more risky and results in behaviors inconsistent with consumer needs and values. Knowledge is an integral part of the sustainable consumption model proposed by Jager (2000). This especially means actionable knowledge rather than knowledge of facts (Tanner, Kast, 2003). Knowledge of facts relates to definitions, causes and consequences of environmental problems (e.g. what is the greenhouse effect?). Conversely, actionable knowledge refers to information on possible activities (e.g. what human behaviors are related to the greenhouse effect?). Unlike knowledge of facts, actionable knowledge has an effect on environmental behaviors of market operators.

Literature review

So far, the behavior of organic food consumers has been a topic addressed in many Polish empirical studies which differed in their area of focus, population surveyed, sample size and findings. Some of these studies are of limited cognitive value due to the methodology they are based on. This is true for studies carried out with the general population of food consumers without making an attempt to separate the group of organic food consumers. Such surveys are mostly a way to discover the perception of organic food among conventional food consumers. However, they fail to provide grounds for extending the knowledge on the organic food consumer segment, its basic characteristics, evolving motivations, purchasing preferences, market assessments, market weaknesses and opportunities for reducing them. Meanwhile, the knowledge of organic food consumers is a way to learn more about the components and basic characteristics of, and conditions for, sustainable consumption.

In the group of Polish researchers into diverse aspects of organic food consumer behaviors, particular attention should be given to papers by Żakowska-Biemans (2017), Nestorowicz and her team (2017), Bryła (2016, 2018), Grzybowska-Brzezińska and Grzywińska-Rąpcy (2016, 2018), and Wojciechowska-Solis, Soroka (2016). Some results corroborate certain generally known research findings, especially the perception of and characteris-

tics associated with organic food. These studies, however, do not answer the research questions related to the motives for consuming organic food, preferred places and frequency of purchasing, and willingness to accept prices. Despite extensive research efforts, there is still a deficiency of knowledge in this respect, all the more so since some surveys deliver different and incomparable findings. Moreover, it is difficult to tell whether these discrepancies are caused by the findings being not fully correct or by the large variations in consumer behavior. Some studies, e.g. those focusing on the motives for buying organic food, fail to take any account of the motive related to environmental concerns which is a major shortcoming (Wojciechowska-Solis, Soroka, 2016). Other studies replace that motive with one generally referred to as "ecological" (Bryła, 2016). In turn, when identifying the place of purchasing, some studies fail to take account of organic farms as a direct distribution channel (Wojciechowska-Solis, Soroka, 2016, p. 357) or of online sales as a developing distribution channel (Grzybowska-Brzezińska, Rudzewicz, 2015).

The new research questions tackled in recent years include attempts made to determine the degree of ethnocentrism of organic food consumers, to segment the consumers by diverse criteria, and to look for opportunities to transform occasional consumers into regular consumers through marketing improvements. According to research, a relationship exists between the frequency of buying organic food and an ethnocentric attitude (Nestorowicz, Jerzyk, Pilarczyk, 2016). Organic food buyers proved to be more ethnocentric than people who buy organic food occasionally or do not buy it at all.

The studies on segmentation included interesting attempts to classify organic food consumers into types by different criteria. These efforts had a great knowledge enhancing potential. According to the literature, gender, age and other demographic characteristics are not so important in segmenting the organic food market as psychographic characteristics, lifestyles, value systems and behavioral criteria (expected product features, product uses, contextual situations during the purchasing process, frequency of buying). In the case of sustainable consumption, too, demographic characteristics are not a clear criterion for market segmentation (Witek, 2015).

The psychographic classification into types by food lifestyle, carried out by Żakowska-Biemans and her team (2017), includes 4 consumer segments with similar shares in the organic food market, varying in the range of 20% to over 30%. Setting aside the demographic characteristics, the distinctive features are: the degree of interest in buying organic food; attitudes towards and willingness to accept higher prices; and the product's country of origin. This research resulted in identifying the following consumer segments: 1/ the disinterested group (26%): the least interested in buying organic food, not willing to pay a higher price for organic food; 2/ aspiring environmental-

ists (21.4%): interested in organic food, they declare to be willing to pay a higher price for organic food; 3/ the demanding group (20.2%): they find it important that organic food be cheap and made using traditional methods; 4/ traditionalists (32.6%): they value the Polish origin of organic food and traditional production methods.

As shown by previous research, the identification and description of characteristics of organic food consumers as a new segment in the food market requires diverse and detailed time comparison analyses. This will allow to determine the trends followed by purchasing preferences of these consumers, their hierarchy of motivation, and the features that make them different from or similar to consumers of conventional food. This paper makes an effort to sort that out.

Research methods

The purpose of this paper is to discuss the purchasing behavior of organic food consumers based on survey findings, and to identify their evolution by comparing these findings with a 2010 study and selected conclusions from other research carried out in Poland. A survey was carried out in 2018 with 214 respondents who buy organic food in stores located in Poznań (a Paper and Pencil Interview, PAPI). The survey questionnaire included 28 questions. Some answers used the ordering scale and the 1-to-5 Likert scale. The survey questionnaire included questions that enable characterizing the consumers of organic food in terms of their knowledge of the organic farming logo, motivation, places of purchasing, range of products purchased, frequency of purchasing, acceptance of prices, and willingness to pay more. Some of the key research findings were compared with a 2010 study carried out with 395 organic food consumers in 5 specialized organic food stores located in the city of Poznań. The description section was based on a study of the relevant literature; the empirical section was based on basic metrics of descriptive statistics.

Results of the study

In the survey sample, women had a greater share (66.1%) than men which is a typical demographic feature of purchasing surveys where women predominate. Two groups, young and middle-aged people, accounted for nearly 2/3 of respondents: 19-30 years old (27.2%) and 31-50 years old (45.4%). Most interviewees had a secondary (36.0%) or tertiary (34.5%) education; this is an important finding as it affects consumer knowledge which drives health and environmental awareness. There is evidence in the

literature that a significant relationship exists between education and recognition of organic food (Dziekan, Konieczny, 2017). Indeed, knowledge has a stimulating effect on organic food consumption whereas ignorance is a barrier to the development of the organic food market.

As shown by this survey, the greatest group of consumers (43%) were unable to clearly indicate the extent of their knowledge of organic food. They were followed by the group who believed to have a good knowledge of it (41%). More women than men declared to have quite good (37%) or very good (22%) knowledge of organic food. According to a study by Kawa and Cyran (2015), there is a greater percentage of men than woman who find their knowledge of organic products to be good or very good (44.4% and 24%, respectively). The declared levels of knowledge differed between the age groups. The highest share rated it as very good and good in the age group 18-24 (50%), as sufficient in the age group 40-59 (52.7%) and 60 and more (45%). The survey suggests that consumers do not have enough knowledge on organic food. This is also confirmed by other national and international studies. In a survey by IMAS (2017), only 16% of the interviewees associated organic food with the organic farming certificate. Meanwhile, knowledge and information have an impact on the cognitive component of environmental attitudes among consumers.

As shown by a comparative analysis of research findings regarding the sources of information on organic food, TV and press have seen their importance decline in recent years. In many studies, these media were long regarded by the respondents as the key source of information (Żakowska-Biemans, 2009; Kucińska, 2009; Samolińska, Kaczorowska, 2013). The growing role of Internet as a source of information was noted in studies by Olech, Kuboń (2014) and Cichocka, Krupa (2016). That pattern was corroborated by the distribution of replies to the question on the sources of information on organic food in a survey by Jarok-Guzy (2018). The importance of these sources is ranked as follows: 1. Internet (33% of replies), 2. product label (28%), 3. feedback from friends (13%), 4. TV advertisement (10%), 5. in-store information (9%), leaflets (7%).

In the author's own study, the vast majority of respondents equate organic food with such concepts as healthy food (79%) and high-quality food (67%). Nearly half of respondents associated it with high taste qualities (41%). This is confirmed by other research where more than 50% of respondents equated organic food with healthy food (Jarczok-Guzy, 2018).

The symbols of certificates placed on food products include the organic farming mark in the form of the Euroleaf (figure 1). The Union logo for products originating from certified organic farming and growing was introduced by Commission Regulation (EU) No. 271/2010 of March 24, 2010. Consumer

knowledge related the use of that mark is of key importance to the identification of organic products and to the credibility of their value added (Schleenbecker, Hamm, 2013).

Figure 1. Organic farming logo applicable in European Union countries since 2010
Source: www.biocert.pl [29-01-2019].

Table 1. Knowledge of the organic farming logo among consumers

Source	Year of the study	Sample	Percentage of respondents who declared to know the Euroleaf logo
Eurobarometr	2012	1,000 (a sample of the Polish population)	12,0%
Nestorowicz (2017)	2013	444	24.8%
Kaczorowska et al. (2018)	2016	146	51.0%
Żakowska-Biemans et al. (2017)	2017	1,424	27.8%
Bryła (2018)	2017	1,000	20.5% know it well, 40.7% know it poorly, 38.8% do not know it
Jarczok-Guzy (2018)	2017	1,159	16% recognize it properly, 19% recognize it improperly, 44% do not know it
IMAS (2017)	2017	518	33%
IMAS (2018)	2018	1,000	44.0%

Source: author's own work.

In this survey, more than half of respondents (almost 53%) declared to know the Euroleaf mark when asked about the recognition of the logo of organic farming products. This means that nearly every second consumer of organic food is unable to recognize the mark of products purchased, which puts him/her at risk of making wrong purchasing decisions. Surveys con-

ducted with the general food consumer population yielded different findings regarding the lack of knowledge of the logo (table 1). Some of the studies found an increase in the levels of knowledge. For instance, according to IMAS data (2017, 2018), the recognition of the organic farming logo grew from 33% in 2017 to 44% in 2018 among online respondents who declare themselves to be organic food buyers.

The behavior of organic food consumers is determined by motivations of different nature, strength and sources. Consumer decisions are driven by a multitude of motivations whose nature refers to tangible and intangible values. From the perspective of the nature of their motivations (2014), three types of organic food consumers can be identified (Mazurek-Łopacińska, Sobocińska, 2014):

- consumers who consider organic products as a basic thing due to their vital effects; these are the ones who want to address their core values,
- consumers who find it very important to seek harmony with the environment because this provides them with peace of mind while also being a way to express their responsible attitudes,
- consumers guided by integrated motivations who consider the consumption of organic products in a holistic way because the practical values of products purchased coincide with spiritual values; these are the most educated and most aware consumers who strongly believe that harmony with the environment-reached by purchasing organic products-has an impact on satisfaction and self-fulfillment.

According to the declared motivations for buying organic food, Polish consumers are guided by basic values related to the beneficial effects it has on their lives. As shown by the survey, this is mostly the need for health safety which is derived from strongly felt individual needs rather than from social needs related to environmental concerns or from the need to support farms and their local nature. In this survey, health concerns were the top-ranked motivation with 78.4% replies. In turn, environmental concerns were only ranked fifth with 22.1% of replies (table 2). The comparison of findings between 2010 and 2018 evidences the growing importance of health concerns as a motivation for buying organic food. Conversely, environmental concerns continue to be ranked low (fifth), although their importance has slightly increased. The studies differed in the percentages recorded for environmental concerns as a motivation: IMAS (2017) 17%; Pilarczyk, Nestorowicz (2010) 14.6%; Escher, Petrykowska (2014) 25.9%; in a survey by Grzybowska-Brzezińska, Grzywińska-Rąpca, it was 46% (i.e. 33% more than what was recorded in 2010). In other countries, organic food consumers not only exhibit high levels of health awareness but are also socially and environmentally responsible (Nasir, Karakaya, 2014).

Table 2. Motivations for buying organic food in 2010 and 2018 [% of replies]

Motivations	2010	2018
Health concerns	58.4	78.4
Preferring a healthy lifestyle	48.2	52.1
Increased health risks	26.4	34.8
Health issues	25.4	26.3
Environmental concerns	12.9	24.1
Organic food as a trendy choice	0.5	1.5

Source: author's own work.

Nearly half of respondents (48.7%) found the availability of organic products to be good while 30% found it to be sufficient. The range organic food product becomes increasingly wider although the improvements are slow. Nevertheless, there is shortage of many products; according to the consumers surveyed, this is especially true for raw and processed meat (56.2%). Every third respondent (29.6% of replies) believes fruits and organic food for ill people (allergy/diabetes sufferers) to be offered in insufficient quantities. The response rate for confectionary was nearly identical (28.5%). Also, certain vegetables, milk, milk products and organic bakery are not part of the product range (24.8% of replies). The smallest percentage of interviewees (4.4%) believe there is shortage of juice in the organic product market.

According to the survey, some changes are taking place as regards the preferred places of buying organic food (table 3). Although most respondents continue to buy organic food in specialized stores (77.5%) and supermarkets (62.1%), some data shows that in the future, organic shopping is likely to move towards other distribution channels, such as discount stores, hypermarkets and online stores. The organic food market can be expected to converge with the conventional market which means it will gradually merge with the mainstream food distribution system: from intermediate channels through to wholesales and retail sales.

Table 3. Places of buying organic food in 2010 and 2018 [% of replies]

Specification	2010	2018
Specialized organic food stores	77.2	77.5
Supermarkets and hypermarkets	68.1	62.1
Street markets and marketplaces	60.1	34.8
Grocery stores (including discount stores)	55.2	58.3
Organic farms	46.1	34.1
Online organic food stores	19.7	21.2

Source: author's own work.

Organic food offered at discount stores such as Lidl and Biedronka-who used their own brands to generate demand from occasional consumers-proved to be particularly successful in the market (figure 2). The purchasing potential of these consumers was not timely seized by specialized stores whose competitive strategy based (in some cases) on high prices proved to be poorly effective. The strategic error of specialized stores was/is a price policy based on high margins and on the conviction that high prices, as a distinctive feature of premium products, would attract new consumers.

Figure 2. Own brands of organic products in discount stores

Source: websites of organic stores.

Also, growing interest in online sales should be expected; it will grow in importance as the New Economy becomes more and more widely adopted. The advantages of online sales are not only the reduction of information asymmetry between consumers and producers but also the limited number of intermediaries in the supply chain, which has an effect on price levels. Currently, 19% of consumers declare they buy food products online and intend to do so more frequently in the future (E-commerce, 2017). In the Internet, organic food is mainly offered by specialized stores who, just like conventional stores, rely on the high-price policy. The transactional costs of shipments are relatively high and not competitive compared to stores offering other product ranges. This is typical of an unbalanced market where the producer/seller is in a privileged position.

