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THEORETICAL AND METHODOLOGICAL PROBLEMS

PROBLEMY TEORETYCZNE
I METODYCZNE



Stanisław CZAJA

INTERPRETATION OF ECONOMIC AND ENVIRONMENTAL BARRIERS IN POLISH ECONOMIC AND ECOLOGICAL THOUGHT

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ABSTRACT: The economic and environmental barriers belong to the important problems of present economic sciences, especially the sustainable development economy. In the article author introduced the ways of understanding of the economic and environmental barrier in the Polish literature. He also talked over the chosen conceptions of the environmental barrier, introduced by some explorers and level of investigations over this type limits in Poland.

KEY WORDS: economic barriers, ecological barriers, the sustainable development economics

Introduction

Economic and environmental barriers are among the most interesting but also most important problems of modern economics and the economics of sustainable development. Their significance stems from at least two important reasons. Firstly, recognition of barriers allows understanding of the threats they pose to the desirable transformations (processes) in the mega system of economy, society and natural environment, and thereby creates conditions for limiting undesirable modifications of these processes. Secondly, identification of the barriers and the factors determining them creates a good situation for avoiding them, either by means of eliminating the reasons or through reducing the effects. This is especially desirable within the economics and strategy of sustainable development.¹

The objective of this study is to characterise and evaluate the main ways of understanding economic and environmental (ecological) barriers in economics and the economics of sustainable development. This is a vast research area, therefore the author limited himself to one issue. The research hypothesis is in the form of a question, 'Does the Polish economic and ecological thought employ unified interpretations of the notion of economic and environmental barriers?' The research has a character of an analysis of the achievements of the economic thought (*desk research*) as well as studies on the experience of the economic practice in Poland.

Ways of understanding economic and environmental barriers in Polish literature

In the Polish literature, the notion of barriers occurs most commonly on two basic levels:

- the level on which the issues discussed concern economic growth or more broadly social and economic development (discussions thus concern the population barrier, the barriers of labour force or human capital, technology, organisation, institutions and laws, and distribution; also, various determinants impeding the process of economic growth are

¹ The literature offers several ways of coping with barriers, such as, (1) pushing the barrier, mainly by means of new discoveries; (2) slowing down the rate of reaching the barrier, i.e. the critical level, by actions rationalising the use of a resource or by technological changes; (3) removal of a barrier also through discoveries and/or substitution of a missing element; or (4) avoiding a barrier by means of substituting an element that might generate barriers (Becla, Czaja, 2018).

pointed out, as for example: lack of capital, shortage of human capital, scarcity of natural resources, poorly developed institutional factors or a high natural growth);

- the level on which interrelations between management processes and the natural environment are investigated.

Research on the ways of comprehending economic and environmental barriers in the Polish literature reveals some essential sources of inspiration (table 1).

Table 1. Main impulses influencing Polish research on economic and environmental barriers

Impulse	Characteristics
Impulse 1	Effects of the discussion between D. Ricardo and T. Malthus and formulation of the Malthusian and Ricardian theorems
Impulse 2	L. Robbins' definition of economics based on scarcity and finiteness
Impulse 3	Empirical research by H. Barnett and Ch. Morse
Impulse 4	The emergence of global modelling and J. Forrester's World models
Impulse 5	Report of UN Secretary General U Thant and the 1st and 2nd report to the Club of Rome
Impulse 6	Stockholm Conference and its effects
Impulse 7	J. Kornai's concept of shortage economy
Impulse 8	The raw material crisis in Polish economy of the late 1970s and the 1980s
Impulse 9	The concept of sustainable development and the Rio de Janeiro Earth Summit
Impulse 10	Agenda 21 and experiences from implementation of the strategy of sustainable development (eco-development)

Source: author's own work.

Undoubtedly, it was the discussion between D. Ricardo and T. Malthus that had the greatest influence on the issues of environmental and economic barriers; this discussion resulted in the working out of two basic theorems in this matter: (1) the Malthusian approach, based on the assumption of the existence of an absolute impassable barrier, and (2) the Ricardian approach, according to which the management processes asymptotically converge towards the barrier and the growing costs of acquisition of a certain factor trigger off substitution mechanisms. This discussion, even though it took place in the first two decades of the 19th century, left a lasting mark on the economic and ecological thought. It could even be argued that all contemporary concepts of barriers in management processes have their sources in those theorems.

Another major impulse was the spreading of L. Robbins' definition of economics based on scarcity and finiteness. (Robbins, 1932) This concept, proposed in the early 1930s, became the leading approach to the subject of economics. In contemporary economics, these characteristics (scarcity and finiteness) are rather subjects of searching for optimal ways of managing resources, and not investigating barriers in the availability of such resources. Nevertheless, scarcity and finiteness make a good starting point to explore the issue of economic or environmental barriers, or management barriers in general.

In the mid-20th century, quite numerous studies were carried out in a lot of countries regarding the phenomenon of scarcity of mineral resources and fuels. Well known studies conducted by H. Barnett and Ch. Morse did not confirm either paradigm, the Ricardian or the Malthusian one, to the extent that was expected (Barnett, Morse, 1967). The studies themselves became, however, a very strong impulse to take up further studies on resource barriers, also in the Polish literature. This concerns in particular the ideas developed in papers by J. Dembowski and J. Czarkowski.

In the mid-1960s, computer models World were successfully designed at the MIT; they became, on the one hand, an impulse for the arrival of computer modelling and a formalised form of futurology, and on the other hand, opened new possibilities of studying economic and environmental barriers, especially in a more dynamic form.

The World models also provided opportunities to formulate cautionary forecasts for the human civilisation and to raise the issue of barriers in a new, neo-Malthusian, but also global, approach. There appeared the probably most famous UN Secretary General report in the history of this organisation – U Thant's report – as well as two most important reports to the Club of Rome, *The Limits to Growth* from 1972 and *Mankind at the Turning Point* from 1974. These documents were widely discussed around the world, and they even opened the Polish academic circles to the global perspective.

The summary of those discussions and at the same time the launching of a new stage in the studies on social and economic development and its barriers was the conference in Stockholm. It can be referred to as the Zero Earth Summit; as an effect of this conference, the idea of *Sustainable Development* was born.

In Poland, two other impulses were of greater importance than the Stockholm conference for the progress of the debate around barriers, and these were, the concept of shortage economy by J. Kornai (Kornai, 1977; Kornai, 1985), being the best model of the problems of centrally planned economy, and a series of raw material problems in the late 1970s and the 1980s. A good summary of those influences is the book by W. Herer and W. Sadowski,

Zderzenia z barierami rozwoju [Encounters with barriers to development] (Herer, Sadowski, 1898).

After 1990, an essential increase was noted in Poland's activity on the international scene. This was also the case in the course of preparations to the Earth Summit in Rio de Janeiro. This has translated into a rapid increase in interest in ecological issues including barriers (Ekologiczne, 1990; Ekologiczne, 1991).

The last essential impulse influencing Polish studies on economic and environmental barriers was the AGENDA 21 as well as the implementation experiences related thereto. They turned out to be extremely interesting; however, for different reasons, mainly cost-related, no major empirical research into ecological and economic barriers in Polish economy was carried out after 1995.

Careful and critical analysis of the Polish literature provides grounds to distinguish at least eight types of interpretation of this category (figure 1).

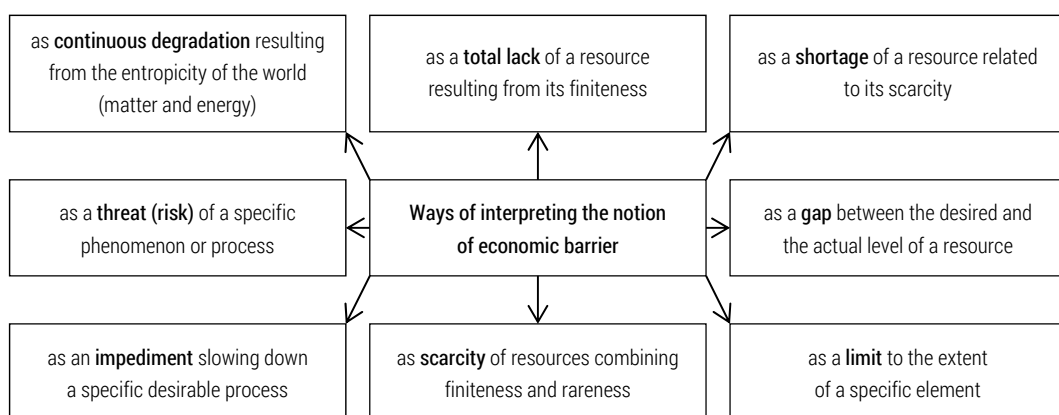


Figure 1. Ways of interpreting the category of economic barrier in Polish literature

Source: author's own work based on selected items in relevant Polish literature.

The first interpretation of an economic barrier – as a total lack of a resource – is associated with the quality of physical finiteness (limitation) of all resources, which was emphasised by T. Malthus,² and representatives of neo-Malthusianism in modern times. Such an approach can be found in *The Limits to Growth* and other cautionary forecasts (Meadows, 1973). This is one of the approaches to barriers most frequently used in the literature and eco-

² The physical finiteness of each form of matter or energy is confirmed in the first law of thermodynamics.

conomic discussions, especially with regard to ecological barriers in ecological economy and deep ecology, or limitations within the neo-institutional concepts of 'vicious circle of poverty'. This is, at the same time, an interpretation useful from the point of view of modelling these phenomena. It also has its social and political impact because forecasts of this type cause even more serious repercussions than extensive studies with a large number of data and conclusions.

The second way of interpreting treats a barrier as a shortage of resources related to their scarcity. This elementary notion does not only determine barriers but, more broadly, the essence of management. Scarcity is the expression of the relation between the required quantity of a specific resource and its available quantity. If this relation is greater than one, this means occurrence of the attribute of scarcity regarding the economic resource under consideration. In other words, the economic resource in question is a rare resource. This is an interesting basis of the Ricardian theorem. It allows for the possibility of changes in the level of scarcity caused by various reasons, such as for instance appearance of new resources, technological progress, growing possibilities of substituting resources with other ones or the impact of changes in prices and costs on the ways and scope of utilising a particular economic resource endangered due to a barrier. Such an interpretation is also the basis for contemporary modelling attempts in the dynamic theory of non-renewable resources (Dembowski, 1989).

The quality of scarcity is also associated with the third interpretation of a barrier as a gap. This is a disproportion between the desired and the actual level of the element concerned (e.g. a barrier), similar to rareness but treated as a dynamic process of becoming (Czaja, 1996). A gap may occur both as an effect caused by reasons independent of the management processes and as a very frequent consequence of the implementation of these processes. Gap is referenced as a form of barrier characterising poorly developed economies, underdeveloped regions or social groups exposed to poverty. This is thus a form of economic barrier used within the framework of the so-called theory of economic underdevelopment. In the modern literature, somewhat more attention is devoted to the consequences of the occurrence of gaps than to the reasons of their occurrence. This last problem is, however, more relevant to the issue of economic and ecological barriers.

The fourth way of interpretation treats a barrier as a limit to the extent of a particular element. This can be the lower limit that cannot or should not be crossed from the above, i.e. such a low level of a resource should be avoided. This can also be the upper limit signifying the level of the element (resource) concerned that is impossible to reach or absolutely critical. This approach is quite typical for a lot of modern concepts of social and economic develop-

ment, including sustainable development. Within their frameworks there are some impassable limits to exploitation of renewable and non-renewable resources or environmental services as well as degradation of components and elements of the natural environment, which set the principles of sustainability and the criteria of intra- and intergenerational justice. This kind of interpretation can be easily described mathematically (either in the form of a function or a numerical index), and therefore it is commonly used in models of ecologically determined economic growth (Czaja, 1993).

The scarcity interpretation is very readily used in economics and theories of social and economic development. Combining in itself the issues of limitations (physical finiteness) with scarcity, it does not require any in-depth explanation of the real sources of this barrier and at the same time corresponds to the 20th-century way of understanding the field of economics originating from the concepts of L. Robbins and T. Koopmans. According to it, economics is the study of the allocation of scarce resources between alternative ends. Thus, this is rather a problem of decision-making and optimisation, and not a social, ethical or ecological one. The barrier is a limitation in an optimisation task.

Treating an economic barrier as an impediment to economic growth (social and economic development) is typical for adherents of treating the functioning of economy as a dynamic process. In the Polish literature, this idea was initiated by M. Kalecki. In this approach, the barrier is a process slowing down the desirable social and economic transformations, the said process being also related to the latter ones. This relation does not feature prominently in the conception of barrier as a gap. An impediment is a mechanism that to a smaller or greater extent hinders the process of economic growth (a specific 'ball and chain') while a gap is an increasing divergence between the elements of this process, one that should not take place (it is undesired both as an effect of economic growth and from the point of view of stabilisation of sustainability of this process).

Economic or environmental barriers are occasionally also interpreted as a difficult-to-predict threat understood in the form of growing risk or uncertainty of management. The currently best, in my opinion, concept, originating from F. Knight, allows for distinguishing a situation of risk from uncertainty, mainly as an effect of the information differences regarding the fact whether the probability distribution for the occurrence of a given element is known or not. In the case of risk we know it, at uncertainty we do not. The apparent randomness of the occurrence of a given barrier, difficult to interpret based on the conventional determinism, finds its explanation on the basis of the theory of deterministic chaos as the effect of sensitive parameters at bifurcation points. The eighth and last interpretation of economic (or

environmental) barriers is of a fatalistic, albeit also realistic, character, being based on the effect of two laws of thermodynamics, and the law of entropy in particular. According to the same, barriers are the effect of inevitable degradation (the increase of entropy) of all material and energy forms of reality. It also implies atrophy of symbolic relations existing between them (Czaja, 1995). With such an approach barriers cannot be avoided in any way. We can, however, slow down the rate of their appearing through appropriate action. In this case it is necessary to follow certain principles of managing resources (capitals) including natural ones (natural capital), as e.g., (1) the principle of maintaining a balance between resources and uses; (2) the principle of not depleting natural resources, especially the core natural capital; (3) the principle of maintaining diversity of the components of natural capital; (4) the principle of substituting natural capital with other forms of capital; (5) the principle of minimising entropy sources; (6) the principle of rational utilisation of natural capital resources, i.e. application of the criterion of maximising utility gained from natural capital; and (7) the principle of effective utilisation of elements of natural capital, i.e. the criterion of surplus of benefits over costs (Czaja, 2007). From the point of view of the processes of social and economic development, additional significance in this interpretation of barriers is taken on by their determinants, being at the same time barriers, such as, (1) the entropical and temporal finiteness of the physical world; (2) entropical and spatial finiteness of the physical world; (3) the resource finiteness of the world with regard to matter and energy; and (4) assimilation limitation of the natural environment; as well as principles of conduct, such as, (a) the principle of intra- and intergenerational justice; (b) the principle of minimising entropy and applying entropical and ecological rationality; (c) the principle of global and local horizon; and (d) the principle of sustainable development (Czaja, 1997).

Conclusion

The problem of understanding economic (or environmental) barriers is one of the most important issues of the contemporary economic and economic and ecological thought, and especially economy of sustainable development. In the world literature, a lot of studies can be found, devoted to comprehending barriers as well as to their occurrence in the social and economic reality. Also the Polish literature contains numerous studies on these matters. Their critical analysis reveals some interesting issues.

Firstly, barriers should be perceived in a two-fold form – as a process and as a phenomenon. The first aspect deals with barriers as constraints that

'become'. This combines the static dimension and the dynamic one, while in the phenomenal aspect the barrier appears. Literature research shows that the same barrier can be understood in a variety of ways within the framework of the above aspects.

Secondly, an element that is becoming extremely essential is the control of the barrier-forming processes. Such control requires:

- developing knowledge on the relations existing in the mega system of economy, society and natural environment;
- creation of a system of measures and indicators similar to business barometers for evaluating threats associated with economic or environmental barriers;
- building adequately efficient systems of responding to the barriers appearing and their effects.

Thirdly, the appearing of economic or environmental barriers is above all the effect of long-term changes in the importance of the individual groups of economic resources in the management processes, changes in the scope of substitutability and complementarity between these resources, or in the technological progress; and in the short-term, not insignificant are the price/cost ratio, market competition and applicable legal and institutional regulations (Czaja, 2002).

The objective that was assumed in the study has been achieved. The research hypothesis, 'Does the Polish economic and ecological thought employ unified interpretations of the notion of economic and environmental barriers?', has been proven to be wrong. Thus, the answer is as follows, 'The Polish economic and ecological thought employs a variety (the author has identified eight kinds) of interpretations of the notion of economic and environmental barriers. However, the problem lies not in wrong (incorrect) understanding of economic or environmental barriers but in the incomplete approach to this very complex matter. There are a lot of relevant proposals in the Polish literature.

We only need to extend our understanding of economic barriers, which includes economic and environmental barriers.

The diversity of treating economic barriers is not an error or a cognitive obstacle. It is merely an expression of the complexity of the phenomenon itself; and it draws the researchers' attention to the need for developing methods of studying it. The most difficult challenge is here the overlapping of the static dimension (resources – the existence of a barrier) and the dynamic dimension (process/streaming – the becoming of a barrier).

Literature

- A. Jankowska-Kłapkowska (ed.) (1991), *Ekologiczne bariery wzrostu i rozwoju społeczno-gospodarczego w Polsce*, Kraków
- Barnett H., Morse Ch. (1967), *Ekonomika zasobów naturalnych*, Warszawa
- Becla A., Czaja S. (2018), *Bariery ekologiczne a współczesny rozwój społeczno-gospodarczy*, Wrocław, in preparation for printing
- Becla A. (2002), *Klasyfikowanie barier ekologicznych. Wybrane zagadnienia*, G. Dobrzański (ed.) *Teraźniejszość i przyszłość ekorozwoju w Polsce*, p. 78-90
- Czaja S., Becla A. (2007), *Ekologiczne podstawy procesów gospodarowania*, Wrocław
- Czaja S. (1995), *Entropia jako podstawa analizy ograniczoności zasobów naturalnych*, „Ekonomia i Środowisko” No. 1(6), p. 9-19
- Czaja S. (2002), *Historia gospodarki i gospodarowania*, Wrocław
- Czaja S. (1997), *Teoriopoznawcze i metodologiczne konsekwencje wprowadzenia prawa entropii do teorii ekonomii*, Wrocław
- Czaja S., Fiedor B., Graczyk A., Jakubczyk Z. (1996), *Luka energetyczno-ekologiczna (na przykładzie gospodarki polskiej)*, Opole
- Czaja S., Fiedor B., Jakubczyk Z. (1993), *Ekologiczne uwarunkowania wzrostu gospodarczego w ujęciu współczesnej teorii ekonomii*, Białystok-Kraków
- Czarkowski J. (1978), *Wizja świata. Proroctwa i prognozy*, Wrocław-Warszawa-Kraków-Gdańsk
- Dembowski J. (1989), *Zarys ogólnej teorii zasobów naturalnych*, Warszawa
- Fiedor B. et al. (1991), *Określenie aktualnych i przewidywanych na przyszłość barier ekologicznych wzrostu (rozwoju) w Polsce oraz barier gospodarczych dla ochrony środowiska* in: A. Jankowska-Kłapkowska (ed.), *Ekologiczne bariery wzrostu i rozwoju społeczno-gospodarczego w Polsce*, Kraków, p. 231-244
- Herer W., Sadowski W. (1989), *Zderzenia z barierami rozwoju*, Warszawa
- Kornai J. (1977), *Anti-equilibrium. Teoria systemów gospodarczych. Kierunki badań*, Warszawa
- Kornai J. (1985), *Niedobór w gospodarce*, Warszawa
- Meadows D., Meadows D., Randers J., Behrens W. (1973), *Granice wzrostu*, Warszawa
- Mesarović M., Pestel E. (1977), *Ludzkość w punkcie zwrotnym*, Warszawa
- Piontek F. (ed.) (1990), *Ekologiczne i pozaekologiczne bariery wzrostu gospodarczego w Polsce*, Wrocław-Warszawa-Kraków-Gdańsk-Lódź
- Robbins L. (1932), *An Essay on the Nature and Significance of Economic Sciences*, London



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PROMOTIONAL DILEMMAS OF A TOURISM PRODUCT OF ENVIRONMENTALLY VALUABLE AREAS

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ABSTRACT: The study involves the issues of promotional activities undertaken in terms of supporting a tourism product of environmentally valuable areas. It includes the theoretical aspects of promoting a tourism product and the structure of a tourism product of environmentally valuable areas. There is also a discussion on typical forms of tourism movement in environmentally valuable areas. The most significant part of the work includes issues concerning the promotion of a tourism product of an environmentally valuable area and an indication of their limits. The objective of the study is to consider dilemmas pertaining to promotional activities undertaken to give marketing support to a tourism product of an environmentally valuable area, especially in terms of its range and intensity.

KEY WORDS: promotion, tourism economy, tourism marketing, tourism product, environmentally valuable area

Introduction

Trends currently observed on the tourism market also concern tourism in environmentally valuable areas. Therefore, competitiveness of tourism offers also refers to tourism products of these areas. Reaching target markets effectively requires influencing consumption through undertaking marketing activities, including promotion. These activities may be conducted by both commercial entities (direct providers of tourism services), tourism regions as well as through special attractions connected with making environmentally valuable areas and places available.

The subject of the study is a tourism product of an environmentally valuable area and support it gets through promotion. The deliberations focus on the issue of undertaking promotional activities by competent entities in tourism economy in order to reach consumers (tourists). Taking account of the fact that environmentally valuable areas are subject to various forms of protection, excessive promotion and causing significant interest among tourists are not explicitly recommended. Therefore, in the study the author formulated promotional dilemmas of a tourism product of an environmentally valuable area which result from in particular a relation between sustainable tourism and mass tourism. Thus, the objective of the study is to consider dilemmas pertaining to promotional activities undertaken to give marketing support to a tourism product of an environmentally valuable area, especially in terms of their extent and intensity. The deliberations are theoretical and conceptual. Such research methods were applied as a critical analysis of literature on the subject, logical operations and a holistic method.

Promotion of an area's tourism product

Marketing as a field of practical managerial knowledge is used in many fields of economic and social life not only in enterprises providing finished market goods, i.e. producing goods and generating services, but also in local authority bodies, municipal enterprises, territorial communities, non-profit institutions, social organizations and associations (Szromnik, 2006, p. 33). The concept of marketing is widely known in business and is also adapted to many forms of non-commercial activities; it can be easily used within a commercial aspect of developing a tourism product of environmentally valuable areas as well as in activities of entities enabling access to tourism assets and attractions in these areas to the interested tourists.

In the analysis of marketing activities in the field of tourism, a five-element mix marketing structure is used (Payne, 1993, p. 150; Palmer, 1994, pp. 279-300) whose an integral element, apart from a product, price, distribution and personnel, is promotion.

Promotion should be treated as a form of communication of market entities (Wiktor, 2005, p. 40), i.e. communication of providers with consumers, co-operators and competitors. It encompasses activities and instruments enabling informing the surroundings about an organization and its offer. It is an element of the mix marketing structure which determines the market position of an entity that generates promotion, thus enables influencing other market participants through providing them information on an offer, encouraging them to get this offer, as well as gives grounds for creating an opinion about a provider and the scope of their activities on the market, and as a result it should contribute to the growth of demand for the offer range (Sznajder, 1993, p. 4).

Promotion in tourism economy involves presenting values of a region and its location and undertaking activities popularising region's assets among entrepreneurs (including investors), professionally active people, academic youth and potential tourists. These activities should not be limited to supporting economic values, but their task is also to point out values of the natural, cultural and scientific environment (Markowski, 2006, p. 101).

A tourism product interpreted in a broad sense (area's product) is a category which is equally complex as a product of a region, thus marketing activities (including promotion) conducted in regional areas and tourism areas are of a similar nature.

Instruments for promoting a region have been adopted from a marketing concept used by enterprises producing goods and providing services and are also called the promotion-mix. Therefore, these are internally integrated instruments and entities undertaking promotional activities decide which of them should be used, with what intensity and how specific instruments should be connected. Marketing literature provides many classifications of elements making up the promotion-mix. Trying to be objective, the following instruments should be distinguished (Panasiuk, 2013, pp. 163-183):

- personal selling,
- advertising,
- public relations,
- publicity,
- sales promotion,
- sponsorship.

Whereas not all of the aforementioned instruments may be used with an equal intensity in terms of promotion of a region. Personal selling and spon-

sorship are of considerably minor importance, similarly to sales promotion which may be used to a limited extent (Meffert, 1989).

Tourism product of environmentally valuable areas

A tourism product is a set of goods and services which tourists use and which are a special subject of their interest. To specify the interpretation of the term tourism product, one should differentiate its narrow and broad aspect (Panasiuk, 2014b, pp. 113-115). From a narrow perspective, a tourism product is everything that a tourist can acquire (e.g. transport, accommodation, catering, cultural services) (Medlik, 1995, p. 243). The remaining elements, connected with tourist impressions and feelings, are connected with the definition of a tourism product in a broad perspective. A tourism product can take the form of numerous combinations of particular elements. However, it should always meet tourists' needs, i.e. their expectations concerning a tourism product which consumption results in satisfaction (Bąk, 1999, p. 121). In terms of psychology, a tourism product may be understood as a sum of impressions which a tourist receives during and after its consumption as well as a tourist's complex experience from the moment of leaving their permanent place of living until their return (Smith, 1994, pp. 583-586; Medlik, Middleton, 1973; Żemła, 2000, p. 27).

A broad perspective of a tourism product results in considering it as a spatial category. In terms of this aspect, an area's (place's) tourism product is defined as a product that has a complex structure developed by many entities and consisting of many single elements which are partially similar, partially heterogenic, but always complementary (Hołderna-Mielcarek, 1998, p. 10). However, a tourism product of an area is not just a sum of all tourism goods and services offered in a given area. It is a special, spatially determined product which consists of selected elements of tourism potential (or existing simple products) of a given area which are joined thanks to a superior idea determining its originality, distinctiveness and market attractiveness (Kaczmarek, Stasiak, Włodarczyk, 2005, pp. 100-101).

Hence, the interpretation of the essence of a tourism product forms the basis for explaining the concept of a tourism product of an environmentally valuable area. It should be emphasised that a tourism product may be considered in various ways depending on tourist's identified needs.

Environmentally valuable areas are highly biodiverse areas whose resources must be managed in a planned and sustainable way (Żegleń, 2010, pp. 549-550; Panasiuk, 2015, pp. 185-198). These areas are a crucial factor for the development of many forms of tourism, including: ecotourism, heri-

tage tourism, specialized tourism, agri-tourism. Tourism goods become the purpose of travelling and determine the strength of the tourism potential (Niedziółka, 2010, pp. 569-570).

A tourism product of an environmentally valuable area should be interpreted as a sum of material and non-material elements of the tourism potential of an area whose essential component is high quality natural values and attractions constituting a dominant reason for tourist trips to an area.

Similarly, to a tourism product, a tourism product of an environmentally valuable area can be interpreted from a narrow and broad perspective. These perspectives also determine elements making up this product.

From a narrow perspective, a product of an environmentally valuable area should be associated with services connected with undertaking this form of tourism activities (accommodation, catering, transport, high-quality natural values and attractions).

A product of an environmentally valuable area, treated as an area's (place's) product, consists of components being tourism products understood narrowly (tourism services) and elements connected with tourism offers of tourism places and destinations in environmentally valuable areas (natural values together with general and specialist facilities as well as additional services).

A factor determining an actual distinction of a tourism product of an environmentally valuable area should be reasons directly concerning existing natural values and attractions made available to tourists and influencing reasons for coming to a specific destination.

A tourism product of an environmentally valuable area is spatially determined. It is a synergistic combination of an offer of a tourist destination and offers of tourism entrepreneurs in a given environmentally valuable area, and, therefore, it contributes to providing various tourism services. Nevertheless, in an environmentally valuable area there can be elements which are single, narrowly understood tourism products that have a very specific and single tourism function.

Detailed elements making up the structure of a tourism product of an environmentally valuable area include, among other things, (Panasiuk, 2015, p. 190):

- values of the natural environment which are not typical tourism values (the clean natural environment and the abundance of its values, landscape),
- tourism values (e.g. a national park, natural monuments, a natural history museum),
- tourism attractions (e.g. an outdoor event organized in a national park, canoeing, a rally),

- elements of tourism facilities for all forms of tourism (transport, accommodation, catering, recreational, information facilities, other additional facilities),
- specialist tourism facilities for environmentally valuable areas (e.g. tourist walking, water and cycling routes, educational and thematic paths and trails, specialist equipment rentals and service providers),
- typical tourism services (offered by commercial and public entities),
- other tourism services dedicated to nature tourism (e.g. guide services).

A product understood in such a way is also connected with detailed conditions of using a tourism offer in protected areas (e.g. a limited number of tourists on trails or in touristically attractive places, the necessity of having specific qualifications, having skills and equipment to undertake the forms of qualified tourism in protected areas, limitations concerning the size of tourist groups, participants' age, time spent in protected areas, etc.).

The range of elements making up the structure of a tourism product of an environmentally valuable area constitutes a general framework which can be adjusted to various forms of tourism in these areas. The diversity of elements results from the abundance of tourism values and attractions in these areas as well as from the state of tourism facilities. Moreover, it depends on the requirements of consumers who select relevant elements of an offer together with their quality in order to satisfy their tourism needs in an environmentally valuable area.

Forms of tourism movement in environmentally valuable areas

Areas that feature atmospheric and biosphere conditions favourable for humans are environmentally valuable areas, and thus they are intensively used by tourists. Not only should existing and potential environmentally valuable areas be publicly available in accordance with defined rules, but they should be also under appropriate legal regulations that would limit an extensive tourists' impact on the environment. The presence of tourists in environmentally valuable areas and their various behaviours can lead to negative effects. Therefore, the applied legal regulations should help to eliminate the tourist-nature conflict, whilst enabling the co-existence of nature with tourists and tourists with nature (Sikora, 2010, pp. 190-181).

Environmentally valuable areas are a crucial factor for the development of tourism. They include protected areas, mainly in the form of national and landscape parks, nature reserves and natural monuments. Functions of legally protected areas are very complex; apart from a protective function, they also have other ones: economic, tourism, recreational, educational func-

tions (Sawicki, 2014, pp. 41-43). Due to the development of tourism, protected areas are the basis for local and regional development.

Consumers of a tourism product of environmentally valuable areas are tourists who, in very simple terms, can be classified into the following groups for which an environmentally valuable place or area constitutes:

- a) the main goal of travelling, whereas the main reason for coming and staying is:
 - mainly the fact of staying in a such an area (e.g. sightseeing, educational tourism),
 - the exploration of natural values (e.g. active, exploration tourism),
- b) only a place of a stay, whereas tourism values and attractions are of minor importance (e.g. recreational tourism at the seaside).

The listed types of tourists directly determine the impact of their behaviour on natural values and attractions. In terms of the first listed group, these are more conscious behaviours and generally their impact on the natural environment should not lead to its degradation. In the second case, and in the case of mass tourism in particular, tourists' behaviours can have a high level of the human impact on the environment. Nevertheless, an active tourist on a mountain trail undertaking sightseeing tourism activities as well as a passive tourist undertaking recreational tourism activities at the beach can negatively influence the natural environment.

A decisive factor is identifying two groups of tourists using a tourism product of an environmentally valuable area. The first group comprises conscious tourists who mainly undertake individual tourism activities and have a low level of the human impact on the valuable natural environment. The second group consists of tourists of a low level of awareness who mainly undertake mass tourism activities and have a high level of the human impact on environmentally valuable areas. Therefore, completely different marketing and promotional activities should be addressed to both groups of consumers.

Promotion of a tourism product of environmentally valuable areas

Undertaking promotional activities connected with a tourism product of an environmentally valuable area should be a task executed by using adequate and well-thought-out tools and addressing the target market properly.

The fundamental scope of the discussed issues involves the following aspects of promoting a tourism product of an environmentally valuable area:

- a) an attributive aspect – referring to a subject which is promoted, a value or tourism attraction (e.g. a natural monument, a botanical garden), a tour-

- ism area (a forest area, a water basin), events connected with natural attractions, a tourism natural route (e.g. walking, water route),
- b) an institutional aspect – concerning entities conducting promotional activities in term of a tourism product of an environmentally valuable area (a city, a municipality, a region, a national park, a natural history museum),
- c) an instrumental aspect – pertaining to the selection of promotional tools, including in particular:
- the selection of specific means (media) of promotion,
 - methods for making means of promotion reach consumers (target markets) – tourists,
 - the measurement of promotion effectiveness.

The listed examples can constitute a direct subject of the undertaken promotional activities with regard to a tourism product of an environmentally valuable area. From the point of view of tourists' groups, suitable instruments and forms of promotion, as well as their intensity, should be selected.

In terms of entities, three fundamental approaches can be indicated in relation to promotion of a tourism product of an environmentally valuable area undertaken by:

- a) commercial entities – according to general market rules, by providers of tourism services which can select all available tools to influence customers directly (advertising, personal selling, sales promotion, sponsorship),
- b) territorial entities (municipality, city, region) – taking account of the adopted territorial marketing solutions, not fully commercially, considering a specific product or its elements as the main subject of promotion, or as one of many elements which make up a tourism offer of a given area (advertising, public relations, publicity, sponsorship, sales promotion),
- c) tourism values and attractions of a highly-protected place – under the special conditions – using only selected means of promotion, mainly information (public relations, publicity, information, sales promotion).

When undertaking promotional activities, a dilemma is to select not only means (television, press, outdoor advertising, advertising publishing or the Internet) but also the content of the message which should refer to a place itself, a value and an attraction in a proper manner. It is a significant issue to apply such an approach which would not result in excessive interest in highly-protected areas (e.g. national parks), but, on the other hand, it would not discourage and, consequently, would not limit possibilities of using protected places for some forms of tourism. Table 1 presents the scope of instruments applied to promotion of a tourism product of environmentally valuable areas. It is an attempt to draw attention to the diversity of components of a product and specify entities responsible for promotion (Panasiuk, 2014a, pp. 32-33),

methods for using promotional tools, determine the level of intensity of promotional activities as well as indirectly indicate types of tourism offer consumers undertaking some kinds of tourism.

Table 1. The scope of instruments applied to promotion of elements of a tourism product of environmentally valuable areas

Product element	Promoting entities	Methods for using promotional instruments	Intensity of promotional activities (on a scale of 0 to 5)	Examples of promotional aspects (reaching target groups)
Single natural values	Local authorities Tourism organizations Environmental protection organizations	Educating Informing Encouraging	3	Environmental education Sightseeing
Natural areas (forests, water basins, mountains)	Local authorities Tourism organizations	Informing Encouraging Attracting	3	Sightseeing Qualified tourism
Nature tourism attractions (e.g. events, gardens)	Local authorities Tourism organizations Event organizers Entities managing attractions	Informing Encouraging Attracting	5	Sightseeing Mass tourism
Protected areas	Entities managing protected areas Environmental protection organizations	Educating Informing	1	Environmental education Sightseeing
Specialist infrastructure and services in protected areas	Business entities Local authorities Tourism organizations	Informing Attracting	5	Qualified tourism Mass tourism
Tourism infrastructure and services (accommodation, catering, transport, additional ones)	Business entities Local authorities Tourism organizations (including local tourism organizations) Cultural and educational institutions	Attracting	5	Mass tourism

Source: author’s own work.

The summary presented in table 1 is a form of a discussion on dilemmas of promotion of a tourism product of environmentally valuable areas. On the one hand, these areas together with product elements should be accessible, thus supported promotionally. On the other hand, natural elements, including those of great natural uniqueness, should be protected and should not be exposed to influence that tourism, and in particular excessive tourism move-

ment as well as developing tourism infrastructure, causes. Plenty of natural values are of decisive importance for tourism when creating a tourism offer (a sea, lakes, mountains) as they are directly exposed to the extensive tourists' impact on the environment. It happens in areas where the developed tourism economy often functions and intensively promotes its offer. A significant part of natural areas are protected areas where tourism movement of various intensity is observed. Tourism promotion of these areas should involve mainly educational activities connected with protecting these areas and not exposing them to excessive tourism movement.

The listed activities should correspond to specific instruments and means of promotion of selected intensity and a method of communication with a target group. In the case of a tourism product of an environmentally valuable area, it should be noted that such instruments, mainly in terms of public relations and publicity, should be selected so that excessive interest in tourism in these areas is not caused as it could lead to environmental degradation. Simultaneously, all forms of promotional activities should be properly planned to not limit access to places for tourists interested in nature, qualified and exploration tourism and tourism which does not pose a risk to the natural environment. Therefore, entities conducting promotional activities should select instruments of promotion skilfully and in a well-thought-out way and address them to all people potentially interested in arriving in a given place, or assign promotional activities to particular segments of tourists: mass tourists and tourists interested in nature tourism as well as in the aspects of environmental protection.

The most difficult aspect of the analysis of issues connected with promotion of a tourism product of an environmentally valuable area is measuring effectiveness. At the same time, it can be claimed that in both the entire national economy as well as tourism economy it is a difficult task and there is often no measurement. Promotion effectiveness should be measured, especially when there are specific funds allocated to that (e.g. publication and distribution of brochures and leaflets). With regard to entities dealing with a commercial range of a tourism product of an environmentally valuable area, promotion effectiveness can be analysed in monetary terms (revenues, profit). For the purpose of the analysis of the effectiveness of activities conducted by entities in given areas, especially by entities managing protected areas, quantitative measurement should be deemed adequate – the size of tourism movement (the number of domestic and foreign tourists). Simultaneously, this is one of the main dilemmas when undertaking activities aimed at promoting a tourism product of an environmentally valuable area. Therefore, the policy of promotion of a tourism product of an environmentally valuable area should be focused on information and educational policy.

Conclusion

The presented deliberations, especially those in the last part of the study, should be considered as the introduction to a discussion. It seems that the discussed issues refer to individual consideration of both tourists staying in environmentally valuable areas as well as entities undertaking promotional activities in terms of a tourism product of an environmentally valuable area. It should be highlighted that a tourism product of environmentally valuable areas as a market offer follows the same market rules as other offers on the market. Excessive promotion as well as media coverage referring to, e.g. ecologically endangered areas or areas in which controversial economic or protection activities are conducted (e.g. in the region of Białowieża Forest), can cause excessive interest of potential tourists and an increase in tourism movement. On the one hand, it will be beneficial to local and regional tourism economy, on the other hand, intensified tourism movement has a negative impact on protected areas. In such cases, promotion of a tourism product of an environmentally valuable area or just extensive media coverage concerning a situation in such an area becomes a dilemma not only in market terms, i.e. seller (tourism area) – consumer (tourist), but also in social terms.

Literature

- Bąk S. (1999), *Marketingowa koncepcja produktu turystycznego*, in: K. Mazurek-Łopacińska (ed.), *Problemy zarządzania sferą kultury i turystyki*, Warszawa–Wrocław
- Hołderna-Mielcarek B. (1998), *Regionalizacja produktu turystycznego*, „Rynek Turystyczny” No. 12
- Kaczmarek J., Stasiak A., Włodarczyk B. (2005), *Produkt turystyczny*, Warszawa
- Markowski T. (2006), *Marketing miasta*, in: T. Markowski (ed.), *Marketing terytorialny*, Polska Akademia Nauk, Komitet Zagospodarowania Przestrzennego Kraju, tom CXVI, Warszawa
- Medlik S. (1995), *Leksykon podróży, turystyki i hotelarstwa*, Warszawa
- Medlik S., Middleton V.T.C. (1973), *Product formulation in tourism*, “Tourism and Marketing” No. 13
- Meffert H. (1989), *Städtmarketing – Pflicht oder Kür? Sympozjum “Stadvisionen”, Stadtstrategien und Städtmarketing in der Zukunft*, Münster
- Niedziółka A. (2010), *Rola władz gminnych w zarządzaniu turystyką na obszarach przyrodniczo cennych w wybranych gminach powiatu krakowskiego*, in: M. Jalinik (ed.), *Turystyka na obszarach przyrodniczo cennych*, Białystok
- Palmer A. (1994), *Principles of Service Marketing*, Cambridge
- Panasiuk A. (2008), *Introduction to sustainable tourism management*, “Management” No. 2, Vol. 12
- Panasiuk A. (ed.) (2013), *Marketing w turystyce i rekreacji*, Warszawa

- Panasiuk A. (2014a), *Oddziaływanie instrumentów polityki turystycznej na obszary chronione*, „Zeszyty Naukowe AlmaMer Szkoła Wyższa” No 4(73)
- Panasiuk A. (2014b), *Rynek turystyczny. Studium strukturalne*, Warszawa
- Panasiuk A. (2015), *Struktura oferty turystycznej na obszarach przyrodniczo cennych*, „Ekonomia i Środowisko” No. 3(54)
- Payne A. (1994), *The Essence of Servicess Marketing*, London
- Sawicki B. (2014), *Rola obszarów chronionych w rozwoju edukacji, turystyki i rekreacji w opinii mieszkańców Lubelszczyzny*, „Zeszyty Naukowe AlmaMer Szkoła Wyższa” No. 4(73)
- Sikora J. (2010), *Możliwości rozwoju turystyki na obszarach przyrodniczo cennych w Wielkopolsce*, in: M. Jalinik (ed.), *Turystyka na obszarach przyrodniczo cennych*, Białystok
- Smith S. (1994), *The Tourism Product*, „Annals of Tourism Research” No 21
- Sznajder A. (1993), *Sztuka promocji czyli jak najlepiej zaprezentować siebie i swoją firmę*, Warszawa
- Szromnik A. (2006), *Marketing terytorialny – koncepcja ogólna i doświadczenia praktyczne*, in: T. Markowski (ed.), *Marketing terytorialny*, Warszawa
- Wiktor J. (2005), *Promocja. System komunikacji przedsiębiorstwa z rynkiem*, Warszawa
- Żegleń P. (2010), *Zarządzanie turystką na obszarach przyrodniczo cennych województwa podkarpackiego*, in: M. Jalinik (ed.), *Turystyka na obszarach przyrodniczo cennych*, Białystok
- Żemła M. (2000), *Produkt turystyczny – ujęcie podmiotowe*, „Problemy Turystyki” No. 1-2

ENVIRONMENTAL POLICY AND MANAGEMENT

POLITYKA EKOLOGICZNA
I ZARZĄDZANIE ŚRODOWISKIEM



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SUSTAINABLE INNOVATION AS AN IMPORTANT FACTOR OF FIRM DEVELOPMENT

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ABSTRACT: The environmental and social aspects are becoming increasingly important for enterprises. A very important matter is also achieving the high level of innovation for gaining competitive advantage. The way to reconcile these aspirations seems to be a development path called sustainable innovation.

The aim of the article is to identify the concept of sustainable innovation in the context of modern enterprises and to propose the method of supporting it using an algorithmic approach.

KEY WORDS: sustainable innovation, sustainable development, graph exploration

Introduction

The concept of sustainable development is becoming increasingly important in many countries' policies. This fact is reflected in legal regulations. These regulations impose specific obligations on public administration and enterprises. In this situation it is necessary to implement the principles of sustainable development in the practice of companies. The attitude of companies towards sustainable development can be various and depends on many factors like: the size of the company, the profile of industry or the country of origin which determines specific management rules. The most common rule seems to be the pursuit of profit, without taking into account environmental and social factors.

The next rule is declaring of taking into account the postulate of sustainable development due to the image benefits. These declarations, however, are rarely being realized. This phenomenon is often observed in case of companies engaged in the exploitation of natural environment (oil companies, forestry, mining and metallurgical industries). Unfortunately, no legal regulations have been established to punish this abuse so far. However, there are companies interested in real, not fake, sustainable development. The main problem of these companies is the issue of taking into account the demands of sustainable development in the offer of manufactured products and rendered services. This often requires an unconventional, creative approach. These reasons lead to the concept of sustainable innovation. This term is subject of interest to an increasing number of researchers, who underline its significance for the implementation of the overall concept of sustainable development.

The need for sustainable innovations

The definition of sustainable innovation might be problematic. As in the case of sustainable development, sustainable innovation should describe the creative process, which takes into account environmental, social and economic criteria. With these assumptions, the sustainable innovation can be defined as follows (Ketata, Sofka, Grimpe, 2014):

- sustainable innovation concerns a product, process, service or method,
- aims to meet market needs,
- reduces the negative impact on the environment,
- takes into account the entire life cycle of developed solution,
- sets up a new standards for current issue.

The key issue for making distinction between sustainable innovation and innovation in general is considering social and environmental factors. In order to develop an innovative solution in the sustainable category, it must have a positive impact on major environmental and social issues. Classic examples of sustainable innovations can be, for example, more efficient waste water treatment or the development of new types of dust reduction filters. Despite the cited examples, sustainable innovation should not be equated only with environmental engineering. Such innovations can be found in the textile, food, furniture and energy sectors (Schaltegger, Wagner, 2011).

Sustainable innovation can be assigned to following categories (Aagaard, Lindgren, 2015):

- improving the functioning of existing products, services and processes with respect for environmental and social factors,
- use of alternative technologies for existing applications,
- applying present knowledge in new market areas,
- development of innovative technologies applicable in new market areas.

The issue of improvement of existing products, services and processes is associated with the emergence of new restrictions on changing market realities. These restrictions may include rising prices of raw materials and energy but also costs associated with greenhouse gas emissions. As an example of this type of innovation, it can be mentioned the information system, which provides assistance in optimizing the consumption of disposable items in enterprises (Seidel et al., 2017). Another form of restrictions are consumers, who pay more attention to environmental and social aspects (Bekmezci, 2015). There are even consumers for who environmental and social aspects are fundamental motivators in decision making (Jastrzębska, 2017). This category includes all innovations which lead to reduce of raw material and energy consumptions. Similar connotations can be found in the category of alternative technologies usage. For companies, the incentives to develop such innovations are generally more oppressive legal forms. As an example, it can be pointed attempt to replace combustion engine with electric engine in cars and buses (Maxwell, 2009). This kind of innovation is forced by more strict pollution emission standards. Applying the present state of knowledge in new market areas is a form of transferring experience from one market segment to other segments. It generally involves the use of existing organizational solutions in a new environment.

The most innovative approach to innovation is the development of new technologies that create a new market sector. As an example, it can be pointed the market for household installations for generating electricity from renewable sources. It is obvious that this case has economic (profits for companies which produce renewable energy sources facilities), environmental (lower

environmental burden of industrial emissions from non-renewable sources) and social benefits (new jobs in renewable energy sources sector, reduction of household expenditures).

Algorithmic approach for sustainable innovations support

The process of developing of innovative solutions often requires the ability to synthesize information from multiple disciplines. This phenomenon is strongly present in the process of developing of sustainable innovations. The necessity of taking into account many of technical, environmental, economic and social factors makes it necessary to combine information from many areas of knowledge. Here, one of the basic barriers appears. In the age of strict specialization, the ability to link accumulated knowledge with other disciplines is becoming increasingly difficult. Another barrier is the increasing number of various documents' types like: technical documentation, scientific articles, reports and legal acts. It is very hard to get familiar with the content of all documentation on a particular issue. Finding common elements between different subjects it is even harder task. The described situation is reason for using algorithmic methods in supporting innovation. Computer support for innovation process aims at overcoming barriers resulting from limitations of human abilities. A various methods have been used for this purpose. The most common are data mining and machine learning (Toivonen, Gross, 2015). This approach is not aimed at eliminating man from the innovation process. Developing innovative solutions still requires human invention and, probably, will require in future. However, without going further into the nature of innovation, support for this process is possible through usage of specialized tools. The scheme of functioning of such tool has been shown on figure 1.

The proposed solution is based on the exploration of a set of documents on specific subjects. The choice of knowledge domain and documentation that consists the description of particular domains, depends mainly on organizational conditions such as the specify of the company using the described solution. The next step is to extract the key terms, which are describing the content of the document. The obvious activity at this step, is to use the keyword list (if it is included in the document) as well as the lexical decomposition of the document's title. In the next step, a list of obtained keywords attached with links to source documents are placed in the repository. The created repository is a data source for links exploration algorithm. Identification of links-relations takes place by searching keywords associated with user's query. In the next steps, the found keywords are organized in the form of an undirected graph. The graph can be defined as finite set of vertices

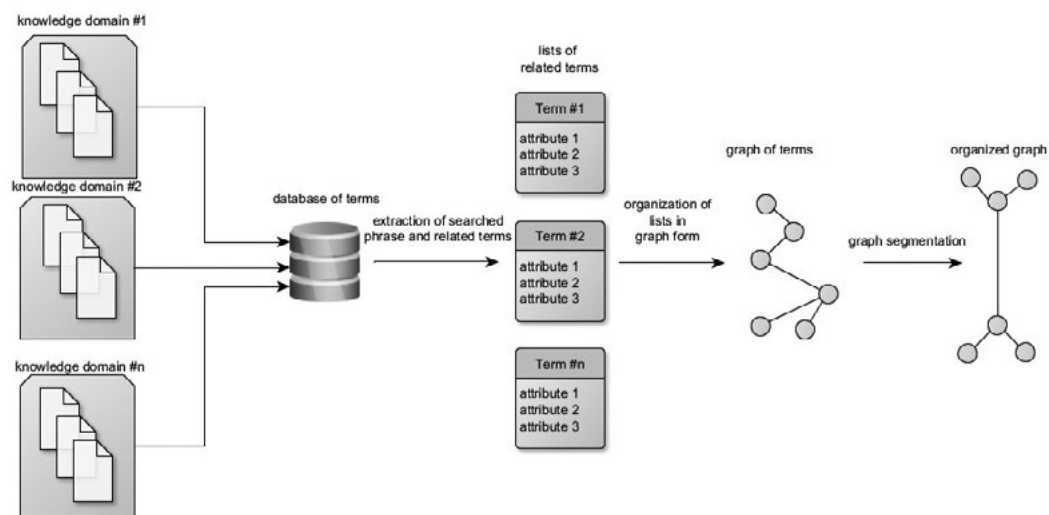


Figure 1. Data extraction and preparation workflow

V and a finite set of edges E containing pairs of elements of the set V (Wilson, 2012). In this case, vertices of the graph are the individual keywords and the edges are links of co-occurrence between keywords in the processed documents. Such data structure has much more potential for visualizing than data stored in tabular form. It is especially well suited for relational data visualization (Wang, Tao, 2016). In order to make it easier to notice the relationships that occur in the analyzed set, it is necessary to organize it, before visualizing the final graph. For this purpose, it can be used (Lee, Sohn, 2016):

- simple algorithms, which place vertices in a coordinate system in a random way,
- circular algorithms, which organize graph vertices in circle form,
- spring layout algorithms, based on the concept of virtual forces repelling and attracting individual vertices,
- multidimensional scaling algorithms, based on the similarity measure of the individual vertex pairs.

The purpose of organizing the graph is to reveal specific structures that show the interaction between the concepts. These structures may have different forms, depending on the strength and nature of the relationship. The most characteristic structures are: bridging concepts, bridging graphs and graph similarity (Kötter, Berthold, 2012). These structures are presented on figure 2.

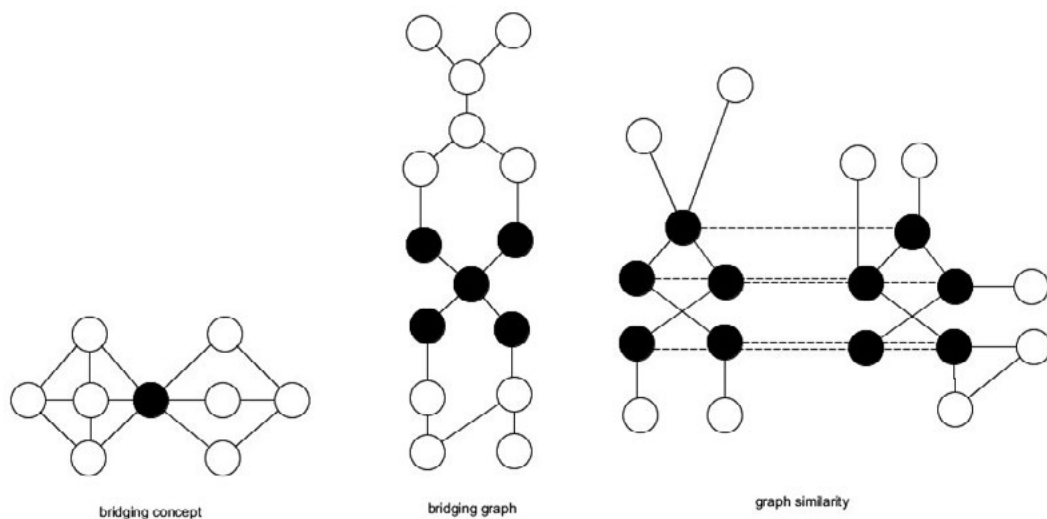


Figure 2. Relations in graph structures

Source: (Kötter, Berthold, 2012).

Bridging concept is a form of relationship that manifest itself through the presence of a node connecting two clusters which represent different ranges of concepts. In this way, it is possible to detect concepts that are seemingly unrelated to each other. The more sophisticated forms of relations are bridging graphs. In this case, the two knowledge domains are linked together by a set of terms. The graph similarity is an indirect form of relation. It manifests itself by the structural similarity of subgraphs in two different domains (Berthold, 2012). The potential relations are not limited to the mentioned types. There are other interesting patterns like: clusters, outliers and other types (Raymond, Belbin, 2006). A list of interesting patterns, indicating the existence of significant relationships between concepts is not limited. Relational patterns can be variable, depending on the subject being analyzed or the publication period. This feature introduces a specific lack of determinism to the described method. Creativity is still inextricably linked with human capabilities.

The described method has been implemented as a Python script. The Python language has been chosen due to good ability for text processing. Moreover, there is a possibility for using a wide range of libraries for graph processing. In this case the NetworkX library has been chosen. The NetworkX is one of the most well developed and tested (Boschetti, Massaron, 2017). As a visualization tool, the Gephi library has been used. The graph layout has

been performed with use of ForceAtlas2 algorithm, which belongs to spring layout algorithms group (Jacomy, Heymann, Venturini, Bastian, 2012). The data source contained 2758 records about scientific articles and 300 records about patents. The example result of simulation has been shown on figure 3. On the graph, a part showing the concepts associated with the term “energy efficiency” has been presented.

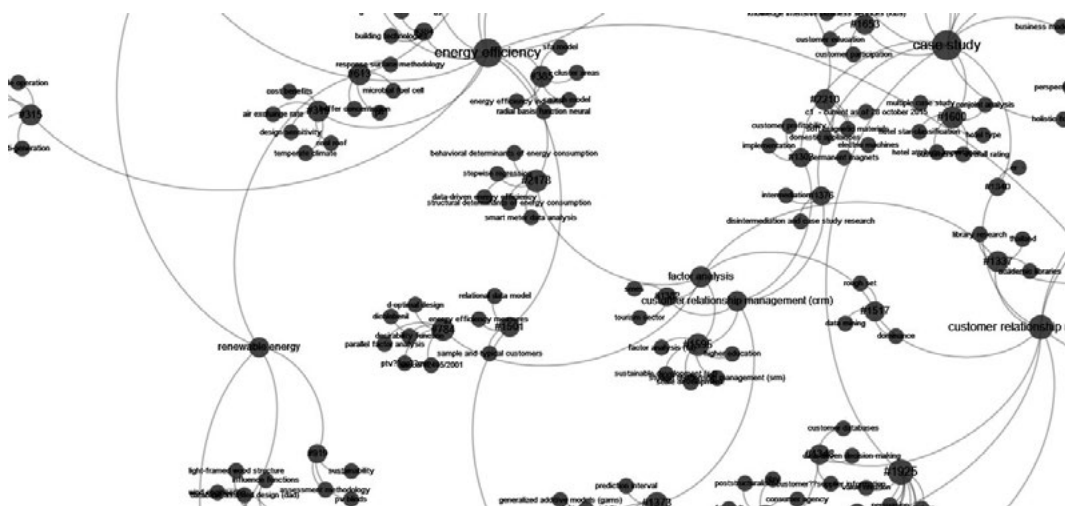


Figure 3. Graph organization result

In the presented graph, it can be noticed the presence of vertices representing documents (vertices marked by “#”), and what keywords are assigned to each of these documents. It can be also noticed which term links certain publications (these are: “energy efficiency”, “renewable energy”, “factor analysis”).

Despite the promising, initial results, the presented approach has many limitations. The limitations of described method are following:

- the clarity of the result is strongly dependent on the selection of source documents,
- the need to process a large number of different documents formats,
- difficulties related to text extraction due to the language of processed publications (e.g. processing Polish and English documents),
- high processing complexity during analyzing large numbers of documents,
- possibility of complications at the level of lexical processing (e.g. due to the presence of synonyms),

- problems with processing of poorly structured documents,
- possibility of overlooking important information by inexperienced users.

Conclusions

There is no doubt that are growing challenges for the companies. Future expectations of consumers will surely include pro-environmental and pro-social elements. In this situation, gaining competitive advantage will depend on the ability of the company to develop product and service innovations with taking into account environmental and social requirements.

In the innovation policy, companies must take into account following considerations:

- growing number of documents' types, necessitates the possessing of knowledge management capabilities,
- development of sustainable innovations will require the ability to synthesize different areas of knowledge,
- computer supporting may be helpful in developing sustainable innovations.

The concept of sustainability innovation described in this article is probably one of the possible approaches. Developing alternative methods and assessing their effectiveness is a promising subject for future research.

Literature

- Aagaard A., Lindgren P. (2015), *The Opportunities and Challenges of Persuasive Technology in Creating Sustainable Innovation*, "Wireless Personal Communications" No. 81, p. 1511-1529
- Bekmezci M. (2015), *Companies' profitable way of fulfilling duties towards humanity and environment by sustainable innovation*, "Procedia-Social and Behavioral Sciences" No. 181, p. 228-240
- Berthold M. (2012), *Towards Bisociative Knowledge Discovery*, in: G.J. Williams, S.J. Simoff (eds), *Data Mining*, Lecture Notes in Computer Science No. 3755, Berlin-Heidelberg
- Boschetti A., Massaron L. (2017), *Python. Podstawy nauki o danych*, Gliwice
- Jacomy M. et al. (2012), *ForceAtlas2, A Continuous Graph Layout Algorithm for Handy Network Visualization*, medialab.sciences-po.fr/publications/Jacomy_Heymann_Venturini_ForceAtlas2.pdf [02-10-2017]
- Jastrzębska E. (2017), *The responsible consumer as an answer to new sustainable development challenges*, "Ekonomia i Środowisko" No. 60, p. 198-206
- Ketata I., Sofka W., Grimpe Ch. (2014), *The role of internal capabilities and firm's environment for sustainable innovation: evidence for Germany*, "R&D Management" No. 45, p. 60-70

- Kötter T., Berthold M. (2012), *From Information Networks to Bisociative Information Networks*, in: M. Berthold (ed.), *Bisociative Knowledge Discovery*, Lecture Notes in Computer Science No. 7250, p. 33-50
- Lee H., Sohn I. (2016), *Big Data w przemyśle*, Warszawa
- Maxwell I. (2009), *Managing Sustainable Innovation. The Driver for Global Growth*, New York
- Raymond B., Belbin L. (2006), *Visualisation and Exploration of Scientific Data Using Graphs*, in: G.J. Williams, S.J. Simoff (eds.) *Data Mining*, Lecture Notes in Computer Science No. 3755, Berlin-Heidelberg
- Schaltegger S., Wagner M. (2010), *Sustainable Entrepreneurship and Sustainability Innovation: Categories and Interactions*, "Business Strategy and the Environment" No. 20, p. 222-237
- Seidel S. et al. (2017), *Design principles for sensemaking support systems in environmental sustainability transformations*, "European Journal of Information Systems", <https://doi.org/10.1057/s41303-017-0039-0>.
- Toivonen H., Gross O. (2015), *Data mining and machine learning in computational creativity*, Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery No. 5, p. 265-275
- Wang Ch., Tao J. (2016), *Graphs in Scientific Visualization: A Survey*, "Computer Graphics Forum" No. 36, p. 263-287

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DIVERSIFICATION OF THE LEVEL OF SUSTAINABLE DEVELOPMENT IN EU MEMBER STATES WITH THE USE OF TAXONOMIC METHODS

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ABSTRACT: The aim of this article is to define the degree of sustainable development in EU member states with the use of various taxonomic methods. The first part of the article addresses the issues related to the definition of sustainable development and the methods used to assess the level of this phenomenon. The second part is dedicated to the assessment of the level of sustainable development in EU member states on the basis of statistical data from the year 2010 and 2015. The possible use of multidimensional comparative analysis was pointed out to define the degree of sustainable development. Linear classification of EU member states in terms of sustainable development level was carried out on the basis of standard and non-standard methods. Moreover convergence of the classifications was examined. Ward's method and the PAM method were used to group EU member states in terms of similar sustainable development level.

KEY WORDS: sustainable development, sustainable development indicator, linear classification, object grouping

Introduction

Together with the growing criticism of Gross Domestic Product being a measuring instrument of social prosperity, numerous indicators and aggregate data have been developed to assess this phenomenon. As time went by, they were subject to “greening”, which consisted in the correction of economic results and cost adjustment resulting from the depreciation of natural capital, referring to the idea of sustainable development – a concept much broader than conventional economic development. Due to the multi-faceted nature of sustainable development, the construction of measuring instruments is substantial when it comes to the assessment of its degree as they function as both information and diagnostic barometers, thus being fundamental to analyses and comparisons on local, regional, national and international levels.

The aim of this article is to assess the degree of sustainable development in EU member states in the years 2010 and 2015 on the basis of taxonomic indexing methods. In order to quantify the degree of sustainable development, multidimensional statistical analysis based on synthetic development indicators were used. Despite numerous analyses, measuring the level of sustainable development in individual regions still remains an issue, which has not been fully solved. The author claims this issue concerns the selection of diagnostic variables (diverse formal and substantive criteria), methods used to measure the phenomenon, as well as methods used to group objects under analysis. When using different taxonomic methods, researchers oftentimes marginalize the necessity of compliance and grouping classification or neglect to verify if the object grouping was carried out correctly. The first part of the article presents theoretical aspects of the level of sustainable development as well as synthetically describes chosen measuring methods of this phenomenon. By applying standard and non-standard methods, linear classification of analyzed objects was carried out. Furthermore, the classification of analyzed objects was performed with use of Ward’s method and PAM method. The selection of partial variables was done on the basis of substantial, statistical and formal criteria. 28 EU member states were subject to this analysis.

Sustainable development indicators

Despite the term “sustainable development” being widely popular both in scientific publications and different legal documents, the definition and thus was of measuring remain an object of heated discussion among researchers. W. Florczak (2011) lists out the following common characteristics found

in numerous definitions of sustainable development: the rejection of zero growth concept to bring together ecological and socio-economic problems; interaction between the economic, ecological, demographic and social components of development; emphasis on the necessity for the whole society to be engaged in the implementation of the principles of sustainable development; necessity of analysis of the consequences of decisions made on future generations; the principle of distributive justice; emphasis on the role of non-material aspects of life.

Taking these issues into consideration as well as the multi-aspect nature of the level of sustainable development, quantification poses a significant problem. With regards to this matter, research conducted at the end of the 1990s deserves special consideration, among others by J. Śleszyński (among others *Agregatowe wskaźniki trwałego rozwoju*, 1998), T. Borys (among others *Wskaźniki ekorozwoju*, 1999), B. Fiedor (among others *System wskaźników i indeksów ekorozwoju*, 1996), which significantly contributed to the popularization of research regarding the quantification of sustainable development or eco-development. Among more current research on measuring sustainable development on the basis of taxonomic analysis, the analyses of E. Roszkowska and R. Karwowska are worth mentioning. The authors performed an analysis and assessment of how the concept of sustainable development of Polish voivodships in 2010 is being accomplished, on the basis of synthetic measure of the level of development (the average of normalized values of simple features) (see: Roszkowska, Karwowska, 2014). As part of a research M. Reiff, K. Surmanová, A.P. Balcerzak and M.B. Pietrzak based on Hellwig's method and Ward's method assessed the efficiency diversification of agricultural sectors in the EU (see: M. Reiff, K. Surmanová, A.P. Balcerzak, M.B. Pietrzak, 2016). As a result of attempts to measure this phenomenon, very diversified measures have been created, applicable in domestic and international comparative analyzes. They enable the monitoring and assessment of the progress of implementation of sustainable development goals set by individual societies.

One of these measures is the so-called „Ecological footprint”, which is used as a measure of people's demand for broadly defined natural capital. According to E. Lazarus and others „ecological footprint” determines how many biologically productive land and sea areas are necessary to provide resources for consumption and to absorb generated waste, based on existing technological solutions combined with specific practices in resource management (Lazarus et al., 2014). Another measure used to quantify the level of sustainable development is the *Environmental Performance Index* (EPI). In 2016, this measure was constructed on the basis of over 20 indicators aggregated in 9 thematic areas: impact on health, air quality, drinking water

and sanitation, water resources, agriculture, afforestation rate, fishing grounds, biodiversity of species and habitats, climate and energy. The first three groups of indicators are distinguished within the framework of the strategic objective of health protection, while the remaining ones concern the protection of ecosystems (HSU, 2016). In the context of measurement of sustainable development – especially in the social sphere – the Human Development Index (HDI) is often used (for instance under the United Nations Development Program), taking into account the GDP per capita, as well as life expectancy at the time of birth and the level of education (UNDP, 2015a). The derivative of the HDI index is a relatively new (applied for the first time in 2010) *Multidimensional Poverty Index* (MPI), which replaced the HPI (*Human Poverty Index*) index used since 1997. It includes 10 elements aggregated in 3 dimensions (UNDP, 2015b): I. Education (1. no household member studied for at least 6 years; 2. school-age child does not attend school); II. Health (1. at least one member of the household is undernourished 2. child mortality); III. Living conditions (1. no access to electricity, 2. no access to clean drinking water, 3. no access to sanitary facilities, 4. use of „dirty cooking fuel”, 5. mess at home, 6. having at the most one piece of property related to: access to information (radio, television, telephone), mobility or subsistence (fridge, arable land, livestock)). One of the first measures of economic well-being taking into account the environmental aspect in a greater extent was the EAW index (*Index of the Economic Aspects of Welfare*), used by X. Zolotas in 1981. Its construction is based on the current flow of goods and services. It includes expenses related to public buildings, value of work in households, spending on durable consumer goods, advertising, value of free time, value of public sector services, adjusted by expenses related to health and education, costs of environmental pollution and depletion of natural resources (Redclif, 2005). *The Index for Sustainable Economic Welfare* (ISEW) was developed in 1989 by H. Daly and J. Cobb. The first step in the construction of this measure is to adjust the personal expenditure of a given population by indexing the income spread. Next, the value obtained is modified by adding or subtracting monetary values from a predetermined set of factors (of social, economic and environmental nature), depending on whether a given factor has a positive or negative impact on prosperity (Lawn, 2003; Gasparatos et al., 2008).

Classification and grouping of EU member states in terms of sustainable development level

The analysis of spatial diversity of the EU member states in terms of the level of sustainable development requires comparison of many research

objects described with the help of a large set of variables, therefore it is difficult to express the level of this phenomenon by one measurable feature. In order to quantify the degree of sustainable development, multidimensional statistical analysis based on synthetic development indicators were used (which replace the description of objects using a series of variables with one aggregated quantity).

In the source literature, it is difficult to find a universal list of indicators used to quantify the level of sustainable development of individual areas, but three basic dimensions can be considered without major reservations in the analysis of the level of this phenomenon (Borys, 2011; GUS, 2011): economic (including socio-economic infrastructure, employment structure), social (including health, culture) and environmental (including air quality). Therefore, taking into account the criterion of availability and completeness of data, 42 indicators have been proposed, divided into three dimensions:

- environmental: OS1 – electricity consumption by households (1000 tons of oil equivalent); OS2 – energy consumption in transport in relation to GDP; OS3 – municipal waste recycling rate; OS4 – production of waste by economic entities (t/km²); OS5 – pollution, soot or other environmental problems (percentage of population exposed); OS6 – chemical and medical waste (t/km²); OS7 – greenhouse gas emissions; OS8 – emission of sulfur oxides by the source sector (t/km²); OS9 – ammonia emission by the source sector (t/km²); OS10 – emission of non-methane volatile organic compounds (t/km²); OS11 – energy generated from renewable sources (in %);
- social: S1 – number of entities involved in the production of animated films, video and tv programs, sound recording and publishing activity per 1 person; S2 – population density; S3 – number of people killed in road accidents per 1000 people; S4 – percentage of people with higher education; S5 – income replacement indicator; S6 – median income (PPS); S7 – inability to meet unexpected financial expenses (percentage of population); S8 – inequality of income distribution; S9 – percentage of people experiencing deep material deprivation; S10 – crime, violence or vandalism in the area (percentage of the population); S11 – people leaving education and schooling prematurely (in % of the total population); S12 – people living in households with very low work intensity (in % of the total population); S13 – subjectively perceived health condition (as very good – in %); S14 – neonatal mortality rate; S15 – share of children under the age of 3 in institutional care; S16 – the impact of social transfers (excluding pensions) on reducing poverty; S17 – fertility rate; S18 – indicator of severe housing deprivation; S18 – participation rate in education and training (last 4 weeks); S19 – differentiation of salary based on sex; S20

- percentage of people at risk of poverty or social exclusion; S21 – life expectancy.
- economic: G1 – GDP per capita (in EUR); G2 – expenditure on research and development (% of GDP); G3 – gross debt of the general and local government sector (% GDP); G4 – unemployment rate; G5 – eco-innovation index (EU=100); G6 – density of motorways¹; G7 – total expenditure of the public finance sector (% of GDP); G8 – energy intensity of the economy; G9 – energy efficiency of the economy (in euro per kilogram of oil equivalent); G10 – economic activity indicator.

Due to the fact that many authors question the validity of the weighing procedures for variables referring to spatial data, for the purposes of these analyzes, the assignment of diagnostic weight factors to variables was omitted. The fact that for instance variables that were not selected would have zero weight in advance, would argue for such a solution (Balicki, 2009; Młodak, 2006). From the set of potential variables, the features for which the value of the coefficient of variation (in both analyzed periods) was smaller than the arbitrarily determined, critical threshold value of this coefficient of 10% were eliminated. In addition, it is commonly accepted that two highly correlated variables convey similar information, so it is recommended to eliminate one of them. Therefore, the so-called inverted correlation matrix method is used to assess information value. This method consists in determining the matrix inverse to the matrix of correlation coefficients between variables. If there is such a necessity, the variable for which the corresponding diagonal element of the inverse correlation matrix was characterized by the highest value exceeding the arbitrarily set threshold value (usually $r^*=10$) is eliminated. The inverse correlation matrix is then recalculated and checked if the diagonal values do not exceed the set threshold. The action is continued until all diagonal values, which do not exceed the established threshold value have been reached (Młodak, 2006; Panek, Zwierzchowski, 2013). For the purposes of the article, for each subject subgroup of variables, the inverse correlation matrix was calculated. If necessary, the variable corresponding to the diagonal element of the matrix inverse to the correlation matrix with the highest value was eliminated, simultaneously exceeding the arbitrarily set threshold value.

The above set of diagnostic features was reduced due to the low degree of differentiation, eliminating variables related to life expectancy and professional activity rate. However, due to the low discriminatory capacity (in both periods analyzed), the variable related to the number of people at risk of pov-

¹ Due to the lack of access to more current data, the indicators referring to the density of motorways in Denmark, Belgium, Cyprus and Malta refer to the year 2012. This data comes from: *Road Statistics Yearbook 2016*.

erty was eliminated. The variables included in the set of destimulant are: OS1, OS2, OS4-OS10, S3, S7-S12, S14, S18, S19, G3, G4, G8. The other variables are stimulant. Due to the requirement to ensure the comparability of final diagnostic variables in taxonomic analyzes, a standardization process was carried out using classical standardization.

In order to organize the EU countries due to the level of sustainable development, four methods of linear ordering were used (non-standard (average rank method and standardized sum method) and standard (distance method and TOPSIS method) (wider: Balicki, 2009; Dziechciarz, 2002; Młodak, 2006; Panek, Zwierzchowski, 2013; Hwang, Yoon, 1981). The calculated synthetic development measures reflect the position of EU countries in particular years, in relation to other areas. In the case of the TOPSIS method, standardized sum methods and average rank methods, the higher value of the synthetic development measure means a higher level of the studied phenomenon, while in the case of the distance method the interpretation is reversed. It is worth noting that for all the methods used, the highest measures were recorded in Sweden, Denmark and Luxembourg.

Based on the values of synthetic development measures, rankings of EU countries were created focusing on the level of sustainable development. For all the methods used, Bulgaria finished last both in 2010 and in 2015. Also Latvia didn't get very high in the ranking based on the data from 2010 (three times came 27th and once 26th in the case of the middle-ranking method) and Romania (which finished on the 27th place (average rank method) twice 26th (sum method and distance method) and 25th place in the ranking based on the TOPSIS method). For the 2015 data, Greece was identified most frequently (three times) as next to last, and slightly better results were observed in the case of Malta. Such low ranks of these countries come from low or very low values of the included partial variables.

Poland in the created rankings came 17th for the 2010 data (for the TOPSIS method), 18th (for the standardized sum method and the distance method) and 23rd for the middle rank method. In turn, for 2015 data, Poland ranked 15th in the rankings created by three methods: distance method, TOPSIS method, sum method, and only 25th in the ranking created on the basis of the average rank method. These disproportions are related to high values in a given period of a synthetic measure taking into account the dispersion of the analyzed variables (distance method, TOPSIS method, sum method) and at the same time a lower value of the measure that does not take into account the variation of features, which is the rank arithmetic average (rank method). Analyzing the results of the linear ordering of EU countries in terms of the level of sustainable development, it is easy to notice that in individual years there have sometimes been significant shifts in the rankings

Table 1. A synthetic measure of the level of sustainable development of EU member states

	The value of synthetic measure								Ranking							
	Non-standard methods				Standard methods				Non-standard methods				Standard methods			
	I		II		III		IV		I		II		III		IV	
	10'	15'	10'	15'	10'	15'	10'	15'	10'	15'	10'	15'	10'	15'	10'	15'
AT	0,44	0,55	16,17	16,39	0,34	0,24	0,61	0,61	5	5	5	4	5	4	5	5
BE	0,34	0,45	13,95	14,17	0,50	0,41	0,55	0,55	11	11	11	11	10	11	13	12
BG	0,00	0,00	8,56	7,73	1,00	1,00	0,45	0,41	28	28	28	28	28	28	28	28
HR	0,20	0,29	12,05	12,20	0,74	0,64	0,51	0,51	22	21	18	18	23	24	23	23
CY	0,27	0,31	12,88	12,22	0,61	0,59	0,55	0,52	14	19	14	16	17	22	14	19
CZ	0,29	0,39	12,73	12,95	0,54	0,44	0,56	0,56	13	12	16	14	13	13	11	11
DK	0,53	0,67	18,10	18,51	0,22	0,16	0,65	0,65	2	2	2	2	2	2	2	2
EE	0,22	0,33	11,66	12,71	0,67	0,54	0,53	0,54	20	18	21	15	20	18	19	16
FI	0,46	0,55	17,02	16,39	0,31	0,29	0,63	0,61	4	4	4	5	4	7	4	6
FR	0,37	0,49	14,68	14,76	0,42	0,32	0,58	0,58	9	9	9	9	9	10	8	10
GR	0,19	0,17	10,63	9,22	0,74	0,76	0,50	0,46	24	27	24	27	22	26	24	27
ES	0,27	0,34	13,02	13,22	0,56	0,51	0,54	0,53	15	16	13	13	14	16	15	17
NL	0,40	0,50	15,61	14,90	0,42	0,30	0,58	0,58	6	6	6	7	8	8	9	9
IE	0,40	0,50	15,49	15,20	0,53	0,28	0,57	0,61	7	7	7	6	12	6	10	4
LT	0,19	0,29	11,71	11,54	0,74	0,58	0,52	0,52	23	22	19	22	24	21	21	18
LU	0,49	0,60	17,32	16,51	0,29	0,22	0,63	0,62	3	3	3	3	3	3	3	3
LV	0,09	0,27	10,07	11,54	0,88	0,59	0,48	0,52	27	23	26	21	27	23	27	20
MT	0,11	0,18	10,17	11,29	0,85	0,78	0,48	0,47	25	26	25	24	25	27	26	26
DE	0,31	0,39	13,56	13,39	0,51	0,43	0,55	0,54	12	13	12	12	11	12	12	13
PL	0,23	0,34	10,83	11,29	0,65	0,50	0,53	0,54	18	15	23	25	18	15	17	15
PT	0,26	0,33	12,78	12,22	0,60	0,51	0,53	0,52	16	17	15	17	16	17	16	21
RO	0,10	0,19	9,68	9,85	0,85	0,74	0,49	0,49	26	25	27	26	26	25	25	25
SK	0,23	0,36	11,59	12,20	0,67	0,50	0,53	0,54	19	14	22	19	19	14	18	14
SL	0,38	0,49	15,27	14,73	0,40	0,32	0,59	0,58	8	8	8	10	7	9	6	8
SE	0,61	0,72	19,59	19,61	0,00	0,00	0,72	0,69	1	1	1	1	1	1	1	1
HU	0,21	0,30	11,68	11,71	0,68	0,57	0,52	0,51	21	20	20	20	21	20	22	22
GB	0,35	0,45	14,22	14,78	0,39	0,27	0,58	0,59	10	10	10	8	6	5	7	7
IT	0,25	0,27	12,17	11,37	0,57	0,57	0,53	0,49	17	24	17	23	15	19	20	24

Legend: I – The method of standardized sums, II – Average rank method, III – Distance method, IV – TOPSIS method.

AT – Austria, BE – Belgium, BG – Bulgaria, HR – Croatia, CY – Cyprus, CZ – Czech Republic, DK – Denmark, EE – Estonia, FI – Finland, FR – France, GR – Greece, ES – Spain, IE – Ireland, LT – Lithuania, LU – Luxemburg, LV – Latvia, MT – Malta, NL – Netherlands, DE – Germany, PL – Poland, PT – Portugal, RO – Romania, SK – Slovakia, SL – Slovenia, SE – Sweden, HU – Hungary, GB – Great Britain, IT – Italy.

Source: author's own work based on data from Eurostat, <http://ec.europa.eu/eurostat>; Road Statistics Yearbook 2016.

created under the given method. In the analyzed period, the greatest advancement was recorded in the case of Italy (depending on the method, by at least 4 places) and Cyprus (for the three methods used it was a advancement by 5 places). The largest drop in the rankings created was identified in the case of Latvia and Estonia (depending on the adopted method, it was a decrease in the ranking between 4th and 7th places in the case of Latvia and between 2nd and 6th place in the case of Estonia). On the basis of synthetic values of development measures and created rankings, it can be stated without any reservations that in the spatial differentiation of the level of sustainable development of EU countries, there is no clear division into the western part and the eastern part of these associated countries. On the other hand, Nordic countries – Sweden, Denmark and Finland topped the ranking. In order to evaluate the convergence of the classification results obtained by four taxonomic methods, the values of Spearman's rank correlation coefficients were calculated between them. In the years analyzed, these coefficients are very high and in each case exceed the value of 0,92. In order to supplement the analysis, Kendall's τ correlation coefficients were calculated (Spearman's rank correlation coefficient does not take into account the fact that the distances between neighboring values are unknown (and not equal)). The analysis of Kendall's τ correlation coefficients confirmed the high consistency of obtained classification.