Therefore, Stefańska (2010) used the criterion of the place of purchasing organic food to identify 3 consumer segments whose shares in the organic food market vary in the range of below 20% to over 50%. The first segment, "moderate consumers" (53%), prefer specialized stores, followed by supermarkets and street markets. Members of this group believe the access to organic product information to be insufficient. The second segment, "impressionable consumers" (19%), prefer supermarkets followed by specialized stores. They expect the store staff to be committed to make their offering more credible. The third segment, "incisive consumers" (27%), are the most

convinced of the advantages of organic food. When choosing the place of buying, location is the most important criterion for them.

One of the most complex problems affecting the organic food market is the price level. The organic-to-conventional price ratio is high, reaching 300% in extreme cases (Łuczka-Bakuła, Sikorska-Smoluk, 2010). Consumer decisions on price acceptance affect the relation between the costs and benefits of a product. In the case of organic food, the benefits are of a tangible and intangible nature; they affect not only the vitality of consumers but also the natural environment, the condition of organic farms, the local economy etc. The costs are mostly the higher price paid for the value added, as well as the alternative cost incurred to travel to specialized organic food stores, and the lost benefits related to lower sensory value. This is why the willingness to pay a higher price, although economic in nature, is also related to the consumers' environmental and social awareness. The consumers' willingness to pay (WTP), defined as the maximum price the buyer is willing to pay for a good, depends on product type, market maturity, and the consumers' environmental awareness and purchasing behavior (Grunert et al., 2009). Informed, regular consumers of organic food exhibit the highest levels of WTP.

Generally, the organic food consumers' price sensitivity does not change despite the growth in income and in purchasing power. According to the author's own study carried out in 2018, most consumers (57.2%) are willing to accept the price of organic food if higher by 10% to 20% compared to conventional food. This is consistent with previous research (Sojkin, Witczak, 2009). If higher by 20% to 40%, the price is accepted by 28.3% of consumers; 40% to 60% by 10.4% of consumers; and 60% or more by 4.1% of consumers. The low willingness to pay a higher price for organic food continues to be the key barrier to the development of the Polish organic food market.

Conclusions

According to this survey, organic food consumers gradually become a segment with defined distinctive characteristics. This is evidenced by the motivation for and the frequency of buying organic food. Among the motives for buying organic food indicated by the consumers, both health and environmental concerns grow in importance. Compared to findings from previous research, there are improvements in consumer awareness and a transition from an egoistic to an altruistic approach to how their purchasing decisions affect the natural environment. Positive developments also include the increase in importance of conventional distribution channels for organic

food, such as discount and online stores, which will increase the share of occasional consumers in the organic food market. The changes presented in this paper reveal that organic food consumers play an increasingly important role in sustainable consumption patterns.

This study provided more extensive knowledge on organic food consumers and sustainable consumption. These findings could become a conceptual framework for future research on this topic. It is advisable that in-depth studies be carried out on information barriers which affect the organic food market, and on the perceived credibility of organic products. Future research should preferably address the behavior of organic food consumers in other markets to determine whether, and to what extent, their environmental and social focus also plays a distinctive role in non-food markets and whether they form a coherent consumer segment which is consistent with the sustainable consumption concept.

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Stanisław **ŁUNIEWSKI** • Artur **ŁUNIEWSKI**

SELECTED LEGAL AND FINANCIAL CONDITIONS FOR THE LIQUIDATION OF ASBESTOS AND PRODUCTS CONTAINING ASBESTOS ILLUSTRATED WITH AN EXAMPLE OF RURAL MUNICIPALITIES IN THE PODLASKIE VOIVODESHIP

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ABSTRACT: The article indicates selected legal and environmental conditions for the decommissioning of asbestos and asbestos products using the subject literature, own research and existing data. The legal basis is the Act of 19 June 1997 on the prohibition of the use of products containing asbestos (volume 2017, item 2119). Legislative framework is complemented by executive acts to it. The governmental programs for asbestos removal are a tool for implementation. The Ministry of the Environment, as an internal law, prepared guidelines, information and procedures for dealing with products containing asbestos. Own research was carried out in 77 rural communes in the Podlaskie Voivodeship. Their subject was the asbestos problem in the context of the "Program of cleansing the country from asbestos for years. 2009-2032". The research was carried out in the social, economic and environmental dimension. In the rural communes of the Podlaskie Voivodeship, the asbestos problem is an important barrier to economic development, and the amount of this material and its products is still an environmental threat. It is caused by a shortage of financial resources and low social awareness of rural residents and local government.

KEY WORDS: asbestos, asbestos-containing products, asbestos law, environmental risks

Introduction

Difficult asbestos heritage, caused, among other things, by the lack of its harmfulness, downplaying the problem, ignorance about the financial aspects of removing asbestos (mainly asbestic tile), generates problems and barriers to its liquidation. In the United States and in Western Europe, far stricter regulations prohibiting the use of asbestos have been introduced much earlier. The lack of such legislative regulations in Poland meant that for many foreign producers our country became a market. It was not until 1999 that the ban on the production and marketing of asbestos products was introduced. According to the current legal status, asbestos may be conditionally applied until 31 December 2032. The environmental exposure during work on removal of asbestos should be monitored for 13 years. The 100% elimination of asbestos products in urban and rural space will be an exemplification of the effectiveness of the actions taken. This can be served by the effective use of economic instruments and the shaping of awareness of the health risks of using this product.

The severity of the asbestosis problem, despite the various activities intending to eliminate it, still results from the large amount of asbestos and asbestos products in the immediate environment of people. This creates a serious epidemiological and ecological threat. From an epidemiological point of view, the fundamental problem that justifies taking action to completely remove asbestos and asbestos products from Poland is that the mineral is considered to be one of the most widespread carcinogens in the environment (Szczenia-Dąbrowska, 2013).

The seriousness of the situation is exacerbated by the fact that due to the widespread use of asbestos in the economy in the past, the majority of the population in Poland had the opportunity to come across this substance. The problem must therefore be urgently solved, which due to its scale is a serious legal, organizational and economic challenge.

The effective disposal of asbestos and asbestos products requires stable, clearly formulated legislation, an adequate amount of financial resources that will generate the basis for protecting the environment from the impact of this extremely dangerous mineral and will allow for minimizing the effects of its use before the introduction of a ban.

Currently, after cessation of production and use of asbestos products, the main sources of threats are (*Wpływ*..., 2017):

- improperly stored asbestos waste, including the so-called wild landfills, especially in forests and open excavations,

- use of asbestos products, which in turn leads to air pollution with asbestos dust as a result of: corrosion and mechanical damage of asbestos-cement panels, abrasion of clutch plates and brakes,
- inappropriate removal of products containing asbestos from roofs and façades.

Exposure to asbestos is the result of irregularities in the implementation of the programme, its liquidation, and therefore non-compliance with prescribed procedures for disposal of asbestos products buildings and installations, their transport to the storage place. You must, however, bear in mind that asbestos is still used by people, so the asbestos dust still negatively affects the natural environment.

The legal bases for the disposal of asbestos and asbestos products

Disposal of asbestos and asbestos products must be carried out in accordance with the applicable legislation and adopted stringent procedures.

In accordance with the terms of the legislators, asbestos is a hazardous substance, common mine, a particular threat to the environment, which residues are classified as hazardous waste. In accordance with the environmental law (POŚ) (Act, 2001), establishing the generic standards, asbestos was attributed to substances posing a particular threat to the environment (art. 160, act 2, p. 1). And therefore, should be used, moved and eliminated while retaining the special precautions. Installations and equipment, in which it was used should be cleaned or disposed of. Asbestos removal must be done in a way that does not endanger people and the environment. It is necessary to perform measurement of concentrations of dust containing asbestos in the work environment, before and after finishing work, but also marked in a visible place on the installation or device.

Title VI (sections II and III) of the POŚ clearly sets out penal liability (arrest, restriction of liberty, fines) imposed on the basis of the provisions of the code of conduct in offense cases and administrative liability by suspending operations affecting the deterioration of the environment or threatening the health or life of people organizational units and natural persons who do not comply with obligations regarding the safe use and removal of asbestos-containing products and reporting obligations in this respect.

In Poland, asbestos removal activities were undertaken at the end of the 20th century, although the problem was already recognized. The Government of the Republic of Poland on June 19, 1997 adopted a resolution on the program of withdrawing asbestos from the economy (Rezolucja..., 1997). It happened on the same day, when the Act of 19 June 1997 on the prohibition of

the use of asbestos-containing products was passed (Ustawa..., 1997). It explicitly stated – in order to eliminate the production, use and trade of products containing asbestos, it is prohibited to:

- entering:
  – products containing asbestos,
  – asbestos,
- production of asbestos-containing products,
- turnover of asbestos and products containing asbestos (article 1, paragraph 1, points 1, 2, 3).

This Act has been amended many times. The ban on the production of asbestos-containing products (article 1, paragraph 1), which was in force in 2019, regulating the directives of the European Communities within the scope of its regulation. The ban on the production of asbestos-containing products (article 1, paragraph 1) was introduced under (the amendment of) the Act in force in 2019, regulating the directives of the European Communities within the scope of its regulation. Only placing on the market and use of diaphragms for existing electrolytic installations containing chrysotile asbestos and the use of chrysotile asbestos shafts used for drawing glass installed or in use before 1 January 2005 until their consumption or until non-asbestos substitutes are available, whichever occurs first (article 1, paragraph 3).

Pursuant to the Act, anyone who, contrary to the provisions of the Act, puts asbestos or products containing asbestos on the territory of the Republic of Poland, is subject to a fine, restriction of liberty or imprisonment from 3 months to 5 years. The same penalty shall be imposed on anyone who manufactures products containing asbestos or trades asbestos or articles containing asbestos (article 7b, paragraphs 1, 2).

The methods and conditions for the safe use and disposal of asbestos-containing products are set out in the ordinance by the minister competent for economy, in agreement with the minister competent for home affairs, minister responsible for environmental issues, minister responsible for transport and minister responsible for environmental matters (article 4, paragraph 1). The ordinance specifies the obligations of the contractor and the methods and conditions for the safe use and disposal of asbestos-containing products and the conditions of transport and transport of these products and their waste to landfills. It is emphasized that it is necessary to take into account the protection against asbestos penetration into the environment and indicates the requirements for marking asbestos products and wastes (article 3, paragraph 1a, points 1-4) (see more in: Łuniewski, Łuniewski, 2013; Łuniewski, Łuniewski, 2019).

Government documents were also prepared regarding the removal of asbestos and asbestos-containing products as a tool for implementing the

law. These are the Program for asbestos removal and asbestos-containing products used on the territory of Poland (Warsaw, May 2002) and the following anti-asbestos program: Program for the cleansing of the country from asbestos for 2009-2032 passed by the Council of Ministers on 14 July 2009 and amended by a resolution of the Council of Ministers of March 15, 2010. This program is a basic instrument supporting the acquisition of external funds for projects for the purification of Poland from asbestos products.

Proper implementation of the Program at the central level (the Council of Ministers, minister competent for economy and structure of the Ministry, Main Program Coordinator), voivodeship (voivode, voivodeship self-government) and local (district self-government, commune government) should be based on:

- cleaning the Polish territory from asbestos and removing asbestos-containing products,
- elimination of negative health effects in Polish residents caused by asbestos,
- successive liquidation of asbestos impact on the environment,
- creating appropriate conditions for the implementation of legal provisions and standards of conduct with products containing asbestos used in the European Union.

Acting internal law, the Ministry of Economy and Labour has developed and presented (Asbestos, 2002) guidelines, information for administrative bodies, or procedures for dealing with products containing asbestos. The purpose of the six procedures is to present the duties and rules of conduct of owners and managers of buildings, structures, installations or equipment and areas where asbestos or products containing asbestos are. The procedure applies to their safe use. The scope of the procedure covers the whole period in which the building, construction, installation or industrial equipment and area, regardless of their size or condition, are characterized by the fact that there are products containing asbestos.

Own research in rural communes of the Podlaskie Voivodeship

The research (the article uses research conducted for the purposes of the doctoral dissertation: S. Łuniewski, *Ekonomiczne i społeczne uwarunkowania likwidacji azbestu i wyrobów azbestowych*, University of Economics, Poznan 2018, unpublished) covered 77 rural communes in the Podlaskie Voivodeship, having the status of a local government, corresponding to the European region criterion at NUTS2 level, and they concerned the occurrence of asbestos in the social dimension in these communes, with particular emphasis on

economic aspects of decommissioning, solutions taken from the perspective of the economics of protection environment. The subject of the conducted research was the asbestos problem in Poland in the context of the objectives and tasks set out in the National Asbestos Clearing Program for 2009-2032, adopted by the Council of Ministers on July 14, 2009, amended by the resolution of the Council of Ministers of 15 March 2010, in its epidemiological dimension and ecological, with particular emphasis on the economic aspect, i.e. issues related to the financing of projects implemented within its framework, the origin of these funds, their level, adequacy to needs (and) efficiency of use.

All municipalities were included in the research as institutional responders. As part of the research, e-mail has been addressed (a postal questionnaire using modern means of communication) survey questionnaires designed specifically for the needs of planned research regarding the asbestos problem in their daily activities, with particular emphasis on the volume of expenditures and spending structures.

The empirical material obtained by the analysis of the existing data proved to be valuable. The analysis took account of public data concerning the asbestos problem in rural communes and included in published and archival official materials. Those were among others NIK reports and proceedings, data from the Asbestos Base, communal programmes of asbestos removal (and programmes from higher levels of administrative division) and data concerning financing the programme from the state budget as well as from NFOŚiGW (National Fund for Environmental Protection and Water Management) and WFOŚiGW (Provincial Fund for Environmental Protection and Water Management) financial resources.

When analysing the existing data from the Asbestos Base, the asbestos to dispose was inventoried with the division into communes and districts in the Podlaskie Voivodeship in rural areas (table 1).