Table 2. Conformity of the results of the classification of EU countries based on the level of sustainable development

	Distance method (2010/2015)		TOPSIS method (2010/2015)		The method of standardized sums (2010/2015)		Average rank method (2010/2015)	
	I	II	I	II	I	II	I	II
Distance method	1,000*	1,000*						
TOPSIS method	0,979*/ 0,973*	0,899*/ 0,894*	1,000*	1,000*				
The method of standardized sums	0,981*/ 0,975*	0,921*/ 0,899*	0,984*/ 0,976*	0,915*/ 0,899*	1,000*	1,000*		
Average rank method	0,955*/ 0,928*	0,831*/ 0,810*	0,953*/ 0,933*	0,825*/ 0,820*	0,977*/ 0,949*	0,899*/ 0,857*	1,000*	1,000*

Legend: I – Spearman's rank correlation coefficient, II – Kendall's τ correlation coefficient.

* statistically significant at the significance level $p < 0,05$.

Source: author's own work.

Due to the high compliance of the classification results, further analysis focuses on the results obtained with the TOPSIS method. On the basis of the

analysis of the value of measures for sustainable development, it can be concluded that there is moderate variation in the level of this phenomenon in the EU (measured at the national level). The average value of the constructed measure in 2010 was 0,5543, while in 2015 it was 0,5484. The coefficient of variation was 0,1050 and 0,1101 in 2010 and 2015 respectively. It is worth noting that in both analyzed years this measure was characterized by right-sided asymmetry (in 2010 the asymmetry index was 0,7848, while in 2015 0,1639), which means that values not exceeding the arithmetic average predominated. In 2010, for three-quarters of EU countries, the synthetic measure of the level of sustainable development did not exceed the value of 0,5196, with the maximum value of 0,7176 and the minimum 0,4501, while in 2015 in 75% of the analyzed countries the value of 0,5851 with the maximum value of 0,6932 and a minimum of 0,4109.

In order to deepen the analysis, the EU countries were classified according to two methods based on taxonomic similarity – the Ward's method (as a way to measure the distance between objects a square of Euclidean distance was used (to assign more weight to objects further away from the others)) and PAM method (Partitioning Around Medoids). The Ward's method aims to minimize the square deviations from the mean within clusters. One of the basic problems that appear in the Ward's method is to determine the so-called critical distance size at which the arms of the dendrogram² are cut off and thus the clusters of the objects are determined. In order to limit subjectivity one of the assisting techniques based on the following formula was used (Panek, Zwierzchowski, 2013):

$$d_{i+1}^* > \bar{d} + ks_d,$$

where: d_{i+1}^* – critical value of the distance corresponding to $i+1$ branch length; $\bar{d}$, s_d – arithmetic mean and standard deviation of tree branch length; k – parameter whose optimal value is estimated at 1,25.

For the data from 2010, the critical value of the distance at which the dendrogram's arms were cut was 214,08, while for the data from 2015, 210,43.

The less frequently used classification method is the relatively new PAM division method, which is a modified version of the k -means method. The algorithm³ consists in finding k representative objects that are centrally located in clusters (so-called medoids). The cluster representative is an

² The effects of using Ward's method are often presented in the form of a tree diagram – a dendrogram.

³ The simplified algorithm is described on the basis of UNESCO, 2008 pp. 321-323.

object in which the average dissimilarity (distance to the representative) of all objects in the cluster is minimal. The selection of k medoids is done in two stages. The first stage is based on a preliminary division through another selection of representative objects, until the verification of k objects. The first object is the one for which the sum of dissimilarities to all other objects is as small as possible. Then, in each step, an object is chosen that reduces the function of the goal (sum of dissimilarity) as much as possible. The second phase is an attempt to improve the set of representative objects. This is done by including all pairs of objects (i, h) for which the object has been selected for the set of representatives, and h does not belong to the set of representatives, checking whether, after swapping i and h , the target function decreases.

Based on the criterion adopted to determine the critical distance size at which the arms of the dendrogram are cut off, in the case of the Ward's method, three groups of countries were created (in both periods analyzed). In order to ensure the comparability of classification results, in the case of the PAM method, the same number of groups was arbitrarily assumed. Grouping results are presented in descending order according to arithmetic means of synthetic measures (obtained with the TOPSIS method) within a given cluster.

Table 3. Classification of EU countries by the level of sustainable development

Gr.	2010	2015
Ward's Method		
I	SL, PT, IT, ES, GR, CY, FI, SE, AT, DK, GB, IE, FR, DE, BE, LU, NL	IE, GB, FR, DE, SL, FI, AT, SE, DK, LU, BE, NL
II	BG, CZ, EE, HR, LV, LT, HU, PL, RO, SK	GR, ES, IT, CY, PT, BG, CZ, EE, HR, LV, LT, HU, PL, RO, SK
III	MT	MT
PAM method		
I	BE, DK, IE, FR, LU, NL, FI, SE, GB	BE, IE, FR, LU, MT, NL, AT, FI, SE, GB
II	DE, GR, ES, IT, CY, MT, AT, PT	DE, DK, GR, ES, IT, CY, PT, SL
III	BG, CZ, EE, HR, LV, LT, HU, PL, RO, SL, SK	BG, CZ, EE, HR, LV, LT, HU, PL, RO, SK

Source: author's own work.

The use of different classification methods has contributed to various grouping results in the analyzed years. These inconsistencies may arise, inter alia, from a different way of calculating the distance between objects, or the distance between the clusters themselves. In the case of the Ward's method, in both analyzed years a single-element group was distinguished, which

included Malta. It is clear that for the 2010 data, all countries included in the first group created on the basis of the PAM method are included in the first group formed by the Ward's method (for the data from 2015, the exception being Malta). In the case of grouping results obtained by the Ward's method, it is much easier to identify the clusters of countries that form extensive and compact spatial areas with a similar level of this phenomenon (this is mainly due to the much larger (compared to PAM results) concentration of countries only in the first two groups created). For the 2010 data, this mainly applies to countries in the first group: Portugal, Spain, France, Luxembourg, Belgium, the Netherlands, Denmark, Germany, Austria, Slovenia and Italy. For the data from 2015, this applies mainly to countries belonging to the second selected group: Estonia, Latvia, Lithuania, Poland, the Czech Republic, Slovakia, Hungary, Romania, Bulgaria and Greece. The adjusted Randa index was used to assess the conformity of the obtained classifications by PAM and Ward's methods. This index takes values from the interval [0,1], where the value of 1 means identical results of grouping of objects, while 0 when the compared orderings are independent. The value of the Randa index for the 2010 data was 0,7407, while for the data from 2015 0,7354. After classification using different methods, their correctness was verified. For this purpose, measures of homo- and heterogeneity were determined. Homogeneity meters determine the level of cluster unification. This unification increases if the objects in the group are closer together. In turn, heterogeneity meters measure the level of individuality in groups of objects. For the assessment of cluster homogeneity, a meter reflecting the average arithmetic distance of objects in the group was used:

$$hm = \frac{1}{k} \sum_{l=1}^k \overline{d_l}; \quad \overline{d_l} = \frac{1}{(n_l^2 - n_l)} \sum_{i=1}^{n_l} \sum_{j=1}^{n_l} d_{i,j},$$

where: n_l – number of l -th of a group; k – number of groups.

However, in order to assess the heterogeneity of clusters, a meter was calculated that reflects the arithmetic mean between groups, expressed by the formula:

$$hr = \frac{1}{k} \sum_{l=1}^k d_{\min}^{(l,l')}, \quad d_{\min}^{(l,l')} = \min_p (\min_{o \notin \{p\}} d_{p,o}),$$

where: $\{p\}$ – a set of objects from the l -th group; p – object belonging to the set $\{p\}$; o – collection of objects not belonging to the group of l .

The cluster correctness meter is the quotient of homogeneity and heterogeneity measures.

Table 4. Total measures of homogeneity, heterogeneity and correctness of clusters

	Summary measures					
	Homogeneity		Heterogeneity		Correctness	
	I	II	I	II	I	II
2010	7,394	35,600	5,613	58,856	1,317	0,605
2015	7,374	38,131	5,176	59,198	1,425	0,644

Legend: I – PAM method; II – Ward's method

Source: author's own work.

The results of the assessment of the effectiveness of the conducted groupings in particular years indicate that the Ward's method is more effective for the analyzed set of variables. In the case of this method, higher measures of clustering heterogeneity than homogeneity measures were observed – inversely than in the PAM method.

Conclusion

Relatively easily accessible statistics on national and international economic, social and environmental issues make the search for indicators and constructing aggregate measures of sustainable development level an important research direction since many years. Despite numerous analyzes, searching for new indicators and measures, and making analyzes in dynamic and spatial terms, it seems that the research should be continued. This is particularly important for justifying the sense of implementing sustainable development principles and monitoring the progress of the implementation of these principles in a given area. The results of this type of research can be an impulse to correct and update the actions adopted in the strategic records. The article defines synthetic measures of the level of sustainable development, using four taxonomic methods, which were used to rank EU member states with regards to the level of the analyzed phenomenon. As a result of the conducted research, groups of countries with a similar level of sustainable development were created. The analysis shows that the highest level of sustainable development can be found in Sweden, Denmark and Luxembourg. In the years taken into account, Bulgaria came last. In the analyzed period, the diversification of the level of sustainable development in the EU

countries can only be assessed as moderate. It should be emphasized that despite the application of different methods of linear classification with regards to the level of sustainable development, in the years analyzed no significant differences were observed between the places of individual countries in the ranking, which indicates the consistency of classification.

The contribution of the authors

Magdalena Jaworska – 50% (concept, theoretical part, conclusions).

Mariusz Malinowski – 50% (data collection, analysis and interpretation of results).

Literature

- Balicki A. (2009), *Statystyczna analiza wielowymiarowa i jej zastosowanie społeczno-ekonomiczne*, Gdańsk
- Borys T. (2011), *Zrównoważony rozwój – jak rozpoznać ład zintegrowany*, „Problemy ekorozwoju – problems of sustainable development” No. 6(2), p. 75-81
- Borys T. (1999), *Wskaźniki ekorozwoju*, Białystok
- Dziechciarz J. (2002), *Ekonometria. Metody, przykłady, zadania*, Wrocław
- European Union Road Federation (2016), *Road Statistics Yearbook 2016*, Brussels
- Fiedor B. (1996), *System wskaźników i indeksów ekorozwoju*, „Gospodarka – Środowisko Przyrodnicze – Informacja”, Biblioteka „Ekonomia i Środowisko” No. 19
- Florczak W. (2011), *Rozwój zrównoważony a długookresowy wzrost gospodarczy. Alternatywa czy koniunkcja?*, in: B. Poskrobko (ed.), *Teoretyczne aspekty ekonomii zrównoważonego rozwoju*, Białystok
- GUS (2011), *Wskaźniki zrównoważonego rozwoju Polski*, Katowice
- Hsu A. et al. (2016), *2016 Environmental Performance Index*, CT: Yale University, New Haven
- Lawn P.A. (2003), *A theoretical foundation to support the Index of Sustainable Economic Welfare (ISEW), Genuine Progress Indicator (GPI), and other related indexes*, „Ecological Economics” No. 44, p. 105-118
- Lazarus E. et al. (2014), *Working Guidebook to the National Footprint Accounts*, Oakland
- Młodak A. (2006), *Analiza taksonomiczna w statystyce regionalnej*, Warszawa
- Panek T., Zwierzchowski J. (2013), *Statystyczne metody wielowymiarowej analizy porównawczej: Teoria i zastosowania*, Warszawa
- Redclif M. (ed.) (2005), *Sustainability. Critical Concepts in the Social Sciences*, London-New York
- Reiff M. et al. (2016), *Multiple Criteria Analysis of European Union Agriculture*, „Journal of International Studies” Vol. 9, No 3, p. 62-74
- Roszkowska E., Karwowska R. (2014), *Wielowymiarowa analiza poziomu zrównoważonego rozwoju województw Polski w 2010 roku*, „Economics and Management” No. 1, p. 9-37

- UNDP (2015a), *Human Development Report 2015. Work for Human Development*, New York
- UNDP (2015b), *Human Development Report 2015. Work for Human Development – TECHNICAL NOTES*
- UNESCO (2008), IDAMS. *Internationally Developed Data Analysis and Management Software Package*, Paris
- Walesiak M. (1991), *O stosowalności miar korelacji w analizie wyników pomiaru porządkowego*, „Prace Naukowe AE we Wrocławiu” No. 600, p. 13-19



Monika NIEDZIÓŁKA

ECONOMIC SECURITY ON RURAL AREAS

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ABSTRACT: The problem of economic security is an interdisciplinary issue. The research of economic safety of spatial entities and economic entities is also included in this research. The purpose of this article is to bring together issues related to the economic security of rural areas and economic entities located in these areas. The study will define the economic security and determinants of this security, particularly in rural areas. Factors influencing the security of rural areas and entities operating there will be described.

KEY WORDS: economic security, rural areas

Introduction

Safety is a lack of treats. It means that, as a matter of fact the state when we can feel completely safe doesn't exist. Nowadays, one thing we know for sure is that change is certain. It seems that in recent history it didn't occur so big unpredictability and asymmetry of safety like today. In this situation, only action of human, corporation or country should be taking measures to limit risk and get close to the state of safety.

Economic security is relatively balanced operating state of national economy, in which involved risk of imbalances maintains within designated and acceptable organizational and legal standards and principles of community life (Raczkowski, 2012, p. 81).

Economic security matters are usually considered in the context of national security. Meanwhile, it is also reasonable to consider safety at other levels of spatial arrangement of country but also in the other arrangements than just at the level of country, whilst bearing in mind that nation's safety determines safety of its citizens, companies and spatial units, but at the same time their security is a component of national security. There is constant feedback loop between corporation's safety and national safety, meaning that economic security of country determines security of companies located on its territory, being at the same time its function (Kuciński, 2015).

Economic security of undertakings means ability of undisturbed, stable, continuous, balanced, true to determined mission and targets doing business activities and at the same time economically efficient functioning of economic entitles. It must be constantly created, protected. The more complicated is economic activities conducted by undertaking concerned, the higher is its sensitivity to economic safety and gaining and maintaining it is more difficult. On the other side the bigger and economically stronger the business is, the bigger is its economic safety and ability to counteract external and internal dangers and unfavorable consequences for particular business (Kuciński, 2015, p. 9).

Category of economic safety of rural areas

Ability to shape economic safety of enterprises also depends on what economic entitle is, how it is managed, but also where it is located. Characteristics of that place could promote safety of enterprise, but could also generate dangers (Kuciński, 2015, p. 9).

Both the rural areas in Poland and agricultural activity are special and specific especially when it comes to safety and risk of doing business in

certain localization. In recent years the concept of intermediary areas named also areas in large measure rural. It is an effect of on-going changes consisting of human migration and business activity from rural areas to cities and “reversed urbanization” meaning migration from urban areas to easy to reach rural areas. The result of these processes is more and more imbalanced economic progress in rural areas. This inequality isn’t beneficial in terms of safety. Since it requires using varied instruments and tools to provide and maintain safety.

Safety of rural areas can be perceived in three levels (Kuciński, 2017, p. 259) that is: manufacturing, social and ecological. Speaking of manufacturing level, we have in mind manufacturing balance consisting of maintenance natural, economic, institutional, social and technical conditions for conducting business and maintenance of dominant function of rural areas, that is agricultural activity. This function is still fundamental for these areas, mainly because of food safety of country, but nowadays is no longer only. Increasingly, rural areas are localization of non-agricultural activities and varied services.

In reference to social level (balance) it is important to adjust economic base to changing needs of rural society and new communities, for which rural areas are living space. On the one hand, this mean necessity to preserve and concern for regional cultural heritage, but on the other side creating conditions to attain standard and quality of living complied with modern requirements (e.g. development of communication and services accessibility, creation of social infrastructure, etc.).

Ecological balance (level) means non-interfering, economically efficient execution of economic and social functions of rural areas, but with due care and preservation of local resources. All three levels permeate, complete and affect each other and there is coupling between their elements.

Determinants of ecological safety on rural areas

Security level is gradable concept. It is impossible to unequivocally define, whether the economy is growing fully safely. However, it is possible to determine the direction the economy is moving in aspect of economic safety and scale of the threat determining safety level (Piocha, 2001, p. 20). It requires to set and identify certain key factors which affect and create safety. Some of them have universal characteristics, some are specific to particular unit. In reference to rural areas, it is worth noting following conditions of safety:

- institutional (country, local and regional authorities, legal conditions of country, Union and foreign relations),

- social (migration, unified structure of employment, domination of agricultural activity, low level of education, ageing population, quality of functioning in region),
- technical (low level of basic infrastructure: communication, technical, informative and social),
- political (bigger than in the city opportunity to effect on local authorities on rural areas, a wide and significant electorate, managing, entrepreneurship, creativity),
- economical (production marketization, profit, cost-effectiveness and economic calculation as dominant criteria of economic activity, local investments, accessing Union funds),
- natural (huge environmental risk in economic activity).

Speaking of institutional conditions, it is important to remember that situation of rural areas and most of changes that are taking place on this area are connected with system changes and marketization of agricultural production, but also of the European Union. Economic politics pursued on rural areas must be consistent with UE requirements. On one side, this membership imposed many restrictions in polish agriculture (quantitative, sanitary, epidemiological etcetera), but on the other side it enriched economy with new support instruments, which are financed from Union's budget. This whole situation demands from country activity, which will allow to use this funds in most efficient way. It is the task of a country, which significantly affects on economic safety level of rural areas, to create organizational and legal system, which allows for clear, readable, possible to plan in long time distance functioning of rural businesses. A practical example of this action is existing in Poland obligatory insurance system, which most significantly concerns agriculture. Based of the assumption that the highest risk in polish agriculture concerns natural dangers and related material and personal damages, Polish country obliged farmers to insurance their properties, crops and liability in relation to third parties for an unintentional act of farmers and their families (Niedziółka, 2016, p. 125-161).

Analysis of social conditions supposed to start with statement that drive of everything is always human. He could be chance or danger for safety of country, region or business. Rural areas are specific in terms of social structure. Too abundant workforce in agriculture, defective agrarian structure, shortage of non-agricultural workplaces, low work producibility, poor education of villagers are key problems of rural areas. Basic condition to their development is enriching structure of socio-economic function. Particular attention is paid to necessity of development of non-agricultural economic functions, that is services, touristic, housing, forestry, crafts, production and minor manufacture.

Among technical conditions it is worth to mention economic infrastructure. Location of enterprises on rural areas, less populated, worse equipped with technical infrastructure, reduce their competitiveness in regard to limited availability of potential collaborators, business environment institutions and outlet. Intensive changes are taking place on rural areas, especially in the area of technical infrastructure. In years 2005-2013 sewage line doubled (increased of 104%) in villages, amount of buildings connected to sewage system increased of 80%, waste segregation system was introduced, number of gas customers increased of 25% (whilst every fifth apartment in village is provide with gas from a network), length of water distribution system increased by more than 17% (92% village apartments have waterworks). Investments in communicative infrastructure are progressing much more slowly, but for that in recent years huge investments were made in social infrastructure (playgrounds, common rooms, community centers etcetera) (Wilkin, Nurzyńska, 2016). In rural areas dynamic progress of accessibility of informative infrastructure is observed, which certainly could become a chance to counteract the influence of unfavorable localization of rural undertakings. Unfavorable for various reasons conditions of the different locations reduce ability to compete with undertakings and spatial units what for sure lower their sense of security.

Conditions named political concern entrepreneurship, creativity, innovation and actual managing possibilities in reference to various entities of economic space. Today local conditions established by local and regional authorities are becoming increasingly important for safety of spatial units or economic entities. Decentralized management system creates huge opportunities for authorities to create safe operating conditions for their citizens and businesses. Taking actions aimed at creating safe functioning of country, regions, local units, businesses or citizens demands coordination and integration at all levels of management. Only then ensuring security of economic entities and society is possible. Increasingly importance for effectiveness of conducted policy is given to the commitment of authorities and local communities in her execution. An example can be creating energy safety, which is important component of economic safety. The country is responsible for providing energy safety, but more possibilities is observed on local level. Legal and organizational conditions are created to achieve that in most efficient way. The Law of 20 February 2015 on renewable energy sources is significant documentary in this regard. The amendment to this law was introduced, which introduces regulations fostering the development of scattered power industry aimed at creating local energy cooperatives – cooperatives and energy clusters. Public policy in favour to support for production of green energy is observed with so-called Energy Three Pack introduced as a change to Energy

Act in 2013. Amendment of previous law arrangements facilitates investment in renewable energy forces in Poland mainly by providing the conditions for microinstallations. This will enable local communities to make a greater commitment in creating their energy safety.

Economic determinants of safety concern primarily structure of business activity on rural areas. Nowadays agriculture is still dominant direction of activities on rural areas even though more and more it is noticed their multifunctional nature. Next to agriculture other non-agricultural types of activities performed by farmers or other villagers unconnected to agriculture or people from outside the village locating their assets in development of companies. Diversification of activities on rural areas on one side favours their safety, creates new chances, but from the other side creates new, unknown operating conditions. Previous lifestyle, dependent on agriculture on rural areas nowadays is not possible. Non-agricultural activity is performed with using resources of agriculture holdings and often is based on diversification of holdings. In recent 10 years 53 thousands of new workplaces unrelated with agriculture have been created. In fact, these outcomes aren't impressive in the area of creating new workplaces, but they initiate the process, which favours diversified local economy, less open economic cycles and bioeconomy.

Equally important changes are taking place in the composition of the income consisting of increasing proceeds from employed activity and non-profit work and reducing proceeds from agricultural work. Employed activity is main source of income for 27% of villagers (36% of people from the city) while self-employment which in the village includes mainly working in agricultural holding is the main source of income for 10% of villagers (5% of people from the city). Social benefits (retirement pension, disablement pension and benefit) are main source of income for 25% of villagers (28% of people from the city). Dependants represent 36% of villagers (29% of people from the city).

Two issues are associated with natural conditions, these are sustainable development and risks in agriculture. Original definition and meaning of sustainable development were about conservation of necessary natural resources for future generations. This means rational management without overexploitation, degradation and devastation. Nowadays category of sustainable development was widened by cultural, social, economic and spatial zone. However, its key area is environment and natural resources.

Agriculture activity like barely any of economic activity is associated with natural risks. Agriculture is the sector, in which dominates catastrophe risk. This risk is source of most serious and frequent losses in production. Furthermore, there are many categories of catastrophe risks causing serious

damages basically just in agriculture (drought, frost). Mass, reaching large areas damages having characteristics of natural disasters are dominant in agriculture (Klimkowski, 2002, p. 10). It's estimated, that financial results depend on weather in 80% types of all economic activities. However, strength of this correlation is biggest in agriculture. Furthermore, it is not limited to financial results. This causes that production risk is there particularly high and fluctuations in production results are bigger than in other branches of production (Wojciechowska-Lipka, 2002, p. 244). Equally relevant characteristic of agricultural production, which doesn't affect size of the risk, but affects severity of damages caused by natural disasters is need to consider timeliness and seasonality of economic processes meaning that individual production steps should be taken in established order and in specified period influenced by climatic factors.

Economic security depends on sector in which undertakings operate, whilst its sensitivity on safety issues is variable dependent on sector and localization. The more technologically and organizationally complicated is the economic activity, the higher is its sensibility on security and harder it is to achieve it and especially maintain in the long run. The more economically attractive is the localization of entity and the more external benefits it provides, the easier it is to achieve safety and maintain in time (Kuciński, Niedziółka, Trzcińska, 2015, p. 15).

Conclusions

Economic security could be treated as risk function emerging in various layers of activities and at different stages. Defining risks could be compared to setting specific, critical control points, which should be constantly monitored (Kuciński, Trzcińska, 2015, p. 34). It is equally important to indicate safe development directions. This applies to both spatial units, but also economic entities and societies functioning on its area. Actual and most relevant elements, which affect on safety level of rural areas was indicated in this scientific description. Some of these factors have spontaneous character, forced by economic or social conditions, but most of them could be created in appropriate way and use to become an element, which improve safety of local unit, country, but also businesses and citizens. Undoubtedly, today major importance is given to entrepreneurship and creativity of local authorities, which besides proper and scrupulous fulfilling statutory obligations could take initiatives creating safe living and functioning conditions.

Literature

- Klimkowski C. (2002), *Istota, skutki i zarządzanie ryzykiem katastroficznym w rolnictwie polskim*, „Studia i monografie IERiGZ” No. 114, Warszawa, p. 10
- Kuciński K. (ed.) (2015), *Lokalizacyjne uwarunkowania bezpieczeństwa ekonomicznego przedsiębiorstw*, Warszawa
- Kuciński K. (2017), Ład przestrzenny a bezpieczeństwo ekonomiczne podmiotów gospodarczych Lokalizacja ekonomicznie bezpieczna. Aspekty metodologiczne i praktyczne, Warszawa, p. 259
- Kuciński K., Niedziółka D., Trzcińska B. (2015), *Mikroekonomiczny aspekt bezpieczeństwa ekonomicznego* in: K. Kuciński (ed.), *Lokalizacyjne uwarunkowania bezpieczeństwa ekonomicznego przedsiębiorstw*, Warszawa, p. 15
- Kuciński K., Trzcińska B., (2015), *Bezpieczeństwo ekonomiczne jako przedmiot poznania* in: K. Kuciński (ed.), *Lokalizacyjne uwarunkowania bezpieczeństwa ekonomicznego przedsiębiorstw*, Warszawa, p. 34
- Law of 20 February 2015 on renewable energy sources, Dz.U. nr 15 poz. 478
- Law of 26 June 2013 on change of Energy Act and some other acts, Dz.U. nr 13 poz. 984
- Niedziółka M. (2016), *Ubezpieczanie ryzyka lokalizacyjnego*, in: K. Kuciński (ed.), *Lokalizacja działalności gospodarczej a jej ryzyko*, Warszawa, p. 125-161
- Piocha S. (2001), *Nauki ekonomiczne o problemach bezpieczeństwa*, in: *Bezpieczeństwo w obszarze badań nauk ekonomicznych i prakseologii*, Koszalin, p. 20
- Raczkowski K. (2012), *Bezpieczeństwo ekonomiczne. Wyzwania dla zarządzania państwem*, Warszawa, p. 81
- Wilkin J., Nurzyńska I. (eds) (2016), *Polska wieś 2016. Raport o stanie wsi*, <http://www.fdpa.org.pl/uploads/downloader/polskawies2016e-book-160916113041.pdf> [16-08-2017]
- Wojciechowska-Lipka E., (2002), *Ubezpieczenia rolne*, in: J. Monkiewicz (ed.), *Podstawy ubezpieczeń*, Warszawa, p. 244

STUDIES AND MATERIALS

STUDIA
I MATERIAŁY



Agnieszka **BECLA**

THE IMPORTANCE OF INFORMATION IN SUSTAINABLE MANAGEMENT OF NATURAL RESOURCES (NATURAL CAPITAL) AT THE LOCAL LEVEL (IN THE LIGHT OF EMPIRICAL RESEARCH)

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ABSTRACT: The author has discussed the importance of information in sustainable development. She has presented sets of information indispensable for local strategies of sustainable development. She has also presented a procedure of using such information. Additionally, she has identified and explained issues regarding the use of information for managing natural resources in a sustainable manner. The author has also presented results of empirical research concerning the information practice of managing local natural resources.

KEY WORDS: sustainable development, sustainable management of natural resources, information, municipality, local development strategy

Introduction

The contemporary literature does not call into question the importance of information in the processes involved in pursuing balanced and sustainable development. Ordered sets of information, understood as knowledge, are the basis for the preparation of each strategy of balanced and sustainable development at any level of management and functioning of the society. They are also indispensable in the accomplishing, monitoring and improving such strategies¹.

The objective of this study is to verify the hypothesis expressed in the form of the following question: Are there appropriate sets of information in the municipalities under research based on which it is possible to pursue balanced and sustainable management of the local natural resources? A hypothesis thus formulated necessitates defining two essential issues. The first of them is the notion of balanced and sustainable management of natural resources. The other one is linked to identifying the sets of information that are necessary for such management.

For the purpose of verifying the research hypothesis as well as accomplishing the other tasks, the author had conducted a number of studies and empirical analyses. The empirical research was conducted for the regions of Dolny Śląsk (Lower Silesia), Ziemia Lubuska, Wielkopolska and Opole, and comprised 110 municipalities for which it was possible to obtain appropriate data focussed on managing the local natural resources. This is approximately 20% of the total number of municipalities of these regions (548 municipalities). In the empirical research, several facts were verified concerning: (1) availability of a local development strategy in the municipalities, (2) inventory of natural resources, (3) municipal information policy, (4) participation of municipal offices in the development of the local economy, (5) surveys of social expectations, and (6) active creation of local sets of information. These are manifestations of the processes involved in managing sets of information at the level of municipality and local community.

The notion of balanced and sustainable management of natural resources (natural capital)

Sustainable Development causes a lot of controversy and contentions, beginning with translation of the notion itself, through ways of understanding the essence of such an approach to management and ending with imple-

¹ This distinction can be found in the literature: (1) base and inventory information, (2) implementation information, (3) identification information, (4) improvement information, and (5) information as final knowledge (Czaja, 2007).

mentation challenges. From the theoretical perspective, of particular importance are discussions around the notion of development – balanced, sustainable, self-sustaining or integrated – as well as natural capital. Other issues willingly discussed include interrelations between different forms of economic capitals, understood as the problem of the principles of sustainable natural capital – the weak, sensitive, strong and restrictive ones². There is less interest in principles of managing natural capital and its constituents – non-renewable resources, renewable resources and services, or in a wider context, in principles of managing economic resources (dynamically speaking, capitals). Let us thus concentrate on those more seldom discusses issues. As a matter of fact, they contain some very interesting hints for the processes of managing local natural resources as well as clues for identifying information needs in this respect.

Sustainable utilisation of natural capital must be based on definite principles with varying degrees of generality. Thus, the following principles can be distinguished as one of the concepts (Czaja, Becla, 2007):

- the principle of maintaining a balance between resources and uses;
- the principle of not depleting natural resources, particularly the core natural capital;
- the principle of maintaining diversity of the components of natural capital;
- the principle of substituting natural capital with other forms of capital;
- the principle of minimising entropy sources;
- the principle of rational utilisation of natural capital resources (application of the criterion of maximising utility gained from natural capital);
- the principle of effective utilisation of elements of natural capital (surplus of benefits over costs).

The first of them is essential for the information basis of any form of the processes of managing (opening balance) and is at the same time the appropriate response to the need for monitoring rare and also limited economic resources (capitals).

The second of the above listed principles is a specific carry-over of the issue of sustainability of natural capital and at the same time a security criterion for the survival of the mankind.

The third of the principles determines the present and future potentials for the development of the human civilisation, inherent in the interactions

² The first one denotes preserving the volume of total capital (natural, anthropogenic and social) without taking account of its structure. The sensitive principle calls for preserving the whole of the capital and the appropriate structure thereof. The strong principle draws attention to the necessity of preserving each resource in the capital separately while the restrictive principle forbids causing depletion of any of the resources.

between man and the natural environment, which K. Marx referred to as the law of progressive development of productive forces.

The fourth principle, like the second one, touches upon the issue of substitution (replacement) and complementarity (reciprocity) of various forms of capitals. At the same time, it expresses the essence of the management processes as described in production function models, which consists in the necessity of combining different forms of economic resources (capitals) in order to produce goods and services satisfying human – individual and collective – needs. It also enables touching upon the issues of the availability (scarcity) and controllability of the individual forms of economic capital.

The fifth principle expresses the inevitability associated with operating in the real world of the law of entropy. Since degradation of its elements is unavoidable, then such actions should be taken that do not exceedingly aggravate this situation. This principle has some particularly interesting implications, in the aspect of information and decision-making, for the local management of natural resources that are particularly limited in volume or productive capabilities.

The last two principles enable moving directly to the issues of managing economic resources *sensu lato*. The sixth one refers to the problem of rational utilisation of natural capital resources and emphasises the criterion of maximising utility gained from such exploitation. And the seventh one indicates the trend of the (desirable) choices made, determined by the imperative of gaining surplus of benefits over costs. These last two calculation and information elements are broadly understood unlike in the traditional economic account, but rather like in the cost and benefit analysis.

The rational approach to managing is the starting point for taking up some important problems, such as (1) the issue of scarcity of economic resources; (2) the issue of their finiteness (limitation), and (3) management as a decision-making process accomplished under conditions of the unlimited character of human needs and the scarcity of resources. Here, rationality assumes the form of the well-known two-variant principle of rational management treated as a criterion of choice. Because these choices take place in definite conditions, they assume the form of searching for optimal solutions. But this generates additional challenges relating to the relations: goals-effects and goals-efforts. They can be referred to as the need for taking account of the following principles: (1) expediency, (2) praxeological effectiveness, and also: (3) aptness of the choice of means of implementation, as well as (4) viability of the selection of goals.

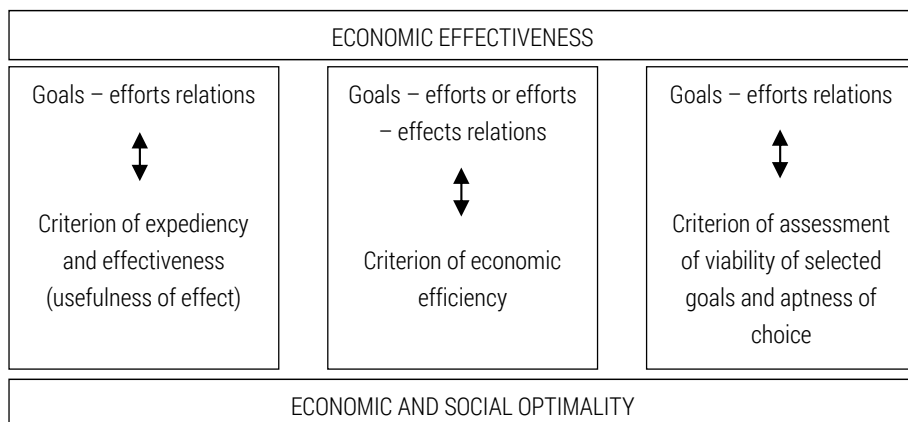


Figure 1. Criteria for assessment of effectiveness and optimality of management

Source: author's own work.

These principles are applicable in relation to each economic endeavour in which any forms of economic resources (capitals) are used. Therefore, they are also the basis for managing natural resources in the local scale³. In other words, there is no possibility of balanced and sustainable management of natural capital (natural resources) without adherence to all of the above principles.

Identification of sets of information indispensable for balanced and sustainable management of local natural resources and characteristics thereof

The second essential challenge is identification of indispensable sets of information as well as specification of the features that the information contained in them should be characterised by. Information-related basis for implementing balanced and sustainable management of natural resources is beyond dispute. There is virtually no possibility to achieve and pursue the path of such development in the local scale without appropriate sets of information and the ability to taking advantage of it (appropriate knowledge or even wisdom).

The empirical research conducted by the author made it possible to recognise and distinguish several sets of information that is extremely useful for

³ There is not enough space here to discuss these principles in detail. Please refer to relevant literature (Becla, 2012).

carrying out sustainable management of local natural resource (local natural capital). This is, most importantly:

- information originating from the natural inventory of the geographic and biological environment of the specific municipality, being a detailed characteristic of the components and elements of the local natural environment;
- statistical and empirical data on the local economy, with regard to their spatial and temporal distribution, allowing to understand the character of the managing processes being carried out, the level of their advancement, intensity and modernity as well as the temporal prospectiveness in the dynamic, globalising economy;
- information originating from various sources on the social expectations (needs), being an expression of the quality of the relationship (communications between the local community and the municipality, correctness of the municipal information policy, and also the level of civic participation and modernity of the democratic procedures);
- information on local economic resources (in the typical breakdown into five elements distinguishing human, physical/financial/structural, natural, information and cultural resources) and on the surroundings of the municipality, enabling to define the development potential of the local community and the municipality in the form of an inventory, and also to identify the barriers (inhibitors) and determinants (stimulants) of the future development, and define the viability of making it sustainable;
- documentation of the cultural heritage (of material and non-material character) of the municipality and the local community, which is becoming an increasingly featured cultural resource, a source of social capital increasing the effectiveness of the management processes and of building relationships within and between generations;
- a strategy of local development and accompanying documents containing a socially accepted vision of the future development of the municipality and the local community, being an indication for the authorities with regard to the expectations and desirable actions (or, more broadly, ventures).

Each local community and its administrative representatives (self-government authorities) seeking ways of implementing such management processes that would be characterised by structural sustainability (desirable relations between the orders) and by sustainability regarding time and resources must gather, order and update such sets, and utilise them appropriately. Their existence (possession or accessibility) is both the precondition and the baseline condition.

Empirical research⁴ conducted for 110 municipalities provided answers to some questions, such as:

- does the municipality have a strategy of local development?; the character and quality of the strategic documents were not evaluated in this question;
- has natural inventory been accomplished in the territory of the municipality?; only the fact itself was verified and not the quality and scope of the studied carried out;
- does the municipality pursue a local information policy?; additionally with this question, the objectives, scope and instruments (techniques) of the municipal information policy were checked;
- does the municipality pursue an active economic policy in the form of an own activity and/or supporting small and medium-sized enterprises as well as attracting investors from outside the area of the municipality?;
- are there any systematic surveys conducted in the municipality concerning social expectations and the inhabitants' needs?; additionally with this question, the ways used to recognise these issues were checked;
- and, are there any appropriate sets of information being actively created in the municipality, especially in the scope of natural resources in the municipality, the local economy and forms of economic activity, cultural heritage – material and non-material – or local economic resources?; no reference was made in the question to the entities responsible for the work being conducted, the scope of this work or the quality of the sets of information collected.

In the case of the first problem, the answer is unambiguous. All of the municipalities in the research had local strategies of development. In many cases, however, they did not have the form of a strategy of sustainable development.

In the case of natural inventory, the affirmative answer only concerns 30% of municipalities. There are several reasons that affect the situation, namely: (1) absence of a statutory obligation for municipal offices to carry out a natural inventory; (2) dispersion of competences concerning the ownership and management of the individual components of the natural environment; (3) the need for having appropriate knowledge and qualifications in order to carry out a natural inventory; (4) relative high costs of carrying out a natural inventory, especially with regard to geological tasks and registers of renewable resources; and also (5) the need for updating the data.

⁴ In order to increase reliability of results, the research employed an approach based on the *desk research* method, field verification, statistical and inductive processing of empirical data, interviews and deductive evaluation of information.

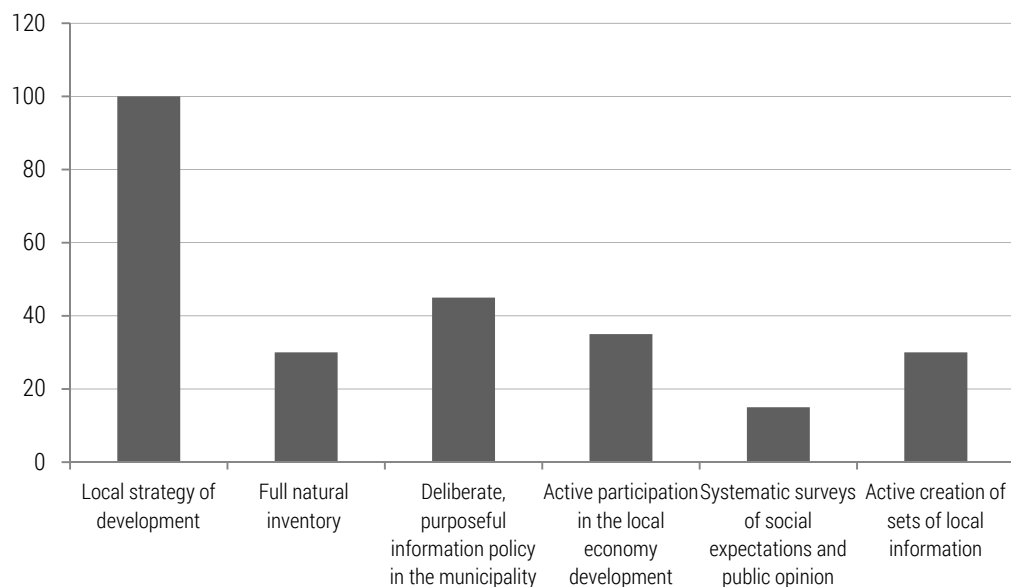


Figure 2. Answers to questions concerning selected aspects of managing local natural resources in the municipalities covered by the research [% of affirmative answers]

Source: author's own work based on the results of the research.

Among the municipalities in the research, 45% of entities pursue a defined information policy which does not only involve passing information from the authorities to the inhabitants but also acquiring information from individuals or social groups. These municipalities also endeavour to influence the information recipients' behaviours, which is an essential element of active social communication. In these municipalities, a better and better utilisation of the modern methods and tools of communications can be observed, especially concerning websites but also other carriers, appropriately prepared in terms of quality (leaflets, posters, local newspapers and bulletins, and even radio or television). In the remaining 55% of the municipalities covered in the research inconsistent information actions are performed instead of social communication. Municipal offices pass information using the available means and channels without undertaking any actions to make sure that it reaches the recipient. The assumption is that it is in the interest of the recipient, not the sender, to receive information. This is completely at variance with the principles of modern social communication as well as costly and ill-considered with regard to effectiveness. In such circumstances it is not possible to pursue sustainable management of natural resources or other forms of local economic resources.

Municipalities have great potentials for active participation in the economic life and influencing the development of the local economy. Not all municipalities take advantage of this; they frequently limit their range of activity to tasks that are required by the law and/or the easiest to accomplish. In the group of municipalities covered by the research approx. 35% extend their activity to other facultative options of supporting the local economy. These municipalities create better opportunities for future development, also for sustainable development founded primarily on their own available economic resources. The other ones, by minimising their activity, generate risks of decline of the development potential and of becoming dependent on external resources (domestic or from the EU).

The most difficult situation in the municipalities in the study concerns the problem of recognising social expectations, the inhabitants' needs or their opinions. Polish democracy has not worked out any effective mechanisms of subjecting authorities to ongoing control, and not just the control exercised at elections. The problem does not only concern people in power but also the voters, who never demand such control but content themselves with election 'promises'. Lack of insight in social expectations and needs is a frequent reason of alienation of the local authorities and lack of acceptance or even interest in their activities. Social resistance and conflicts first occur after a certain critical social border has been crossed. Each strategy of balanced and sustainable development is based on a broad social foundation, and thus the inhabitants' expectations and needs are an element thereof. The research confirms the existing information and communication shortages. Merely 15% of the municipalities in the study conduct ongoing analyses of social expectations, gather information on the inhabitants' needs and take into consideration the opinions that are submitted.

The last issue investigated was the activity of the municipalities in creating local sets of information. Approximately 30% of the municipalities concerned exhibit desirable activity in this area, and thus seek information, gather it and process, and then use it in their decision-making processes. Nearly 60% of municipalities are characterised by a passive approach. The information flowing in is gathered but not ordered or processed. It is sometimes used in decision-making processes even though it is more common to seek information directly in the course of making decisions. Opportunities for pursuing sustainable management of local resources are directly linked to the change of approach from passive to active. Such strategies cannot be accomplished without appropriate sets of information.

Conclusion

In summary, the empirical research and the theoretical analyses conducted lead to some conclusions. Firstly, a lot of information-related deficiencies can be observed in the field of managing natural resources at the local level. Secondly, sustainable management of natural resources requires access to appropriate information, which has to be created, updated and skilfully utilised. Thirdly, some procedures for utilising information should be worked out and implemented at the municipal level. The general principles of such procedures are known. They only need to be adapted to the local conditions. Fourthly, it is essential to avoid any serious threats associated with utilising information at the local level. Fifthly, municipalities should substantially improve the situation regarding collecting and utilising sets of information as well as the local information policy because the empirical research confirmed many deficiencies and shortcomings. Sixthly, it can be asserted that the objective of the study has been achieved. On the other hand, the research hypothesis has been disproved – sets of information concerning sustainable management of natural resources are not correctly used in the municipalities covered by the research.

Literature

- Becla A., Czaja S., Zielińska A. (2012), *Analiza kosztów-korzyści w wycenie środowiska przyrodniczego*, Warszawa
- Czaja S., Becla A. (2007), *Ekologiczne podstawy procesów gospodarowania*, Wrocław
- Czaja S. (2007), *Information as Basis for Implementation of Sustainable Development*, "Towards the Theory of Sustainable Development. Studies on Sustainable Development" Vol. 5, Białystok-Warsaw, p. 273-290

Jolanta FIEDUCIK

AN ANALYSIS OF ELECTRICITY GENERATION IN A WIND FARM IN NORTH-EASTERN POLAND – A CASE STUDY

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ABSTRACT: There are various methods of generating electric power. This article analyzes electricity generation in the Wronki wind farm in Poland. Wind farm specifications and turbine parameters were presented. The correlations between the wind farm's performance and wind speeds in 2014-2016 were analyzed. Turbine availability was estimated. The economic performance of the wind farm was analyzed by calculating the proceeds from the sale of generated electricity. The wind farm's environmental impact was determined by calculating the volume of CO₂, SO₂, NO_x, CO and dust emissions associated with the generation of equivalent amounts of electricity in a conventional power plant.

KEY WORDS: wind farm, electricity generation, wind speed, environmental protection

Introduction

The wind turbine market has evolved dynamically in the last decade. Renewable energy sources have been classified into two main groups. In the first group, wind power is harnessed on a small scale to generate electricity for households, farms and telecommunications networks (Boczar, 2010).

These wind farms have an output of several to several dozen kilowatts, and most of them are connected to the power grid. The second group is composed mainly of foreign companies with extensive experience in wind turbine operation and manufacturers of wind turbine systems which can be operated in severe climates and which have been successfully implemented in hundreds of thousands locations around the world. This group includes large wind farms with nominal output of 10 MW and higher (Flaga, 2008).

Modern wind turbines have similar structural design. The most popular models have three aerodynamic blades made of glass fiber, carbon fiber and composite materials, and they are mounted on steel towers with a height of 50-100 m or even 150 m.

The aim of this article is to analyze energy efficiency depending on wind speed and turbine availability. The economic benefits resulting from obtaining electricity on the wind farm have been presented. The farm is located in north-eastern Poland, where there are excellent wind conditions. The article analyzes actual data gathered in 3 years period on the wind farm „Wronki”.

Wind turbine parameters

The analyzed wind farm is equipped with Vestas V90 wind turbines manufactured in Denmark. The turbines are mounted on towers with a height of 105 m. The nacelle has the weight of 70 Mg, the rotor – 41 Mg, and the tower – 285 Mg. The turbine has three blades, a rotor with a diameter of 90 m, and swept area of 6.362 m². Nominal rotational speed is 16.1 rpm in the range of 8.6 to 18.4 rpm. Power output is controlled by the OptiSpeed® system. The aerodynamic brake consists of three separate hydraulic actuators that control blade pitch. Cut-in wind speed is 4 m/s, and rated wind speed for a 3000 kW turbine is 15 m/s. Cut-out wind speed is 25 m/s. The turbine is equipped with the OptiSpeed® asynchronous generator with rated output of 3000 kW, 1000 V voltage and 50 Hz frequency. Turbine operation is controlled automatically with the use of microprocessors, and it is remotely monitored. Turbine output is controlled and optimized by the OptiSpeed® system, and

blade pitch is controlled by the OptiTip® system. The operating temperature range of a standard turbine is -20°C to 40°C (<https://www.vestas.com>).

Turbine structure

The rotor is one of the key components of a wind turbine which converts wind energy to mechanical energy. Mechanical energy is transferred to the generator via the gearbox (<https://www.vestas.com>).

In many wind turbines, blade pitch is controlled by hydraulic actuators in a range of -5° to $+90^{\circ}$. The rotor is mounted directly on the gearbox or the low-speed shaft which transfers mechanical energy to the generator via the gearbox. In turbines without a gearbox, rotor speed ranges from 1 to 30 rpm, and the gearbox increases that speed to 1500 rpm. The degree of speed transmission is determined by the type of generator. Most wind turbine generators are asynchronous devices.

The operation of a wind farm is controlled by a microprocessor system which collects data for calculations and monitoring. The nacelle is mounted at the top of the tower, and it houses the power transformer, generator, gearbox and control devices. The nacelle also contains lubricating and cooling systems, brakes, hydraulic drive train with pumps and other devices. The nacelle and the rotor are set into motion by electric motors and gears at the top of the tower. The tower is a tapered steel tube.

The structure of the Vestas V90 wind turbine is presented below (<https://www.vestas.com>).

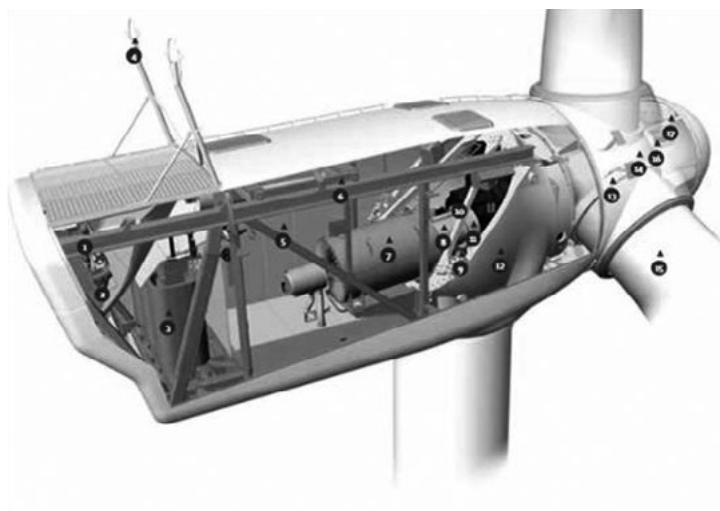


Figure 1. Cross-section of the Vestas V90 nacelle

Source: <https://www.vestas.com> [15-10-2017].

1. Oil cooler
2. Water cooler for generator
3. High voltage transformer
4. Ultrasonic wind sensors
5. VMP-Top controller with converter
6. Service crane
7. OptiSpeed generator
8. Composite disc coupling
9. Yaw gears
10. Gearbox
11. Mechanical disc brake
12. Machine foundation
13. Blade hub
14. Blade bearing
15. Blade
16. Main shaft
17. Hub controller

Description of the Wronki wind farm

The Wronki wind farm is situated in the Region of Warmia and Mazury near Gołdap, by national road No 65 from Węgorzewo to Gołdap.

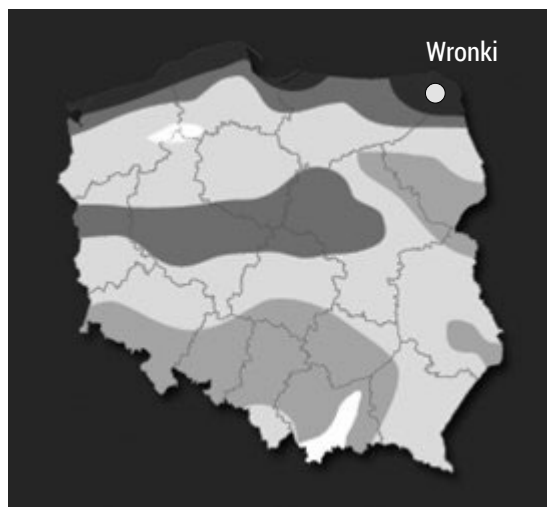


Figure 2. Location of the Wronki wind farm

The wind farm comprises 16 Vestas V90-3.0 MW wind turbines, and its total installed capacity is 48 MW. The wind farm has a transformer station, and it is connected to the 110 kV power grid. It was commissioned for use in 2010, and it has been in operation since 2011 (<https://vortex-energy-group.com/pl/>).

The wind farm is situated between plots of arable land in the vicinity of several farms. It is accessed by hardened dirt roads which had been built for the needs of the project. The roads provide local residents with access to the nearest town and farm fields (<http://in-ventus.com/content>).

Wind turbines are not marked with numbers in chronological order, and some numbers have been omitted. This is because a higher number of 2 MW wind turbines had been initially designed, but 16 3 MW turbines were ultimately installed with total installed capacity of 48 MW (<http://goldap.wm.pl>). The location of turbines in the wind farm is presented in figure 3.

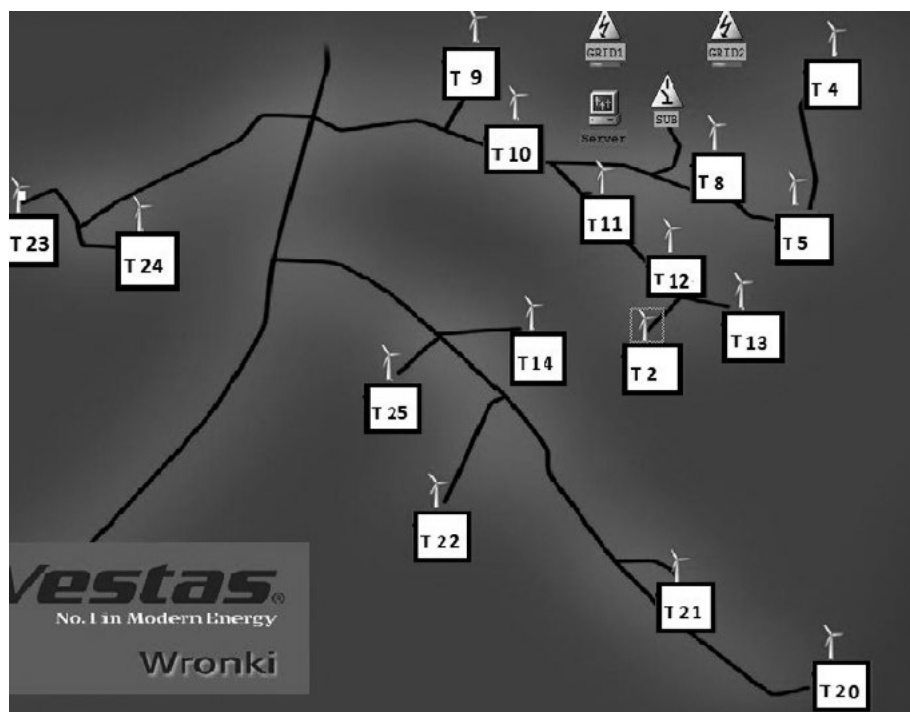


Figure 3. Location of turbines in the Wronki wind farm

Source: company materials.

The Wronki wind farm is managed by In.Ventus Sp. z o. o. sp. k of Poznań which designs and manages wind farms in Poland and Germany. The company manages several wind farms in Poland, including Mogilno, Wronki,

Śniatowo, Dobrzyń and Inowrocław, and in Germany, including Lilet (Luboń, 2017).

Analysis of electricity generation, wind speeds and turbine availability in the Wronki wind farm in 2014-2016

In a wind turbine, the rotor and the blades are propelled by wind energy. The rotor's mechanical energy is converted to electricity by a generator. The conversion of the wind's kinetic energy to electricity can be described with the following formula (Lewandowski, 2006):

$$P = C_p \cdot \eta_m \cdot \eta_{el} \cdot 0.5 \cdot \rho \cdot v^3 \cdot A$$

where:

P – power output of a wind turbine,

C_p – wind turbine power coefficient,

η_m – mechanical efficiency of the rotor and auxiliary systems,

η_{el} – electrical efficiency of the generator, transducers and transformers,

ρ – air density determined by temperature and humidity,

v – wind speed,

A – swept area of a wind turbine.

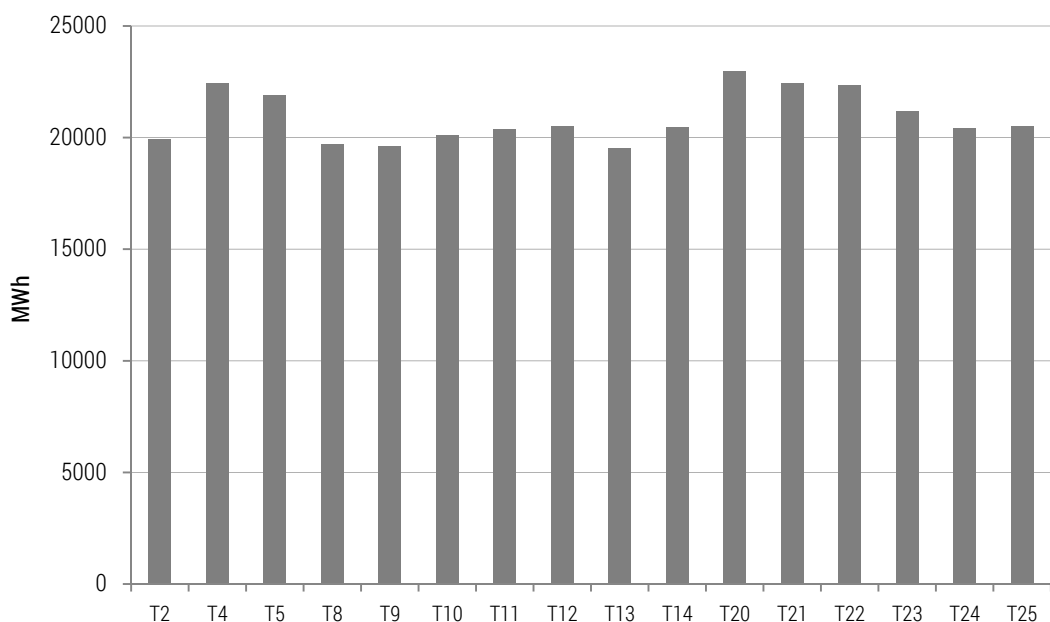


Figure 4. Energy output of each turbine in the Wronki wind farm in 2014-2016

Table 1. Energy output of the Wronki wind farm in 2014-2016 [MWh]

Turbine	T2	T4	T5	T8	T9	T10	T11	T12	T13	T14	T20	T21	T22	T23	T24	T25	Together
January 2014	1172	1195	1195	1161	1112	1118	1182	1193	1137	1152	1266	1258	1219	1116	1176	1152	18804
February 2014	773	832	832	667	688	746	679	708	755	795	468	851	872	874	858	761	12160
March 2014	657	741	741	652	672	680	648	710	680	611	783	752	743	706	681	678	11135
April 2014	407	462	462	395	385	397	403	423	395	401	480	449	462	421	433	417	6793
May 2014	435	486	486	422	408	407	396	410	433	437	520	422	484	484	485	453	7168
June 2014	353	392	392	346	347	352	362	345	321	373	412	344	404	349	377	364	5835
July 2014	379	454	454	382	341	338	340	394	408	394	460	438	455	422	206	374	6238
August 2014	384	411	411	340	367	366	387	404	359	371	457	429	444	401	375	366	6272
September 2014	405	475	475	401	364	287	359	389	409	399	468	439	458	424	410	381	6543
October 2014	485	822	822	747	746	761	777	696	779	782	742	780	825	791	809	778	12141
November 2014	689	713	713	604	566	564	612	632	666	687	754	727	693	655	681	640	10598
December 2014	754	820	820	743	786	798	781	571	709	768	855	817	841	813	699	775	12350
January 2015	1002	1064	1064	986	1000	1023	935	1009	969	1031	1104	1083	1067	936	634	1033	15940
February 02 015	552	570	570	546	549	561	571	558	512	559	543	619	609	586	595	566	9068
March 2015	686	746	746	675	669	674	687	686	636	703	785	726	756	735	741	696	11345
April 2015	626	749	749	685	691	698	701	698	626	705	765	731	741	689	659	676	11189
May 2015	427	498	498	450	411	429	437	446	344	447	513	503	497	480	466	442	7289
June 2015	262	258	258	253	225	240	254	248	214	214	282	268	211	270	272	225	3952
July 2015	437	508	508	435	444	441	444	461	402	431	506	497	434	465	439	424	7278
August 2015	304	410	410	310	347	337	331	388	390	368	438	423	416	390	405	393	6059

Turbine	T2	T4	T5	T8	T9	T10	T11	T12	T13	T14	T20	T21	T22	T23	T24	T25	Together
September 2015	416	485	485	177	393	400	424	416	430	401	504	481	486	475	322	446	6742
October 2015	586	652	652	548	524	527	567	598	550	579	673	640	602	567	575	572	9411
November 2015	754	826	826	762	773	801	807	772	720	773	869	825	846	797	781	790	12721
December 2015	924	1039	1039	966	997	998	1022	1009	848	945	1108	1054	1062	974	969	965	15919
January 2016	497	664	612	520	433	603	601	609	565	600	691	659	658	577	545	527	9361
February 2016	783	848	789	768	748	791	801	782	698	791	887	853	876	834	840	801	12890
March 2016	390	454	436	397	368	384	407	402	399	412	492	465	433	446	428	413	6726
April 2016	445	490	449	434	400	434	456	455	431	427	540	517	461	470	447	457	7314
May 2016	312	341	316	284	285	284	288	310	302	272	352	331	312	289	302	284	4863
June 2016	316	350	320	318	292	283	305	306	276	322	357	315	326	347	344	319	5096
July 2016	270	347	298	316	291	306	302	308	270	295	368	354	344	307	296	310	4981
August 2016	381	401	376	363	389	402	410	388	352	352	471	444	450	426	408	380	6393
September 2016	243	283	205	247	257	248	257	268	229	239	317	294	284	256	236	240	4102
October 2016	918	969	938	849	824	804	827	889	907	906	983	961	941	842	911	850	14320
November 2016	818	863	793	799	740	812	800	834	766	824	887	859	867	852	850	820	13185
December 2016	685	791	723	741	760	775	782	775	627	666	850	797	766	721	730	720	11909
Total [MWh]	19925	22409	21861	19692	19593	20068	20346	20488	19511	20435	22949	22408	22344	21188	20385	20489	334091

Source: author's own work based on company materials [2017].

The power of a wind turbine is a function of wind speed to the third power. The energy output of a wind turbine is determined by turbine power and its operating time.

The energy output (MWh) of the analyzed wind farm, average monthly wind speeds (m/s) and turbine availability (%) in 2014-2016 are presented in table 1.

In 2014-2016, the combined energy output of the Wronki wind farm was 334,091 MWh. The energy output of each turbine in the analyzed period is presented in figure 4.

The monthly power output of the wind farm in 2014-2016 is presented in figure 5.

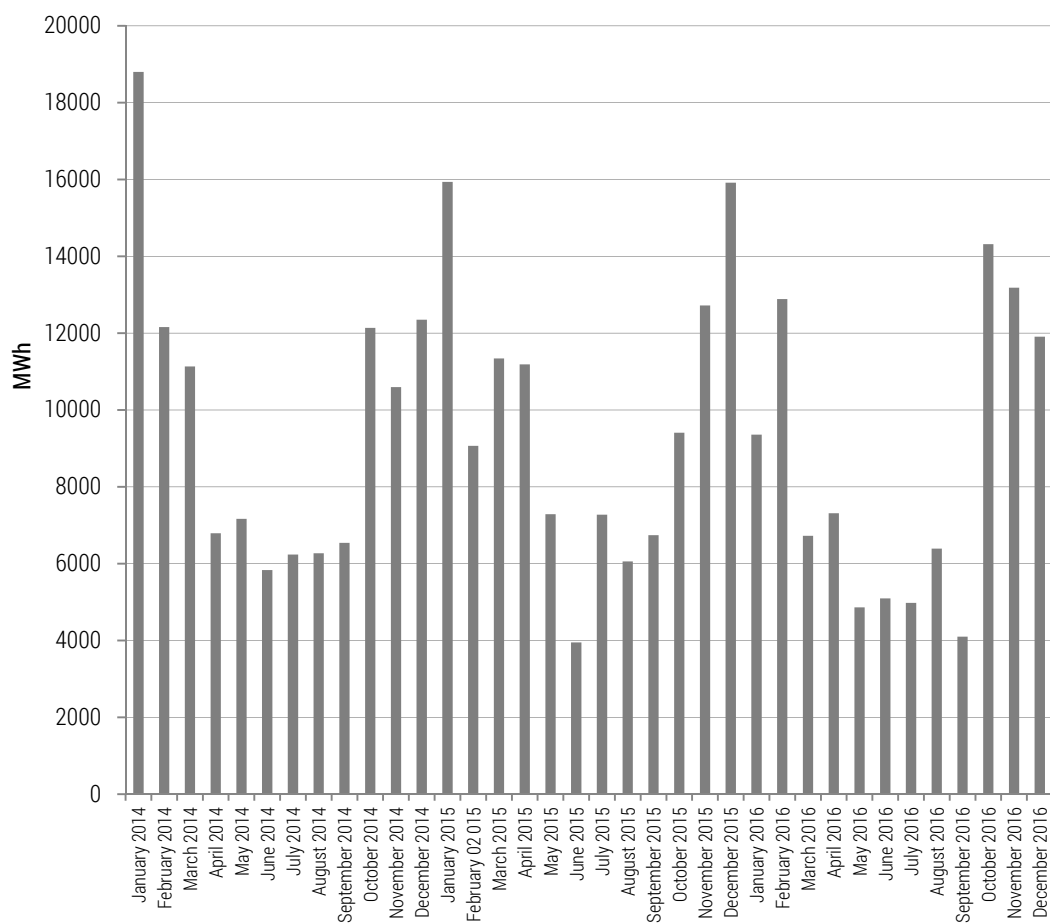


Figure 5. Monthly power output the Wronki wind farm in 2014-2016

Annual power output of the Wronki wind farm in 2014-2016:

- 2014 – 116,036 MWh,
- 2015 – 116,914 MWh,
- 2016 – 101 140 MWh.

The above data were analyzed to identify the turbine with the highest power output in the analyzed period. In 2014-2016, the highest amount of energy was generated by turbine WTG20 whose output reached 22,949 MWh at average wind speed of 7.62 m/s. The availability of turbine WTG20 was determined at 96.3%. Wind speed and turbine location are the critical determinants of turbine performance. In 2014, maximum energy output was 18,804 MWh in January, and minimum energy output was 5835 MWh in June. In 2015, maximum power output was 15,940 MWh in January, and minimum power output was 3952 MWh in June. In 2016, maximum power output was 14,320 MWh in October, and minimum power output was 4102 MWh in September.

Wind speeds in the Wronki wind farm in 2014-2016

Wind speeds measured in different turbines and at different heights over a period of three consecutive years (2014-2016) are presented in table 2.

The average wind speed measured in different turbines in 2014-2016 is presented in figure 6.

Table 2. Average monthly wind speeds in the Wronki wind farm in 2014-2016 [m/s]

Turbine		T2	T4	T5	T8	T9	T10	T11	T12	T13	T14	T20	T21	T22	T23	T24	T25	Average wind speed [m / s]
January 2014	2014-01	9,90	9,90	10,00	10,20	9,00	9,40	9,50	9,80	9,50	9,40	10,50	9,90	9,80	9,30	9,50	9,60	9,70
February 2014	2014-02	8,50	8,50	8,70	8,40	7,40	7,90	8,00	8,00	8,00	7,90	7,10	8,40	8,50	8,60	8,40	8,10	8,15
March 2014	2014-03	7,20	7,50	7,30	7,40	6,90	7,00	7,10	7,30	7,00	7,00	8,20	7,50	7,40	7,20	7,10	7,20	7,27
April 2014	2014-04	6,10	6,40	6,40	6,20	5,80	5,90	6,00	6,00	6,00	5,80	6,80	6,30	6,20	6,00	6,20	6,10	6,14
May 2014	2014-05	6,10	6,30	6,30	6,30	5,90	5,90	5,90	6,00	5,90	6,00	7,00	6,20	6,20	6,30	6,30	6,20	6,18
June 2014	2014-06	5,90	6,30	5,80	6,10	5,80	5,80	5,80	5,80	5,50	5,90	6,60	6,00	6,10	6,00	6,00	6,00	5,96
July 2014	2014-07	6,10	6,60	6,50	6,40	5,80	5,90	5,90	6,10	6,20	6,00	7,00	6,50	6,50	6,30	6,40	6,00	6,26
August 2014	2014-08	5,80	6,00	5,80	5,90	5,70	5,90	5,90	6,00	5,60	5,70	6,70	6,10	6,20	6,20	6,00	5,90	5,96
September 2014	2014-09	6,30	6,70	6,60	6,30	5,90	5,80	5,90	6,60	6,20	6,00	7,00	6,40	6,50	6,40	6,20	6,10	6,31
October 2014	2014-10	7,30	7,70	7,70	7,60	7,10	7,20	7,30	7,30	7,30	7,30	8,20	7,50	7,60	7,60	7,60	7,50	7,49
November 2014	2014-11	7,40	7,60	7,40	7,30	6,50	6,90	6,90	7,20	7,20	7,30	8,20	7,50	7,30	7,50	7,40	7,20	7,30
December 2014	2014-12	7,80	7,90	7,60	7,80	7,50	7,70	7,70	7,60	7,30	7,50	8,50	7,80	7,90	8,10	7,60	7,60	7,74
January 2015	2015-01	9,00	9,10	8,80	9,00	8,60	8,80	8,10	8,80	8,40	8,60	9,80	9,00	8,90	9,30	8,80	8,90	8,87
February 02 015	2015-02	7,10	7,00	6,90	6,90	6,50	6,80	6,80	6,90	6,50	6,80	7,70	7,10	6,90	7,20	7,00	6,90	6,94
March 2015	2015-03	7,60	7,60	7,70	7,50	7,00	7,10	7,20	7,30	7,10	7,30	8,20	7,50	7,50	7,80	7,50	7,40	7,46
April 2015	2015-04	7,50	8,00	7,70	7,90	7,50	7,60	7,60	7,60	7,10	7,50	8,40	7,70	7,80	8,00	7,50	7,60	7,69
May 2015	2015-05	6,20	6,40	6,30	6,40	5,80	5,90	6,00	6,10	4,70	6,00	6,80	6,30	6,30	6,50	6,20	6,10	6,13
June 2015	2015-06	5,30	5,30	5,20	5,40	5,00	5,10	5,20	5,20	5,00	5,30	5,80	5,50	5,40	5,50	5,40	5,20	5,30
July 2015	2015-07	6,40	6,60	6,40	6,50	6,20	6,30	6,30	6,30	6,00	6,30	7,20	6,60	6,50	6,70	6,30	6,30	6,43

Turbine	T2	T4	T5	T8	T9	T10	T11	T12	T13	T14	T20	T21	T22	T23	T24	T25	Average wind speed [m / s]
August 2015	5,40	6,20	6,40	6,00	5,60	5,60	5,80	6,10	5,80	5,70	6,60	6,10	6,10	6,10	6,00	5,90	5,96
September 2015	6,50	6,70	6,70	4,00	6,10	6,10	6,30	6,30	6,40	6,40	7,20	6,60	6,70	6,70	6,50	6,50	6,36
October 2015	6,90	7,10	7,10	6,70	6,30	6,30	6,50	6,70	6,50	6,60	7,60	6,80	6,70	6,50	6,60	6,60	6,72
November 2015	7,90	8,10	7,80	8,20	7,70	8,00	8,00	8,00	7,60	7,70	8,80	8,00	8,10	8,40	8,00	7,90	8,01
December 2015	8,70	8,90	8,60	9,00	8,60	8,80	8,70	8,80	8,10	8,40	9,90	8,80	9,00	9,20	8,70	8,70	8,81
January 2016	6,98	7,29	7,15	7,15	6,53	6,89	7,01	7,11	6,80	6,97	7,90	7,23	7,21	7,19	6,92	6,86	7,07
February 2016	8,41	8,60	8,62	8,44	7,77	8,06	8,14	8,14	7,59	8,01	9,23	8,42	8,44	8,89	8,38	8,20	8,33
March 2016	6,11	6,46	6,48	6,21	5,71	5,93	6,00	6,05	5,92	5,99	6,83	6,30	6,11	6,45	6,21	6,05	6,18
April 2016	6,39	6,52	6,39	6,36	5,89	6,09	6,19	6,28	6,12	6,14	7,04	6,58	6,41	6,55	6,31	6,22	6,34
May 2016	5,14	5,65	5,49	5,46	5,21	5,23	5,24	5,40	5,30	5,13	5,97	5,53	5,50	5,42	5,44	5,29	5,40
June 2016	5,51	5,83	5,57	5,77	5,30	5,20	5,47	5,47	5,35	5,58	6,12	5,68	5,61	5,93	5,80	5,55	5,61
July 2016	5,26	5,60	5,43	5,64	5,26	5,35	5,35	5,35	5,18	5,40	6,04	5,63	5,60	5,70	5,50	5,43	5,48
August 2016	5,91	6,09	6,07	5,97	5,87	5,99	6,05	6,01	5,64	6,01	6,82	6,19	6,29	6,47	6,11	6,01	6,09
September 2016	5,04	5,33	5,03	5,21	4,98	4,93	5,00	5,12	4,79	4,91	5,73	5,25	5,19	5,24	4,64	5,02	5,09
October 2016	8,38	8,78	8,95	8,41	7,72	7,87	7,86	8,18	8,14	8,18	9,25	8,30	8,31	8,65	8,37	8,08	8,34
November 2016	8,05	8,45	8,17	8,36	7,59	7,91	7,67	8,15	7,68	7,90	8,88	8,04	8,11	8,72	8,16	8,01	8,12
December 2016	7,85	8,21	8,04	8,22	7,80	7,92	7,93	8,01	7,23	7,28	8,87	8,03	7,85	8,17	7,74	7,75	7,93
Together	6,89	7,15	7,03	6,96	6,55	6,70	6,73	6,86	6,57	6,72	7,62	7,04	7,02	7,13	6,91	6,83	6,92

Source: author's own work based on company materials [2017].

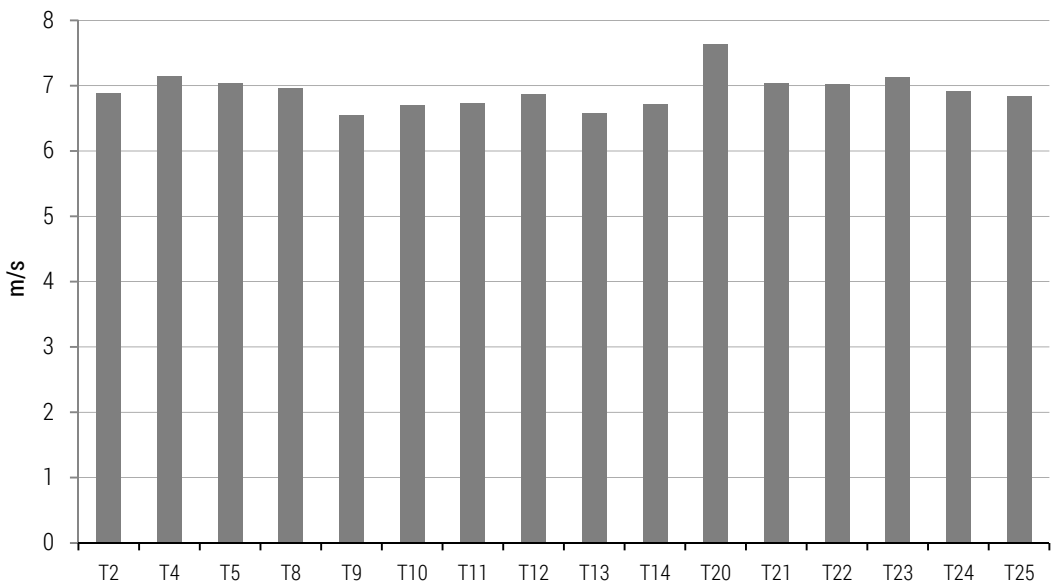


Figure 6. Average wind speed measured in different turbines in 2014-2016

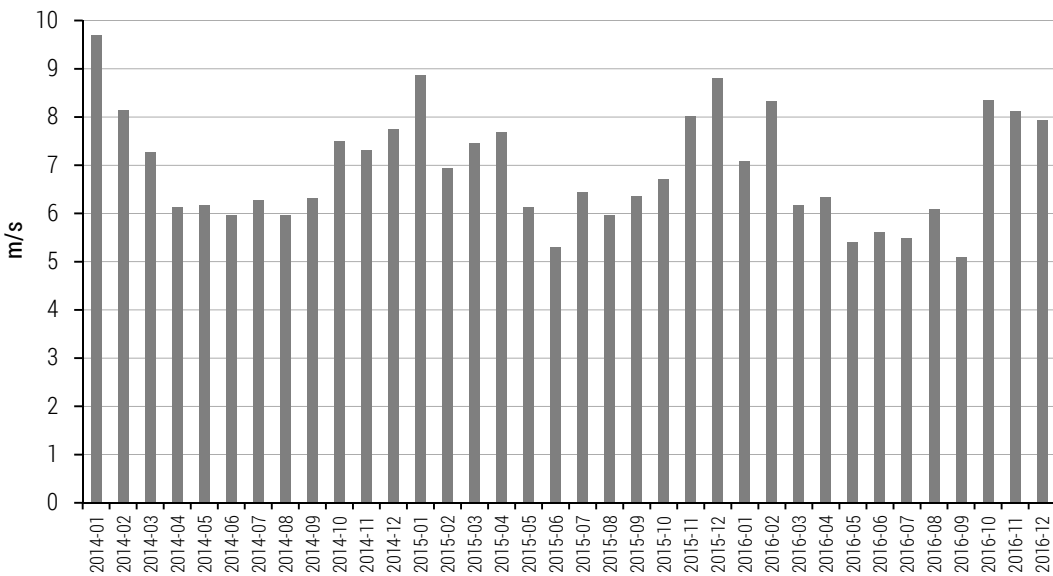


Figure 7. Average monthly wind speed in 2014-2016

Average annual wind speed in 2014-2016:

- 2014 – 7.04 m/s,
- 2015 – 7.06 m/s,
- 2016 – 6.67 m/s.

The data presented in table 2 indicate that average wind speed was 6.92 m/s in 2014-2016. In every analyzed year, wind speeds were higher in fall and winter months, which increased the wind farm's energy output in these seasons. In spring and summer months, winds were generally weaker, but sufficient for energy generation. The highest average wind speeds of 9.7 m/s and 8.9 m/s were noted in January 2014 and January 2015, respectively. In 2016, the highest wind speed of 8.3 m/s was noted in October and February. Average wind speed in the analyzed farm ranged from 6.8 m/s to 8.2 m/s, which is a highly satisfactory result. The Region of Warmia and Mazury is characterized by high wind speeds, and it belongs to the first energy zone according to the classification system of the Polish Institute of Meteorology and Water Management. The least windy months in the analyzed period were June (6.0 m/s and 5.3 m/s), August (6.0 m/s) and September (5.09 m/s).