A real danger to the environmental balance is the asbestos which is still in use. According to the data from the Asbestos Base, 606 985 580 kilograms of asbestos were identified in the country. In Podlaskie Voivodeship there are 15 217 930 kg, including 4 136 066 kg in rural areas. Nearly 100% of objects in which asbestos was identified remains in use of natural persons. These people shall be considered the main group of direct users of asbestos.

Table 1. The Asbestos inventoried in rural areas of Podlaskie Voivodeship (state 2017) [kg]

District	Commune	The amount of asbestos in the inventoried objects		
		Summed	Natural persons	Legal persons
Augustów	Bargłów Kościelny	4 326 257	4 271 942	54 316
	Nowinka	8 448	0	8 448
	Płaska	414 851	382 643	32 208
	Sztabin	4 666 985	4 472 871	194 115
	Dobrzyniewo Duże	2 686 552	2 678 269	8 283
In total		12 103 093	11 805 725	297 370
Białystok	Gródek	1 199 856	1 170 170	29 685
	Juchnowiec Kościelny	3 054 315	2 876 523	177 792
	Poświętne	2 976 892	2 973 762	3 130
	Turośń Kościelna	1 821 187	1 781 415	39 772
	Zawady	4 686 313	4 651 539	34 774
In total		13 738 563	13 453 409	285 153
Bielsk	Bielsk Podlaski	2 392 316	2 284 441	107 874
	Boćki	1 602 631	1 574 104	28 527
	Brańsk	1 504 109	1 401 746	102 364
	Orla	4 679 701	4 518 383	161 318
	Rudka	1 425 336	1 405 184	20 152
	Wyszki	5 037 680	5 010 907	26 773
In total		16 641 773	16 194 765	447 008
Grajewo	Grajewo	540 866	410 406	130 460
	Radziłów	8 309 699	8 292 091	17 608
	Wąsosz	1 746 893	1 746 893	0
In total		10 597 458	10 449 390	148 068
Hajnówka	Białowieża	1 263 972	1 209 436	54 536
	Czeremcha	1 493 150	1 463 166	29 984
	Czyże	2 410 476	2 407 946	2 530
	Dubicze Cerkiewne	3 916 146	3 916 146	0
	Hajnówka	2 391 172	2 200 775	190 397
	Narew	1 801 796	1 255 800	545 996
	Narewka	59 688	42 427	17 261
In total		13 336 400	12 495 696	840 704
Kolno	Grabowo	4 442 664	4 438 924	3 740
	Mały Płock*	500 466,16	499 854,16	612,00
	Kolno	1 421 562	1 235 096	186 466
	Turośl	4 220 260	4 220 260	0

In total		10 084 486	9 894 280	190 206
Łomża	Łomża	6 347 011	6 232 648	114 363
	Miastkowo	2 692 800	2 692 800	0
	Piątnica	82 935	63 082	19 853
	Przytuły	3 219 980	3 193 275	26 706
	Śniadowo	8 810 120	8 704 783	105 337
	Wizna	4 764 755	4 508 741	256 014
	Zbójna	5 141 755	5 073 467	68 288
In total		31 059 356	30 468 796	590 561
Mońki	Jasionówka	1 797 305	1 794 404	2 901
	Jaświły	6 777 084	6 722 443	54 641
	Krypno	2 072 189	2 061 233	10 956
	Trzcianne	5 020 768	5 020 768	0
In total		15 667 346	15 598 848	68 498
Sejny	Giby	1 633 032	1 564 910	68 122
	Krasnopol	1 716 014	1 709 618	6 396
	Puńsk	4 145 126	4 145 126	0
	Sejny	3 015 122	2 930 840	84 282
In total		10 509 294	10 350 494	158 800
Siemiatycze	Dziadkowice	2 487 634	2 469 914	17 720
	Grodzisk	5 512 817	5 510 617	2 200
	Mielnik	1 746 116	1 725 484	20 632
	Milejczyce	2 608 153	2 608 153	0
	Nurzec-Stacja	4 358 008	4 242 794	115 214
	Perlejewo	5 872 668	5 820 981	51 686
	Siemiatycze	2 029 018	1 756 110	272 909
In total		24 614 414	24 134 053	480 361
Sokółka	Janów	2 205 945	2 192 679	13 266
	Korycin	1 604 185	1 597 618	6 567
	Kuźnica	3 646 698	3 603 818	42 880
	Nowy Dwór	2 196 560	2 196 560	0
	Sidra	4 997 222	4 956 468	40 754
	Szudziałowo	3 377 709	3 296 756	80 953
In total		18 028 319	17 843 899	184 420

Suwałki	Bakałarzewo	2 551 659	2 525 633	26 026
	Filipów	2 790 304	2 709 767	80 536
	Jeleniewo	12 619 512	12 619 512	0
	Przerośl	3 332 410	3 312 100	20 310
	Raczki	3 219 205	3 084 407	134 798
	Rutka-Tartak	1 268 388	1 268 388	0
	Suwałki	3 649 790	3 544 085	105 704
	Szypliszki	1 889 758	1 887 644	2 114
In total		31 321 026	30 951 536	369 488
Wysokie Mazowieckie	Klukowo	4 557 303	4 557 303	0
	Kobylin-Borzymy	4 885 430	4 868 490	16 940
	Kulesze Kościelne	5 994 454	5 968 650	25 804
	Nowe Piekuty	3 730 045	3 721 459	8 586
	Sokoły	3 647 124	3 639 124	8 000
	Wysokie Mazowieckie	4 860 761	4 786 139	74 622
In total		27 675 117	27 541 165	133 952
Zambrów	Kołaki Kościelne	3 426 194	3 404 150	22 044
	Rutki	10 745 101	10 716 804	28 297
	Szumowo	680 955	680 955	0
	Zambrów	675 279	636 075	39 204
In total		15 527 529	15 437 984	89 545
Rural areas in total		250 904 174	236 170 650	4 136 066
Podlaskie Voivodeship		401 106 578	385 888 657	15 217 920
Poland		5 529 198 168	4 922 212 587	606 985 580

Data for Mały Płock in m^2. Liquidation of products containing asbestos programme for Mały Płock Commune, page 30. No data to convert precisely the given quantities to kilograms. It is generally assumed that $1m^2$ of flat asbestos corresponds with 12 kg, while $1m^2$ of curved asbestos corresponds with 16 kg. Vademecum usuwania azbestu. Informator samorządowy, p. 11, *www.sii.com.pl/__media*/images/Vademecum/Vademecum-01.pdf. The programme does not precise whether the quantities pertains to slabs of curved asbestos or flat asbestos. In the former case the amount of asbestos in weight would be 8 007 459 kg, in the latter one – 5 505 128 kg.

Source: author's own work based on data from the Asbestos Base, http://www.bazaazbestowa.gov.pl/ [10-05-2016].

The process of solving the asbestos problem in rural communes of Podlaskie Voivodeship is not progressing smoothly. It encounters institutional, economic, social-psychological and organisational barriers. Formulating a strategy aimed at overcoming the obstacles in dealing with the asbestos problem requires identifying its character on the examined area. Respond-

ents were asked to assign a rank from 1 to 10 to each concept from the list describing the issue.

Table 2. The nature of the asbestos problem in rural communes of Podlaskie Voivodeship according to rural communes of Podlaskie Voivoideship (N=45)

No.	Alternative	Average value of indications on 1-10 scale
1.	Low awareness of threats posed by products containing asbestos	8,0
2.	Low level of the households' wealth	7,2
3.	Strong saturation of asbestos products	7,0
4.	Economic backwardness of the region	6,8
5.	Low efficiency of the financial resources spent on solving the asbestos problem	6,3
6.	Low level of community organisations' engagement in the realisation of Communal Program	5,7
7.	Lack of thorough examination of the asbestos problem in the region	5,0
8	Local authorities' insufficient engagement in seeking extra-budgetary funds	4,1
9.	Low level (or lack) of Communal Programs	3,3
10.	Others	0

Source: author's own work.

The nature of the asbestos problem in the region is determined mainly by economic and awareness premises such as: low-risk threat posed by the presence of asbestos in social and natural environment as well as the residents' low level of affluence. Therefore, even if the condition of the awareness of the asbestos problem is met, the economic barrier still poses a threat both on the individual scale (low level of the residents' affluence) and on the general one (the economic backwardness of the Podlaskie region). The scale of the problem, which affects its specificity, is determined by the strong saturation of the social and ecological space with asbestos (items 1-4 in the ranking).

Conclusions

From the conducted research (selectively presented in the article) one may conclude that the main obstacle in solving the asbestos problem in rural communes of Podlaskie Voivodeship is insufficient financing of the relating activities. It is indicated both by the direct data, obtained from surveys, and by indirect premises resulting from the economic analysis. In financial terms

the implementation of anti-asbestos programmes is based almost exclusively on public funds from targeted grants, delivered to communes via NFOŚiGW (National Fund for Environmental Protection and Water Management) and WFOŚiGW (Provincial Fund for Environmental Protection and Water Management), and, if possible, assisted by a financial support from the commune. Low level of affluence of local communities means that removing asbestos from one's private property is not placed high in the hierarchy of one's individual needs. The conducting factor in this respect is the low level of social awareness of epidemiological and ecological threats posed by the presence of asbestos in social and natural environment and caused by regular contact with asbestos dusts which are produced by the heating or electrical devices used in buildings structures. In practice, the main source of epidemiological risks lays in the use of asbestos in roofing materials. Its dust-generating potential grows with time. Therefore, a professional approach to asbestos removal, the essence of which is to minimise exposure to asbestos dust, is so important. It is possible that in many cases natural persons remove elements of building structures and devices containing asbestos on their own, exposing themselves – sometimes completely unconsciously – to the risk of developing any of the asbestos-related diseases. Such behaviour may be fostered not only by the insufficient supply of public funds for asbestos-related services or a lack of own resources, but also by a lack of access to preferential bank loans.

In this context rural communes' low level of activity in terms of obtaining EU funds for the purpose of eliminating the asbestos problem draws attention. Rural communes hardly exploit the possibilities offered by Regional Operational Programme for Podlaskie Voivodeship (RPOWP) records.

The system for solving the asbestos problem in rural communes of Podlaskie Voivodeship is highly formalised and bureaucratic. It is closed circuit for public funds and therefore it is hardly susceptible to a market mechanism based on supply and demand. In this situation normal market relations between companies operating in the field of anti-asbestos services cannot develop. Slightly over twenty companies specialising in this type of service operate on the territory of Podlaskie Voivodeship, only two of which offer a full spectrum of services: from asbestos removal and disposal (storage) to training workers and preparing professional asbestos control programmes. Some of these companies do not currently have asbestos work permits. However under current legislation work permit is not required to perform such work if the company guarantees that its workers are properly trained and that the service will be performed in accordance with the requirements. Another part of the companies has a range of operations covering only the Podlaskie Voivodeship or only a part of it (a district or a few communes).

At present, the ability to provide fully market-driven services in a fully market-driven environment is severely constrained in terms of financing. The companies specialised in this kind of services do not have freedom in their acquisition, and thereby business planning based on the observation of user driven mechanism. The possibilities in this respect are limited by the size of the financial stream, the basic source of public funding as contracts dependent on calls for tenders which currently take place on a biennial basis. The size of unrestricted private demand is in this situation difficult even to estimate. As a result, there are no market stimuli encouraging to undertake business activity in the asbestos sector. Until this situation changes, the financial barrier which blocks the development of a mature market for services in this sector will limit the possibility of efficient and timely solution for the asbestos problem not only in the above mentioned areas, but also in the whole voivodeship.

The solution to the problem is not accompanied by negative social emotions such as suspicions of corruption. Institutional solutions, with the exception of the mentioned production sphere, are considered to be accurate, requiring only some improvements. However, these barriers which exist (mainly financial ones) are a sufficient threat to an efficient and timely solution of the asbestos problem in the examined area of rural communes of the Podlaskie Voivodeship.

The legal bases for the prohibition of asbestos contain specific guidelines for the disposal, elimination and minimisation of the effects of the mineral. Institutional barriers, both of government administration and legal institutions, economic and financial, social and psychological, organizational require acting on undertakings to overcome them. At various levels of state management asbestos removal programmes create legal, organisational and financial conditions for achieving the the goal. Through appropriate – educational or even penal – impact on users and entities specializing in the removal of asbestos, they also create proper conditions for minimising the environmental threats present during the removal of asbestos products, their transport to the place of disposal or their storage in special landfills. However, ensuring adequate financial resources is a necessary condition to solve the asbestos problem. Research has shown that the principal impediment to overcome the threat of asbestos and its products is a shortage of money.

The contribution of the authors

Stanisław Łuniewski – 75%
Artur Łuniewski – 25%

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GENERAL ENVIRONMENTAL AND SOCIAL PROBLEMS

PROBLEMATYKA OGÓLNOEKOLOGICZNA I SPOŁECZNA

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REGIONAL DIFFERENCES IN THE PRO-ECOLOGICAL MEASURES OF THE 2007-2013 RDP IN POLAND

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ABSTRACT: The article deals with regional differences in the use of the EU funds allocated to pro-ecological measures in Poland. The research covers support for land management in mountain areas and other less-favoured areas (LFAs), agri-environmental programme, afforestation of agricultural and non-agricultural land implemented under the 2007-2013 Rural Development Programme. The analysis was made by voivodeships on the basis of data from the Agency for the Restructuring and Modernisation of Agriculture and Statistics Poland. Ward's method was used for the division of voivodeships into groups with similar intensity of absorption of funds from pro-ecological measures. Three groups of voivodeships, most similar internally and with the largest differences between them were selected. It has been stated that the highest level of use of RDP funds concerned the voivodeships of northern and western Poland, while their lowest use was in the voivodeships of the south-eastern part of the country and in Łódź.

KEY WORDS: less-favoured areas, agri-environmental programme, land afforestation, Ward's method

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Introduction

The common agricultural policy (CAP) of the European Union combines the aspects of the protection of environmental resources and assets with the economic and social goals of agricultural and rural development (Liro, 2003; Zegar, 2010; Kutkowska, 2010; Bujanowicz-Harnaś, 2011; Mickiewicz et al., 2013; Pawlewicz, Bórawski, 2013). Measures for preserving the precious richness of the natural environment, supporting areas with unfavourable natural conditions as well as those allowing the economic and ecological activation of local communities take an important position among EU instruments for the development of rural areas. It has been indicated by, e.g. Bołtromiuk (2012, p. 126), who wrote that "The multidimensional interdependence of the agricultural economy and the natural environment is increasingly noticed and considered in the objectives and instruments of CAP to a large extent." The measures implemented as part of the 2007-2013 Rural Development Programme (RDP 2007-2013), which is the continuation of the 2004-2006 RDP, serve to promote the environmentally friendly agriculture, preserve the landscape assets of the countryside, protect valuable natural areas, consolidate sustainable farming and form the landscape structure. Three measures of the RDP are of particular pro-ecological importance: support for farming in mountain areas and other less favoured areas (LFAs), the agri-environmental programme and the afforestation of agricultural and non-agricultural land. Financial support is a kind of remuneration for generating environmental public goods (Bołtromiuk, Kłodziński, 2011; Brodzińska, 2013). The implementation of pro-ecological measures contributes to the improvement in the management and protection of the environment, and is also conducive to the restructuring and modernisation of agriculture and rural areas (Polna, 2012).

Material and research methodology

The article aims to present regional differences in the use of the EU funds allocated to measures for pro-ecological land management. The spatial scope of the analysis covers the area of the entire country, with the voivodeship adopted as the basic research unit. The research was conducted on the basis of the data shared by the Agency for the Restructuring and Modernisation of Agriculture (ARMA) on the implementation of pro-ecological measures as part of the 2007-2013 RDP and the data of Statistics Poland (in Polish GUS) on the number and area of agricultural holdings above 1 ha of AL. Moreover, the documents of the Ministry of Agriculture and Rural Development were the complementary source of information.

In order to distinguish regions characterised by the similar absorption of EU funds use was made of Ward's method (1963) which belongs to hierarchic agglomeration methods of cluster analysis. What is applied in this method to assess the distance between clusters is variance analysis. It aims at minimising the sum of squared deviations inside clusters (Parysek, 1982; Stanisz, 2007).

While indicating groups of voivodeships with similar absorption of resources allocated to the pro-ecological measures of the RDP (2007-2013), the following indicators were used:

- the number of applications granted under the measure per 1,000 farms with the area above 1ha of AL,
- the payment received under the measure in PLN per 1 application for a farm larger than 1ha of AL,
- the payment received under the measure in PLN per 1ha of AL.

Results of the research

The measure "Support for farming in mountain areas and other less favoured areas (LFAs)" is an instrument of financial support for farms situated in areas where agricultural production is difficult because of unfavourable natural conditions. Payments were to compensate for existing problems in relation to agricultural holdings located outside the LFAs. The budget of the measure amounted to almost 2.6 m euros, including about 2.1 m euros which came from the European Agricultural Fund for Rural Development (EAFRD).

As part of the RDP measure, 5,861.3 thousand applications were granted – from 55.7 thousand in Opole to 1,121.9 thousand in Mazovia (table 1). The activity of beneficiaries measured with the number of applications per 1,000 farms varied between 1,957 in Opole and 6,612 in Podlasie, with the average of 3,751 applications for the country. As part of the LFA payments 10,891.2m PLN were spent – from 97.2m PLN in Opole to 2,025.3m PLN in Mazovia. Such high payments resulted from the large area qualified for LFAs (9.2m ha, i.e. 56% of agricultural land in the country), relatively high amount per 1 ha (from 179 PLN – lowland zone I to 320 PLN – mountain areas) and an easy access of farmers to these resources – farmers submitted an LFA application together with an application for uniform area payments (UAP). The amount paid to the end of 2015 per 1 ha of AL was 621.3 PLN and was regionally diversified – from 180.1 PLN in Opole to 1,153.4 PLN in Podlasie. On average, one granted application was subsidised with 1.9 thousand PLN. These payments were the lowest in Małopolska (980.4 PLN) and the highest in West Pomerania (3.4 thousand PLN).

The spatial differences in the measure are a consequence of the delimitation of areas with unfavourable conditions of farming, hence the relation with the quality of the farming production space. In voivodeships with low values of the index the absorption level was observed to be the highest, while in those with higher values the activity of the beneficiaries and the payments were lower. This regularity is corroborated by correlation analysis (r = -0.754 and r = -0.891 respectively).

Table 1. Level of use of funds from the measure "Support for farming in mountain areas and other less-favoured areas (LFAs)"

Voivodeship	Applications granted			Payments received			
	number [in thousands]	% of the total	per 1,000 farms	total [in millions of PLN]	% of the total	per 1 ha of AL [in PLN]	per 1 application [in thousands of PLN]
Lower Silesia	165.2	2.8	2,603	401.1	3.7	389.1	2.4
Kujavia-Pomerania	245.6	4.2	3,617	558.2	5.1	444.3	2.3
Lublin	529.3	9.0	2,787	727.4	6.7	451.8	1.4
Lubuska Land	133.1	2.3	5,661	348.2	3.2	697.0	2.6
Łódź	604.0	10.3	4,492	823.0	7.6	723.8	1.4
Małopolska	418.3	7.1	2,578	410.1	3.8	530.7	1.0
Mazovia	1,121.9	19.1	4,721	2,025.3	18.6	868.9	1.8
Opole	55.7	1.0	1,957	97.2	0.9	180.1	1.7
Podlasie	568.7	9.7	6,612	1,465.1	13.5	1,153.4	2.6
Pomerania	193.4	3.3	4,515	540.7	5.0	568.6	2.8
Silesia	154.5	2.6	1,990	187.7	1.7	376.2	1.2
Subcarpathia	349.9	6.0	2,410	355.4	3.3	464.9	1.0
Świętokrzyska Land	297.5	5.1	2,885	309.3	2.8	498.1	1.0
Warmia-Mazuria	252.5	4.3	5,688	784.8	7.2	649.9	3.1
Wielkopolska	621.5	10.6	5,017	1,352.4	12.4	689.3	2.2
West Pomerania	149.9	2.6	4,700	505.2	4.6	469.5	3.4
Poland	5,861.3	100.0	3,751	10,891.2	100.0	621.3	1.9

Source: author's own work based on the ARMA data and Local Data Bank, Statistics Poland.

The agri-environmental programme was a stimulus for farmers to take action for environmental protection. It comprised 9 packages with 41 variants available. One farm could implement up to three agri-environmental

projects. The means allocated to Polish agricultural holdings under the agri-environmental payments were 2.3 bln euros (including over 1.8m euros from EAFRD). The programme benefited 138.4 thousand farmers who were paid 6,936.9 m PLN – from 81.7 m in Silesia to 860.4 m PLN in West Pomerania (table 2). Beneficiaries submitted 566.5 thousand applications (with a maximum of 12.5% in Lublin). The number of applications granted per 1,000 farms (with the national average of 363 applications) varied between 97 in Silesia and 969 in Warmia-Mazuria. On average one application in the country was subsidised with the amount of 12.2 thousand PLN – from 5.1 thousand PLN in Świętokrzyska Land to 27.8 thousand PLN in West Pomerania. On the other hand, the payment received per 1 ha of AL was 395.7 PLN, and it varied between 131.3 PLN in Łódź and 880.2 PLN in Lubuska Land.

This measure was especially popular in regions with extensive areas attractive in natural terms. The dependence between the absorption level and the proportion of such areas is indicated by, e.g. Rudnicki (2010), Biczkowski, Jezierska-Thöle (2012), Pawlewicz, Bórawski (2013), Czudec et al. (2017) as well as Kutkowska, Barczyk (2017).

The spatial differences in the "Agri-environmental programme" are also connected with the historically formed areal structure of farms. The most extensive areas benefiting from agri-environmental payments are in voivodeships where large and economically effective farms predominate (Głębocki, 2014). This regularity is corroborated by an analysis of the correlation between the features examined and the mean area of farms (0.871 for the number of applications per 1,000 of farms; 0.656 for the payment received per application and 0.592 for the payment received per 1 ha AL).

The afforestation of agricultural and non-agricultural land was aimed at improving the conditions of the natural environment. The purpose of this measure was to enlarge forest areas, maintain and strengthen their ecological stability by reducing the fragmentation of forest complexes and creating ecological corridors and also to raise the economic value of low-quality soils. It concerned the afforestation of low quality agricultural land and land listed in the records as agricultural land or farmland overgrown with trees and shrubs, not used for agricultural production.

The budget of the measure "Afforestation of agricultural and non-agricultural land" was 245.8m euros, including 196.6m euros from EAFRD. The analysis shows that 16.8 thousand decisions granting afforestation payments were issued. By voivodeship, the number of granted applications varied between 193 (1.2%) in Opole to almost 3.4 thousand (20.2%) in Mazovia. The beneficiaries of the programme afforested 36.8 thousand of private land in total, including 33.7 ha (91.5%) of agricultural land and 3.1 thousand of non-agricultural land. The largest proportion of forest areas appeared in

Table 2. Level of use of funds from the measure "Agri-environmental programme"

Voivodeship	Applications granted			Payments received			
	number [in thousands]	% of the total	per 1,000 farms	total [in millions of PLN]	% of the total	per 1 ha of AL [in PLN]	per 1 application [in thousands of PLN]
Lower Silesia	21.0	3.7	331.6	378.8	5.5	367.5	18.0
Kujavia-Pomerania	48.0	8.5	706.6	551.4	7.9	438.8	11.5
Lublin	70.9	12.5	373.3	606.2	8.7	376.5	8.6
Lubuska Land	16.9	3.0	720.5	439.7	6.3	880.2	26.0
Łódź	22.6	4.0	168.2	149.3	2.2	131.3	6.6
Małopolska	28.6	5.0	176.0	189.2	2.7	244.9	6.6
Mazovia	54.8	9.7	230.5	536.5	7.7	230.2	9.8
Opole	11.7	2.1	409.3	164.2	2.4	304.2	14.1
Podlasie	48.4	8.5	562.5	522.7	7.5	411.5	10.8
Pomerania	34.1	6.0	796.1	529.3	7.6	556.6	15.5
Silesia	7.6	1.3	97.5	81.7	1.2	163.8	10.8
Subcarpathia	41.7	7.4	286.9	353.2	5.1	462.0	8.5
Świętokrzyska Land	37.2	6.6	360.3	188.7	2.7	303.9	5.1
Warmia-Mazuria	40.5	7.1	911.9	744.1	10.7	616.2	18.4
Wielkopolska	51.8	9.1	418.0	641.3	9.2	326.9	12.4
West Pomerania	30.9	5.5	969.5	860.4	12.4	799.6	27.8
Poland	566.5	100.0	362.6	6,936.9	100.0	395.7	12.2

Source: author's own work based on the ARMA data and Local Data Bank, Statistics Poland.

Mazovia – 8.0 thousand ha, i.e. 21.7% of the general area afforested in the study period. On the other hand, the smallest area of agricultural and non-agricultural land was designated for afforestation in Opole – 0.47 thousand ha (1.3%) (Polna, 2018). As part of the afforestation payments 567m PLN were spent – from 7.4 m PLN in Opole to 120.5m PLN in Mazovia (table 3).

The analysed indicators of the absorption of the RDP means were as follows:

- the number of applications granted per 1,000 farms (the country average 10.7 applications) – from 2.5 in Małopolska to 25.8 in Warmia-Mazuria,
- the payment received in PLN per 1 application for a farm (the country average 33.8 thousand PLN) – from 16.6 thousand PLN in Subcarpathia to 91.2 thousand PLN in Pomerania,

- the payment received in PLN per 1 ha of AL (the country average 32.3 PLN) – from 10.9 PLN in Małopolska to 71.0 PLN in Warmia-Mazuria.

The highest values of the analysed indicators were recorded in voivodeships with a favourable area structure of agricultural holdings, whereas the lowest – in voivodeships most fragmented in terms of agriculture because they had problems with meeting the requirements and making decisions concerning the limitation of agricultural activity (Polna, 2018). A barrier was often a negative attitude of farmers towards formalities involved in completing the necessary documentation and the requirement for the land owner to cover the cost of afforestation. Small holdings producing mostly for their own needs only rarely had a surplus of financial means necessary for making investments.

Table 3. Level of use of funds from the measure "Afforestation of agricultural and non-agricultural land"

Voivodeship	Applications granted			Payments received			
	number	% of the total	per 1,000 farms	total [in millions of PLN]	% of the total	per 1 ha of AL [in PLN]	per 1 application [in thousands of PLN]
Lower Silesia	493	2.9	7.8	26.5	4.7	25.7	53.8
Kujavia-Pomerania	780	4.7	11.5	26.5	4.7	21.1	34.0
Lublin	2,044	12.2	10.8	44.1	7.8	27.4	21.6
Lubuska Land	258	1.5	11.0	15.3	2.7	30.6	59.3
Łódź	1,485	8.9	11.0	29.4	5.2	25.9	19.8
Małopolska	410	2.4	2.5	8.4	1.5	10.9	20.6
Mazovia	3,385	20.2	14.2	120.5	21.2	51.7	35.6
Opole	193	1.2	6.8	7.4	1.3	13.7	38.2
Podlasie	1,071	6.4	12.5	32.4	5.7	25.5	30.3
Pomerania	428	2.6	10.0	39.1	6.9	41.1	91.2
Silesia	271	1.6	3.5	10.1	1.8	20.3	37.3
Subcarpathia	2,379	14.2	16.4	39.4	7.0	51.5	16.6
Świętokrzyska Land	1,449	8.6	14.1	30.4	5.4	48.9	21.0
Warmia-Mazuria	1,147	6.8	25.8	85.7	15.1	71.0	74.7
Wielkopolska	694	4.1	5.6	29.2	5.2	14.9	42.1
West Pomerania	268	1.6	8.4	22.5	4.0	20.9	83.8
Poland	16,755	100.0	10.7	567.0	100.0	32.3	33.8

Source: author's own work based on the ARMA data and Local Data Bank, Statistics Poland.