The highest wind speed was registered by turbine T20 which is situated remotely from the remaining turbines in the wind farm. Turbine T20 is surrounded by empty space, and it is separated by a considerable distance from a forest. Somewhat lower wind speeds were registered by turbines 21, 22, 23, 24 and 25. These turbines are situated practically along the same line, they are surrounded by a forest on one side and by farm fields and pastures on the other side.

The remaining turbines are more clustered, and they occupy an area with variations in altitude. They are not situated in the vicinity of a forest, and they are surrounded by farm fields. The only exception is turbine T2 which is set in close proximity to trees.



Figure 8. Distribution of turbines in the Wronki wind farm. From the left: turbines T8, T4 and T5

Source: <http://goldap.wm.pl>.

Table 3. Turbine availability in the Wronki wind farm in 2014-2016 [%]

Turbine	T02	T04	T05	T08	T09	T10	T11	T12	T13	T14	T20	T21	T22	T23	T24	T25	Together
January 2014	99,9%	99,3%	98,0%	99,9%	99,5%	99,1%	99,9%	99,9%	100,0%	99,9%	99,7%	99,9%	99,9%	99,9%	98,2%	99,3%	99,5%
February 2014	99,9%	99,7%	100,0%	90,2%	99,7%	99,6%	99,4%	96,9%	99,3%	99,9%	67,3%	100,0%	100,0%	99,9%	99,7%	99,7%	96,9%
March 2014	99,9%	99,5%	97,3%	99,0%	99,7%	99,5%	96,6%	99,9%	99,9%	95,8%	99,9%	99,9%	99,9%	99,9%	99,9%	99,9%	99,1%
April 2014	100,0%	99,9%	99,9%	98,3%	99,7%	99,9%	100,0%	99,4%	99,3%	99,7%	99,9%	99,9%	99,9%	100,0%	98,9%	100,0%	99,7%
May 2014	100,0%	99,9%	97,1%	98,6%	99,7%	100,0%	99,5%	99,9%	99,9%	99,5%	99,7%	97,9%	99,7%	99,4%	99,6%	99,5%	99,4%
June 2014	99,7%	97,5%	100,0%	99,7%	98,9%	99,7%	98,6%	99,1%	99,6%	99,9%	99,9%	95,1%	99,7%	99,0%	100,0%	99,6%	99,1%
July 2014	98,8%	99,9%	99,8%	99,6%	99,9%	99,7%	97,0%	99,9%	99,5%	99,3%	99,5%	99,6%	99,9%	95,9%	99,7%	99,5%	99,2%
August 2014	99,7%	100,0%	99,9%	97,9%	99,5%	99,6%	99,6%	99,9%	99,9%	99,9%	99,9%	99,7%	100,0%	98,9%	99,5%	98,5%	99,5%
September 2014	99,9%	99,9%	100,0%	99,7%	99,9%	92,3%	98,2%	99,9%	100,0%	100,0%	99,7%	99,1%	99,9%	99,6%	99,9%	98,1%	99,1%
October 2014	82,1%	97,4%	99,9%	99,7%	100,0%	98,5%	99,9%	93,5%	100,0%	100,0%	97,5%	97,7%	99,9%	99,9%	99,9%	99,7%	97,8%
November 2014	100,0%	99,4%	99,9%	99,9%	99,9%	97,3%	99,9%	99,9%	99,7%	99,9%	99,9%	99,6%	99,9%	99,7%	99,9%	99,9%	99,6%
December 2014	100,0%	100,0%	99,9%	100,0%	99,6%	100,0%	98,5%	87,3%	100,0%	99,9%	100,0%	99,9%	99,7%	99,9%	88,8%	99,9%	98,3%
January 2015	99,9%	99,7%	99,2%	99,9%	99,2%	99,9%	99,9%	99,9%	99,9%	99,9%	99,9%	99,9%	99,5%	93,3%	93,8%	99,9%	99,0%
February 02 015	100,0%	100,0%	99,9%	99,9%	99,7%	99,9%	99,9%	99,4%	99,9%	97,7%	99,8%	100,0%	99,7%	99,9%	99,9%	100,0%	99,7%
March 2015	98,1%	99,9%	99,7%	99,7%	100,0%	99,9%	100,0%	99,9%	97,1%	100,0%	99,9%	97,1%	99,5%	100,0%	99,9%	100,0%	99,4%
April 2015	100,0%	99,9%	100,0%	99,7%	99,9%	100,0%	100,0%	99,7%	99,9%	100,0%	99,9%	100,0%	99,2%	100,0%	100,0%	99,9%	99,9%
May 2015	99,1%	99,6%	99,9%	99,7%	99,9%	99,9%	100,0%	99,7%	99,5%	99,7%	99,9%	100,0%	99,7%	99,6%	99,9%	99,6%	99,7%
June 2015	99,4%	96,1%	99,7%	96,3%	99,4%	99,5%	99,5%	99,4%	95,3%	97,3%	99,7%	99,9%	96,6%	95,7%	99,4%	96,5%	98,1%
July 2015	99,9%	99,9%	99,9%	99,6%	99,9%	99,7%	97,7%	99,9%	99,7%	95,7%	96,7%	99,7%	93,8%	99,7%	98,8%	94,8%	98,5%
August 2015	89,6%	98,0%	99,7%	93,0%	99,7%	98,7%	96,6%	98,8%	99,7%	99,2%	100,0%	99,1%	99,0%	99,5%	99,5%	99,9%	98,1%

Turbine	T02	T04	T05	T08	T09	T10	T11	T12	T13	T14	T20	T21	T22	T23	T24	T25	Together
September 2015	99,4%	99,6%	99,6%	90,5%	99,4%	99,4%	99,4%	97,1%	99,9%	92,7%	99,4%	99,6%	99,6%	99,3%	77,1%	99,7%	97,0%
October 2015	99,7%	99,9%	98,5%	99,2%	99,5%	99,7%	99,7%	100,0%	98,4%	99,9%	99,9%	98,9%	99,9%	99,9%	99,9%	99,1%	99,5%
November 2015	100,0%	99,9%	99,7%	99,7%	99,6%	99,9%	100,0%	97,1%	99,9%	99,9%	99,9%	99,4%	100,0%	99,9%	93,0%	99,6%	99,2%
December 2015	99,9%	99,9%	99,9%	100,0%	100,0%	100,0%	99,9%	99,9%	99,9%	99,9%	99,9%	100,0%	99,9%	99,9%	99,6%	99,7%	99,9%
January 2016	97,4%	99,7%	100,0%	95,0%	93,5%	99,9%	99,4%	100,0%	99,9%	99,9%	100,0%	100,0%	99,9%	98,5%	95,9%	97,5%	98,5%
February 2016	100,0%	99,9%	99,9%	10,0%	10,0%	99,9%	99,9%	99,9%	99,9%	10,0%	100,0%	99,6%	100,0%	100,0%	100,0%	99,9%	83,0%
March 2016	100,0%	99,6%	100,0%	99,9%	99,9%	99,6%	99,9%	1,0%	100,0%	100,0%	100,0%	99,9%	98,9%	99,7%	99,9%	99,9%	93,6%
April 2016	99,9%	100,0%	99,9%	99,7%	97,3%	100,0%	100,0%	99,9%	99,4%	98,2%	99,9%	99,0%	96,1%	100,0%	97,5%	99,7%	99,2%
May 2016	99,9%	99,6%	99,9%	99,9%	99,5%	99,9%	1,0%	100,0%	99,9%	100,0%	100,0%	98,6%	97,8%	98,2%	99,9%	97,3%	87,6%
June 2016	99,6%	99,6%	98,5%	99,9%	99,7%	100,0%	99,6%	99,9%	95,1%	99,9%	99,6%	92,2%	98,8%	99,4%	99,6%	99,6%	98,8%
July 2016	9,6%	100,0%	99,7%	99,7%	99,6%	99,9%	98,8%	99,7%	100,0%	99,0%	99,6%	99,6%	99,7%	99,7%	9,9%	99,7%	88,4%
August 2016	98,9%	99,2%	99,9%	99,6%	99,7%	99,7%	98,9%	10,0%	99,6%	88,4%	99,5%	10,0%	100,0%	99,7%	10,0%	98,4%	82,0%
September 2016	99,9%	99,7%	97,5%	99,9%	100,0%	99,7%	99,9%	99,7%	100,0%	100,0%	99,7%	99,6%	99,6%	99,9%	99,7%	99,4%	99,6%
October 2016	99,9%	10,0%	99,7%	99,9%	99,9%	99,9%	99,7%	99,9%	99,9%	100,0%	10,0%	10,0%	99,7%	97,8%	100,0%	97,7%	82,7%
November 2016	98,7%	99,9%	1,0%	100,0%	96,9%	100,0%	99,6%	99,9%	100,0%	99,7%	99,9%	99,7%	99,6%	99,6%	99,7%	100,0%	93,4%
December 2016	99,9%	97,3%	10,0%	99,7%	99,1%	100,0%	10,0%	100,0%	99,7%	10,0%	99,9%	99,7%	96,9%	10,0%	100,0%	99,9%	77,0%
Together	96,3%	96,9%	94,2%	96,2%	96,9%	96,9%	94,1%	93,8%	99,4%	93,9%	96,3%	94,2%	99,2%	96,7%	93,2%	99,2%	96,1%

Source: author's own work based on company materials [2017].

Turbine availability in the Wronki wind farm in 2014-2016

Turbine availability in the analyzed period is presented in table 3. The availability of every turbine was expressed in percentage terms [%] as the amount of time when the turbine was able to produce electricity during the analyzed period (2014-2016).

The availability of each turbine in the analyzed wind farm in 2014-2016 is presented in figure 9.

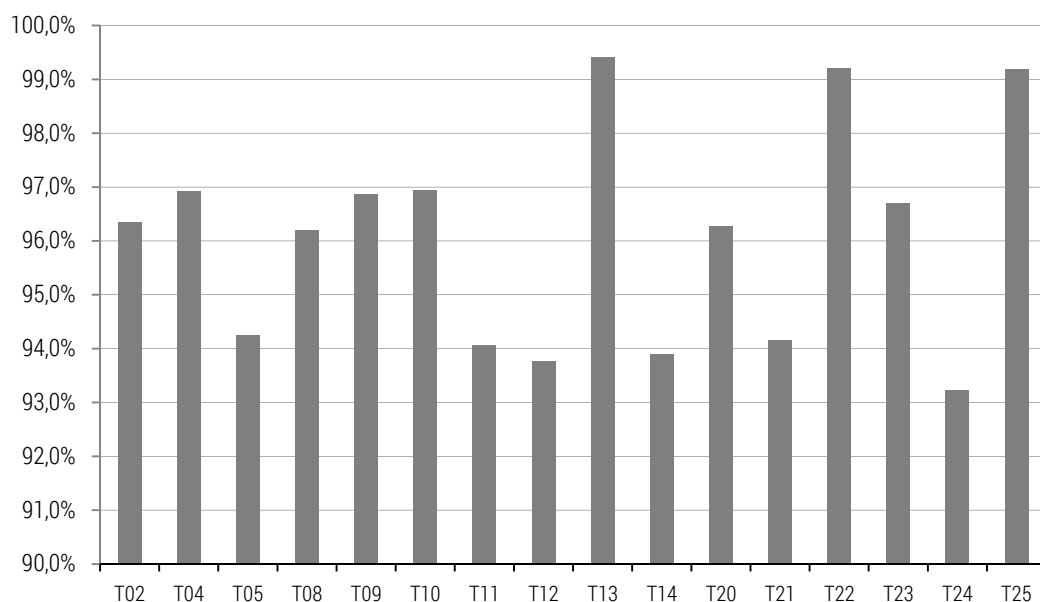


Figure 9. Average turbine availability in 2014-2016

Average annual turbine availability in 2014-2016:

- 2014 – 98.9%,
- 2015 – 99.0%,
- 2016 – 90.3%.

Turbine availability is the amount of time that a turbine is able to produce electricity over a certain period. Regardless of wind speed, a turbine's status is set to RUN when the turbine is in operation or is waiting for cut-in wind speed. A turbine's operating time and availability decreases every time it is shut down for repair, inspection or maintenance.

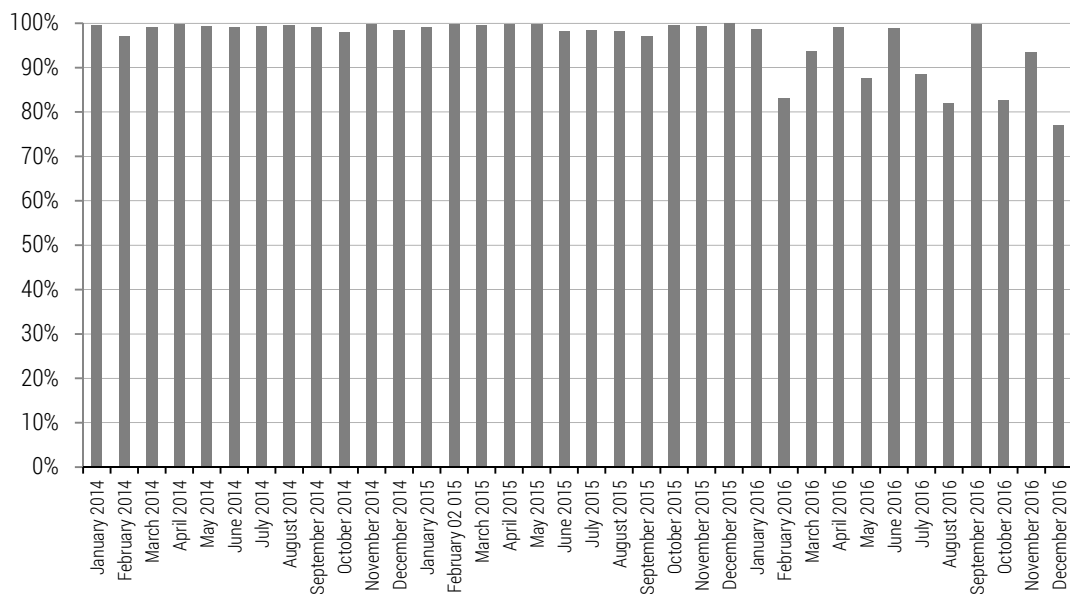


Figure 10. Average monthly turbine availability in 2014-2016

In the analyzed wind farm, turbine availability approximated 100% on numerous occasions during the examined period. The lowest availability was noted when a turbine was shut down due to a failure of a critical component. The replacement required specialist equipment, trained personnel and cranes. The operation was prolonged due to strong winds and severe winter weather, which significantly decreased the turbine's availability in that month.

Economic performance

According to the Polish Power Exchange, the average price of 1 MWh of electricity was PLN 184.94 in 2014, PLN 158.97 in 2015 and PLN 169.70 in 2016. The average price of 1 MWh of electricity in 2014-2016 was PLN 171.20 (<https://www.tge.pl>). In 2014-2016, the Wronki wind farm generated 334,091 MWh of electricity, therefore, the value of production for the analyzed period based on the average annual price of PLN 171.20/MWh was PLN 57,196,379. The value of green certificates was not included in the above calculations because their price varies. The current price is around PLN 50 per 1 MWh, and it marks a nearly 80% decrease from 2014 when the prices of green certificates peaked at around PLN 250 per 1 MWh. In 2014-2016,

the highest income of PLN 2,908,971.32 was achieved by turbine WTG20 ID 32487, and the lowest income of PLN 2,347,802.03 – by turbine WTG8 ID 32488.

Environmental impact

Unlike conventional power plants which emit considerable amounts of pollutants such as CO₂, SO₂, NO_x, CO and dust, wind farms generate clean energy and do not pollute the environment. Pollution emissions from coal-fired power plants in 2014 based on the data of the National Center for Emissions Management are presented in table 4. The above data were used to calculate pollutant emissions associated with the generation of equivalent amounts of energy in a conventional coal-fired plant.

Table 4. The amount of pollutants that would have been generated in the production of 334,091 MWh of electricity in a conventional power plant

Type of pollution		CO ₂	SO ₂	NO _x	CO	Dust
Emissions from conventional power plants	kg/MWh	831.500	1.572	1.049	0.235	0.064
Emissions avoided by the wind farm	Mg	277,7967	525.2	350.5	78.1	21.3

Source: author's own work [10-10-2017].

The data in table 4 indicate that significant amounts of CO₂, SO₂, NO_x, CO and dust emissions were avoided by the Wronki wind farm during the generation of 334,091 MWh of electricity in the analyzed period.

Conclusions

In 2014-2016, the Wronki wind farm generated 334,091 MWh of electricity, and its total revenue was calculated at PLN 57,196,379 based on the average price of electricity of PLN 171.20/MWh. Average wind speed was 6.92 m/s in the analyzed period. High average wind speeds in the evaluated wind farm confirm that the Region of Warmia and Mazury belongs to the first energy zone according to the classification system of the Polish Institute of Meteorology and Water Management. In 2014-2016, turbine T20 was characterized by the highest energy output of 22,948.8 MWh, and turbine T13 – by the lowest energy output of 19,511.0 MWh. The energy output of turbines in the Wronki wind farm was relatively similar, and the output of individual

turbines did not deviate from the mean value of 20,880.7 MWh by more than 10%. Considerable variations in average wind speed and energy output were noted on a monthly basis. The highest wind speeds were observed between November and March, and the lowest wind speeds were recorded between May and August.

Wind farms significantly reduce pollutant emissions which are associated with the generation of equivalent amounts of energy in conventional coal-fired plants. Wind power is a renewable resource that is widely available and not confined to international trade agreements.

The article presents the data collected on the Wronka wind farm in the years 2014-2016 and analyzes the amount of energy produced by individual turbines depending on wind speed and turbine availability. This made it possible to estimate the economic benefits associated with electricity production. A comparison of pollutant emissions on a wind farm and a conventional power plant has been presented. This data may help potential investors to analyze the profitability of wind farms in long-time period.

Literature

- Boczar T. (2010), *Wykorzystanie energii wiatru*, Gliwice
- Flaga A. (2008), *Inżynieria wiatrowa. Podstawy i zastosowania*, Warszawa
- Lewandowski W.M. (2006), *Proekologiczne odnawialne źródła energii*, Warszawa
- Lubośny Z. (2017), *Farmy wiatrowe w systemie elektroenergetycznym*, Warszawa
- Farm Wronki 2017 – company materials, Tyszlak R.
- <http://goldap.wm.pl/Park-wiatrakowwe-Wronkach-i-Jablonskich,43383> [15-10-2017]
- <http://in-ventus.com/content/go%C5%82dap/> [15-10-2017]
- http://www.kobize.pl/uploads/materialy/materialy_do_pobrania/wskazniki_emisyjnosci/16061_WSKAŻNIKI_zanieczyszczenia.pdf / [15-10-2017]
- <https://www.tge.pl/> [15-10-2017]
- <https://www.vestas.com/>[15-10-2017]
- <https://vortex-energy-group.com/pl/portfolio-galleries/park-wiatrowy-goldapi-wronki/> [15-10-2017]



Tomasz HERODOWICZ

THE SPATIAL DIFFERENTIATION OF THE INTERVENTION OF THE REGIONAL POLICY OF THE EU SUPPORTING PRO-ENVIRONMENTAL ECONOMIC CHANGES IN POLAND

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ABSTRACT: The goal of this article is to identify the environmental economic changes supported as part of the intervention of the regional policy of the EU and to identify the regional differentiation of employing the relevant funds. In the research, relative data was used from the System of Monitoring and Financial Control of Structural Funds and Cohesion Funds SIMIK 07-13. The research results indicate a wide range of the regional policy's impact on the environment-oriented economic changes including increase in energy effectiveness, the development of renewable sources of energy, the development of rail and water transport as well as local public transport and bicycle traffic, a more rational use of water resources, enhanced protection from adverse effects of the element of water, the development of recycling, restoration of degraded land and improvement of biodiversity protection. The regional differences in the value of the related support resulted from two types of conditions: the level of anthropogenic impact and the specific environmental conditions.

KEY WORDS: sustainable development, EU regional policy, environmental intervention

Introduction

The major goal of the regional policy of the EU is to stimulate social, economic and territorial cohesion in all of Europe's regions. This is reflected in the way of allocating structural funds: a majority of them is channelled to relatively least developed regions which included Polish provinces. Since 2004, the financial support from the regional policy of the EU has affected investments in Poland, offering more opportunities to satisfy the domestic and regional environmental needs also related to the development of rural areas in line with the concept of the integrated development of agriculture and the country (Kozak, 2014; Kutkowska and Pilawka, 2016; Kołodziejczak 2017). The regional policy is among the fundamental EU investment policies. It represents approximately 30% of the EU budget and as such, it can be viewed as an important financial instrument supporting positive social and economic changes. They are also related to implementing the concept of sustainable development according to which the spatial diversity of the intervention of the regional policy of the EU should be conditioned by the scale and type of regional and local developmental needs¹.

The content-related focus of the regional policy of the EU is stipulated in the Community's strategic documents referring to the requirement of laying the foundations for sustainable development. At present, it is among the developmental priorities for the entire European Union, strongly emphasized in the Europe 2020 Strategy (2010). There, sustainable development is identified with supporting an economy that draws on the resources more effectively, is more environmentally-friendly and more competitive. The postulated related activities include environmental changes to areas of economic activities which are of key importance to the natural environment and include energetics, transport, water management, waste management and environmental protection (Minorski, 1977; Clini et al., 2008; Trzepacz, 2012; Revell, 2013; Ryszawska, 2013).

The goal of this article is to identify the environmental-oriented economic changes supported as part of intervention of the regional policy of the EU and to identify the diversity in employing the related funds. What is more, in the article, an attempt has been made to determine the conditioning behind the spatial differentiation of employing environmental intervention within the regional policy of the EU. Is it related to the specific environmental conditioning in a region or perhaps the level of anthropogenic impact?

¹ In accordance with the resolution adopted by the United Nations General Assembly on 25.09.2015 "Transforming our world: the 2030 agenda for sustainable development" (A/RES/70/1).

Areas of economic activity of key importance to the natural environment and changes thereof

The environmental intervention of the regional policy of the EU is based on the assumptions of sustainable development which highlights the importance of desirable relations between the economy and the natural environment in a way ensuring lasting social and economic development (Constanza et al., 1991; Rogall 2009; Górka, Łuszczczyk, 2014). A question arises what *desirable* relations means. In order to answer this question, we should identify the nature of the economy's impact on the natural environment. Since the beginning of human development, man has drawn on natural resources to satisfy his needs. As the population grew and civilization spread, this process intensified until it assumed a form of over-exploitation, destroying animals, microorganisms and plants (Janik, Krawczyk, 1982). When human activity was too much of an encumbrance to the natural environment, eco-systemic functions were disturbed, resulting in environmental problems (Mizgajski, 2010; Herodowicz, 2016). Therefore, *desirable* relations between the economy and the natural environment should indicate necessary changes to economic activity in order to limit environmental problems.

Table 1. Areas of economic activity of key importance to the natural environment and its environment-related changes

Area	Environment-oriented changes
Energetics	increase in energy effectiveness
	development of renewable sources of energy
Transport	development of rail transport
	development of water transport
	development of local public transport and bicycle traffic
Water management	more rational use of water resources
	enhanced protection from adverse effects of the element of water
Waste management	development of recycling
	restoration of degraded land
Environmental protection	improvement of biodiversity protection

Source: author's own work.

The instrument intended to support these changes is the regional policy of the EU whose focus is stipulated in the related documents² and which includes certain changes to areas of economic activity of key importance to the natural environment (table 1).

The first environment-oriented change to energetics: **increase in energy effectiveness**, indicates increased effectiveness in producing, transferring and using energy. To this end, ventures have been initiated including (Karaczun et al., 2008), among other things, construction/reconstruction of entities producing simultaneously energy and heat (the so-called cogeneration), construction/reconstruction of the distribution networks of power and heat, thermal upgrading of buildings and conversion from fuel combustion installations to environmentally friendly solutions. The other change identified in energetics is **development of renewable sources of energy**. In this respect, investments should include new entities producing renewable energy, producing biofuels or construction of technological lines to manufacture devices used in renewable energetics.

As for transport, an important source of air pollution (Costabile, Allegrini, 2008), environmental changes include support for forms of transport alternative to road transport. One of them is **rail transport** where the efforts are focused on constructing and upgrading railroads and railway stations coupled with purchases and overhaul of the rolling stock. Another, relatively environmentally friendly form of transport is **water transport**, the development of which is supported by enhancing access to sea ports and improving the quality of the port infrastructure as well as upgrading inland waterways and inland navigation equipment. The last reviewed change to transport is **development of local public transport and bicycle traffic** which should comprise creation of new transport connections, more intense transport of passengers as well as investment in municipal transport vehicles.

Environmentally friendly changes to water management are primarily related to **a more rational use of water resources**. This notion includes on one hand efforts aimed at limiting discharges of compounds of nitrogen and phosphorus, predominantly from industrial and municipal wastewater (Mikulski, 1998) and on the other hand sparing water resources by entrepreneurs and households. The related investments should focus on developing systems of sanitary sewage and upgrading sewage treatments. Another change identified as part of water management is **enhanced protection from adverse effects of the element of water** interpreted as protection from the threat of flood (investment in protective infrastructure) combined

² Community Support Framework (2003), Community Strategic Guidelines (2006), Common Strategic Framework (2012).

with preventing negative effects of droughts (enhanced retention of water resources).

As part of waste management, two environmental changes have been identified: **developing recycling** which is the basis for reorienting waste management as postulated by H. Rogall (2009) consisting in prevention of waste production and in reuse of waste rather than simple neutralisation and elimination of excessive waste. Another identified environmental change to waste management is **restoration of degraded land** including restoration of the use value and natural values to dormant landfills.

Environmental protection is the only considered areas of economic activity which in itself does not pose environmental problems. Its role is to prevent and limit decreases in biodiversity resulting from another type of human activity. **Improvement of biodiversity protection** is to demonstrate itself in maintaining biological diversity owing to protection of all wild plants, animals and fungi as well as all natural habitats (Symonides, 2014).

Research methods

The analysis covers the years of 2004 to 2015 while the spatial range includes 16 Polish provinces. The research was divided into two major stages: the first one was based on an analysis of literature on the subject and the strategic and programme-related documents pertaining to the environmental intervention of the regional policy of the EU. The major effect of this stage was systemization and identification of the major environmental changes to economic activities of key importance to the natural environment. Stage two, an empirical one, resulted in identifying the regional differentiation of the intervention of the regional policy of the EU. To this end, on the basis of data published by the Ministry of Economic Development and obtained from the System of Monitoring and Financial Control of Structural Funds and Cohesion Funds SIMIK 07-13, the value was established of the regional policy of the EU funds employed in the process of stimulating environmental economic changes in Poland. The identification of the regional conditioning of the environmental intervention of the regional policy of the EU was based on an analysis of the intensity indicators reflecting the value of the per capita funds allocated to a specific region. What is more, a typology has also been developed for the provinces with respect to the intensity of using the EU support. To this end, the researched units were allocated weighting which reflects the ranges of the value of intervention as part of each environmental transformation. The sum of the weighting allowed to indicate regions with high, average and low intensity of using the environmental intervention of the regional policy of the EU.

The regional diversity of environmental intervention of the EU regional policy

The characteristics of the regional diversity of the environmental intervention of the regional policy of the EU were identified as part of a system of environmental changes to economic activity. At this stage, the obtained EU funds were used as part of specific change against the number of a region's inhabitants.

More than 160 billion Polish zlotys i.e. approximately 30% of all the funds allocated to Poland in 2004-2015, were earmarked for projects implemented as part of the environmental intervention of the regional policy of the EU. This amounts to more than PLN 4,200 per capita of total project value and almost PLN 2,300 per capita of UE funding. The funds allocated directly from the EU budget represented on average 54% of the total project value. The biggest EU funds exceeding PLN 2,000 per capita were enjoyed in five provinces: Lower Silesian, Łódź, Masovian, Pomeranian and West Pomeranian (figure 1).

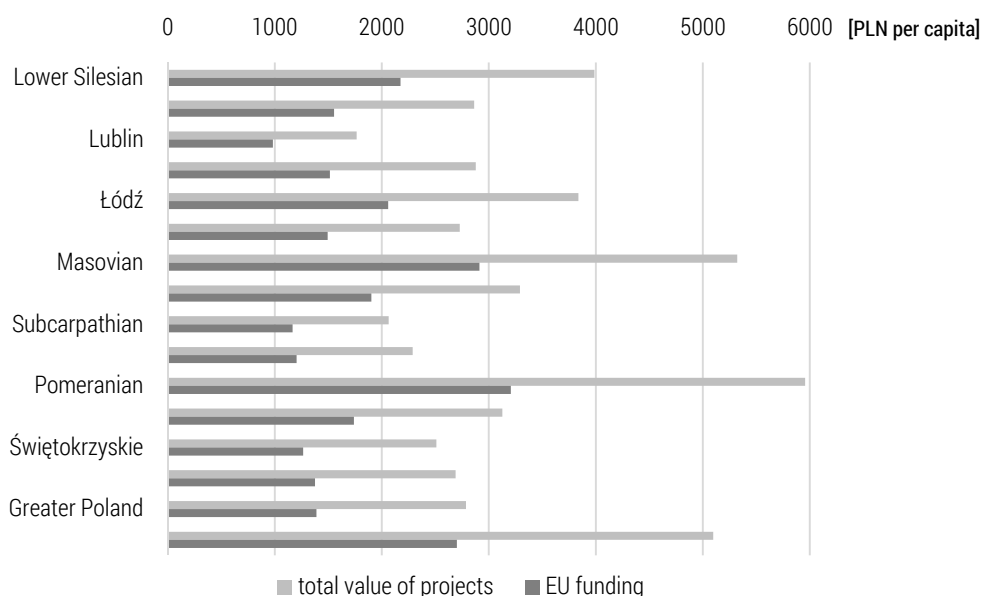


Figure 1. Per capita value of the environmental intervention of the regional policy of the EU in Polish provinces in 2004-2015

Source: author's own work based on data from the System of Monitoring and Financial Control of Structural Funds and Cohesion Funds SIMIK 07-13.

Pomeranian and Masovian provinces were special cases where exceptionally large per capita funds were allocated for environmental intervention. It resulted from stepping up huge investments related to the enhancement of accessibility to the Gdańsk sea port (PLN 1.4 billion) and the development of the Pomeranian Metropolitan Railway (PLN 1.1 billion) in Pomeranian province. On the other hand, in Masovia PLN 6 billion were allocated to the country's biggest self-governed project, namely construction of line 2 of the Warsaw metro. In the other provinces, the per capita value of EU funds exceeded PLN 1,000 with the exception of Lublin province where the value was slightly lower (figure 1).

On the one hand, an analysis of the regional diversity of the environmental intervention of the regional policy of the EU in a system of identified environmental changes to economic activity indicates transformations accompanied by relatively high dispersion (e.g. the development of local public transport or a more rational use of water resources). On the other hand, there are changes indicating trends for a relatively strong concentration (e.g. the development of water transport or enhanced protection from adverse effects of the element of water (figure 2)). This situation seemed to result from two types of conditions: in the case of fairly dispersed changes, the value of environmental intervention was conditioned by population density and the intensity of economic activity. However, the intervention as part of changes relatively strongly concentrated in selected provinces was conditioned by specific features of the natural environment, e.g. access to the seashore or a province's hydrological conditions.

Increase in energy effectiveness can be identified as a dispersive change conditioned by the level of anthropogenic impact. The most intensive EU intervention exceeding PLN 125.00 per capita was enjoyed in densely populated provinces and ones hosting large power distribution plants, e.g. Silesian, Opole and West Pomeranian. The relatively generous funds earmarked for every inhabitant of Lubusz province stemmed from carrying out a relatively large-scale project of updating the heating system in Zielona Góra and a number of energy efficiency projects. Coupled with a small number of the province's inhabitants, it resulted in a high value of the analysed indicator (figure 2).

In the case of the **development of renewable energetics**, the type of change indicates tendencies to focus intervention on a specific area in the country, resulting from specific environmental conditions. The amplest EU funds (over PLN 150.00 per capita) were allocated to the north of Poland, especially West Pomeranian and Podlaskie (figure 2). They are also provinces with the best wind conditions for the development of wind energy (Wiśniewski et al., 2012) which was the major direction of the development of renewable energetics in Poland.

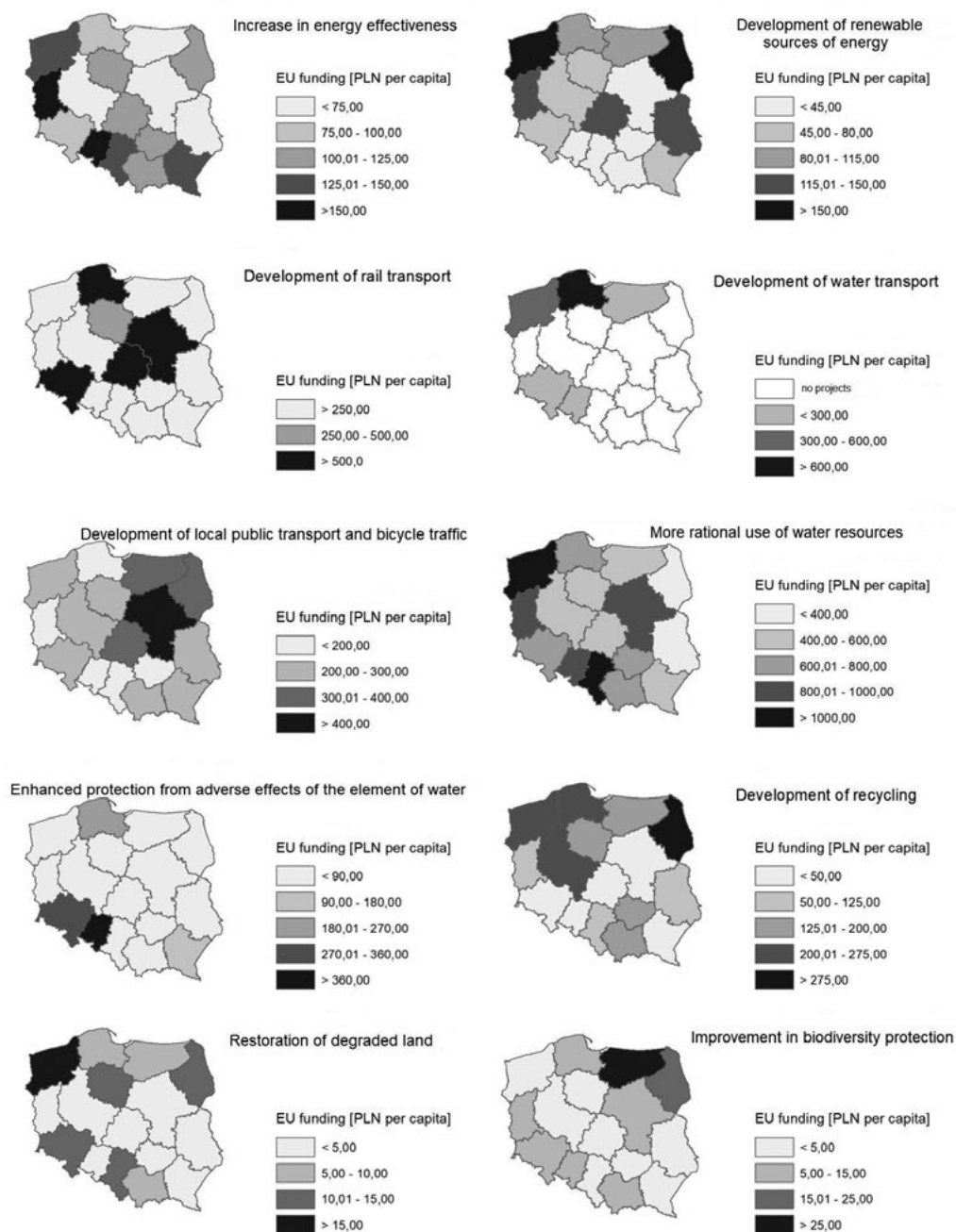


Figure 2. The diversity of the environmental intervention of the regional policy of the EU in the system of environmental changes to economic activity in Poland in 2004-2015

Source: author's own work based on data from the System of Monitoring and Financial Control of Structural Funds and Cohesion Funds SIMIK 07-13.

The environmental intervention of the regional policy of the EU in the realm of **rail transport** tended to differ from one province to another with respect to the financial support. The development of rail transport prevailed in four provinces: Masovian, Łódź, Pomeranian and Lower Silesian where more than 65% of total EU funds were allocated, obtained as part of the analysed change. Another outstanding province is Kuyavian-Pomeranian where the value of EU funds reached an unprecedented level of almost PLN 300.00per capita (figure 2). Even if in rail transport there is a clear trend for concentrating EU funds, there is no evidence of the influence of environmental conditions. The situation in question resulted from the fact that many railway projects in Poland could not be included in the analysis as their scope went beyond one province and therefore it was impossible to clearly identify their regional locations. For this reason, in the lead were provinces whose capitals were among the biggest cities in the country and as such attracted large-scale projects related to the development of agglomeration railways or restoration of traffic in railway nodes aimed at solving the problem of traffic congestion.

The environmental intervention in **water transport** was implemented only in five provinces: three seaside provinces and two located in the Oder basin (figure 2). To a large extent, it resulted from the environmental conditioning i.e. access to the sea, affecting the location of port infrastructure and access to navigable waterways, the basis of inland water transport. The non-existence of such projects in the remaining provinces can be attributed to the hydrological conditions which in a large part of the country “do not allow to enjoy the desired navigation parameters, even with huge investments involved” (Jarzębińska, 2008, p. 15).

The environmental intervention of the regional policy of the EU pertaining to the development of **local public transport and bicycle traffic** was different. The projects were carried out all over the country, with Masovian province standing out for the very high value of funds allocated to a single project i.e. construction of line 2 of the Warsaw metro. In general, the value of funds earmarked for local transport was largely related to the anthropogenic impact resulting from population density in cities. The relatively high per capita funds allocated to, among others, Podlaskie and Warmian-Masurian provinces, are related to the smaller general number of inhabitants in these provinces (figure 2).

The diversity of environmental intervention as part of **more rational use of water resources** also seemed to be more related to the level of the anthropogenic impact than to the specific environmental conditions in a specific province. The considerable per capita EU funds earmarked for Silesian

or Masovian provinces and the modest funds for Podlaskie and Lublin provinces can be attributed to population density in these provinces (figure 2).

The situation was different with respect to **enhanced protection from adverse effects of the element of water**; this is a change caused by the specific environmental conditions. In Poland, the provinces most vulnerable to flooding are located in the Oder basin and the Vistula basin as well as the depression area in Żuławy (Mioduszeński, 2012). This provided an explanation of the relatively ample funds for intervention focused on protection from adverse effects of the element of water earmarked for Lower Silesian, Opole and Pomeranian provinces (figure 2).

The development of recycling can be defined as a dispersive change which does not tend to concentrate and is theoretically conditioned by the level of anthropogenic impact related to waste production. This statement is justified for provinces like Greater Poland, West Pomerania and Pomerania which enjoyed relatively generous EU funds for development of recycling. At the same time, these provinces produce most waste per capita (Infrastruktura Komunalna..., 2013). A question arises why relatively generous intervention funds were allocated also to Podlasie province where the waste production output is rather low? On the other hand, why were limited EU funds allocated to Lower Silesian and Masovian provinces where lots of waste is produced? Perhaps the level of waste management in these provinces was high enough not to require more intervention? Or perhaps the intervention of the regional policy of the EU was accompanied by errors in spatial distribution? In order to provide answers to these questions, continued in-depth research is required.