Taking into account the absorption level of funds from pro-ecological measures, the hierarchic grouping of voivodeships by Ward's method was carried out. The procedure allowed dividing Poland into three groups of voivodeships, most internally similar and with the largest differences between them (figure 1). These groups embraced the following voivodeships:

I – Lublin, Łódź, Małopolska, Świętokrzyska Land, Subcarpathia
II – Kujavia-Pomerania, Mazovia, Opole, Silesia, Wielkopolska, Podlasie
III – Lower Silesia, Lubuska Land, Pomerania, Warmia-Mazuria, West Pomerania

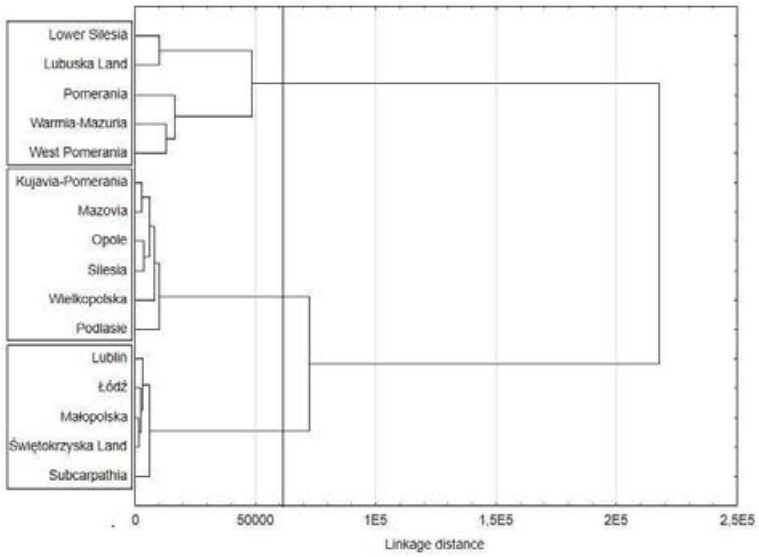

Figure 1. Dendrogram of Polish regions with similar use of funds for the pro-ecological measures of the RDP (2007-2013)

Source: author's own work.

The first group was selected the earliest, which proves the greatest internal similarity of the analysed features within. It is worth noticing that the most similar in the selected cluster are Małopolska and Świętokrzyska Land with Łódź, Lublin and Subcarpathia subsequently "overlapping" them (figure 1). The voivodeships in this group are characterised by the lowest level of the use of EU funds related to the improvement in the natural environment. It has also the lowest mean values of the indicators adopted for the analysis (table 4). An average amount of financial support per 1 ha of AL was 869.2 PLN and the value of one application – 1,771 PLN. At the same time the activity of beneficiaries was at the level of 3.3 applications per 1 farm.

Table 4. Mean values of amounts of funds used as part of the pro-ecological measures of the RDP (by groups of voivodeships)

Group	Number of applications per 1,000 of farms in total above 1 ha of AL	Payments received per 1 ha of AL [PLN]	Payments received per 1 application [PLN]
I	3,276.2	869.2	1,770.9
II	4,820.9	1,070.2	2,806.5
III	5,047.2	1,200.8	5,499.5

Source: author's own work.

The highest level of the use of the RDP means for measures supporting environmental functions of rural areas and agriculture was demonstrated in the third group of voivodeships, situated in the northern and western part of the country (figure 2). In the subsequent stages of the analysis they were not combined with other groups selected earlier, which indicates significant differences between this group and other groups in terms of the investigated indicators. This group recorded the highest mean values of the indicators of the absorption of EU funds as part of pro-ecological measures (table 4). However, one can notice certain differences in Lower Silesia and Lubuska Land, which create a separate subgroup in this cluster in relation to other voivodeships in the group (figure 1).

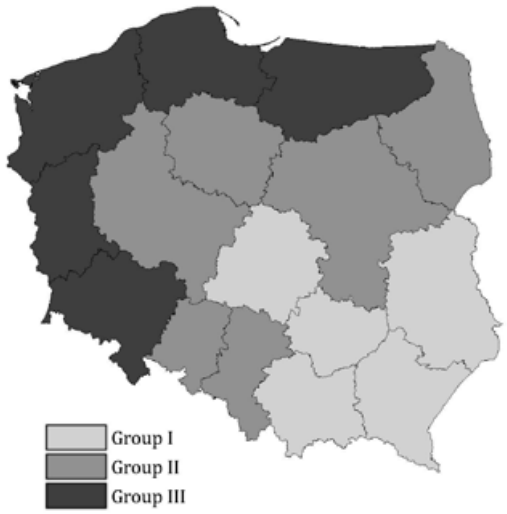

Figure 2. Groups of voivodeships distinguished based on the similarities in the absorption of funds from the pro-ecological measures of the 2007-2013 RDP

Source: author's own work.

Conclusions

The implemented pro-ecological measures under the 2007-2013 RDP, due to a large number of applications and a significant financial influence, were an important instrument for the multifunctional and sustainable development of rural areas. The research revealed that the implementation of pro-ecological measures was diversified regionally. Despite the observed differences in the regional use of the funds under individual measures, the division of voivodeships into several groups is outlined. The conducted grouping of voivodeships by Ward's method allowed selecting three groups of voivodeships. This helped to indicate both the general similarity in the level of absorption in the voivodeships representing particular parts of Poland and differences among its various regions. The financial support from the RDP was the greatest in the northern and western parts of Poland, characterised by, e.g., large-area farms and the richness of environmental assets (Podstawka, Konieczny, 2002; Potocki, 2003; Rudnicki, 2010; Biczkowski, Jezierska-Thöle, 2012). The influence of pro-ecological measures in these areas was the strongest. It helped to initiate conscious actions conducive to preserving and protecting the natural and landscape values of rural areas, increasing their biodiversity, improving the landscape structure, moving away from very intensive agricultural production or limiting the tendency to retreat from the extensive forms of production (Kołodziejczak, Rudnicki, 2012). On the other hand, the lowest use of financial resources supporting pro-ecological land management was reported in the south-eastern voivodeships of Poland (Lublin, Małopolska, Świętokrzyska Land, Subcarpathia) and in Łódź. Those regions are characterised by an unfavourable size structure of farms and strong land fragmentation, which made it difficult for them to meet the conditions for taking advantage of the RDP measures and did not encourage the decision to limit the agricultural activity. The EU payments intended to make up for the lost income on small farms are not a motivation for involvement in activities aiming to make agriculture permanent and sustainable. It is therefore necessary to raise further farmers' ecological awareness and improve their knowledge concerning the mechanisms of support for farming.

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Dariusz PIEŃKOWSKI

SUSTAINABLE DEVELOPMENT AS A CONCEPT OF FAIRNESS FROM THE PERSPECTIVE OF ENERGY CONSUMPTION POLICY

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ABSTRACT: Classical economists have claimed that selfish behaviour and competition are the most efficient way of resource allocation. Their concept of fairness according to one's work was treated as the universal formula of resource allocation very much defined by the individualistic perspective. However, the concept of sustainable development refers to the idea of fairness according to the needs of both present and future generations. This paper presents the sustainable perspective of fairness that postulates new forms of energy consumption related to the concepts of solidarity or social economies. The perspective is contrasted with the example of Friedman's view, a famous advocate of market economy, to illustrate the differences and consequences for socio-economic development. Both the fairness systems are just in the terms of formal justice, despite the dispute regarding their fairness formula; and this paper presents a strategy to the consumption of energy based on a reference point, which utilizes these two formulas to allocation energy resources. Additionally, this study seeks to present the role of the new socio-technical structures, which provide opportunities to create a wide range of goals beyond the narrow targets of energy production from renewables, including reduction of social and economic inequality or generation of social capital and resilient economies.

KEY WORDS: fairness; energy consumption; sustainable development; social capital; local socio-technical structures

Introduction

Renn, Webler, and Kastenholz reported that '*modern democratic societies with pluralistic value systems tend to emphasize procedural justice over substantive fairness since the various actors in society disagree about what is a just and fair solution and what ratio of payoffs and risks is regarded as acceptable*' (1996, p. 145). In turn, Miller (1974) referring to Perelman's view, claimed that a specific model of society reflects the agreements and adequate substantive rights that constitute fairness formulas. The formal approaches to justice differentiate the terms *justice* and f*airness* as an obligation to follow particular rules, which stand for the categories and the explanation of the accepted model of society, which postulates the rules (Miller, 1974). Fairness rules are historically specific and they change, conforming to the development of the conditions of socio-economic and ecological systems. Moreover, they can vary at the same point of time in different areas of human activities (i.e. social and economic) or in different political systems. However, the term *justice* from the perspective of formal language is defined as '*the obligation to treat in a certain way all persons who belong to a given category*' (Sullivan, 1975, p. 327-328). This concept does not provide any reason for the moral obligation resulting from the rule. It acts similarly to the conception of rationality in economics, assuming consistency of judgment as a precondition to the application of market rules.

The dominant way of perceiving the relationship between market efficiency and social justice is the perception of the former from the perspective of free-market activities, as a timeless, universal and value-free mechanism of natural resource distribution (Wilkin, 1997). Classical economists have claimed that the selfish behaviour of all the actors in the market is the best strategy for resource allocation, with competition being the most efficient way of doing so. Neoclassical schools have confirmed this point of view, offering mathematical formulas to portray the equilibrium mechanism of resource allocation. The economic equilibrium referred to Pareto optimum underpinning the economic efficiency and the concept of justice (Narveson, 2002). Therefore, the conceptions of economic efficiency and Pareto optimum are value-oriented, although many economists claim non-axiomatic conditions. The market formula of *fairness* according to one's work was treated as the universal formula (= *justice*) of resource allocation very much defined by individualistic ethics.

The present global society disputes on sustainable development postulate a new formula of fairness, which should also be applied in economic systems. The concept of sustainable development refers to the idea of fairness

according to the needs of both present (intertemporal allocation and intragenerational equity) and future (intertemporal distribution and intergenerational equity) generations (Daly, Farley, 2003). It postulates different formulas of fairness and the reorganization of the neoclassical mechanism that produced social inequalities and ecological threats. Therefore, market activities are discussed from the perspectives of solidarity, sharing or social economies. The new forms of socio-economic activities are related to new socio-economic structures that generate potential not only for the goals related to economic activity but also to increase capacity to achieve a wide range of social and ecological postulates, such as changes in consumption patterns or a reduction in inequalities.

Both the fairness formulas represent one of many dimensions of fairness, which are invoked in literature (Barry, 1989; Dobson, 1998; Lebacqz, 1986; Nozick, 1974; Perelman, 1967; Rawls, 2009; Roemer, 1998; Stone, 2012). This paper presents the sustainable perspective of fairness that postulates new forms of energy consumption and production. The new approach is contrasted with the example of Friedman's view, a famous advocate of market economy, to illustrate the differences and consequences for socio-economic development postulated by the fairness formula in the concept of sustainable development. The new approaches emphasise the role of social capital, collaborative consumption and prosumption as complementary to market individualism, competition and profit maximization.

This research seeks to present the role of new local socio-technical structures and distributed generation of renewable energy in sustainable energy transition. The main hypotheses stated in this paper are the following:

- The economics of sustainable development postulates a *fairness* formula different to that of neoclassical economic schools, although both the formulas are *just*.
- The fairness formula postulated in the concept of sustainable development is determined by the present global socio-economic and ecological conditions. The global society is mutually dependent and a local action can have global impact and change the global situation. Therefore, independent competing individuals are less effective than cooperative communities.
- The creation of institutional capacities for the production of social capital is a precondition for sustainable energy transition. In other words, the transition aimed at providing secure and affordable energy from renewable resources has to be centred on the building of new socio-technical structures formed under the conditions of new economic forms such as a collaborative, sharing or social economy.

The new socio-economic structures have to provide opportunities to create of a wide range of different goals beyond the narrow targets of production and distribution of energy from renewables, including the reduction of social and economic inequality or the generation of social capital and resilient economies.

Sustainable development as a fairness formula in light of Friedman's view

Friedman in his works emphasized the key fairness formula that justifies the free market society: '*to each according to what he and the instruments he owns produces*' (Friedman, 1962, pp. 161-162). In the section titled *Facts of Income Distribution* he clearly stated that '*there is surely drastically less inequality in Western capitalist societies*' (Friedman, 1962, p. 139). To support this view, he provides the example of capitalist countries such as the Scandinavian countries, France, Britain and the United States in comparison with India or Egypt (Friedman, 1962). The inequalities generated by capitalism were to be substantially reduced in the Western countries, although '*of course, there were many losers along the way-probably more losers than winners. We don't remember their names. But for the most part they went in with their eyes open. They knew they were taking chances. And win or lose, society as a whole benefited from their willingness to take a chance*' (Friedman, Friedman, 1990, p. 138).

It is meaningful that the author, in this small section devoted to the facts, in no one place indicated any data, indicators, research or references supporting his theses. The section pointed out misleading conclusions resulting from the well-known limitations of such indicators as the Gini index. To back up the problems, a general view was presented of a higher standard of living in the Western countries in terms of technological and medicine advancements or the higher availability of many upper-class products for the masses. Additionally, he pointed out the benefits of social mobility in terms of change in households' income hierarchy over time resulting from market dynamics (Friedman, 1962, p. 139).

Many of these counterarguments put forward by Friedman are at least as misleading as the problems resulting from the limitations of the Gini index and other indicators. For example, the mass consumption of former upper-class products and services challenges the feudalism that entailed rigid social classes. Since the capitalistic order has transformed the feudalistic one, debates are dominated by the benefits of socialism, but not feudalism. The advocates of feudalism are only a marginal part of reflections on future political and economic systems in the contemporary debates on resource

allocation mechanisms. However, the statement in the same paragraph that '*comparison with communist countries like Russia is more difficult because of paucity and unreliability of evidence*' (Friedman, 1962, p. 140) is an eristic argumentation technique. The central distribution of income characteristic of socialism resulting in a low wage policy and relatively lower income inequalities than in capitalistic countries is widely presented in research (Ellman, 1979; Filek, 2011; Wang, 2008); this is probably the least debatable issue in these terms.

The discourse on market justice can be illustrated in the context of a well-known concept of fairness formulas presented by Perelman (1967), which indicates six principles, including that invoked by Friedman: to each according to one's works; to each the same thing; to each according to one's merits; to each according to one's needs; to each according to one's rank; and to each according to one's legal entitlement. Additionally, the deliberations reflect the debates on process as presented by Stone (2012), who offered three dimensions: recipients; items; and process. The process dimension emphasizes procedures such as competition, lottery or voting. It can be said that competition is the primary mechanism of fair distribution in the market economy.