The scale of intervention targeted at **restoration of degraded land** should also reflect the level of anthropogenic impact in the specific provinces. Projects carried out as part of the regional policy of the EU focused chiefly on restoration of dormant landfills. Relatively large EU funds were administered to the provinces in Northern and Southern Poland. A case in point is the very well channelled, restoration-related intervention in Lower Silesia and Silesia (figure 2) where the allocated funds were relatively ample and in proportion to the scale of environmental problems. Before accession to the EU, these provinces represented the largest share of total devastated land and degraded areas.

The last analysed change to economic activity was **improvement of biodiversity protection**. It is a change with a degree of concentration which may stem from a province's natural assets. The value of the intervention reached its peak in Warmian-Masurian and Podlaskie provinces, the "green lungs" of Poland. Similarly, in Lubusz province the relatively large funds allocated to the local projects can be attributed to the natural values of the prov-

ince which enjoys the highest forestation rate in the country, coupled with considerable natural assets. The country's southern provinces also stood out with their valuable mountain ecosystems.

Conclusions

In 2004-2015, the regional policy of the EU was an instrument financing activities conducive to environmental changes to economic activity in Poland, identified in this article. The major goal was to limit the negative human impact on the natural environment and, on the other hand, to protect valuable natural assets. Due to the spatial diversity of the environmental intervention of the regional policy of the EU, two major types of this intervention can be identified:

1. **Dispersive intervention**, without tendencies to concentrate in specific provinces whose value most typically resulted from the level of anthropogenic impact. This type of intervention included the following environmental changes to economic activity: increase in energy effectiveness, development of the local public transport and bicycle traffic, a more rational use of water resources, development of recycling and restoration of degraded land.
2. **Focused intervention**, indicating concentration in specific provinces which stemmed from a very strong concentration of people and economic activity as was the case of the development of rail transport. On the other hand, it resulted from specific environmental conditions which affected the scale of the intervention as part of the development of renewable energetics, development of water transport, enhanced protection from adverse effects of the element of water and improvement of biodiversity protection.

In order to synthesize the regional diversity of the environmental intervention of the regional policy of the EU in Poland, the provinces were divided into types with respect to the intensity of using EU's funds (table 2).

Therefore, provinces with high intensity of using the EU funds as part of the environmental intervention of the regional policy of the EU included Podlaskie, Pomeranian and West-Pomeranian provinces. An average intensity was recorded in Lower Silesian, Lubusz, Opole and Warmian-Masurian provinces. As for provinces with a relatively low intensity of using the EU funds, these included Kuyavian-Pomeranian, Lublin, Łódź, Lesser Poland, Masovian, Subcarpathian, Silesian, Świętokrzyskie and Greater Poland provinces. It is worth noting that the typology does not take into account the intervention on a supra-regional level as it was impossible to attribute it correctly to specific provinces. This certainly affected the intensity of using the funds allocated as part of the regional policy of the EU.

Table 2. Types of Polish provinces with respect to the intensity of using the environmental intervention of the regional policy of the EU

change province	Increase in energy effective- ness	Develop- ment of renewable sources of energy	Develop- ment of rail trans- port	Develop- ment of water transport	Develop- ment of local public transport and bicycle traffic	More rational use of water resources	Enhanced protection from adverse effects of the element of water	Develop- ment of recycling	Restoration of degraded land	Improve- ment in biodiversity protection	total
Lower Silesian	2	2	3	2	2	3	4	1	3	2	24
Kuyavian-Pomeranian	3	2	2	1	2	2	1	3	3	1	20
Lublin	1	4	1	1	2	1	1	2	1	1	15
Lubusz	5	4	1	1	1	4	1	2	1	2	22
Łódź	3	4	3	1	3	2	1	1	1	1	20
Lesser Poland	3	1	1	1	2	3	1	3	2	2	19
Masovian	1	1	3	1	4	4	1	1	1	2	19
Opole	5	1	1	2	1	4	5	1	1	2	23
Subcarpathian	4	2	1	1	2	2	2	1	1	1	17
Podlaskie	3	5	1	1	3	1	1	5	3	3	26
Pomeranian	2	3	3	4	1	3	3	4	2	2	27
Silesian	4	1	1	1	1	5	1	2	3	1	20
Świętokrzyskie	3	1	1	1	1	3	1	3	1	1	16
Warmian-Masurian	1	3	1	2	3	2	1	3	2	4	22
Greater Poland	1	2	1	1	2	2	1	4	1	1	16
West Pomeranian	4	5	1	3	2	5	1	4	4	1	30

 - high intensity (26-30 p.)  - average intensity (21-25 p.)  - low intensity (16-20 p.)

Source: author's own work.

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Literature

- Clini C., Musu I., Gullino M.L. (2008), *Sustainable Development and Environmental Management: Experiences and Case Studies*, Dordrecht
- Common Strategic Framework (2012), *Elements of common strategic frameworks for 2014-2020*, a working document of the Commission of 14 March 2012 SWD(2012) 61 final
- Community Strategic Guidelines (2006), *Council Decision 2006/702/EC of 6 October 2006 on Community strategic guidelines on cohesion*. L 291
- Constanza R., Daly H.E., Bartholomew J.A. (1991), *Goals, Agenda, and Policy Recommendations for ecological economics*, in: R. Constanza (ed.), *Ecological Economics: The science and management of sustainability*, New York, p. 1-20
- Costabile F., Allegrini I. (2008), *A new approach to link transport emissions and air quality: An intelligent transport system based on control of traffic air pollution*, "Environmental Modelling & Software" No. 23, p. 258-267
- Górka K., Łuszczuk M. (2014), „Zielona gospodarka” i gospodarka oparta na wiedzy a rozwój trwały, "Studia Ekonomiczne" No. 3(69), p. 22-31
- Herodowicz T. (2016), *Interwencja środowiskowa polityki spójności w Polsce – merytoryczne ukierunkowanie i regionalne zróżnicowanie*, "Rozwój Regionalny i Polityka Regionalna" No. 33, p. 95-116
- Infrastruktura Komunalna w 2013 r. (2014), *Informacje i opracowania statystyczne*, Warszawa
- Janik S., Krawczyk Z. (1987), *Ochrona środowiska naturalnego*, Poznań
- Jarzębińska T. (2008), *Rola polskich dróg wodnych śródlądowych w sieci europejskiej*. in: Z. Babiński (ed.), *Rewitalizacja drogi wodnej Wisła-Odra szansą dla gospodarki regionu*, Vol. 1, Bydgoszcz, p. 13-19
- Karaczun Z., Kassnberg A., Sobolewski M. (2008), *Fundusze Unii Europejskiej na lata 2007-2013 a ochrona klimatu*, Warszawa
- Kołodziejczak A. (2017), *Koncepcja zintegrowanego rozwoju rolnictwa i wsi a wiejskie obszary funkcjonalne*, "Rozwój Regionalny i Polityka Regionalna" No. 37, p. 41-49
- Kozak M.W. (2014), *10 lat polityki spójności w Polsce*, "Studia Regionalne i Lokalne" No. 4(58), p. 25-50
- Kutkowska B., Pilawka T. (2016), *Implementation of the cohesion policy in rural areas of Dolnośląskie region*, "Journal of Agribusiness and Rural Development" No. 4(42), p. 567-575
- Mikulski Z. (1998), *Gospodarka wodna*. Warszawa
- Minorski J. (1977), *Środowisko przyrodnicze a gospodarka przestrzenna*, Warszawa
- Mioduszeński W. (2012), *Zjawiska ekstremalne w przyrodzie – susze i powodzie*, in: A. Łachacz (ed.), *Wybrane problemy ochrony mokradeł*, Olsztyn, p. 57-74

- Mizgajski A. (2010), Świadczenia ekosystemów jako rozwijające się pole badawcze i aplikacyjne, "Ekonomia i Środowisko" No. 1(37), p. 10-13
- Resolution adopted by the United Nations General Assembly on 25.09.2015 "Transforming our world: the 2030 agenda for sustainable development". A/RES/70/1
- Revell K. (2013), *Promoting sustainability and pro-environmental behaviour through local government programmes: examples from London, UK*, "Journal of Integrative Environmental Sciences" No. 10:3-4, p. 199-218
- Rogall H. (2009), *Nachhaltige Ökonomie. Ökonomische Theorie und Praxis einer nachhaltigen Entwicklung*, Marburg
- Ryszawska B. (2013), *Zielona gospodarka – teoretyczne podstawy koncepcji i pomiar jej wdrażania w Unii Europejskiej*, Wrocław
- The Basis for the Community's Support (2003), A document adopted by the Council of Ministers on 23 December 2003 and approved by the European Commission on 22 June 2004
- The Europe 2020 Strategy (2010), *The Commission's Communiqué of 3 March 2010 EUROPE 2020 Strategy for intelligent and sustainable development conducive to social inclusion*, The Commission Communication, Brussels, 3.3.2010 COM (2010) 2020 final version
- Trzepacz P. (2012), *Zasady i mierniki rozwoju zrównoważonego*, in: P. Trzepacz (ed.) *Zrównoważony rozwój – wyzwania globalne Podręcznik dla uczestników studiów doktoranckich*, Kraków, p. 37-52
- Wiśniewski G., Michałowska-Knap K., Koć S. (2012), *Energetyka wiatrowa – stan aktualny i perspektywy rozwoju w Polsce*, Warszawa

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THE ROLE OF INSTRUMENTS OF THE COMMON AGRICULTURAL POLICY TO ENSURE STABILITY OF COMMERCIAL AGRICULTURAL HOLDINGS AND DEVELOPMENT OF RURAL AREAS A CASE STUDY OF OPOLE PROVINCE

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ABSTRACT: The aim of the paper is to show the role of users of commercial agricultural holdings in the development of local areas and to select instruments of the Common Agricultural Policy (CAP), which are significant in building developmental potentials of agriculture and rural areas in Opole Province. The modernization processes going on in commercial agriculture result in its de-placement. Thanks to instruments of the Common Agricultural Policy (CAP) there follows a re-rooting of agriculture in the territory. On the basis of survey research carried out in 2014 in 100 commercial agricultural holdings based in Opole Province, which were selected for the purpose, the authors present an analysis of farmers' opinions concerning different instruments of the CAP, which favor sustainable development of the country and agriculture. According to the farmers, the action "Modernization of agricultural holdings" make the priority instrument of the Program of Rural Areas Development (PRAD), while improvement of agricultural holdings' profitability has facilitated the process of their ecological modernization. The results of the research confirm the fact that farmers still make a vital developmental environment in the rural areas of Opole Region. However, the research has revealed their weak support for financing of grassroots institutions within the actions of the Program of Rural Areas Development, which can pose a barrier to implementing the paradigm of integrated territorial development.

KEY WORDS: sustainable development, integrated development management, rural areas, intervention instruments of the CAP, modernization of agricultural farms

Introduction

The policy of cohesion was launched by the Council of the European Economic Community in June 1988 (Rozporządzenie Rady (EWG) nr 2052/88). It was then when it was decided that the policy should be financed with means coming from structural funds, that is sections of orientation of the European Agriculture Guidance and Guarantee Fund (EAGGF), the European Social Fund (ESF), the European Regional Development Fund (ERDF), and beginning in 1993 – also those from the separately founded Cohesion Fund. Establishing the cohesion policy in this form as well as including it in the realization of sections of guidance of the EAGGF gave rise to a shift of the Common Agricultural Policy (CAP) from individual branch policy to territorial one¹. This process was supported with scientific studies and experts' reports concerning evaluation of effects of implementing instruments of the Program of Rural Areas Development (PRAD) in regions of the United Europe (Westhoek et al., 2012)². In connection with the more and more extensive knowledge on the structure-generating mechanisms of network economy and information society, they allowed formulating assumptions of the cohesion policy in a new paradigm of rural areas. The main conclusion which results from comparing the "old" and the "new" conception of the policy relates to replacing intervention subsidies with investment ones. Therefore, it offers a completely new approach to pro-equality- and pro-effect-oriented actions based on securing stability and development of natural, real, financial, human and social capitals in rural areas.

The institutional innovativeness which is meant to facilitate replacement of subsidies with investment interventions is Common Strategic Frameworks that allow integrating means from the ERDF, the SF (the Structural Funds), the ESF, the EAGGF and the EMFF (the European Maritime and Fisheries Fund) (COM (2013) 1303). On the basis of Declaration Cork 2.0 it can be expected that this paradigm of development of rural areas will be maintained and strengthened as a result of the "health examination" of the CAP. Ensuring stability of family-based agricultural holdings is the condition of restoring their significance in local development and "better life in rural areas" (Cork 2.0 2016).

As regards Poland, new institutional solutions are financially supported primarily within the Program of Rural Areas Development (PRAD) 2014-

¹ The Cork Declaration of 1996 is commonly considered to be the institutional beginning of such a transformation.

² A broad and deepened discussion of this research in both international and national cross-sections was presented in: Bańkowska, Gruda, Klimowski, 2015, p. 25-47.

2020. For this reason it is extremely significant to know farmers' opinions, as the main party interested in the policy of agriculture and rural areas, on the significance of particular actions of the PRAD for the development of agricultural farms and local areas.

Goal, subject and methodology of research

The evaluation of implementing CAP instruments in individual regions of Poland points to different effects of their influence, sometimes even opposing one another. Instead of levelling developmental standards, their implementation can lead to divergence in rural areas of Poland's regions. There follows one basic conclusion from the studies: it is necessary to regionalize instruments of support and investment interventions. The article presents selected results of multifaceted studies conducted with the use of the survey questionnaire method in purposefully selected commercial agricultural holdings, whose area of arable land exceeds 10 hectares. They are located in sub-regions that are representative of the agriculture of Opole Province and run high-intensive and medium-intensive farming. The intensity of organization of agricultural production was calculated with the use of B. Kopeć's point method that is commonly applied in studies of this type (Gołębiewska, 2010). The group of farms examined in 2014 amounted to 100 – 20 in each of the agricultural sub-regions. A relevant survey questionnaire contained questions of the quantitative and qualitative character, open and closed, including the given scale of answers. One of the specific goals of the research was to obtain the answer to the questions: (1) Do the users of these holdings form a developmental environment in their communes and (2) Do they perceive its development in a reliable way? The assumption was accepted that is it not until profitability of family-based agricultural holdings is ensured that their users are ready to see to environmental, social and institutional problems. The authors concentrate on such problems as: subjective assessment of incomes of agricultural holdings by their users, farmers' opinions on the height of incomes after Poland's accession to the European Union, identification – by this environment – of developmental problems in the gmina (commune) and their evaluation of the actions within the PRAD in the context of farmers' participation in programming local development. The aim of the article is to point to the role of users of commercial agricultural holdings in local development as well as to isolate instruments of the CAP, which are essential for building developmental potentials of agriculture and rural areas in Opole Province.

The European Model of Agriculture as the basis of sustainable development of rural areas

Family-run farming makes the foundation of the European Model of Agriculture, which is realized in the EU policy. Its assumptions were defined in Luxemburg in 2003. In contrast to the industrial farming, this is a model of multifunctional agriculture which implements principles of sustainable development (Zegar, 2012). On the other hand, contrary to the traditional one, managing such a holding requires knowledge and institutional reflectiveness, which build trust in abstraction systems, chiefly – specialist knowledge. Perceiving the space of the country from the perspective of knowledge and experience constitutes a feature that distinguishes the new approach to the solidity of development of rural areas³. Its expression is the aphorism “more knowledge per one hectare” (Buckwell, 2014). However, the most important condition behind realization of this model remains a rise in the added value to agricultural production and securing incomes to people who earn their living by farming on the level which is comparable with incomes obtained in other branches of economy.

One of the basic ways of assessing the level of incomes of farmers in the EU is founded on the measure of income from production factors counted per one person working full time. It follows from the calculations of H. Runowski (2015) that in the years 2005-2014 there occurred a real tendency of farmers' growing incomes in the EU as a whole, although since 2012 their stagnation has been noted or even a considerable drop in such countries as: Finland, Lithuania, Belgium, Italy and Denmark (ranging from 22% in the case of Finland to 10.1% in that of Denmark). As regards the newly-accepted member states, these incomes have grown to a much higher level – by 76.1% in comparison with the EU-15, where the rise amounted to 18.8%. The cited author also made ranking lists of countries with reference to the dynamics of changes in this measure. The annual rankings show Poland in the lead in 2007 and in 2010, while in 2014 it took the sixth place (Runowski, 2015). Thus, it seems important to ask the question: Do users of commercial agricultural holdings in Opole Province hold similar feelings (table 1).

³ The approach to the development of the country and farming in economy based on knowledge was presented in: Bisaga, 2014, p. 236-243; see also: Bruckmeier, Tovey (eds), 2009.

Table 1. Changes in the incomes of holdings, following the accession to the European Union, in the opinions of examined farmers [%]

Specification	Indications in %
Improved to a considerable extent	20
Improved only slightly	50
Have not changed	15
Worsened	5
Considerably worsened	0
It is difficult to assess	10

Source: author's own work.

It follows from the data presented in table 1 that 70% of the farmers confirm the positive pace of the changes in the incomes obtained after Poland's accessing the EU, including: 20% who declare the change to have been substantial and 50% – a slight one. Despite this, only 1% of the examined assess their incomes from farming to be very high, 12% – high, 62% – medium (sufficient), and 20% to be low or very low (5%)⁴. The incomes evaluated in this way make it possible, according to the examined farmers, to accomplish the following: maintain the family (33% of the indications), secure material stability (22%), make investments in the holding (21%), provide children with education (16%), invest in residential buildings (8%) and in storage facilities (4%).

In the light of the debate running in different European countries in the 21st century, concerning the role of subsidies in agriculture in creating incomes of agricultural holdings in the EU, it is vital to identify factors which the height of the incomes depends on (table 2).

Polish agricultural holdings, despite the fact that they function locally, must respond to global conditions of purchase prices. The trend of growth in farmers' incomes, described earlier, was connected with the increase in prices of produce in global markets and making use of them for non-nutritional purposes. Purchase prices are thus listed as the main income-generating factor. The components identified in the ranking, which condition incomes, that is prices of fertilizers and plant protection products (2nd place), prices of machinery and installations (3rd place) and prices of seeds and breeding materials (4th place) describe the phenomenon of the so-called "technological treadmill", as a compulsion to adapt innovation.

⁴ These opinions correspond to the data supplied by EUROSTAT, which prove that – as far as absolute values are concerned – incomes of Polish agricultural holdings ought to be ranked the 23rd-24th in the EU (Runowski, 2015, p. 238).

Table 2. Factors determining the height of income of holdings in the farmers' opinions

Specification	Place on the ranking list
Purchase prices	1
Prices of machinery and installations	3
Prices of fertilizers and plant protection products	2
Prices of seeds and breeding material	4
Rise in the price of products due to the possibility of storing on the farm	8
Costs of credits	7
Height of taxes and payments	6
Height of direct grants	5
Premiums obtained from receivers resulting from high quality of produce	9
Premiums resulting from participation in a group of agricultural producers	10

Source: author's own work.

Analyzing the structural transformations going on in agricultural holdings based in Opole Province after 2004, it is possible to formulate the conclusion that their users perceive the area payments (5th place in the ranking) as an instrument of managing income risk, which grows along with specialization of production and “simplifying” its structure.

It is also possible to consider the question whether the presented ranking list of income-generating factors will translate to evaluation of PRAD-related actions by farmers in Opole Province.

Users of commercial agricultural holdings in the developmental environment of the commune

From the perspective of the new paradigm of rural areas development it is vital to clearly separate subsidies connected with unreliability of markets compensating for the rise in efficiency, the income from which is transferred to other branches of agribusiness and subsidies which secure stability of services rendered by holdings for the benefit of the environment from the economic rent – as agricultural interventionism is often perceived (Czyżewski, 2015). Acknowledging, to a considerable degree, subsidies from the CAP to be a kind of economic rent must lead to the conclusion that users of agricultural farms display a high dose of opportunism understood as “sly drive

towards realization of one's own interests" (Williamson, 1998). A natural consequence of the above statement is the view that this social group are unable to identify problems of local development and to comprehend its assumptions. Table 3 presents farmers' opinions concerning problems which require solving urgently.

Table 3. Problem areas in the commune in the farmers' opinions [%]

Specification	Indications in % *
Safety and public order	32
Cleanliness	13
Maintenance of libraries and dayrooms	12
Environmental protection	33
Unemployment	56
Trade and service	12
Development of entrepreneurship in the commune	46
Maintenance of schools and kindergartens	39
Social care	20
Healthcare	27
Water supply and sewage system	21
Others:	
• maintenance of field roads	2
• RES (renewable energy sources)	2

* possibility of indicating more than one option

Source: author's own work.

Agricultural holdings connected with the market contract increasingly many formal transactions and must rely on specialist knowledge to handle them, which leads to weakening bonds with the local space. Farmers' "re-rooting" in this space proceeds through their participation in social networks which are formed for the needs of local development. On the basis of the present studies it can be noticed that, in the respondents' opinions, it is the lack of enterprises which poses the main problem to the development in the commune. Other questions that call for urgent settlement are the following: maintenance of schools and kindergartens (39%), protection of environment (33%), safety and public order (32%), healthcare (27%). Farmers also identify the main developmental barriers, which include primarily the spheres such as: financial limitations (75% indications), "bad" regulations (48%),

conflicts between councilors (44%) and wrong decisions (25%). Solving these problems relies on both endogenous and exogenous factors. According to the respondents, the future of the commune will depend on: the local authorities (71% indications), inhabitants of the commune (52%), inhabitants' entrepreneurship skills (34%) and local-government activists in the commune (31%). Apart from this, the questioned count the state's policy (62% indications) into the most serious factors relating to external conditions. It is characteristic of farmers from Opole Province to marginalize new institutional forms of inhabitants' self-organization, the significance of which is appreciated by mere 10% of the respondents.

Taking account of the fact the financial barrier, in the examined farmers' opinions, is decisive in enhancing local development, the following question can be asked: What hierarchy of actions within the PRAD could be proposed by the farmers themselves as the most interested party?

The obtained results do not confirm the thesis which assumes dominance of the opportunist attitude among farmers. Although it is true, in their opinions, that "modernization of agricultural holdings" should be allotted the most of the available means (the choice ranking the highest), such an attitude can be readily justified: in the conditions of the above-mentioned technological treadmill and sustainable intensification of production, the investment-related activity of agricultural holdings would be considerably restricted without public support.

The stability of family-run farms requires a turn of generations. Regarding holdings which are economically medium-sized and of medium-sized area, succession is strongly conditioned by strengthening of their developmental potentials. Hence, the high position of the scheme "Premiums for young farmers" among the instruments of the PRAD in the region (the second place in the ranking list).

In the case of the Province, the dominant type of holdings are plant-growing farms. It follows from the nationwide research that their users display a strong interest in environmental sustainability at a defined level of economic sustainability (Wrzaszcz, 2012). Unfortunately, in the respondents' opinions, the market does not reward taking care of the natural capital (65% of the indications), therefore when it comes to the regional allocation, agri-environmental programs take the third place. Among the branch-related targets (ones of the territorial character) which require allocating means from the PRAD, there is that of "restoring the potential of agricultural production, which got destroyed in consequence of natural calamities and disasters" (the 5th place).

The phenomenon worth emphasizing is the farmers' concern for the multi-functional development of rural areas, which – apart from maintaining

ecosystems benefits – is associated by them with the following: premiums for commencing a business activity outside agriculture (the 3rd place) and means for “development of business activity” (the 4th place). Support of the development of entrepreneurship in rural areas can come from means designed for processing and marketing agricultural produce (the 6th place), as well.

On the other hand, what can give rise to concern is the farmers’ dislike of collective actions and financial support of grass roots initiatives (Action: Leader – ranking the 11th; Action: cooperation – taking the 13th place; Action: formation of groups of agricultural producers – the 10th place in the ranking list). This may be the effect of given institutional experience held by the farmers, who tend to offer a positive evaluation chiefly of some established organizations (agricultural advisory services, the Agency for Restructuring and Modernization of Agriculture) (Sokołowska, 2014). In the communes, where there were set up groups for renewal of the country and Leader groups, farmers engage in their activities and perceive their impact on the development of holdings and the quality of life in the country.

Conclusions

The process of commercial agricultural holdings coming into existence, which was begun as a result of the socioeconomic system transformation (especially visible in some regions lying in the west and south-west of Poland), that is farming enterprises that build formal links with the market, has led – to a certain extent – to their isolation from rural areas and being neglected in communes’ strategic plans. Thus, the instruments of the PRAD, which became implemented after Poland’s accessing the EU, have produced both similar and completely different effects in the process of restructuring Poland’s rural areas.

The following conclusions can be listed, based on the opinions of farmers from Opole Province:

1. The increase in the incomes of their holdings was connected with a rise in purchase prices and the obtained direct payments made an instrument of managing income risk resulting from cycles of the economic situation and interception of effects of efficiency by other links of agribusiness.
2. The obligation to adapt innovations causes the Action: “modernization of agricultural holdings” to be the priority instrument of the PRAD, regarding commercial agricultural holdings in Opole Region.
3. As far as commercial holdings are concerned (in particular those economically weaker) their succession is linked to securing conditions for their further development through expanding the area of grounds in pos-

session as well as technological modernization. With reference to regional allocation of means designed for the development of rural areas, extra payments for young farmers would take the second place in the budget structure.

4. Improvement in the productivity of agricultural holdings facilitated the process of ecological modernization of farms. Because of the relative instability of the market in this respect, enterprises launched in this sphere should be rewarded within agri-environmental and climatic programs.
5. Farmers' participation in managing ecosystem services invests them with status of a developmental environment in the commune. The awareness of the role played in the local development changes the perception of problems coming up in the commune, as well as the approach to allocation of instruments within the DRA.
6. In the examined farmers' opinions, the third area of allocation of instruments of support, like in the case of agri-environmental-climatic programs, is the development of entrepreneurship in the form of payments to start a business activity outside agriculture.
7. Farmers' experience concerns mainly institutions established to provide them with advice and disseminate practical knowledge. Managing local development should, according to the respondents, concentrate primarily on these institutions. However, it is inhabitants of the commune and their business activity that the quality of life in rural areas will depend on in the first place.
8. The knowledge of developmental possibilities connected with grass root institutions concerns only a certain group of farmers; hence, the low allocation of means for the activity of such organizations in the budget constructed on the basis of farmers' opinions. This, however, can be a broader problem relating to barriers to cooperation in rural areas.

Ensuring stability of agricultural holdings and effectiveness of local development restores the significance of a territory in programming the CAP. The diversity of rural areas in Europe requires different partners rooted territorially to create new mechanisms which will allow defining developmental goals and constructing envelopes of support instruments that satisfy regional needs. Without further qualitative research, which support the system, the allocation of structural means of the CAP will certainly be ineffective.

The contribution of the authors

Conception: Anna Bisaga (50%), Stanisława Sokołowska (50%)

Literature review: Anna Bisaga (50%), Stanisława Sokołowska (50%)

Acquisition of data: Anna Bisaga (50%), Stanisława Sokołowska (50%)

Analysis and interpretation of data: Anna Bisaga (50%), Stanisława Sokołowska (50%)

Literature

- Bańkowska K., Gruda M., Klimowski C. (2015), *Ocena wybranych elementów unijnej polityki rolnej*, Warszawa, p. 25-47
- Bisaga A. (2014), *Instytucjonalne uwarunkowania dyfuzji wiedzy w rolnictwie na przykładzie badań w województwie opolskim*, „Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu” No. 360, p. 236-243
- Bruckmeier K., Tovey H. (ed.) (2009), *Rural Sustainable Development in the Knowledge Society*, Ashgate, Aldershot
- Buckwell A. et al. (2014), *Sustainable Intensification of European Agriculture*, Brussels
- Cork 2.0. Declaration (2016), Luksemburg
- Czyżewski B. (2015), *Renty polityczne w nowym paradygmacie rolnictwa – rozważania na przykładzie gospodarstwa reprezentatywnego FADN w Polsce*, „Roczniki Naukowe SERiA” t. XVII, Z. 6, p. 57
- Gołębiewska B. (2010), *Organizacyjno-ekonomiczne skutki zróżnicowania powiązań gospodarstw rolniczych z otoczeniem*, Warszawa, p. 124-143
- Runowski H. (2015), *Kierunki i skala zmian dochodów rolniczych w krajach Unii Europejskiej w latach 2005-2014*, „Roczniki Naukowe SERiA” t. XVII, Z. 6, p. 234-238
- Sokołowska S., (2014), *Funkcjonowanie systemu doradztwa rolniczego w opinii rolników województwa opolskiego*, „Journal of Agribusiness and Rural Development” No. 1, p. 126-130
- Westhoek H.J., Overmans K., van Zeijts H., (2012), *The provision of public goods by agriculture: Critical questions for effective and efficient policy making*, „Environmental Science and Policy” No. 32
- Williamson O.E. (1998), *Ekonomiczne instytucje kapitalizmu. Firmy, rynki, relacje kontraktowe*, Warszawa
- Wrzascz A. (2012), *Autoreferat pracy doktorskiej Poziom zrównoważenia indywidualnych gospodarstw rolnych w Polsce (na podstawie danych FADN)*, Warszawa
- Zegar J. S. (2012), *Współczesne wyzwania rolnictwa*, Warszawa, p. 25-116

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THE FOREST ARBORETS AND THEIR ACTIVITIES FOR FOREST AND NATURE EDUCATION

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ABSTRACT: Over the centuries, arboreta and botanical gardens have performed a variety of functions, the most important being the collection and sharing of the various plant collections. Initially, these collections mainly included medicinal plants for the education of future physicians or pharmacists. The aim of this article is to show the significant role of these units in the forest and nature education. Conducting scientific research and making collections for educational and research purposes is carried out by botanical gardens primarily by providing access to the public to harvest in a manner that will not endanger the collection. Formal education is carried out in these units mainly through links with universities and through the organization of special educational activities (equivalent to museum lessons) for schools.

KEY WORDS: arboretum, informal education, forest education, biodiversity conservation, State Forests

Introduction

Arboretum, dendrological garden, dendrarium (Latin *arbor*, *arboris* – tree) – the trees and shrubs are usually collected and usually researched. Arborets often carry out scientific research on morphology, anatomy, ecology, physiology and genetics of woody plants and the possibility of acclimatization of alien species (Szweykowska, Szweykowski, 2003). They are tested in them. The possibility of growing exotic species in foreign climatic conditions, the pace of their growth and the creation of new varieties and hybrids.

According to some definitions arboretum is a special kind of botanical garden whose principles of creation and functioning in Poland are defined in the Nature Protection Act 16 April 2004 (Ustawa, 2004). According to other sources, the arboretum is an area for the collection of trees and shrubs (Kiełbaska, 1991).

The species was formerly planted in arboretum collections mainly for aesthetic reasons. Contemporary collections collect different species according to ecological criteria (forming groups with similar habitat requirements) or systematic (grouping species and related species) (Mochtak, 1989).

Arboreta can serve as a gene bank that collects unique populations and clones of particularly valuable tree species, to be used for forest restoration after natural disasters or pest infestations.

Arboreta can also be included in botanical gardens or exist as a stand-alone facility. The first European gardens in Pisa and Padua (Italy), were the medical gardens. With the development of science (at the beginning of the systematics), the importance of showing the relationship of plants was taken up. Over time, botanical gardens, in addition to the purely utilitarian function of providing plant material, have gained a new role in representing the diversity of the plant world. Because of institutional unions, they were usually part of universities and began to function as centers of botanical science, with classic botanists, taxonomists, florists, plant physiologists and phytogeographers. Some of the gardens, such as the Royal Botanic Gardens Kew and the Botanical Garden in Berlin-Dahlem, have earned themselves the status of independent research institutions leading the way in the world of research. Others, like the botanical gardens of the University of Warsaw or the Jagiellonian University, have given rise to numerous university institutes or cathedrals specializing in various branches of botany. Impressive gardens were already established in ancient India, China, Egypt and Mesopotamia (Gelderens et al., 1994; Russell et al.; Tommer 2010).

Aristotle, a Greek scholar and philosopher, lived at the turn of the 4th and 3rd centuries for scientific purposes, and his father, Teofrasta, from Eresos,

founded the botanical garden, which founded a magnificent collection of plants at the Lyceum of Athens.

In Poland the first planned dendrological collections were built around the Royal Castle in Warsaw, the oldest botanical gardens were established at the Jagiellonian University (1783), Wrocław University (1811) and the University of Warsaw (1818). The first typical dendrological park was the Arboretum in Kórnik near Poznań (1826) (Zarzyński, Tomusiak, 2015; Olejnik, 2002; Łukasiewicz, Puchalski, 2002).

With the development of molecular techniques used for a growing number of other research purposes, it has turned out that access to suitable plant material can be a serious technical problem – such as uncovered herbarium collections and collections of live plants collected in arboreta and botanical gardens. One of the important challenges of modern biology has also been documenting and attempting to conserve the biological diversity of our planet, and without the botanical gardens, which

In their collections they maintain almost one third of the described species of seed plants, making it impossible. Moreover, the gardens have become refugees for about 10 thousand dying and endangered species of plants.

Currently, there are almost 2,200 botanical gardens in the world, of which most (about 60%) are in temperate regions (North America, Europe, the former Soviet Union). According to estimated data in their collections, there are about 80,000 species of vascular plants, mainly gymno- and angiosperms (about 160,000 taxa – varieties, subspecies, cultivars), totaling about 6 million of them. Their herbarium collections are even larger, and they are estimated at around 150 million sheets. Especially valuable are, for example, crop collections – in the gardens where the majority of cultivars or taxa closely related to them are planted or stored (in the form of gene banks), the plants are considered to be endangered or dying (according to IUCN on the world red plant list there are about 34 thousand of the species, and 10 000 of them are grown in botanical gardens) (Werblan-Jakubiec, Zych, 2007; Nowak, 1999).

In 2017 in Poland there were 31 arborets and botanical gardens belonging to various scientific institutions and 13 administered by The State Forests (Zarzyński, Tomusiak, 2015; www.danepubliczne.gov.pl). Some of them were founded in the 19th century. Their primary task was to check how alien species of trees can develop in different climates of Poland. Particular attention was paid to the Douglas fir and the exotic species of fir with which it was then European forestry were boud highhope.

Purpose, material and methods of research

The aim of the study is to present the role of forest arborea in undertaking activities in the field of natural and forestry education. Various arboretum information was analyzed for the purposes of this study. These were statistical data of the Central Statistic Office, data presented in scientific publications and other numerical figures on the subject. The work was focused on 13 arborets administered by The State Forests in Poland.

Research results

Arboreta and botanical gardens are located in the whole country, but the largest ones are located in the Wielkopolska, Pomeranian, Silesian and Kujawsko-Pomorskie voivodships. The largest number of forest sites was recorded in the Pomeranian Voivodship (figure 1).

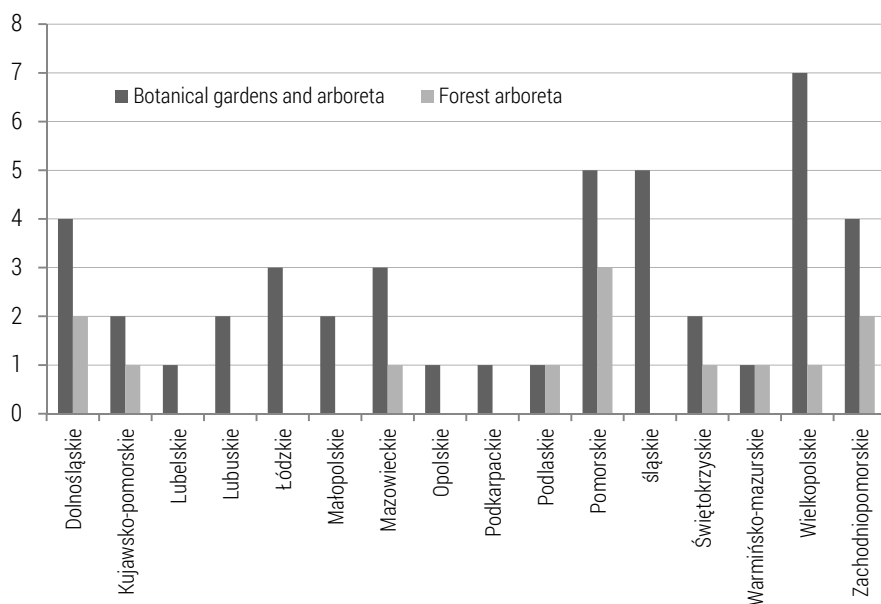


Figure 1. Botanical gardens and forest arborets in Poland in 2017

Source: author's own study based on available sources.

In the area of forest arboretum, mainly trees and shrubs are grown for research purposes. in ecology, acclimatization and breeding. The main advantage of this place is that in a small area we can review the vegetation originat-

ing from different parts of the world and assembled into teams that we will not meet in any natural environment.

Forest arboretum are institutions that, due to their place of origin, status and ownership or relationship to forest experimentation are connected in different ways to forestry (Tumiłowicz, 2010). It is important to emphasize the importance of The State Forests in creating arborea. The State Forests have a statutory duty to conduct forest and nature education, which consists of organizing educational centers with lecture halls, museum collections, didactic pathways, plant gardens at the premises of forest districts or forestry, while the establishment of arboretums goes far beyond these duties and deserves great recognition. The initiative is usually carried out by local foresters. Consultants are usually academics (most forest arborets have scientific supervisors or scientific councilors) (Tumiłowicz, 2010, 1994; Zarzyński, Tomusiak, 2015).

The oldest forest arboretum in Poland – Arboretum in Lipno – has founded in 1783. Among 13 forest arboreta (table 1), the two oldest ones, in Wirty (1875) and Glinna (1880), were established in former nurseries. The Wirtach Arboretum was partly built in existing stands. In addition to the dendrological collections, the Forest Experimental Areas were established from the beginning with trees of foreign origin to examine their suitability for forest management, and since 1979 similar surfaces are assumed in Zielonka. In the arboretum in Syców, in addition to dendrological collections on an area of 70 hectares, a large collection of so-called. selected trees (with the best phenotypic characteristics i.e. healthiness, trunk quality, crown type, stand in the tree with larger dimensions of the breed and height), collected under the „Program of preservation of gene resources of forest trees in Poland” (Tumiłowicz, 2010).

Table 1. Forest arboreta in Poland in 2017

L.p.	Forest arboretum	Voivodship	Year	Area (ha)	Status of botanical garden
1	Park-arboretum Ośrodka Kultury Leśnej in Gołuchow	Wielkopolskie	1894	158,05	-
2	Arboretum Leśne im. Prof. Stefana Białoboka in Sycow Forest Inspectorate	Dolnośląskie	1993	150	+
3	Arboretum in Wirty	Pomorskie	1973	46,32	+
4	Leśne Arboretum Warmii i Mazur in Kudypy im. Polskiego Towarzystwa Leśnego	Warmińsko-mazurskie	1989	15,69	+
5	Ogród Dendrologiczny in Glinna	Zachodniopomorskie	1970	5,57	+
6	Leśny Ogród Botaniczny in Marszewo	Pomorskie	2008	49,69	+
7	Leśne Arboretum im. Powstańców 1863 r. in Kopna Góra	Podlaskie	1988	25	-
8	Arboretum Leśnego Banku Genów Kostrzyca in Miłkowo	Dolnośląskie	1995	12	-
9	Arboretum Lasów Puszczy Iłżeckiej in Marcule	Mazowieckie	2006	7,9	+
10	Botanical Garden in Karnieszewice	Zachodniopomorskie	1881	4,79	+
11	Arboretum in Lipno	Kujawsko-pomorskie	1782	4,18	-
12	Arboretum Leśników Kartuskich in Kartuzy	Pomorskie	2011	4,03	-
13	Arboretum im. Władysława Kapuścińskiego in Drugnia Forest District	Świętokrzyskie	2008	0,8	-
Summ				428,76	-

Source: author's own study based on www.danepubliczne.gov.pl [20-09-2017] and others available sources.