However, the new order postulated in the concept of sustainable development challenges the idea of a wide group of losers devoted to a smaller group of winners in the market game. Friedman's view on more forgotten losers than winners and, at the same time, all of them as a whole to benefit from the situation, can be justified by the poverty debates. However, this perspective ignores the abundant psycho-social determinants of socio-economic development and assumes imperfect market allocation via competition that has to be by its nature corrected by redistribution. Therefore, back in 1974 the participants of the symposium in Cocoyoc declared that '*we therefore reject the idea of "growth first, justice in the distribution of benefits later"*' and '*our first concern is to redefine the whole purpose of development. This should not be to develop things but to develop man*' ('The Cocoyoc Declaration', 1975, p. 896).

The concept of sustainable development challenges the principle of market-specific fairness formula, postulating a new formula of fairness and the need for a new order: '*sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:*

1) *the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and*

2) *the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs*' (World Commission on Environment and Development, 1987, p. 43).

The postulates of sustainable development relativize economic activities with their socio-ecological consequences. According to Friedman's view, sustainable development postulates economic growth, which does not generate groups of winners and forgotten losers either in the present generation or in the future ones. Therefore, the concept emphasizes quality indicators, ethical dimension of economic growth, environmental limits, global consequences of local activities, and complexity of socio-economic and environmental relationships resulting in the necessity of dealing with uncertainty and the participation of all stakeholders (Pieńkowski, 2013).

It should be clearly emphasized that both the fairness systems, i.e. the competition in market system-based individualistic ethics and the collaborative market activities based on social capital, are *just* in the terms of formal justice, despite the dispute regarding their fairness formula and related model of socio-economic development (Pieńkowski, 2013). However, at the same time the postulates of sustainable development advocate different fairness formulas than the neoclassical economic schools, favouring market-oriented values of social development such as egoism and the formula *to each according to one's works*.

The concept of a *reference point as* the sustainable energy allocation mechanism

Perelman warned decision-makers against the extreme consequences of any justice system because of its imperfection and arbitrariness (Perelman, 1967). This would explain the successes of the Western economies, such as the Scandinavian countries, which were able effectively reduce poverty and inequalities achieving a relatively high standard of living. These socio-economic systems combine the market-oriented fairness formula with the fairness formula characteristic for social life. In other words, the 'moral balance' between different formulas is also sustainable.

A diverse economic approach for the allocation of resources was presented by Costanza and Daly (1992), who postulated two distinctive mechanisms of allocation depending on the level of undertaken economic activities. In line with this approach, a micro-allocation mechanism was based on the maximization of individuals' private utility. On this level, a value typical for market approaches is dominant, as postulated by Friedman: i.e. competition and the fairness formula *to each according to one's works*. In turn, macro-allocation represents a social/collective mechanism based on social prefer-

ences, which include the present and future generations and other species. Consequently, the dominant mechanism of allocation is voting and the fairness formula *to each according to one's needs*.

Pieńkowski (2012, 2013) offered a strategy based on a reference point to the consumption of energy from the perspective of these two mechanisms of energy allocation. Micro-allocation refers to country-specific socio-economic conditions, such as energy efficiency or consumption patterns (a style of life and system of values). The country-specific strategy towards energy consumption determines benefits derived from a given amount of energy provided to the economy of the country. However, macro-allocation represents the results of international agreements on the amount of energy that can be input into the country. The agreements reflect social preferences and result from political negotiations at an international level, such as the Kyoto Protocol or Paris Agreement. The agreements consider both global ecological conditions for energy consumption and the specific socio-economic and ecological determinants of the energy input.

Consequently, the author offered some indicators to compare countries and measure the two groups of conditions for energy consumption. For example, the *energy intensity of economy* measures energy efficiency of a national economy defined as energy use per $1,000 Gross Domestic Product in constant Purchasing Power Parity from a specific period (year) ('The World Bank Open Data', n.d.) and illustrates the benefits of the country provided by the energy input. Additionally, the benefits can be completed with the *share of renewables in energy use* (in per cent). Energy use refers to the use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport ('The World Bank Open Data', n.d.). In turn macro-allocation is defined by such indicators as *energy use per capita*, which measures the input of energy allocated due to political agreements. The energy is usually measured in *kg of oil equivalent* (kgoe) or *ton of oil equivalent* (toe), which is a standardized unit with a respectively assigned net calorific value of 41,868 kilojoules/kg and 41,868 gigajoules/kg (equivalent to the approximate amount of energy that can be extracted from one kilogram or ton of crude oil).

The rationale behind the concept is that the micro-allocation mechanism based on market allocation provides motivation for the increase in efficiency at the country level according to individuals' works: lifestyle, technology, and socio-economic institutions that shape energy behaviour. And the macro-allocation mechanism based on political agreements ensures resources according to the social needs with regard to ecological conditions from the global

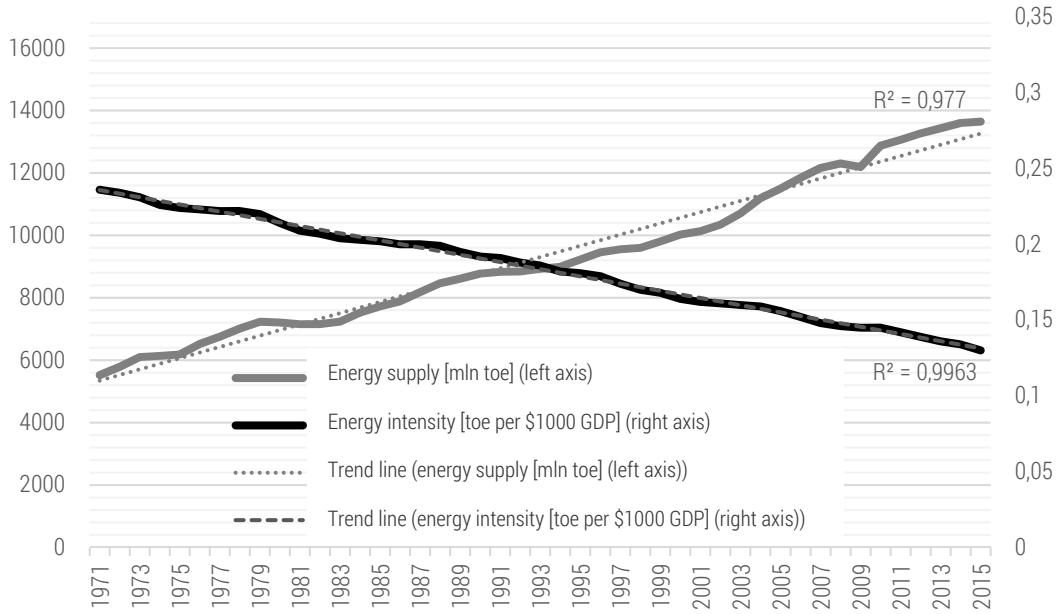

Figure 1. Global primary energy supply [mln toe] and energy intensity of economy [toe per $1000 GDP] in 1971–2015. *Notes: toe – ton of oil equivalent, GDP – Gross Domestic Product*

Source: OECD, n.d.

perspective. The high level of energy intensity and, at the same time, the high level of energy consumption is the real threat for the global ecosystem and climate change mitigation. However, a low level of energy intensity and, at the same time, a high level of energy consumption is what is most beneficial for a country. The problem usually reported in the context of Jevons' effect is that in line with the lower energy efficiency in most developed economies, energy consumption increases. In Jevons' words: '*It is wholly a confusion of ideas to suppose that the economical use of fuel is equivalent to a diminished consumption. The very contrary is the truth [...] As a rule, new modes of economy will lead to an increase of consumption*' (Jevons, 1865, p. 123; see also Pieńkowski, 2012). Figure 1 presents global energy efficiency measured by the *energy intensity index* and global energy consumption measured by the global primary energy supply defined as '*energy production plus energy imports, minus energy exports, minus international bunkers, then plus or minus stock changes*' (OECD, n.d.). The figure shows that in line with the Jevons' effect, energy consumption increases with the increase of energy efficiency, while the sustainable energy strategies postulate an increase in energy efficiency to hamper further energy inputs.

The trends presented on the global level can be treated as a reference point for international agreements, providing a framework that targets energy consumption. However, the final results of the negotiations should mirror the specificity of each country. Figures 2 and 3 show the variety of consumption patterns in the example of some countries and OECD members. The changes in Poland, presented in figure 2, are meaningful in the context of the discussion on consumption models from the perspective of political systems. The capitalistic transition related to the improvement in energy efficiency lowered energy consumption (primary energy supply). The level of energy consumption has been stabilized, although the energy efficiency of the economy has been substantially improved, which also has the character of trends described by Jevons' effect. From the perspective of sustainable energy use, the most desirable trend is found in such countries as North Korea, with decreasing consumption levels and increasing energy efficiency at the same time, particularly as the energy consumption level is much lower than in most capitalistic countries (figure 4). This is not typical for China, which follows the patterns characteristic of developed countries in the industrialization periods.

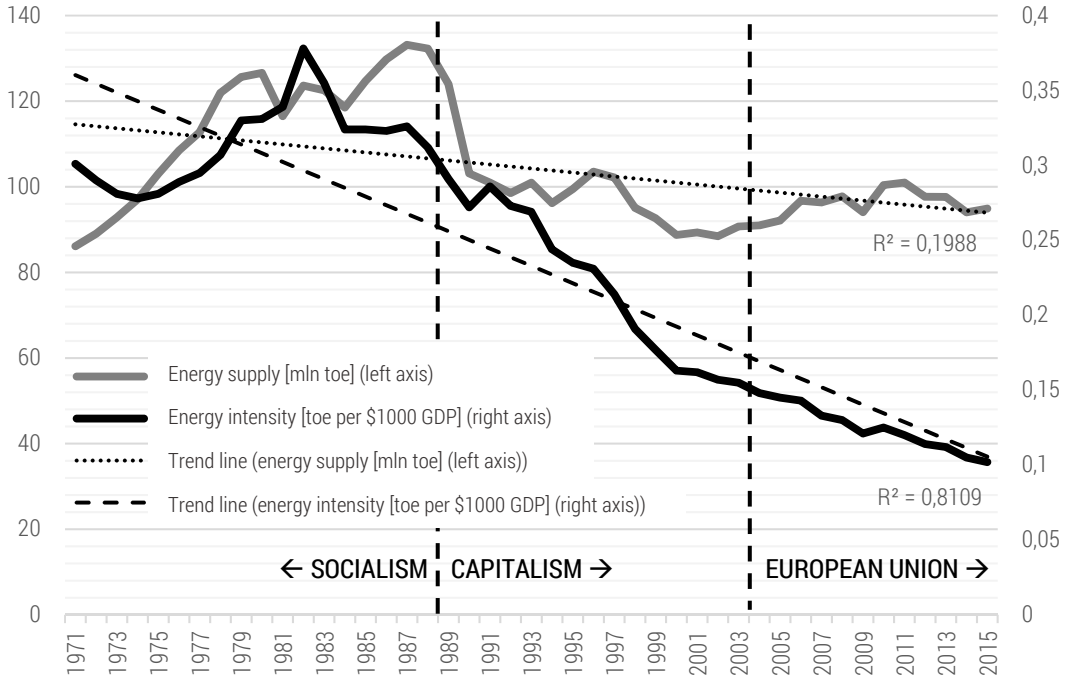

Figure 2. Primary energy supply [mln toe] and energy intensity of economy [toe per $1000 GDP] in 1971-2015 in Poland

Source: OECD, n.d.

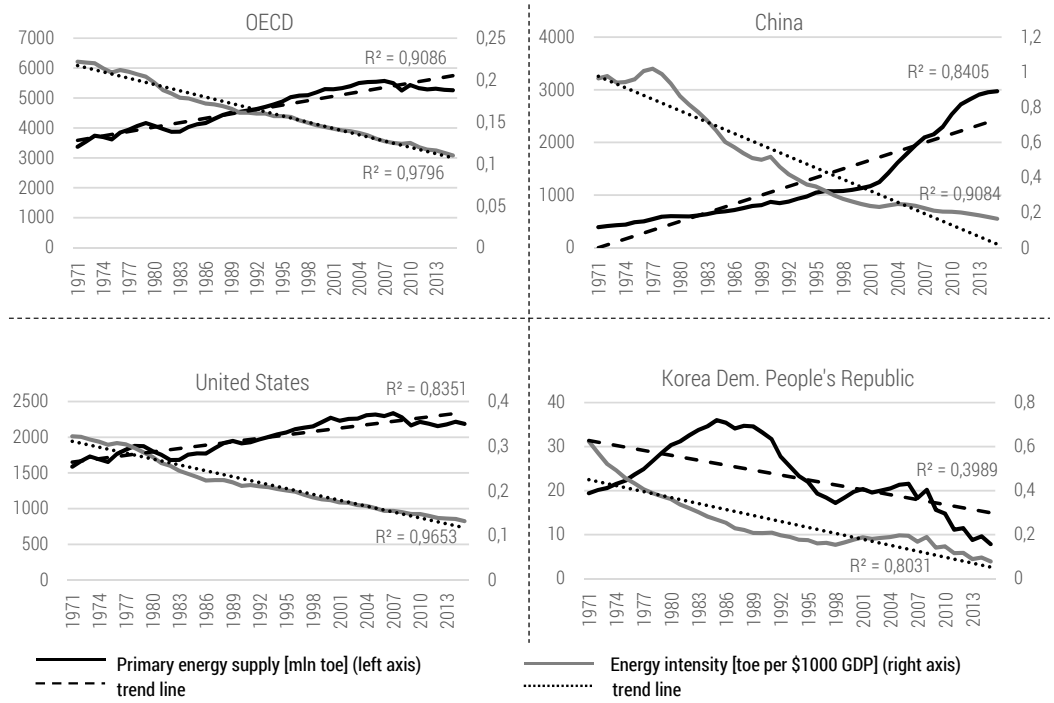

Figure 3. Primary energy supply [mln toe] and energy intensity of economy [toe per $1000 GDP] in 1971-2015 in the US, OECD, China, and Korea Democratic People's Republic

Source: OECD, n.d.

Figure 4 presents energy use per capita including energy from renewables and energy intensity in constant 2011 PPP. It shows the differences between particular countries illustrating the burdens on ecological systems. The energy from renewables is a form of sustainable use energy resources and should be excluded from the political negotiations. The countries were sorted according to the level of energy consumption from non-renewables. The level of using energy from renewables additionally benefits particular countries in terms of energy consumption. For example, in Norway the energy provided from the resources exceeds the use of the energy from non-renewables and the consumption of non-renewables only slightly surpasses the global average. In turn, North-American countries such as Canada or the US consume four times more energy per capita than the global average.

Figure 4 also shows the differences between two socio-economic and political systems within the same nation, as can be seen in the example of the Republic of Korea and the Democratic People's Republic of Korea (there is a lack of data on energy intensity in the World Bank database; however,

the trends can be observed in figure 3 based on the OECD database and due to the typically lower energy efficiency of socialistic economies, it can also be expected that the index of energy intensity of economy is much higher in the Democratic People's Republic of Korea than in the Republic of Korea). The OECD database indicates a close to double higher energy intensity index in 2016 [toe per $1000 GDP] in the Democratic People's Republic of Korea (OECD, n.d.). However, the energy consumption level is more than 10 times higher in the Republic of Korea. The mixed results show the complexity of determinants from the perspective of sustainable development. Very high levels of economic development and high energy efficiency hold in favour of the capitalistic system, while very high levels of energy consumption and Jevons' effect at the same time disadvantage the political system.

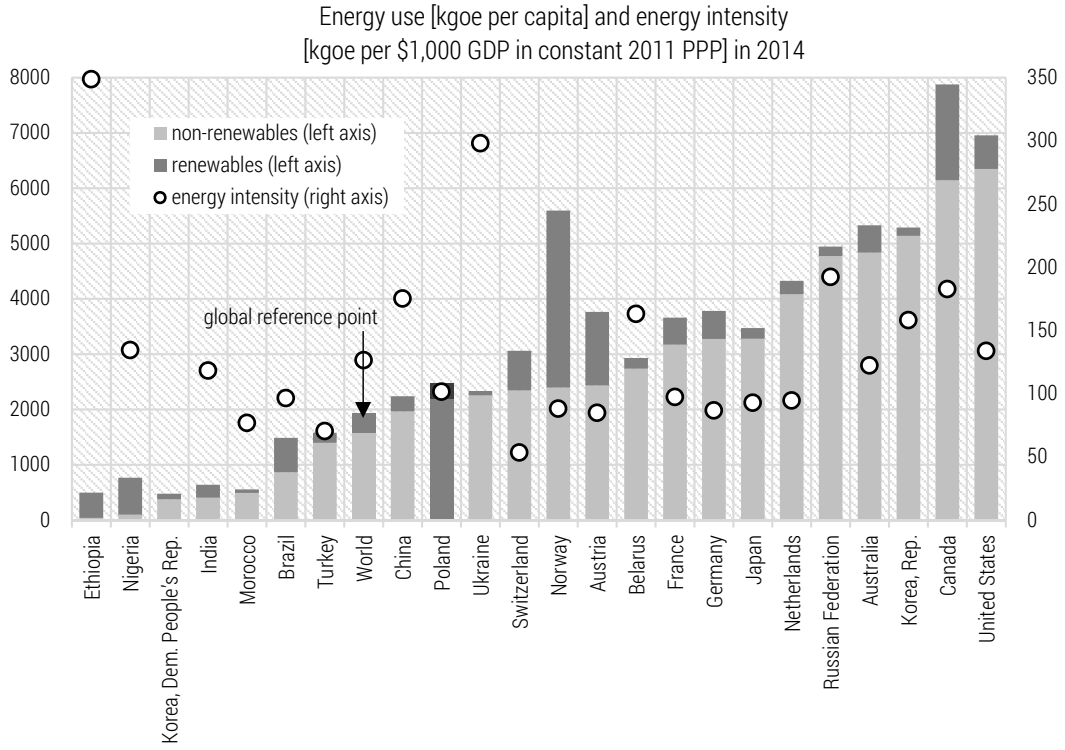

Figure 4. Energy use [kgoe per capita] and energy intensity [kgoe per $1,000 GDP in constant 2011 PPP] in 2014 (no energy intensity data for Korea, Dem. People's Rep.)

Source: World Bank Energy, n.d.

The *concept of a reference point* offers a limit to the energy input in a country motivating changes in energy policy in terms of the needs of other countries and the ecological limits at the global level. The *concept of a reference point* postulates using an average energy consumption level as a starting point for macro-allocation agreements. The global reference point creates a framework for energy consumption from the perspective of global ecosystem limits. However, other reference points can be set up for negotiations in specific geographic and political regions such as the European Union, OECD members, sub-Saharan Africa, or North America (figure 5). For example, the European Union can be compared to the global average as a single unit, although the discrepancies between particular member states can be varied to a much greater extent.

The concept of a reference point aims to achieve three main goals. Firstly, from the economic perspective, it hampers the Jevons' effect, politically limiting (voting as a fairness criteria) the amount of energy input in an economy regardless of the economic affordability of buying energy. The limits enforce countries – and in particular developed countries with high levels of energy consumption – to design energy policies for using renewable resources and changing consumption and production patterns. The quality of life and the inequalities between countries are then solely achieved within the fair quota provided to an economy. Second, from the social perspective, the concept meets the moral postulates of fair inter- and intragenerational allocation of natural resources to each according to one's needs. The mechanism ensures a more balanced allocation between different parts of the world and allows to plan development from the perspective of future generations. Finally, from the ecological perspective, it allows the creation of resilient economies from the global perspective, according to the ecological conditions of the Earth.

Renewable energy communities and social capital as a sustainable micro-allocation mechanism

Miller, Richter and O'Leary claimed that *'energy policy choices shape not just technological trajectories but trajectories in how people envision and construct themselves and their relationships to one another and to the world*' (2015, p. 30). Therefore, the micro-allocation level should be further discussed in the context of sustainable development postulates. The disputes between scientists on the nature of market actors has been increasing since the very beginning and recently they are also joined by behavioural economists (Pieńkowski, 2011, 2013; Pieńkowski et al., 2018).

The most advanced arguments were presented by Siebenhüner (2000), who raised issues such as rationality and emotional reactions, cooperation and communication, learning and creativity as well as morality, which have been widely discussed in biological and social sciences. His model of *homo sustinens*, similarly to the research presented by behavioural economists, is motivated by cognitive and emotional processes. The latter, as evolutionary inherited qualities, also related to emotional learning typical of the first stages of individual development and emotional intelligence, support relationships with the environment and other people. The model emphasizes social qualities of human beings that have been developed over thousands of years of human evolution. Cooperation and solidarity based on communication, postulated in the concept of sustainable development, is a natural and universal human capability, which characterized small communities regulated by social norms. The norms constitute social capital, lowering transaction costs and regulating many areas of economic and social life. The new model of *homo sustinens* challenges the neoclassical model of rational, egoistic utility maximizers typical of a market economy.

The contemporary energy transition postulates the use of decentralized systems based on local renewable energy resources to produce '*competitive, sustainable and secure energy*' (European Commission, 2010). The sustainable perspective of energy transition emphasizes the role of new communities of renewable energy (Büscher, Schippl, Sumpf, 2019; Miller et al. 2015; Ruth, Goessling-Reisemann, 2019; von Bock und Polach et al., 2015; Zbaraszewski, Pieńkowski, 2017). The rationale behind the concept is that the communities go beyond the goals of such narrow approaches as energy production from renewables. In other words, a new seemingly unlimited source of energy without changes in consumption patterns, globally oriented, just distribution and resilient socio-economic systems will soon generate similar problems as those described by Jevons' effect. Therefore, the energy production systems are to be supplementary to the aforementioned socio-economic changes.

Von Bock und Polach et al. (2015), reviewing the goals of energy transition, pointed out such goals as new employment opportunities, generating added value, or increasing the capacity for further economic and social activities. In turn, Miller et al. (2015) indicated more specific issues, such as distributive justice or community resilience manifested in economic stability and well-being. The climate resilience of the contemporary economies has been particularly targeted since the Paris agreement in 2015. Consequently, the complex of sustainable goals provides specific prerequisites for the creation of energy production systems. The socio-technical systems from the experience of many energy initiatives offer the platform for the development of capacities for sustainable energy transition.

The most detailed research is provided by van der Merwe, Biggs, and Preiser (2018), specifying indicators of technical and social resilience. They reported specified and general technical and social resilience at three different organizational levels as follows: 1) operational focused on persistence; 2) tactical focused on adaptability; and 3) strategic focused on transformability. The specified social capacities consist of competence in decisions and the execution of standards, procedures or emergency execution roles, the ability to both anticipate foreseeable accidents and provide leadership in an uncertain environment. The general capacities at the first level consist of monitoring people's attitudes towards safety and resilience, the ability to follow one's intuition based on experience in new situations unregulated by procedures, acting under great pressure or in unplanned scenarios. In turn, at the adaptability level the key qualities involve the ability to network and mobilize support via networks and third-party agreements, monitoring justice or identifying heuristics used in crises. Finally, at the transformability level, the general social capacities are shaped by a resilience culture, social and psychological capital, external and internal connectedness in functions, sectors and disciplines and the ability to see complex relationships, prioritizing objectives and recognizing a phase change.

The goals set in the sustainable energy policy define the character of the new socio-technical structures expected in energy transition. The structures are defined as '*sets of interlinked arrangements and assemblages of people and machines involved in the production, distribution, and consumption of energy, in their supply chains, and in the lifecycles of their technologies and organizations*' (Miller et al., 2015, p. 31). They have to provide opportunities for the creation of social capital as the new qualities such as intuitional behaviour or resilience culture capital are determined by a specific social environment. The typical characteristics of the environment, such as trust building, solidarity and cooperation, are difficult to provide in a group of independent egoists maximizing their interest, as offered in the model of *Homo oeconomicus*. The renewable energy communities are expected to be a platform for the building of the socio-economic capacities postulated in contemporary energy transition. Therefore, their creation assumes ownership, cooperative forms of management and deliberative inclusive decision-making.

Conclusions

The classical and neoclassical economic models of market actors and the fairness formula of social development accompanying the market distribution of resources is no longer acceptable from the perspective of the present global interdependencies. The ethical framework, which shaped the classical

and neoclassical market-oriented models of socio-economic development, was widely criticized from the socio-psychological and economic perspectives. The arguments presented by contemporary economists such as Friedman are very illustrative in understanding the ethical differences and rationale behind the classical/neoclassical model of society and the approach postulated in sustainable development. The short review of Friedman's view presented in this paper shows that the economics of sustainable development postulates a fairness formula other than that of the neoclassical economic schools, although both formulas are just in terms of formal language.

The justice of both the fairness formulas allows a concept of socio-economic development to be offered that will meet their distribution criteria. For example, the concept of a reference point presented in the example of energy distribution shows that both the formulas can be exploited at different levels of socio-economic development to monitor ecological burdens at the global level related to the trends described by Jevons' effect. At the same time, it enforces specific societies to effectively use these resources in line with the marked-oriented ethical approach. The fairness formula postulated in the concept of sustainable development is determined by the present global socio-economic and ecological conditions.

Finally, this paper shows the micro-allocation level changes in line with the postulates of sustainable development. It emphasizes the role of new socio-technical structures to complete a marked-oriented mechanism of resource allocation. The new postulates of energy transition change not only technologies but also reform socio-economic structures, including social meanings or energy consumption and production patterns. The new approaches emphasize the role of social capital, collaborative consumption and prosumption. The creation of institutional capacities for the production of social capital is a precondition for sustainable energy transition. The new structures provide opportunities for the creation of a wide range of different goals beyond the narrow targets of production and distribution of energy from renewables, including a reduction of social and economic inequality or the generation of social capital and resilient economies.

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Stanisław **WRZOSEK** • Magdalena **KISAŁA**

INTERDISCIPLINARY APPROACH IN RESEARCH ON THE ROLE OF LOCAL GOVERNMENT UNITS IN ENVIRONMENTAL PROTECTION

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ABSTRACT: Environmental protection was placed by the legislator as one of the public tasks performed by local government. Due to the fact that the local government performs decentralized tasks, which are mainly intended to meet the needs of local communities in a given territory, tasks related to the field of environmental protection also serve the needs of residents of communes, poviats and voivodships in terms of the use of the environment. Therefore, the type and nature of these tasks will be adapted to the role and specialization of individual local government units. Local government units perform tasks stipulated in the existing legislation. They are also obliged to use instruments related to planning and strategic documents that take account of statutory environmental protection assumptions. In order to achieve higher effectiveness in the scope of environmental protection, local government units may take actions that facilitate the use of techniques and methods for environmental management and use quality management tools.

KEY WORDS: local government, environmental protection, public tasks, administrative policy, management sciences

Introduction

Environmental protection covers issues of an interdisciplinary character, therefore, the considerations in this article may be subject to assessment from the point of view of various research disciplines. The aim of the article is to identify legal, strategic and quality instruments which local governments (or its bodies) use to undertake activities related to environmental protection and assessment of their role in this area. Such an approach to the subject allows to study the functioning of local government units in environmental protection from the point of view of administrative law, administrative science, administrative policy and management sciences. Each of them characterizes the subject matter in a different way and emphasizes distinctive features of applied research and scientific methods (Dobosz, 2001, p. 29). At the same time, however, they complement each other giving a wider scope of assessment of the problem under investigation. In connection with the above, the study begins with the analysis of the legal position of local government units from the point of view of the administrative law, based on the applicable legal provisions regarding separation from the structure and tasks of the state with regard to environmental protection. Using the assumptions of the administrative science, however, issues related to the structure of local government bodies dealing with environmental protection and issues related to the indication and assessment of competences situating these bodies in the indicated structures were presented. Next, the issues were analysed from the point of view of the administrative policy, which complements administrative science, as it includes postulates and guidelines for improving the functioning of local government administration. The discussion ends with the analysis of the applicability of management sciences in the field of environmental protection activities undertaken in local governments in order to find opportunities to increase the effectiveness of local government bodies.