The Arboretum in Rogów (Łódzkie Voivodship) is also included in arboreta whose activity is related to forestry. Since its inception (1925) it has been under the Faculty of Forestry of the Warsaw University of Life Sciences – SGGW.

More than half of the forest arboreta have botanical status, given by the minister of the environment. These units do not surrender to the botanical gardens, and in some cases the botanical garden is a matter of time (the procedure for appointing botanical gardens is complicated and time-consuming) (Zarzyński, Tomusiak, 2015).

In the case of arboreta established in the forest, the age of the stand is known and available in the forest management offices. Forest arboreta are particularly valuable in regions where there are no other such facilities, e.g.

located in northern Poland and in various sub-zones of climate, hence to some extent fill this gap, e.g. in Kopna Góra in Supraśl Forest District, in Kudypach in Kudypy Forest District, in Wirty in Kaliska Forest District and in Glinna in Gryfino Forest District.

Apart from the collector's and scientific functions, the most developed function of forest arboretems seems to be an educational function. This activity mainly includes educational and exhibition activities, taking the form of lessons in the field and specially prepared chambers of education, leadership, cooperation with schools and publishing houses. According to the „Regulations... 1998” (Regulamin Rady..., 1998) arboreta should be made available for sightseeing within the scope determined by the management. The manager's ambition is to prepare the arboretum to accommodate as many visitors as possible, providing them with comprehensive information about the garden and the leisure conditions. The forest arboretum is a place to conduct nature education through the popularization and transfer of botanical knowledge with special regard to the protection of species of plants, animals and fungi and the protection of biological diversity. Natural and forest education is conducted in a passive manner by providing a collection of forest arboretems and in an active way by organizing educational classes for organized groups.

Educational activities conducted in the forest arboretum are organized according to the following principles: classes for professional groups, i.e.: trade groups, students and representatives of other organizations and institutions, excluding educational and educational institutions are organized and implemented by the forestry arboretum or its employees. Classes for organized children's and young people's groups, together with carers, are carried out by the nature and forestry educator assigned by the forest inspectorate as part of the educational activity. Each participant can talk about the practice of the activities and, for example, to see and try the tools used in the forestry and forestry industry today (e.g. Arboretum in Syców, Kudypy) (table 2).

All of the analyzed facilities offer nature-related classes (often conducted in the field), educational activities for youth, workshops and events popularizing forests and forestry. The most popular form of activity are lessons, educational workshops, screenings of nature films and seminars, conferences, talks. Often they are also integrated classes (e.g. combining multimedia presentations with practical exercises) so that their form is as attractive as possible (table 3).

Table 2. Collection of plants in selected forest arboreturns

Arboretum	Plants collections	Educational activities and infrastructure
Arboretum in Stradomia Dolna	Collection of about 1200 species and varieties of trees and bushes from different parts of the world and a unique collection of Polish selected trees (among others the best in Europe pine from Rychtalskie Forest), azalea park, alpine garden with collection of plants, water and protected plants.	Complex of five ponds with bridges and bridges, educational trail and activities for school youth, nursery school ornamental plants.
Arboretum in Kudypy	Collections of trees and shrubs with over 700 species and varieties. The most abundant are represented by clones (over 30 species), iris (29 species) and dry and wild roses. There are collections of juniper, spruce, fir, and other conifer species, including a collection of native trees and shrubs of about 300 species and varieties. Natural forest – it is the most interesting natural part of the old natural forest with monumental trees.	Cooperation with scientific institutions in Poland. Organization of numerous lectures, lectures and the implementation of research programs. Numerous didactic boards, exhibitions and exhibits prepared for younger visitors, among others. Exhibitions of all types of bird and wood booths of different species of trees. Colorful plaques present issues related to the ecology of the forest and its processes. Added bridges and bridges led, among others. over a piece of the swamp forest. Geological Lapidarium – a collection of stones and boulders from Warmia and Mazury. Educational board with natural exhibitions and expositions concerning the former work of foresters.
Arboretum Leśników Kartuskich in Kartuzy	23 species of forest trees, mostly in the age of 100-170 years. These include: giant bramble, green fir, common beech, small lime, maple sycamore, common fir, pine plug. Visitors can follow the process of wood decay.	Nature Education Path. Jerzy Schwengla. For educational purposes, 50 plates were hung with names and 120 trees were numbered. Especially picturesque is the aged beech specimen, called „beech stilts” because of the protruding from the ground and branching roots.
Arboretum in Lipno	„Lipno” Nature and Landscape Park in which there is a Dendrological Park. Numerous species of temperate trees in North America, Asia, Southern Europe, the park has an interesting collection of azaleas and rhododendrons. There is one of the oldest and largest in Poland, giant hedgehogs.	Natural and educational path in the „Lipno” Nature and Landscape Complex, natural path in the dendrological garden.
Arboretum in Drugnia	71 species of coniferous trees and shrubs from the northern hemisphere. Next to the national trees you can admire here. 12 species of pines, Siberian microbe, chinese and japanese spruce, spruce, fir and larch, giant mammoth. Trees were planted in small groups to facilitate their free observation.	Trees were planted in small groups to facilitate their free observation. In addition to the decorative and educational functions, it is possible to track their growth and to evaluate the potential of individual species in local climatic conditions. Interest in the arboretum is a so-called avenue. „Bendyktynek”, ie trees bred from seeds consecrated personally by Pope Benedict XVI during his visit to Warsaw on 26 May 2006.
Arboretum in Wirty	450 species of trees and shrubs; 110-year-old oak stand with an area of 1.01 ha – exclusive seed stand; alpinarium on an area of 0.44 ha	Scientific and educational institution of Kaliska Forest Inspectorate. Scientific supervision is carried out by the Department of Dendrology and the Formation of Green Areas of West Pomeranian Technical University in Szczecin; Previously, the Institute of Dendrology of the Polish Academy of Sciences in Kórnik participated actively in the arboretum.

Source: author's own study based on available sources.

Table 3. Examples of forms of environmental education in the Arboretum in Kopa Góra

Form of education of nature and forest	Realization
Outdoor activities	The project „Forest Folk and Forests” School trips Adult tours
Classes in the educational chamber „Forest school” and in the Museum of Knyszyn Forest History	The project „Forest Folk and Forests” Organizing classes for schools Organizing activities for adults
Educational folders	„Arboretum in Kopa Góra”
Individual education	Information contained in educational and information boards

Source: author's own work.

Arboreta develops and publishes short folders and extensive guides, albums, postcards and souvenirs. Larger and older arborets, with more staff, have fixed tour guides, smaller guides are available upon prior arrangement of arrival dates. At the entrance to the arboret are information boards, which give general information about the garden, as well as regulations, opening times, ticket prices, etc. At the counter, you can buy folders and guides at the entrance. Trees and shrubs should have labels with plant names. In some arbours, larger boards are also set up with selected interesting trees, with more specific characteristics of the species (e.g. Lipno, Kopa Góra, Kudypy).

For the convenience of the visitors in the arboret, there are numerous benches and trash baskets, as well as rain shelters, tables and toilets. Most of the forest arboreas are located outside the city and the countryside (among others: Glinna Karnieszewice, Lipno, Marszewo, Sites).

In many arboretas, there are small natural collections (collections of cones, boards and other botanical exhibits) and educational rooms, as well as a place for bonfires, playgrounds for children. The Spring and Autumn Holidays (e.g. Gołuchów), Open Days (e.g. Syców, Miłkowo, Marszewo), rhododendrons (e.g. Syców) and other festivities like picnics, exhibitions, concerts (e.g. Gołuchów, Miłkowo, Marcule, Karnieszewice). An interesting example of educational activities is the arboretum in Kudypach. Due to the lack of this type of facility in this part of the country and the poorly diversified species rich dendrofolium. Arboretum species make it possible to know and observe the ubiquitous trees, bushes and herbaceous plants. In various forms of forestry education can participate even to 10 ths. each year (www.lasy.gov.pl).

Educational activities are carried out in complementary stages: lecture or lesson (exercise room, green class), exploration of species and communities in arboretum, followed by self-observation on natural and educational paths. The next stage consists of fixing and supplementing the messages sup-

ported by folders, books, films, presentations (library, lecture room) and promoting participants' participation in numerous competitions. During this type of activity, green lessons, field exercises and research are intertwined to create a much more comprehensive content than if they were functioning separately. Arboreta included in this teaching and cognitive process are much more efficiently used as a didactic-scientific and tourist-recreational facility (www.lasy.gov.pl).

Arboreta cooperates, among others. with schools, community centers, non-governmental organizations and organize joint educational and recreational events and sports (e.g. Kudypy, Karnieszewice, Marcule, Kopna Góra, Miłkowo). The actions of the arborets are based on the conviction that the proper and effective protection of these natural resources that still remain to us depends on the level of knowledge of society and of consciousness shaped towards the sustainable use of environmental resources. The most common are the forest communities, which enable active learning of issues requiring greater involvement, improvement of observation and description (field lessons, team games).

Library collections are also available in the arboretums. The vast majority of volumes concern broadly understood conservation. The collections of botany, zoology and nature of the region are distinguished within the collection of natural collections. In order to consolidate tasks, individual facilities cooperate within the Council of Botanical Gardens and Arborets in Poland (www.robip.pl).

Summary

In the arboretum, scientific goals and objectives are put in the first place. This concerns the professional conduct and maintenance of documented plant collections and their extension and the collection of long-term observations and measurements which are the basis for scientific publications. In addition to the scientific aspects, it is important to educate and popularize botanical and forestry knowledge among the public. The educational offer in each of the facilities is provided, as well as brochures and other publications and guides for tour guides.

Arboreta forest also aims to bring closer to the activities of The State Forests to protect natural forest resources through educational activities and initiatives to protect natural resources – such as the active conservation of genetic resources by the preservation of endangered and endangered plant species. Gardens are also monitored for the variability of individual trees and shrubs and the possibility of growing them beyond the natural range of

occurrence. Arboreta visits school trips, students and organized groups of tourists, it is also an interesting destination for family trips.

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The contribution of the authors

Joanna Pietrzak-Zawadka: conception 50%, literature review 50%, acquisition of data 50%, analysis and interpretation of data 50%

Jan Zawadka: conception 50%, literature review 50%, acquisition of data 50%, analysis and interpretation of data 50%

Literature

- Gelderen von D.M., Jong de P.C., Oterdoom H.J. (1994), *Maples of the World*. Timber Press, Portland, Oregon
- Kiełbaska M. (ed.) (1991), *Mała Encyklopedia Leśna*, Warszawa, p. 14
- Łukasiewicz A., Puchalski J. (eds) (2002), *Ogrody Botaniczne w Polsce*, Warszawa
- Mochtak E. (1989), *Tajemnice ogrodów botanicznych*, Warszawa, p. 7
- Nowak T. (ed.) (1999), *Index Plantarum Polskich Kolekcji Dendrologicznych*, „Prace Ogrodu Botanicznego Uniwersytetu Wrocławskiego” No. 5(1), p. 17-305
- Olejniak B. (2002), *Arboretum w Gołuchowie*, in: A. Łukaszewicz, J. Puchalski (eds), *Ogrody Botaniczne w Polsce*, Warszawa, p. 229-237
- Regulamin Rady Ogrodów Botanicznych w Polsce*, Przyjęty na posiedzeniu Rady w Cieszynie, 1 lipca 1998 r., Rogów
- Russell T., Harris D., Westonbirt B.D., *The National Arboretum*, Peterborough, Cambs
- Szweykowska A., Szweykowski J. (eds) (2003), *Słownik botaniczny*, Warszawa, p. 38
- Toomer S. (2010), *Planting and Maintaining a Tree Collection*, Portland-London
- Tumiłowicz J. (1994), *Uwagi do artykułu dr inż. Cezarego Pacyniaka pt. Leśne Arboreta w Polsce i ich znaczenie dla leśnictwa*, „Las Polski” No. 12, p. 14-16
- Tumiłowicz J. (2010), *Uwagi o zakładaniu i prowadzeniu arboretów w Polsce*, „Rocznik Polskiego Towarzystwa Dendrologicznego” Vol. 58, p. 55-60
- Ustawa z dnia 16 kwietnia 2004 roku o ochronie przyrody, Dz.U. 2004 nr 92 poz. 880
- Zarzyński P., Tomusiak R. (2015), *Warto zobaczyć w Lasach Państwowych Ogrody Botaniczne i Arboreta Leśne*, Warszawa, p. 92-178
- www.lasy.gov.pl [20-09-2017]
- www.robpa.pl [20-09-2017]



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SUSTAINABLE DEVELOPMENT AND FORESTATION RATE IN SELECTED VOIVODSHIPS IN POLAND

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ABSTRACT: This paper is an attempt to find interdependencies between selected variables of sustainable development and forestation rate. The scope of paper included 16 Polish Voivodships in the period 2004-2016. The descriptive method supplemented by tools of descriptive statistics has been used (Pearson Correlation Coefficient). Research results indicated above all high interdependency between forestation rate and EU funds for EU programmes and projects in Podlaskie, Śląskie and Warmińsko-Mazurskie Voivodships. Moreover, Voivodeships received support for afforestation in accordance with the arable land available for afforestation (land of class V and VI). Voivodeships in which land of classes V and VI constituted about 20% of their area (Dolnośląskie, Lubuskie, Śląskie, Warmińsko-Mazurskie, and Zachodniopomorskie) received significant financial resources from the European Union for afforestation.

KEY WORDS: sustainable development, forestation rate, Voivodships in Poland

Introduction

The concept of sustainable development is rooted in forestry. It was introduced by a Saxon staroste Hans Carl von Carlowitz (*Lasy Państwowe*, 2013), who in 1713 ordered a restoration of forests under his rule and introduced a rule of a regulated and future use of natural resources. A model of sustainable development was adopted not only in forestry throughout Germany, but also became an example worldwide, which is indicated by above all a review of strategies of European Union (EU) for the benefit of the forest sector, which focus in particular on sustainable management of forests (*Parlament Europejski*, 2017). The assumptions of EU 2020 strategy highlight a sensible, sustainable and global development as a manner to overcome structural faults of European economy and at the same improvement of competitiveness, productivity, and support of sustainable social market economy (*Strategia Europa 2020*, 2010).

A number of legal documents point to the introduction of sustainable development. They draw attention above all to reduction of greenhouse gas emissions by supporting sustainable development (*Protokół z Kioto*, *Journal of Laws* 2005 no. 203, item 1684), or a change in energy policy in line with the rule of sustainable development (Art. 15.1 of the Law Amending the Energy Law and the Environmental Protection Law), as well as on adopting the rule of sustainable development in environmental protection (Art. 5 of the Polish constitution). Educational strategies for sustainable development are appreciated not only in environmental domain (natural resources, climate change, development of agriculture), but also socio-cultural (peace and safety, health protection, gender equality) and economic domains (market economy, corporate responsibility) (*Raport Światowej Komisji Środowiska i Rozwoju ONZ*, 1987).

In EU, the forests area amounts 161 million hectares (4% of forested area in the world) (*Parlament Europejski*, 2017), which constitutes 38% of the total EU area. Poland and the following countries: Spain, Finland, France, Germany and Sweden account for 2/3 of European forested area. In Poland the forestation rate (as an indicator is the participation of the area of forest in total geodetic area of a country) has been increasing since 2000 (GUS, 2016). In 2015 it was 29.5% (9214.9 thousand hectares) – an increase of 1.1% compared to 2000 (GUS, 2016).

An overview of literature

In Poland, within 70 years, the dominant types of land use changes have been the changes in the area of forest distribution, which has been the result of complex historical, social and economic processes. The contemporary spatial image of forests has also been significantly influenced by structural changes associated with political changes in Poland (Poławski, 2006). The forest composition in Poland in 2015 has been dominated by public forests – 80.8%, whereas the private forests have occupied 19.2% (Lasy Państwowe, 2016). Increasing forestation in Poland is an important element of the country's ecological and forestry policy. It contributes to increasing the efficiency in the management of agricultural space. Changes in the rural area of forests in Poland are the result of the afforestation of land used for agriculture or at a wasteland (Polna, 2017). According to Adamowicz (2005), the intensification of works aimed at afforestation of land should take place mainly in Voivodeships with a large wasteland area, such as Zachodniopomorskie, Warmińsko-Mazurskie and Podlaskie. The guides given in the analyzed literature of the subject were confirmed by the authors of the article. Based on the results of the Pearson correlation coefficient, very high correlations were estimated between total afforestation and total forestation in Poland in 2004-2006 and 2014-2016 in such Voivodeships: Podkarpackie, Podlaskie, Świętokrzyskie and Warmińsko-Mazurskie. However, in 2007-2013, high correlation between total afforestation and forestation was confirmed in the following Voivodeships: Dolnośląskie, Małopolskie, Wielkopolskie and Zachodniopomorskie. However, on the basis of data from GUS (2017) and The Agency for Restructuring and Modernisation (ARiMR) (2017) on the total agricultural land of the V and VI valuation class, average support for one-time afforestation and forestation in 2015, it should be concluded that the voivodeships received support for afforestation in accordance with the arable land available for afforestation (land of class V and VI). Voivodeships in which land of classes V and VI constituted about 20% of their area (Voivodeships: Dolnośląskie, Lubuskie, Śląskie, Warmińsko-Mazurskie, and Zachodniopomorskie) received significant financial resources from the European Union for afforestation.

Research methods

The aim of the paper is to determine a significant relation between forestation rate and selected variables of sustainable development (socioeconomic and environmental ones) in all Voivodships of Poland, taking into account the following periods: 2004-2006, 2007-2013, 2014-2016¹. The descriptive method supplemented by the calculation of Pearson's coefficient (ranges from -1 to 1, the degree of correlation is determined in the following manner: $0,4 \leq r_{xy} < 0,7$; $-0,4 \leq r_{xy} < -0,7$ – average correlation, $0,7 \leq r_{xy} < 0,9$; $-0,7 \leq r_{xy} < -0,9$ – high correlation, $0,9 \leq r_{xy} < 1$; $-0,9 \leq r_{xy} < -1$ – very high correlation (Cohen, 1998)) between forest cover (Y) and 14 variables selected in a purposeful manner has been used. The selection of variables for the model has been made on the basis of literature review (for instance: GUS, Grabowska, Poskrobko, Leichenko in references) and substantive conditions. As a model, there have been used, inter alia, sustainable development indicators registered in the issues of social order, environmental order and economic order (GUS, 2011). To the environmental order indicator - land use - have been registered variables: the forest cover (Y), the surface area of non-forestry lands to be afforested (X1), the total surface area of private forests (X2), the surface area of usable agricultural land (X3), afforestation of private forests (X4) in general, afforestation of public forests (X5) in general; to the social order indicator - economic development and employment indicator - have been registered variables: total income of communes (X6), income per capita (X7), EU funds for funding EU projects (X8) (<http://swaid.stat.gov.pl> [27-11-2017]), expenditures per capita (X9), female employment in forestry (X13), male employment in forestry (X14), however, to the social order indicator - demographic changes and public health - have been registered variables: average life expectancy of women (X10), average life expectancy of men (X11), medical centres (X12). The variables apart from the forestation, do not perfectly correspond to the names of indicators, however, they still relate to their meaning. Moreover, there has been taken into account a variable afforestation of private forests (X4) in general and income per capita (X7) (Woźniak, 2011) on the basis of the work of Grabowska (2001) who deals with issues related to sustainable treatment of social, economic and ecological issues as essence of the sustainable development regarding ecological and economic issues. "27 rules of sustainable development" were specified in

¹ Funding from EU funds according to the Regulation (EU) No. 1305/2013 of the European Parliament and of the Council of 17 December 2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) repealing the Regulation of Council (EC) no. 1698/2005 and according to the Act on support for rural development co-financed by the European Agricultural Fund for Rural Development for the period 2014-2020.

Rio de Janeiro in 1992, which are specified in The Preamble to the United Nations Conference on Environment and Development. Despite of the fact that these rules mainly refer to the environment, they also specify the social section in frame of which the sustainable environment should be understood. The first rule specifies the health as the centre (in the model a variable average life expectancy of women (X10) and average life expectancy of men (X11)), the fifth specifies the need to decrease the disparities in standards of living (variable EU funds for funding EU projects (X8) and variable expenditures per capita (X9), the eleventh rules specifies the environmental standards (variable the total surface area of private forests(X2)) (http://old.ko.poznan.pl/pub/ftp/Edukacja_zrownowazonego_rozwoju/DEKLARACJA_Z_RIO_1992.pdf). In table 2 presented Pearson Correlation Coefficient between forest cover and selected variables, which are showed in sub-section 3.1 and 3.2. Moreover, an analysis of the potential of usable agricultural land (class V and VI) for afforestation in every Voivodship in reference to received one-off support for afforestation in the period from 2007 to 2013 was carried out (figure 1). Relevant literature, data from GUS BDL (the Local Data Bank of the Central Statistical Office) and the reports of ARiMR (Agency for Restructuring and Modernisation of Agriculture) have been used as a source material. The article presents selected research results.

Results of the research

The economic aspect

Since May 1 2004 the tools of the EU Common Agriculture Policy (CAP) have been applied in Poland. The main source of funding of support for agriculture and rural areas in the Member States of EU is the European Agricultural Guidance and Guarantee Fund (EAGGF, contribution of funds amounting to 80% between 2004 and 2006). The Agency for Restructuring and Modernisation of Agriculture supports afforestation of usable agricultural lands and agricultural land that is not arable. Between 2004 and 2006 (Action 5. Afforestation of agricultural land), as part of PROW (RDP) 94,6 million EURO was paid out to 8066 beneficiaries from the RDP budget (ARiMR, 2015). As far as the period from 2007-2013 is concerned (Action 221, 223 Afforestation of agricultural and non-agricultural land) 128 million EURO was paid out to 10058 beneficiaries as part of the budget of RDP for the period 2007-2013 (ARiMR, 2015). In 2014, 17894 decisions granting support for afforestation for the amount of 5,4 million EURO were issued, 33,7 million EURO was paid out, including: 21,5 million EURO paid out to 8043 beneficiaries as part of the budget of RDP for the period 2007-2013 and 12,1 million EURO

paid out to 7326 beneficiaries as part of the budget of RDP for the period 2004-2006 (ARiMR, 2017). According to the report of ARiMR (2017) 301 million EURO has been included in the budget of RDP for the period 2014-2020 for afforestation and establishment of forest areas. Taking into account the average support for afforestation per hectare (1445,7 EURO) and the planned budget of RDP for the period 2014-2020 for afforestation (286 million EURO), 197.9 thousand hectares can be afforested (calculated on the basis of incomplete data for each Voivodship) (ARiMR, 2017). Table 1 presents subsidy figures for afforestation in selected years.

Table 1. Subsidies for afforestation for time periods 2004-2006, 2007-2013, and 2014-2020 [euro]

Subsidy	Amount in EURO for the period		
	2004-2006	2007-2013	2014-2020
One time payment	1022-1402	989-1487	1184-1707
Fencing of reforested area:			
- One time payment	-	615	-
- Fence, per meter	-	1,54	2,10
Tree staking, per planted tree	-	-	1132
Annual payment for cultural practices paid for 5 years	100-261	231-323	189-387

Source: author's own work based on the data from ARiMR (2015) and on research Klepacka et al. (2017).

Correlations between EU funds and forestation rate in the period 2010-2016 (no data prior to 2010) have shown high interdependencies in Warmińsko-Mazurskie Voivodship (private forests constituted 3% of geodetic area of the Voivodship in 2016 and 3.45% of private forests in Poland in general) and high interdependencies in the following Voivodships: Lubelskie, Mazowieckie, Podkarpackie, Podlaskie, Śląskie, Świętokrzyskie (average interdependencies in Łódzkie and Wielkopolskie Voivodship) (table 2).

Table 2. Values of the Pearson Correlation Coefficient between forestation and selected economic and environmental variables, 2004-2016

Selected Pearson Correlation Coefficient	Pearson Correlation Coefficient between forestation and EU funds			Pearson Correlation Coefficient between forestation and afforestation			Pearson Correlation Coefficient between forestation and surface area of private forest in general		
	2010-2013	2014-2016	2004-2006	2007-2013	2014-2016	2004-2006	2007-2013	2014-2016	
Voivodships/In years									
Dolnośląskie	0,29	-0,91	-0,87	-0,95	-0,70	0,83	0,99	0,87	
Kujawsko-pomorskie	0,26	-0,89	0,92	-0,55	-0,97	1,00	1,00	0,98	
Lubelskie	-0,87	-0,48	0,43	-0,14	-0,70	1,00	0,99	1,00	
Lubuskie	0,13	-0,77	0,53	-0,77	0,10	-0,30	1,00	0,95	
Łódzkie	-0,71	-0,46	0,66	0,12	-0,80	1,00	1,00	1,00	
Małopolskie	0,71	-0,68	0,37	-0,97	-0,94	1,00	0,97	1,00	
Mazowieckie	-0,93	-0,09	0,98	-0,03	-0,91	1,00	1,00	1,00	
Opolskie	-1,00	-0,99	-0,13	-0,86	-0,10	0,99	0,93	0,94	
Podkarpackie	-0,82	-1,00	0,92	-0,79	-0,94	0,99	1,00	1,00	
Podlaskie	-0,90	0,84	1,00	-0,55	-1,00	0,99	1,00	0,99	
Pomorskie	0,52	-0,58	0,86	-0,79	-0,30	1,00	1,00	1,00	
Śląskie	-0,95	-0,61	0,41	-0,18	-0,36	0,48	0,81	-0,89	
Świętokrzyskie	-0,83	0,39	0,93	-0,54	-0,99	1,00	0,99	0,98	
Warmińsko-mazurskie	-0,98	-0,87	0,97	-0,85	-1,00	0,99	1,00	1,00	
Wielkopolskie	0,26	-0,58	-0,2	-0,84	-0,97	1,00	0,99	0,97	
Zachodniopomorskie	0,98	-0,21	-0,96	-0,87	-0,61	1,00	0,99	0,99	

Source: author's own work based on the data from GUS (2017).

The environmental aspect

Intensification of the increase of forestation (in which a forest is established in a non-forest area (Heze, 2012)) started after the Polish accession to European Union. The document adopted by the Council of European Union aimed to support the development of rural areas by the European Agricultural Fund for Rural Development. Attention was paid to relations between agriculture and forestry, namely between manners in which usable agricultural land is used and the state of natural environment (Skolud, 2008). Afforestation contributes to the improvement of the environment state, strengthen ecological stability of forest areas by decreasing fragmentation of forest complex and establishment of ecological corridors (Polna, Szczepański, 2010). In line with the National Programme for the Augmentation of Forestation Rate (Krajowy Program Zwiększania Lesistości (KPZL)), after 2050 forestation rate should arrived to 33% (Kwiecień et al., 2002; Bułkowska, Chmurzyńska, 2007). By increasing forestation rate Poland achieves a higher level of sustainable development, which was highlighted in Rural Development Plans (RDP) for the period 2004-2006. Forests have important production and social functions. According to the GUS (2015), there are large needs and opportunities to increase forestation of the country by afforestation of productively ineffective or undeveloped arable land (Wskaźniki Zrównoważonego Rozwoju Polski 2015). In the period 2004-2006 and 2014-2016, the process of afforestation related to forestation rate in general indicated correlations in the following Voivodships: Podkarpackie, Podlaskie, Świętokrzyskie, Warmińsko-Mazurskie (high correlations were also found in period 2004-2006 in Voivodships: Dolnośląskie, Zachodniopomorskie, and in period 2014-2016 in Kujawsko-Pomorskie Voivodship) as well as in the following Voivodships in the period 2007-2013: Dolnośląskie, Małopolskie, Wielkopolskie and Zachodniopomorskie (table 2). As part of RDP for the period 2004-2006, 39736.99 ha of usable agricultural land („Afforestation of agricultural land” – Action 5 RDP for the period 2004-2006) in total was afforested and average forestation rate increased by 0.12 percentage point (Konsorcjum, 2009). As part of RDP for the period 2007-2013 on the other hand, 32216.65 ha of usable agricultural land (only 50% of planned area) was afforested. A significant interdependency was found in case of forestation rate and surface area of private forests in general for the period 2004-2006, while for the period 2014-2016 high correlations were found in the majority of Voivodships in Poland (except for Lubuskie, Małopolskie, Opolskie, Śląskie and Wielkopolskie as well as in the period 2004-2006 also in Kujawsko-Pomorskie Voivodship and in the period 2014-2016 in Dolnośląskie, Pomorskie and Świętokrzyskie Voivodship). For data from the period 2007-2013 a high correlation was found only in case of Kujawsko-Pomorskie

and Wielkopolskie Voivodships (average correlation in case of 7 Voivodships: Małopolskie, Opolskie, Podlaskie, Pomorskie, Śląskie, Świętokrzyskie, Zachodniopomorskie out of 16 Voivodships or no correlation in case of the remaining 7 Voivodships: Dolnośląskie, Lubelskie, Lubuskie, Łódzkie, Mazowieckie, Podkarpackie, Warmińsko-Mazurskie) (table 2). According to the FADN data (Klepcka et al., 2017), a potentially forested area (a private forest in particular) in Poland corresponds to approximately 27% out of 159.3 thousand ha of land in the period from 2001-2014.

Based on conducted analysis of the potential of usable agricultural land (Skłodowski, Bielska, 2009) it has been found that by afforesting 77.15 thousand ha (afforested area on account of actual location of a forest) as part of RDP for the period 2007-2013 all Voivodships received a total of 95 million EURO (including 76.4 million EURO from EU funds) and they could receive a total of 12.7 billion EURO by maximizing the use of usable agricultural land (V and VI soil quality class) – 10233 thousand ha to be afforested in total (own research on the basis of the data from the report by ARiMR, 2015). As a result, forestation rate in Poland would almost double. The figure below is a graphic display of total usable agricultural land, V and VI soil quality class, an on-off average support for afforestation and forestation rate in 2015.

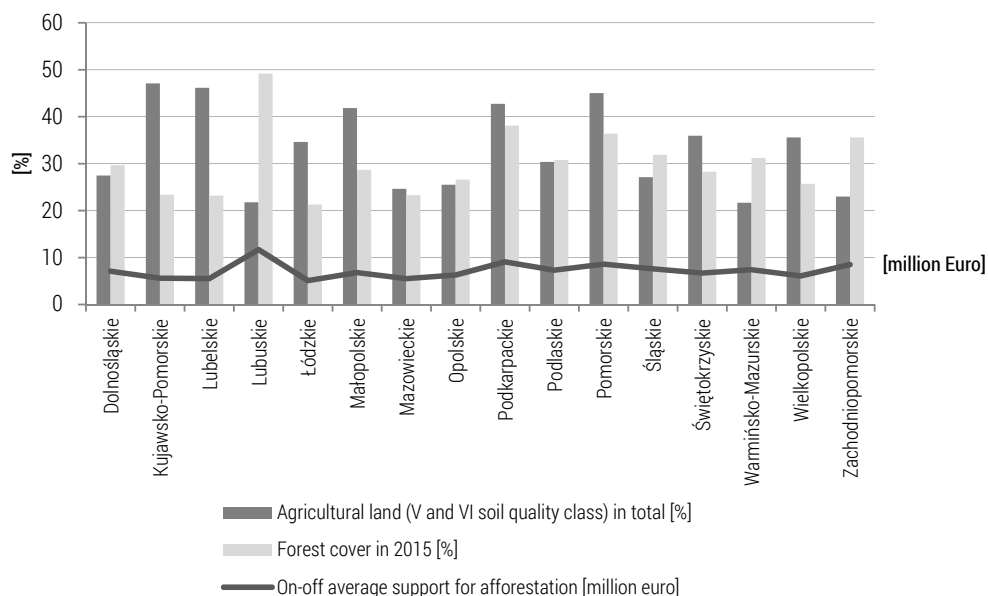


Figure 1. Support for afforestation and usable agricultural land to be afforested by Voivodship

Source: author's own work based on the data from GUS (2015) and ARiMR (2015).

On the basis of the data (figure 1) it should be concluded that the level of forestation is correlated with the average support for one-time afforestation. The level of subsidies from the European Union is highest in Lubuskie Voivodeship, where the level of forestation is highest in Poland, whereas in Łódzkie Voivodeship the lowest forestation has been recorded, with the lowest support of fund for afforestation from the European Union. Moreover, in Lubuskie Voivodeship, the percentage of agricultural land in the V and VI class is one of the lowest in Poland – 21.8% (the lowest in Warmińsko-Mazurskie Voivodeship – 21.7%), whereas Łódzkie Voivodeship takes sixth position amongst 16 Voivodeships. This situation shows the limited possibilities of afforestation of agricultural land in Lubuskie Voivodeship. In 9 Voivodeships in Poland, the level of agricultural land of V and VI class is higher than the level of forestation, whereas in case of Podlaskie Voivodeship the values in both cases are very similar, which creates opportunities for increasing their forestation.

Conclusions

Research results have shown a link between economic and environmental variables and forestation rate is significant. Forestation rate in Poland is an indicator which, starting from 1945 (when it amounted to 21% of the country's area), has been steadily increasing, enabling the implementation of sustainable development of rural areas (GUS, 2015). The sequence of the development of forestation rate, confirmed by research results and observed at a Voivodship level, exerts influence on the provision of benefits of financial support for sustainable development. Additionally, the conducted analysis has shown that there is an interdependency between forestation rate and the surface area of usable agricultural land of V and VI soil quality class, and the averaged level of on-off support for afforestation in all investigated Voivodships, in particular in those with the greatest number of private forests such as Mazowieckie or Podlaskie Voivodship.

The contribution of the authors

Anna M. Klepacka – 50% (conception of framework, literature review, analysis and interpretation of data)

Patrycja Szmulewicz- 50% (literature review, data collecting, analysis and interpretation of data)

Literature

- Adamowicz K. (2005), *Próba wskazania roli zalesień w Polsce agrarnej i w rozwoju obszarów wiejskich w Polsce*, "Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu" Vol. VII (4), p. 9-13
- ARiMR, *Sprawozdanie z działalności ARiMR za rok 2014*, http://www.arimr.gov.pl/fileadmin/pliki/zdjecia_strony/223/Sprawozdanie_ARiMR_2014.pdf [09-09-2017]
- ARiMR, *Sprawozdanie z działalności ARiMR za rok 2016*, http://www.arimr.gov.pl/fileadmin/pliki/zdjecia_strony/223/Sprawozdanie_ARiMR_2016.pdf [09-09-2017]
- Bułkowska M., Chmurzyńska K. (2007), *Wyniki realizacji PROW i SPO „Rolnictwo” w latach 2004-2006. Program Wieloletni 2005-2009*, Warszawa
- Cohen J. (1998), *Statistical power analysis for the behavioural sciences*, New York
- Fundusze Unii Europejskiej jako czynnik modernizacji rolnictwa polskiego (2010), "Studia i Prace z Geografii i Geologii" 7, Poznań, p. 127-140
- Grabowska G. (2001), *Europejskie prawo środowiska*, Warszawa, p.197
- GUS, Bank Danych Lokalnych, <http://bdl.stat.gov.pl> [09-09-2017]
- GUS (2016), *Leśnictwo*, Warszawa
- GUS (2015), *Leśnictwo*, Warszawa
- Haze M. (2012), *Zasady hodowli lasu*, Centrum Informacyjne Lasów Państwowych, Warszawa
- Klepacka A.M., Florkowski W.J., Revoredo-Giha C. (2017), *Farmers and their groves: Will cost inefficiency lead to land use change?*, "Land Use Policy" Vol. 61, p. 329-338
- Konsorcjum, Instytut Ekonomiki Rolnictwa i Gospodarki Żywnościowej – Państwowy Instytut Badawczy, Instytut Rozwoju Wsi i Rolnictwa Polskiej Akademii Nauk, Instytut Uprawy Nawożenia i Gleboznawstwa IUNG – Państwowy Instytut Badawczy, BSM Główny, Skopiński, Starzyński, Załuski Sp. J. (2009), *Ewaluacja ex post Planu Rozwoju Obszarów Wiejskich 2004–2006. Raport końcowy*, Warszawa
- Konstytucja Rzeczypospolitej Polskiej z dnia 2 kwietnia 1997r., Dz.U. 1997 nr 78 poz. 483
- Kwiecień R. et al. (2002), *Modyfikacja krajowego programu zwiększania lesistości – etap III (B3)*, Dokumentacja IBL, Warszawa
- Lasy Państwowe (2013), <http://www.lasy.gov.pl/pl/publikacje/biuletyn-informacyjny-lasow-panstwowych/2013> [20-08-2017]
- Leichenko R.M. (2003), *Does Places Still Matter? Accounting for Income Variation Across American Indian Tribal Areas*, "Economic Geography" Vol.79 (4), p. 365-386
- Parlament Europejski, *Dokumenty informacyjne o UE*, http://www.europarl.europa.eu/atyourservice/pl/displayFtu.html?ftuId=FTU_5.2.11.html [08-08-2017]
- Polna M. (2017), *Zmiany lesistości obszarów wiejskich w Polsce w latach 1995-2016*, "Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu" Vol. XIX (2), p.194-198
- Polna M., Szczepański Ł. (2010), *Skala i zróżnicowanie przestrzenne absorpcji funduszy UE na przykładzie działania „Zalesianie gruntów rolnych” w województwie wielkopolskim w latach 2004-2006*, in: R. Rudnicki (ed.) *Fundusze Unii Europejskiej*

- iej jako czynnik modernizacji rolnictwa polskiego*, "Studia i Prace z Geografii i Geologii" 7, Poznań
- Poławski Z. (2006), *Zmiany powierzchni i przestrzennego rozmieszczenia lasów w Polsce w II połowie XX wieku*, "Leśne Prace Badawcze" Vol. 3, p. 57-70
- Protokół z Kioto do Ramowej Konwencji Narodów Zjednoczonych w sprawie zmian klimatu*, sporządzony w Kioto dnia 11 grudnia 1997r, Dz.U. 2005 nr 203 poz. 1684
- Raport Światowej Komisji ds. Środowiska i Rozwoju ONZ* (1987)
- Rozporządzenie Parlamentu Europejskiego i Rady (UE) Nr 1305/2013 z dnia 17 grudnia 2013 r. w sprawie wsparcia rozwoju obszarów wiejskich przez Europejski Fundusz Rolny na rzecz Rozwoju Obszarów Wiejskich (EFRROW) i uchylające rozporządzenie Rady (WE) nr 1698/2005
- Skłodowski P., Bielska A. (2009), *Właściwości i urodzajność gleb Polski – podstawą kształtowania relacji rolno-środowiskowych*, "Woda – Środowisko – Obszary wiejskie" Vol. 9, No. 4 (28), p. 203-214
- Skolud P. (2008), *Zalesianie gruntów rolnych i opuszczonych terenów rolniczych poradnik właściciela*, CILP
- Strategia Europa 2020* (2010), https://ec.europa.eu/info/strategy/european-semester_en [20-08-2017]
- Ustawa o zmianie ustawy – Prawo energetyczne oraz ustawy – Prawo ochrony środowiska, Dz.U. 2005 nr 62 poz. 552
- Ustawa z dnia 20 lutego 2015 r. o wspieraniu rozwoju obszarów wiejskich z udziałem środków Europejskiego Funduszu Rolnego na rzecz Rozwoju Obszarów Wiejskich w ramach Programu Rozwoju Obszarów Wiejskich na lata 2014–2020
- Woźniak M. (2011), *Zrównoważony rozwój jako strategia definiująca nowoczesne gospodarowanie przestrzenią w Polsce (aspekty prawne)*, "Ekonomia i Prawo" Vol. VII, p. 134
- Wskaźniki Zrównoważonego Rozwoju Polski 2015*, p. 269, https://stat.gov.pl/files/gfx/portalinformacyjny/pl/defaultaktualnosci/5501/5/2/1/wzr_2015_-_publikacja.pdf [27-11-2017]
- Zasady Ogólnych Praw i Obowiązków Deklaracja z Rio de Janeiro w sprawie środowiska i rozwoju*, http://old.ko.poznan.pl/pub/ftp/Edukacja_zrownowazonego_rozwoju/DEKLARACJA_Z_RIO_1992.pdf [27-11-2017]



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RECYCLING OF CONSTRUCTION WASTE AS ONE OF THE ASPECTS OF SUSTAINABLE CONSTRUCTION

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ABSTRACT: The article presents the concept of using construction waste as an alternative to natural aggregates in sustainable construction. Due to the fact that the quantity of concrete produced per year is very large, its complete processing would make it possible to produce large quantities of secondary aggregate. Reuse of recovered debris involves the need to recycle it. Therefore, technologies should be implemented to allow the use of raw materials. Recovered and waste treatment should ensure that the highest quality raw material is obtained. Contemporary technologies and knowledge allow for the development of a method that will allow for complete debris remediation as well as the cost reduction of the entire technological process. It is extremely important from the point of view of environmental protection and economic account.