Research methods

Theoretical and empirical considerations are based on normative acts and specialist literature. First of all, local government units operate on the basis of national law. Therefore, to investigate the subject matter, the legal basis of environmental protection and local government had to be analyzed. Secondly, the content of the article is also a subject to the regulation of community law. For this reason, community law documents regarding environmental management have been analyzed. The conducted thesis have been supplemented by the specialist literature.

Results of the research

Law as the foundation of organisation and the functioning of local government

According to the Constitution of the Republic of Poland, local government in Poland participates in exercising public authority by performing an important part of public tasks not reserved by the Constitution of the Republic of Poland or acts for other bodies. Additionally, public authorities, and hence also local government authorities, are obliged to protect the environment and conduct a policy ensuring ecological security for contemporary and future generations. Clarification of constitutional regulation in the scope of further repartition of reserved tasks for self-government units, including the area of environmental protection, is made in the public administration system laws and specific laws. Tasks are transferred using the principle of decentralization and the principle of subsidiarity.

The principle of decentralization is expressed in art. 15 para. 1 of the Constitution of the Republic of Poland of 1997. According to its content, the territorial system of the Republic of Poland ensures decentralization of public authority which consists in a permanent, legally protected transfer of important tasks, competences and resources of bodies operating at the national level of cooperative entities operating at various levels of the territorial division of the country (Judgment of the Constitutional Tribunal of July 18, 2006, ref. no U5/04, OTK-A 2006, item 80). The legal definition of decentralization emphasizes three aspects: 1) transfer of public tasks to be implemented at the local level, 2) use of property and rights by local authorities, ensuring their independence and the ability to decide on public matters, 3) adequate financial resources to implement their own policies (Gajl, 1993, p. 12).

The principle of subsidiarity is expressed in the preamble of the Constitution of the Republic of Poland of 1997 as the one that is to strengthen the rights of citizens and their communities. The principle of subsidiarity is related to the principle of decentralization and it is complementary thereof. On this basis, the legislator makes a decision regarding the level at which the task should be carried out and communicates the competences related to its implementation. Master decisions regarding citizens should be made at the lowest possible level and the closest to the citizen, and the decision-making criterion at the higher levels is efficiency (Milczarek, 1998, p. 319). The assignment of tasks and competences to a specific unit, and consequently to its bodies, will therefore also have an organizational character (Matczak, 2004, p. 27), which streamlines and improves the functioning of public

administration bodies. In accordance with the principle of subsidiarity, the higher level unit should not be entrusted with tasks that can be performed at lower level unit with the same efficiency. Higher units should operate in those areas whose scope gives them the possibility to undertake more effective actions than lower units (Saint – Ouen, 1991, p. 4). The division of power, according to the principle of subsidiarity, should be rational and based on the criterion of effectiveness (Dolnicki, 2012, p. 30). The division of tasks based on the principle of decentralization and the principle of subsidiarity was reflected in the statutory provisions of the administrative law and in specific laws.

Local government units perform their own tasks and commissioned tasks. The municipality's own tasks include, in particular, matters related to environmental protection and nature protection (Article 7 (1) (1) of the Act of 8 March 1990 on municipal self-government, i.e. Journal of Laws of 2019, item 506). The poviat exercises certain public tasks of a supra-municipal nature with respect to environmental protection and nature (Article 4 paragraph 1 item 13 of the Act of June 5, 1998 on poviat self-government, Journal of Laws of 2019, item 511). The voivodship self-government performs voivodship tasks defined by acts in the field of environmental protection (Article 14 paragraph 1 item 8 of the Act of 5 June 1998 on the voivodship self-government (VSG), i.e. Journal of Laws of 2019, item 512). Additionally, the voivodship self-government defines the goal related to the preservation of the value of the natural environment in the voivodship development strategy, taking into account the needs of future generations (Article 11 paragraph 1 point 4 of the VSG). The voivodship self-government also implements the voivodship's development policy, which consists of the rational use of natural resources and shaping the natural environment, in accordance with the principle of sustainable development (Article 11 paragraph 2 point 5 of the VSG). Tasks assigned to self-government units can be divided into four categories: 1) organizing tasks, 2) direct-executive tasks, 3) obligatory and regulatory tasks, 4) supervisory and control tasks (Górski, 1992, p. 105). Thus, tasks related to environmental protection are located at every level of local government. Organizational tasks are performed by municipalities, poviats and voivodships. The main contractor for direct-executive tasks is the commune, although, of course, the poviat and the voivodship undertake activities in this area. However, the commune and poviat are the units obliged to undertake tasks important from the point of view of local communities. On the other hand, the objective of the voivodship self-government is primarily the civilization development of the region (Barczak, 2015, p. 222-230).

Research on the role of local government in environmental protection from the perspective of administrative sciences

The subject of interest of the administrative sciences is the examination of the administration in a given system, i.e. the problems of the influence of the state system on the shape of administration, the matters of administration structures and the interconnectedness of the administrative institutions (Leoński, 2010, p. 20 and n.). In connection with the above, the next step in the analysis is the identification of self-government bodies that have been granted competences related to environmental protection. According to art. 3 point 15 of the Act of 27 April 2001 – Environmental Protection Law (Journal of Laws of 2018, item 799, with later amendments (E.P. Law), the environmental protection authorities are administrative bodies appointed to perform public tasks in the field of environmental protection. The legislator enumerates environmental protection authorities: 1) commune head, mayor or city president, 2) starosta, 3) voivodship assembly, 4) voivodship marshal, 5) voivode, 6) minister competent for the environment, 7) general director of environmental protection, 8) the regional director for environmental protection. If the Act so provides, the bodies of the Inspection for Environmental Protection operating under the provisions of the Act on the Inspection for Environmental Protection perform tasks in the field of environmental protection (Articles 376, 377 E.P. Law). Some inconsistency of the legislator regarding the recognition of the voivodeship marshal and starosta as the environmental protection body, alongside the mayor or president of the city and the regional government raise doubts in the literature on the subject. It should be agreed with the view of the doctrine that the doubts arising in this context do not pose practical problems, because the tasks and competences of individual bodies have been specified in specific regulations (Kozińska, 2011, p. 97). On the other hand, uncertainty may arise from the recognition of the self-government bodies as the environmental protection body only of the voivodship parliament and omission of the commune council and poviat council, which also have competences in the field of environmental protection, not smaller than the voivodeship regional council (Barczak, p. 221). The competences of the authorities refer to the above-mentioned categories of tasks in the field of environmental protection: organizing tasks, direct-executive tasks, mandatory and regulatory tasks as well as control and supervisory tasks. As part of the organizing tasks, the legislator granted legal instruments to each unit for the adoption of communal, district and provincial environmental protection programs. The competences granted primarily to the commune authorities serve the performance of direct-executive tasks. The content, dates and order of performing these tasks are shaped by supervisory and control bodies, and are implemented by enforcement bodies (Górski,

2002, p. 242). These tasks are implemented primarily in the form of a resolution that most often takes the form of a local law act, as well as in the form of an administrative decision (Barczak, p. 226). The implementation of the obligation and rationing tasks consists in shaping the legal situation of other entities affecting the environment or using it (Górski, 1998, p. 15 and n.). Competences for the implementation of these tasks have been assigned primarily to environmental protection authorities, with particular emphasis on the legal position of the marshal of the voivodship and a reduction in the role of the starosta in this area. Such an assignment of competencies related to the obligation and rationing tasks is justified by reasons of accuracy and efficiency, because it is the voivodeship that gives the greatest guarantee of achieving results related to them (Barczak, p. 226-227). The last group of tasks and related competences concerns the control and supervisory sphere. According to art. 379 E.P. Law, control competences of compliance with and application of environmental protection regulations within the scope of their competence are vested in the voivodship marshal, starosta and mayor of the city. The control measures and the manner of conducting the controls have also been indicated. These authorities or persons authorized by them are entitled to act as public prosecutor in cases concerning offenses against environmental protection regulations.

Administrative policy in the field of environmental protection

The obligation to determine the activities for the implementation of tasks in the field of environmental protection in strategic and planning documents was imposed on the local government. These are activities within the framework of administrative policy, one of which is environmental policy. According to art. 13 E.P. Law, environmental policy is a set of activities aimed at creating the conditions necessary to implement environmental protection, in accordance with the principle of sustainable development. Environmental policy is conducted on the basis of the development strategy, programs and programming documents referred to in the Act of 6 December 2006 on the principles of development policy (Journal of Laws of 2017, item 1376, as amended) and by means of voivodship, poviat and commune environmental protection programs (Article 14 E.P. Law). The primary goal of environmental protection programs is to coordinate the activities and launch appropriate instruments by the competent body, adequate to the needs in the field (Czuryk, 2009, p. 57). The programs make inventories of protective problems, and thus they determine the real scheme of action, which in consequence may lead to the organization of the local government activities in the area (Barczak, 2006, p. 66).

The obligation to implement environmental policy was imposed on local government units at all levels. In documents defining the policy of environmental protection, local government bodies are obliged to undertake specific actions considering their statutory duties as well as conditions and needs of the local government unit. In relation to the obligations imposed on self-government units, the following are created: local government environmental protection programs, repair programs, voivodship waste management plans, resolutions on the implementation of the voivodship waste management plan, local spatial development plans, voivodship spatial development plans, long-term development plans and modernization of water supply equipment and sewage systems and management plans for land located in limited use areas around industrial plants. In reference to the above examples, the characteristic feature is that local environmental protection authorities do not always act as the main planning organ. Their role may be reduced to the function of a co-acting, commissioning or information body (Barczak, 2015, p. 224).

The issues of environmental protection are also regulated by the development strategy of the voivodship, which takes into account the preservation of the value of the cultural and natural environment, considering the needs of future generations (Article 11 paragraph 1 point 4 of the E.P. Law). The voivodship development strategy should take into account the objectives of the medium-term national development strategy, the national regional development strategy, appropriate supra-regional strategies, as well as the goals and directions of the spatial development concept of the country.

Summing up, environmental policy is concerned with taking actions aimed at maintaining or restoring natural balance, rational shaping of the environment and management of its resources in accordance with the principle of sustainable development and aimed at preventing pollution and restoring natural elements to the proper state.

Possibilities of applying management sciences in environmental protection in local government

In order to achieve higher efficiency in the field of environmental protection, local self-government bodies may take actions that facilitate the use of techniques and methods for environmental management. The activities falling within the concept of environmental management include: rational management of natural resources, human resources management in terms of increasing the level of ecological awareness, management of production cycle facilities towards closing these circuits and reduction of waste generation at their source, management of ecological manufacturing, recycling, financial

management – linking environmental and production effects and creating development opportunities for businesses, information management – anticipating internal and external conditions, skilful use of information in decision-making processes and environmental protection (Gajdzik, Wyciślik, 2010). The choice of activities and their formalization depends on the adopted concept of environmental protection in a specific local government unit, which formulates its intentions and intentions regarding environmental protection in strategic documents. The consequence of the acceptance of specific obligations is the selection of means for their implementation. Environmental protection management is primarily associated with the possibility of developing and implementing an environmental management system, whose assumptions are stipulated in the ISO 14001 standard. The basic task of ISO 14001 is to support environmental protection and prevent pollution in accordance with the principle of sustainable development. The objective of implementing the environmental management system specified in the ISO 14001 standard is to improve the environmental performance. The standard is based on periodic reviews and assessments of the environmental management system in order to continuously improve the activity. In turn, the implementation of the ISO standard is a prerequisite for the implementation of the Eco-management and EMAS Audit System. EMAS is an EU environmental certification system that operates on the basis of Regulation (EC) No 1221/2009 of the European Parliament and of the Council of 25 November 2009 on the voluntary participation of organizations in the Community eco-management and audit scheme. Both the implementation of the environmental management system based on the ISO standard and the EMAS system are voluntary. The self-government unit makes its own decision, however, it must be made in connection with the undertaken public tasks. The goal of the activities related to the operation of systems is even more effective protection. The local government unit can also apply quality management methods and tools in addition, regardless of the activities related to the implementation of the system. These include benchmarking, outsourcing, just in time, Ishikawa's cause and effect diagram. They can be used incidentally, jointly or separately, and therefore have a flexible character and are used depending on the needs of the local government unit.

Conclusions

A number of statutory obligations in the field of environmental protection have been imposed on local government units. They are implemented by means of various legal instruments. The complexity of the tools gives a

greater guarantee of protection and counteracting negative effects on the environment. The actions of the bodies are determined by the applicable legal norms. The delegation of tasks to self-government units on the principle of decentralization and subsidiarity is to influence their harmonization and take into account the criterion of rationalization of activities. Assignment of tasks to a specific level of the local government structure also takes into account the division of tasks due to the identification of residents' needs and their gradation in terms of their basic character and higher-order needs, and therefore, the need to satisfy them in a given scope and according to their availability.

Obligations related to the implementation of protective tasks were imposed on the authorities of each local government unit, despite the fact that the legislator did not recognize all bodies of self-government units as environmental protection authorities. By equipping the starosta and voivodship marshal with specific competences, the legislator gave them the status of an organ in functional terms. The extension of competences also to these entities indicates that the legislator gives priority to environmental protection and uses the structure of bodies operating in communes, poviats and voivodships in the widest possible way, creating a network of connections for even more effective action.

The legislator gives a significant role to documents formulated as part of the implementation of environmental policy. This role, analysed in this article, is seen in the imposition of the obligation of statutory creation of the indicated documents and their subsequent implementation. Such a broad scope is also worth emphasizing. They are a manifestation of the growing ecological awareness of authorities and residents of local communities, which is reflected in the creation of pro-environmental activities that take into account specific resources and needs. These instruments can be supplemented by instruments of management sciences: systems, methods and tools of a pro-quality nature, implemented on a voluntary basis, using the potential of local government units and creating innovative pro-ecological attitudes. The effectiveness of the undertaken activities is very much dependent on the inclusion of interdisciplinary research, including research including the areas of knowledge indicated in this study.

The contribution of the authors

Stanisław Wrzosek – 50%
Magdalena Kisała – 50%

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Submissions should have up to 20.000 characters excluding abstract, footnotes, and reference list, with a clearly defined structure (Introduction, Chapters, Sub-chapters, Ending/Conclusions). Please strictly observe the number of characters. Each additional 1.000 characters of the text is charged (25 PLN or 6 EUR net).

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