KEY WORDS: construction waste, construction waste recycling, concrete rubble, sustainable construction

Introduction

In Poland for several years, we have been able to observe the implementation of sustainable building principles, the idea of which is to design, build and use for the future, which is conducive to the construction of buildings that do not pollute the environment of various types of waste and make the use of facilities friendly both for users as well as for the environment. The sustainability and quality of design, construction and material solutions, but also the availability and comfort of the buildings and associated equipment, and the beautiful, healthy and green environment are the key objectives of sustainable construction. In shaping urban space, more attention is paid to the expansion of green areas and rest areas, which integrate into built-up areas. Urbanization processes cause a steady increase in construction investment, while current construction is increasingly aware not to diminish the prospect of future generations for a valuable, healthy life. The goal of sustainable construction is also economics, which means that a city, country or continent is more likely to be chosen for a place to live or to locate a business where healthy living conditions exist.

Sustainable building is a priority for reducing energy consumption and ensuring that end-of-life resources can be used for future generations. This is particularly important in the housing sector, where its visible growth has increased the demand for concrete. Its production is related to the use of raw materials of natural origin, especially natural aggregates, which is slowly becoming a problem.

In recent years there has been a growing awareness of society and a less permissible use of natural resources. The number of plants extracting natural aggregates is decreasing, thus damaging the environment. Consequently, it was necessary to look for alternative raw materials whose properties are at least similar to natural ones. This would justify the replacement of natural aggregate with the aggregate in the production of natural aggregates. This is particularly important in the case of concrete whose production is constantly increasing and the amount of aggregate used in its production is significant. The development of construction and thus the consumption of concrete made it necessary to refine its recipe in order to use substitute raw materials. A number of studies have made it possible to improve the way it is manufactured and the possibility of using alternative aggregates. This greatly reduced the consumption of raw materials.

Concrete rubble as building material for reuse

In the construction sector, in addition to building new facilities, there is also the need to demolish buildings unsuitable for further use. Demolition or demolition of structures results in an increasing amount of concrete debris that hits landfills. This is related to many issues related to both the large areas occupied by debris as well as its negative impact on the environment or the need to set up new landfills. Due to environmental, economic and legal conditions, a ban on the storage of concrete debris is prohibited. Increasing ecological awareness of society has necessitated the need to process concrete debris in such a way that it can be reused. For several years, research has been conducted on both methods of processing rubble and the properties of secondary raw materials. At first, alternative aggregates did not exhibit good properties and limited use. Developing technologies, as well as a number of researches, have allowed the method to be refined and thus produce a secondary aggregate with properties similar to natural aggregates.

The processing of concrete rubble for reuse is, however, associated with a large amount of waste generated by its processing in the form of dusts, as well as problems associated with the production of large amounts of CO₂, which does not in principle favor the environmental principles to which it attaches, more weight. It is therefore imperative to improve the technology of debris removal to eliminate any manufacturing defects.

The quantity of concrete debris produced each year is very large, so its complete processing would make it possible to produce large quantities of secondary aggregate. From the point of view of sustainable construction, this would reduce the amount of waste deposited in landfills as well as the quantity of natural aggregates obtained, and thus the balance between ecology, economy and society. This is quite a problem due to the increasing amount of construction waste and the decreasing amount of natural resources. The legal conditions introduced by both the European Union and the government are brought about by this. This is to promote issues especially related to ecology.

Concrete is one of the most commonly used building materials not only in Poland, but also in the world. The construction industry should meet the requirements of durable and ecological construction, but many factors affect the fact that concrete structures may be considered not to meet these basic principles. The problem is the changing climate, the decline in natural resources and the non-organic production of concrete. The cement production process produces significant amounts of gases into the environment causing global greenhouse effects. The decline in natural resources of such valuable raw materials as sand, gravel, and water is due to their use in the

manufacture of concrete. Over the past several decades, the development of design, optimization and refinement processes of concrete has rapidly developed, allowing for more economical and functional solutions. The use of such concrete had a beneficial effect on the reduction of natural resources. In the future, however, it will be necessary, in justified cases, to get rid of objects made of high-strength concretes, and the resulting debris can be used and be reused in new constructions. Growing ecological awareness of society leads to finding new solutions in the construction industry. Action should be taken systematically and the implementation of the principles of sustainable development (Adamczyk, 2010, p. 125-131) should be carried out so that the effects on the environment are visible and lasting. Ecological practices mean that there is a growing trend towards the use of recycled materials. The use of construction rubble as a substitute for natural aggregates in the production of concrete mixtures is growing in popularity among the supporters. This is due to economic and ecological reasons. Using construction rubble is limited to the consumption of expensive natural aggregates, which also minimizes negative impact on the environment. A significant advantage can be achieved when the largest possible amount of recycled aggregates is used for the production of concrete. Environmental aspects have become increasingly important over the years and therefore the growing interest in alternative solutions in the construction industry. Two of the main reasons that make recycling more and more popular are the continuous increase in the amount of concrete waste and the steady increase in the consumption of concrete as building material. Many authors in their publications have presented concrete tests with recycled aggregates, but in most aggregates from conventional concrete (Bołtryk, 2008; Gołda, 2006; Zając, 2010). Few authors are involved in the use of high-grade recycled aggregates in concrete (Ajdukiewicz, 2009; Sadowska-Buraczewska, 2013) as well as in construction (Sadowska-Buraczewska, 2013, p. 2175-2184).

Types of construction waste

As a result of numerous renovations, demolitions and demolitions of old buildings, not only in Poland but also in the world, the problem of large quantities of debris has occurred. In developed countries, this problem was already addressed at the turn of the 1970s by a series of studies to re-use raw materials from the demolition of concrete structures. The main countries where the emphasis was placed on the recovery of aggregate as well as debris binders were Japan and the United States, where huge quantities of waste were deposited due to numerous earthquakes. The focus was mainly on the

properties of the recovered concrete components and the development of their processing technologies (Zajac, 2010, p. 134-135).

This problem was also addressed in Poland by the implementation of the Waste Act, which introduced measures to reduce the negative environmental impact of waste generation and the poor management of waste. The waste is defined as the object or substance the owner discards, is intended to be disposed of or is required to be disposed of. This law includes the division of waste into groups based on the origin of the waste. Construction waste is included in group 17, which contains the following subgroups:

- construction rubble made of concrete, reinforced concrete or brick construction,
- structural steel, reinforcing steel and other metals,
- wood,
- finishing materials, including glass, insulating materials, plastics and others,
- earth from trenches and road debris (Ajdukiewicz, 2009, p. 65-69).

Construction rubble can also be divided depending on the degree of contamination. There are then divided into three categories: finishing materials, including glass, insulating materials, plastics and others,

1. unloaded – mineral material, which contains small amounts of organic and inorganic substances. Obtaining such debris is only possible with proper demolition work with segregation of the material obtained.
2. loaded – material that is obtained at demolition without proper selection of the components obtained. Once the work is done, sorting and neutralizing of unnecessary components is completed.
3. contaminated – material contaminated with harmful substances that threaten the health and the environment. It is obtained during the demolition work of buildings such as hospitals or laboratories. In case of such debris, the aggregate can be obtained only under pain of carrying out special disposal of harmful substances (Dworzańczyk-Krzywiec, 2011, p. 229-233).

Recycling of construction waste

Construction waste, to recover raw materials from them, must be recycled. Under the Act, this is a process that leads to the recovery of materials, substances or products that can be reused. The purpose of recycling is to create a closed circuit that allows the raw material recovered to build a new structure. Figure 1 shows a simplified scheme comparing recycling now and in the future.

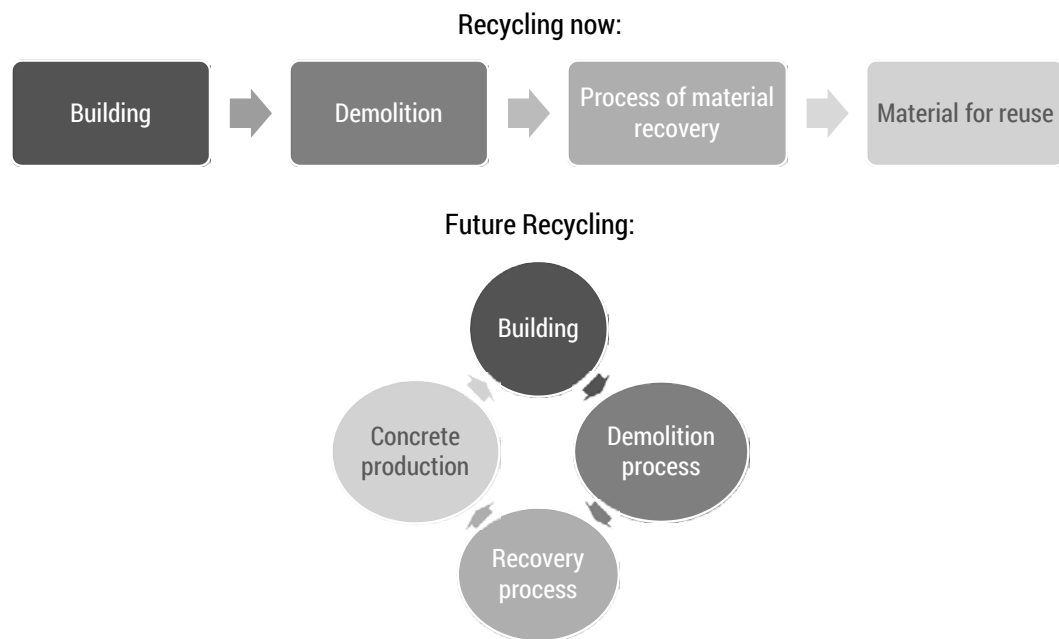


Figure 1. Recycling of current and anticipated recycling in the future

Source: author's own study based on (Zajęc, 2010, p.134-135).

Several basic factors must be fulfilled for the proper functioning of recycling facilities. First and foremost, the market must be prepared to receive aggregates and recycled mortars. Therefore both construction and other industries should implement technologies that allow the use of recovered raw materials. In order to reduce transportation costs, such plants should be located in areas that allow for permanent concrete rubbish deliveries. These areas should be adapted both for the retention of debris from demolitions, as well as for the easy arrival of trucks delivering waste and disposing ready-made aggregate. An important factor is the fact that the amount of natural aggregates is decreasing, and there are quite large costs of debris storage (Wolska-Kotańska, 2005, p. 18-22).

National waste management plan

After Poland entered the European Union, due to its provisions, a resolution of the Council of Ministers on the National Waste Management Plan was adopted. It aimed at analyzing the state of waste management, providing

forecasts for changes in waste management, and proposing actions that could reduce the problem of waste. According to this plan in the construction sector the largest share of waste in 2008. provided:

- metal scrap (40%),
- soil (30,7%),
- construction materials waste (26.9%) (Uchwała Nr 217 Rady Ministrów).

The introduction of policies promoting the recycling of waste from concrete debris is aimed both at reducing the amount of waste in landfills and by reducing the consumption of natural resources. According to the Resolution a large part of the waste from construction is recovered and reused, among others. Road construction, ground leveling or reclamation of excavations. It is estimated that the use of recycled raw materials in the road infrastructure sector will increase, which will allow the processing of the increasing amount of waste. Figure 2 shows the forecast of the generation of waste from construction in subsequent years.

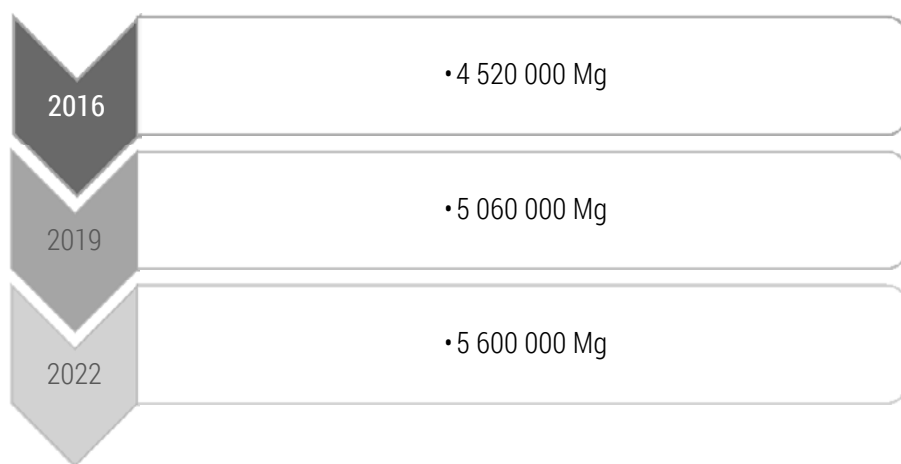


Figure 2. Forecast of generation of waste coming from the construction industry in subsequent years

Source: author's own study based on (Uchwała Nr 217 Rady Ministrów).

It is estimated that the amount of waste recycled or recovered will be about 70% by weight. In order to achieve this, it is necessary to sort the debris properly during demolition. It would be necessary to systematize the whole demolition process, starting from the planning, organization and finally demolition of the individual parts of the building (Ajdukiewicz, 2009, p. 65-69). An aspect that is particularly important when dealing with a problem related to waste is their environmental impact. In the era of ecology this

is a dominant factor. Both preventing the removal of construction waste into a dump and the use of recycled aggregates to reduce the consumption of natural aggregates are beneficial for the environment.

In Western countries: Japan, USA or Singapore recycling and reuse of materials reaches 90%. Large amounts of concrete waste resulting from earthquakes, insufficient natural aggregates, and environmental protection have contributed to the development of recycling in these areas. Also the high storage prices introduced there and the ban on landfill of waste in landfill resulted in increased efforts to recycle as much waste as possible to reuse them (Ajdukiewicz, 2009, p. 65-69). Regulations introduced in the Netherlands allowed the use of recycled aggregates in the amount of up to 20% for the production of concrete, thus replacing the expensive aggregate. 100% can be used in such elements as foundations, ceilings or walls without having to correct the design documentation (Swirydziuk, 2011, p. 79-81). Below Figure 3 shows the recycling aggregate cycle in general and in more developed countries.

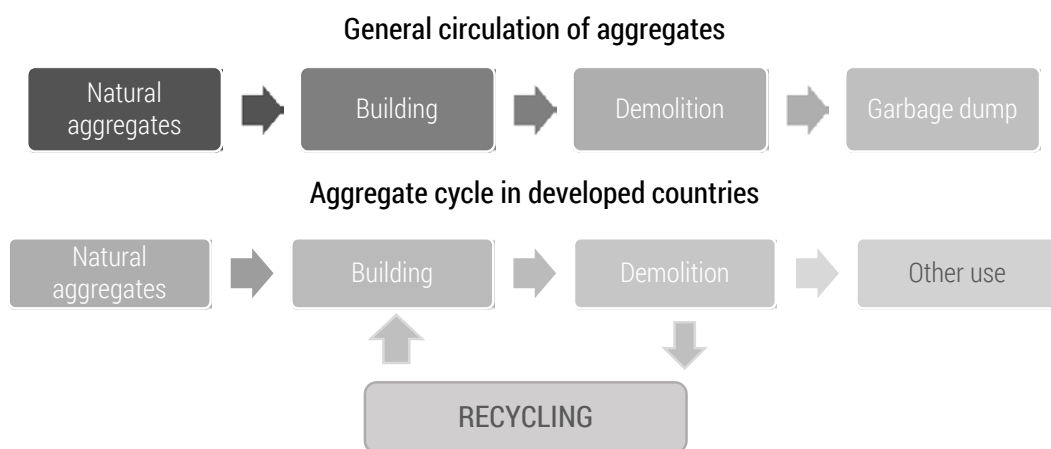


Figure 3. Aggregate cycle in general model and model used in developed countries

Source: author's own study based on (Ajdukiewicz, 2009, p. 65-69).

Stages of processing rubble

Materials obtained from recycled reinforced concrete structures are aggregate and dust with high cement content. In order to obtain the best qualities of the above raw materials, it is suitable to process them using high quality equipment and technology to obtain aggregate from contaminated debris. The steps of processing concrete debris are shown in figure 4 below.

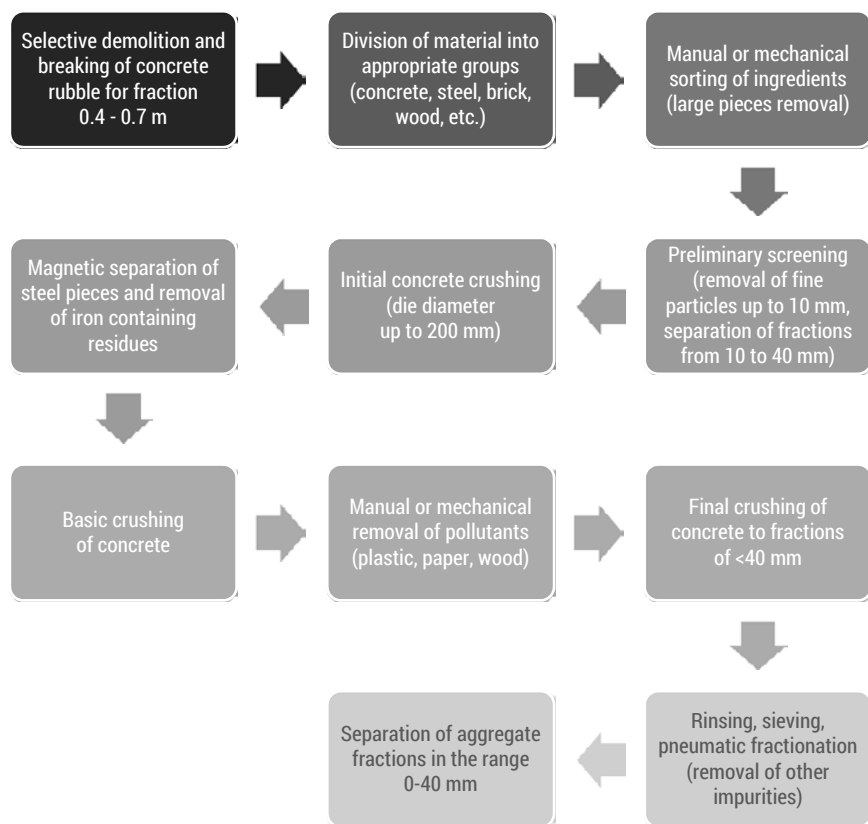


Figure 4. Stages of processing rubble into aggregate

Source: author's own study based on (Ajdukiewicz, 2009, p. 65-69).

In order to unify the way of recycling and thus create the ideal model, a number of studies have led to the release of the report by the International Association of Concrete in 2004. It contained works and documents from teams that carried out a series of studies. There are three areas of recycled aggregates in use:

- material used on the surface of floors and floors,
- material used for non-structural concretes or as an additive for natural aggregates,
- material used for construction concretes as fine and coarse aggregates with appropriate properties (Ajdukiewicz, 2009, p. 65-69).

Methods of obtaining raw materials from recycled construction waste

The country most developed in terms of research and modern methods of obtaining raw materials from recycling is Japan. The most famous are four methods of removing aggregate slurry from aggregate. Belong to them:

- HRM – Heating and Rubbing Method
- MGM – Mechanical Grinding Method
- SMM – Skrew Mill Method
- GCM – Gravity Classification Method.

Most of the aforementioned methods are just a theoretical solution that is not implemented. Most countries base their work on well-structured schemes where the debris processing process takes place in strictly defined stages. It consists of:

- separation of materials,
- segregation of debris into rubble: brick, concrete, ceramics, wood, reinforcing bars, bituminous materials,
- crushing individual, segregated pieces of rubble in impact crushers, jaw or cone crushers,
- sorting aggregates into individual fractions (Zajac, 2014, p. 393-395).

Over the past few years there has been a sharp increase in recycling issues in Poland. However, a number of statistics show that the amount of recycled rubble in our country for secondary aggregates is negligible. Below, figure 5 shows the percentage scale of construction waste processing in Poland and in the world.

In addition, highly developed countries, such as the Netherlands, Denmark and Germany, recycle large amounts of concrete, bricks, tiles or asphalt, while in Poland most of the processed waste is wood, glass, metals or gypsum.

The goal of modern recycling is to completely recycle construction debris, both concrete and brick, wood or other. The choice of waste treatment method should ensure both the highest quality raw material and the minimization of non-reusable components, such as too much dust generated by commonly used rubble crushing technologies. Contemporary technologies and knowledge allow for the development of a method that will allow for complete dehumidification as well as cost reduction of the entire technological process.

Economic analysis made by Japan has shown that in order to ensure the economic benefits of a given aggregate production facility, a productivity of 110-275 t/h has to be established, and in order to ensure adequate return on investment, the plant should produce and sell 200,000 tonnes of aggregate

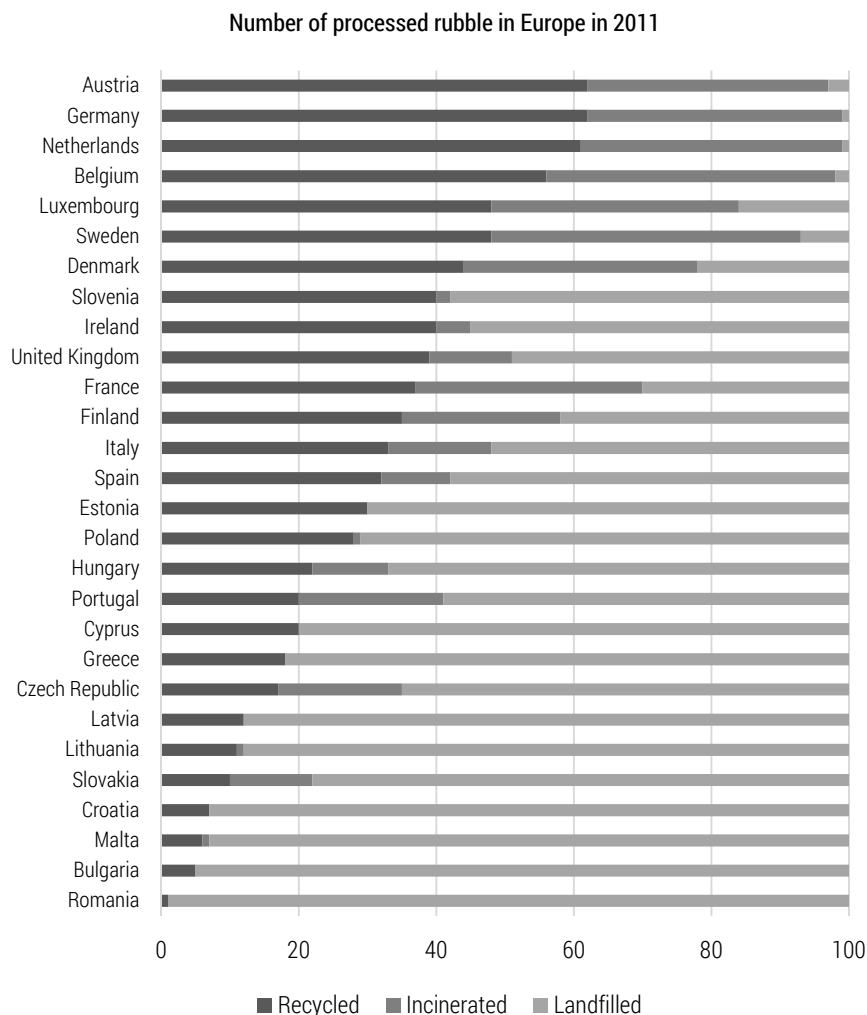


Figure 5. Number of processed rubble in Europe in 2011

Source: author's own study based on (Bhatnagar, 2013).

recycled annually. Apart from establishing capacity, it is also important to ensure the continuity of sales of recycled aggregates. The increase in demand for secondary aggregates is mainly influenced by the price that should be competitive with the prices of natural aggregates. Fulfilling all these requirements, choosing the right method, increasing the quality of the aggregate obtained, reducing the amount of dust produced, adjusting the capacity of the plant, and setting the right price for the raw material you sell will allow you to develop more extensive recycling.

Conclusions

Construction waste is an increasingly serious problem, not only in Poland and in the world, but also ecological and economic. Finding solutions for the reuse of concrete debris is quite a challenge. This article is intended not only to draw attention to this issue, but also to indicate the possibility of minimizing the use of natural resources, whose resources are running out, and the number of mine points is reduced through the reprocessing of concrete debris. The use of concrete waste is conducive to supporting sustainable construction based on ecological, economic and social issues. The possibility of processing huge amounts of concrete debris, which each year increases, reduces the extraction of natural aggregate.

It is postulated to implement new technologies allowing for the use of recycled raw materials that would ensure obtaining the highest quality raw material from processed waste. Current knowledge and modern technologies give the opportunity to develop new methods aimed at total processing of debris and minimizing the costs of the technological process.

Literature

- Adamczyk J., Dylewski R. (2010), *Recycling of construction waste in the context of sustainable construction*, "Problemy ekorozwoju" Vol. 5, No. 2, p. 125-131
- Ajdukiewicz A., Kliszczewicz A. (2009), *Recycling of structural concrete – p. I*, "Inżynier Budownictwa" No. 2(59), p. 65 – 69
- Bhatnagar A., Kaczala F., et. al. (2013), *Landfill Mining: A Sustainable Approach Towards Green Environment*, The international conference in Kokkola/Finland
- Bołtryk M., Pawluczuk E. (2008), *Method of determining the amount of water added to the concrete mixture with recycled aggregate*, "Zeszyty Naukowe Politechniki Białostockiej. Budownictwo" No. 32, p. 35-44
- Dworzańczyk-Krzywiec D. (2011), *Effect of recycled aggregate content on selected properties of concrete*, "Budownictwo i Inżynieria Środowiska" No. 2, p. 229-233
- Golda A., Król A. (2006), *Second life of concrete*, "Budownictwo technologie architektura" No. 4, p. 44-47
- Sadowska – Buraczewska B., Rutkowski P. (2013), *Concretes with high-strength recycled aggregates – a field of sustainable development*, "Rocznik Ochrona Środowiska" No. 15, p. 2175-2184
- Swirydziuk M. (2011), *Recycling of construction waste*, "Inżynier Budownictwa" No. 12 (90), p. 79-81
- Wolska-Kotańska C. (2005), *Properties and use of concrete recycling aggregates*, "Magazyn Autostrady" No. 3, p. 18-22
- Uchwała Nr 217 Rady Ministrów z dnia 24 grudnia 2010 r. w sprawie „Krajowego planu gospodarki odpadami 2014”
- Zajac B., Gołębiowska I. (2010), *Evolution of concrete recycling technology*, "Inż. Ap. Chem." No. 5(49), p. 134-135
- Zajac B., Gołębiowska I. (2014), *Construction waste management*, "Inż. Ap. Chem." No. 6(53), p. 393-395

GENERAL ENVIRONMENTAL AND SOCIAL PROBLEMS

PROBLEMATYKA
OGÓLNOEKOLOGICZNA I SPOŁECZNA

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RISK ASSESSMENT OF TOURISM COMPANIES LISTED ON THE STOCK EXCHANGE BASED ON THEIR FINANCIAL REPORTING

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ABSTRACT: The aim of the research was to identify the level of economic risk and to evaluate the effects of the risk management in the tourism companies listed on the stock exchange from 2010 till second quarter of 2017 on the basis of their financial reporting. Desk research method for identifying specific risks and a comparative indicator analysis of the tourism companies were used in the research process. Operating and financial risk, using degree of leverages and multipliers, bankruptcy risk, systematic risk, and business profitability have been measured. The results indicated that tourism companies operating in the valuable natural areas had a higher level of risk and, at the same time, had lower profitability. The necessity of verification of the way of distinguishing the tourism companies sector on the Warsaw Stock Exchange was pointed out and the implementation of social responsibility reporting standards in the tourist companies was recommended.

KEY WORDS: operational risk, financial risk, bankruptcy risk, tourism company

Introduction

Every business activity is a risky one. Touristic enterprises are exposed to specific industry risks associated with weather, local or political conditions that influence the level of sales and typical economic risks as well. In addition to operational (business) risk related to the appropriate asset structure, there is a financial risk associated with selecting the appropriate capital structure. Entities in the tourist industry that have introduced their shares to the stock market have sought to increase their credibility with customers and, by expanding their market share and increasing their profitability, wanted to reduce the level of economic risk.

The aim of the research was to identify the level of economic risk and to evaluate the effects of the risk management in the tourism companies listed on the stock exchange from 2010 till second quarter of 2017 on the basis of their financial reporting. The Warsaw Stock Exchange listed four tourism companies: Rainbow Tours S.A., Orbis S.A., Interferie S.A. and Tatry Mountain Resorts AS. While the first two focused their activity on the intermediary services (travel agency) and the development of the overall hotel offer (hotel operator), the last two firms run their businesses mainly in the valuable natural areas (respectively for Interferie: tourist and leisure services, sanatorium and spa services, hotels, organization of training courses or conferences and for Tatry Mountain Resort: ski resorts, aqua parks, amusement parks and hotels located in Slovakia, the Czech Republic and Poland).

An overview of literature

The risk is defined as the possibility of potential losses in the material or financial resources of the entity. Risk, as opposed to uncertainty, is related to quantitative or qualitative changes, i.e. risk is measurable (mathematically or statistically). Other approaches to uncertainty and risk, combining those two phenomena, can also be found in the literature (Gładysz, 2006, p. 31-32; Olkiewicz, 2012, p. 556-559).

There are different classifications of risk in an enterprise. Przesmycka and Podstawka (2015, p. 158) have identified risks related to the macroenvironment (political, technical, economic, environmental, social and corruption), risks related to microenvironment (suppliers, customers, competitors) and internal risk (organizational, legal and financial). The economic risk classification was also made by Chłapek (2015, p. 20-27). Those analyses indicate that particular elements of financial reporting allow to identify such types of economic risks as: operating, currency, liquidity, commodity price

changes, interest rate changes, business, financial, investment, bankruptcy, etc. (Chłapek, 2015, p. 74-77). This comparison indicates a lack of uniformity in separating particular types of risk in business entities, which significantly hinders risk management processes.

Pure and speculative risks in the company can also be distinguished. Pure risk arises irrespective of the actions taken and results from violent natural events (fire, flood, epidemic). The speculative risk, called economic, is the result of targeted activities such as introducing a new product or a new technology. The economic risk is a two-way operation, it means the possibility of both profit and loss exists (Dudycz, 2011, p. 180). Economic risks include, among others: business risk, financial risk and bankruptcy risk (Dąbrowski, 2015, p. 55-57). Its measurement is based on financial reporting (Gos et al., 2017, p. 7) and is carried out using financial analysis (Gołębiowski et al., 2014, p. 189, 243-249).

The scope of activity of tourism companies is relatively large, as it includes: transport services, hotel and catering services, health resorts, sports and leisure activities, travel agencies, tour operators and travel agents, as well as agritourism farms (Biczysko, 2011, p. 32-45; Kurleto, 2011, p. 475; Ozimek, 2011, 166-167). Also the tourist product offered is complex and its elements are constantly changing and adapting to the requirements of customers and the environment. Innovative types of tourism are emerging, like for example health tourism, which requires not only appropriate environmental values but also infrastructure and health services (Szymańska et al., 2017, p. 10). Still, the most important component of the tourism product is tourism values, especially environmental (Ozimek, 2011, p. 5). However, it should be noted that valuable natural areas, due to legal protection, will generate additional risks in tourism activity.

The tourism business is also subject to specific risks. Its level depends on many macroeconomic and microeconomic variables, both in the environment and within the enterprise. According to the World Tourism Organization, there are four main sources of risks in tourism: tourism sector and the related commercial sources, human and institutional environment outside the tourism sector, personal risk of individual travellers, physical risks from the environment – natural, climatic, epidemics (Stetić, 2012, p. 69-70). Other authors rated terrorism, war, political instability and health problems as the most important risk factors (Simanavicius et al., 2015, p. 837). A number of these factors are also indicated by Naira's research (2013, p. 142-144).

Attempts are being made to develop risk assessment models for tourism (Simanavicius et al., 2015, p. 839-841) or recommendations for the implementation of strategic risk management programs (Kurleto, 2013, p. 66). However, they do not effectively address all emerging problems. It seems that

a tourism company is not able to control or prevent all these specific risks, in particular that the three most important factors have the nature of uncertainty, not risk. On the other hand, it is the risk that is the impulse to undertake a given activity and gain income, therefore the emphasis in different model is mainly on the correct identification of risk.

Any change in terms and conditions of operation is reflected in financial results. And it was financial results that were the main subject of analysis. Attempts have been made to indicate how specific risks have been reflected in the financial results of business operations, and thus how they have transferred into economic risk.

Research methods

Desk research method for identifying specific risks and a comparative indicator analysis based on the consolidated financial statements of the tourism companies were used in the research process. The objects of the study were four tourism companies, whose shares were listed on the Warsaw Stock Exchange. Orbis S.A. and Rainbow Tours S.A. are large entities with sales revenues of approx. PLN 1.3 billion, whereas Tatry Mountains Resort AS and Interferie S.A. are smaller entities with revenues of about PLN 348 million and PLN 48 million in 2016.

The subject of the research were selected elements of economic risk, i.e. operational (business) risk, financial risk and bankruptcy risk. For comparative purposes, identification of specific risks and systematic risk was also made. Operational risk and financial risk were measured using leverage ratios (Dudycz, 2011, p. 113-142, 166-178). These studies were supplemented with risk multipliers ratios (Dębniewska, Skorwider-Namiołko, 2015, p. 84). The risk of bankruptcy was measured using the Polish prediction models. The model of Mączyńska and Zawadzki, the Poznań model and the Wierzbica model were used (Kitowski, 2015, p. 95-96, 142, 155). Those models were selected according to their high efficiency which were confirmed on the sector level (Antonowicz, 2007, p. 46, 59, 74; Balina, Bąk, 2016, p. 123). The specific risk was identified on the basis of management reports of the surveyed companies using descriptive methods. Systematic risk measurement was performed by determining the beta coefficients of the companies on the basis of their stock quotes and weekly rates of return according to the procedure proposed by Dąbrowski (2017, p. 40-41). In addition, the differences between coefficients were analysed after eliminating the impact of capital structure using the Hamada equation (Brigham, Houston, 2012, p. 547-548).

The study hypothesized that tourism companies listed on the stock exchange operating in the valuable natural areas are characterized by higher levels of economic risk than other tourism entities in the stock market.

Results of the research

The types of risks that have been identified by companies in the years 2010-2017 are set out in table 1. Specifics risk, economic risks and general risks were appeared. The types of risk in the companies were fixed in time and only in a few cases were redefined. The differences between the companies in types of risk were observed.

Table 1. Types of risks in the activity of tourist companies in the years 2010-2017

Rainbow Tours S.A.	Orbis S.A.
Risks associated with the occurrence of disasters in tourist regions Risk related to competition Risk associated with seasonality of sales Risk related to the financial position of subsidiaries Risk related to the macroeconomic situation of Poland Risk related to changes in regulations Currency risk Risk of rising oil prices	Risk related to the macroeconomic situation and the condition of the hotel industry Risk related to competition The risk of cooperation with agencies and travel agents Risk of reputation loss Legal risk
Interferie S.A.	Tatry Mountain Resorts AS
Market risk (including the risk of exchange rate fluctuations or cash flows as a result of changes in interest rates); Credit risk; Risk of liquidity loss; Competition risk; Legal risk; Reputation loss; Investment risk	Market risks (economic climate change in Central and Eastern Europe, seasonality of services (January-March, July-August), weather conditions, competition, under-occupancy and average price change Financial risks: exchange rate, interest rate, credit, liquidity, buyout of bonds, Operational risks: customer and employee safety, IT systems, variable return on investment, takeover risk, environmental risk

Source: authors' own work based on the activity reports of the management boards of the audited companies for the years 2010-2017.

In the case of the Orbis Group, the environmental impact of the company was further defined. They included energy demand and related CO₂ emissions, water demand, pollution and discharges, waste management and recycling, and biodiversity. A positive approach to the use of environmental resources was reflected in the corporate social responsibility report prepared for the first time in the company's history in the second quarter of

2017. This report was compliant with the requirements of the Global Reporting Initiative.

Interferie emphasized that the basis of the adopted strategy has been the potential for growth of the health tourism market, and that is the main direction of development. The approach to risk has evolved. By 2015, it was limited to the statement that „INTERFERIE S.A. is currently performing all duties imposed on the company for environmental protection”. The risk has been identified directly in the form shown in the table 1 only from 2016.

Tatry Mountains Resort (TMR) recognized that the activity was conducted in the valuable natural areas. According to the company's management, minimizing environmental risk occurs in implementing corporate social responsibility (CSR) principles, primarily by minimizing the use of energy and fuels. Other tasks mentioned in reports were more like a sponsorship.

Table 2. Business risk indicators in tourism companies listed on the stock exchange in the years 2010-2017

Items	Years								Mean	Coefficient of variation
	2010	2011	2012	2013	2014	2015	2016	2017 (Q2)		
Assets multiplayer	Overall								8,78	0,95
Rainbow Tours S.A.	1,44	1,41	1,30	1,17	1,13	1,19	1,23	1,18	1,26	0,09
Orbis S.A.	16,99	6,38	7,38	8,30	6,95	6,28	4,29	5,39	7,75	0,51
Interferie S.A.	20,65	17,96	27,63	28,80	27,62	17,22	12,29	9,26	20,18	0,37
Tatry Mountain Resorts AS	1,83	3,11	5,76	6,11	8,77	7,65	5,58	n/d	5,54	0,43
Degree of operating leverage (dynamic formula)	Overall								1,22	0,81
Rainbow Tours S.A.	n/d	0,64	0,76	3,17	1,97	0,94	0,75	1,01	1,32	0,70
Orbis S.A.	n/d	3,70	0,52	1,03	1,19	1,23	1,09	1,08	1,41	0,74
Interferie S.A.	n/d	0,84	0,65	1,19	0,88	1,80	0,82	1,31	1,07	0,37
Tatry Mountain Resorts AS	n/d	-1,43	3,35	1,06	0,62	1,74	0,94	n/d	1,05	1,48

Source: authors' own work.

The element of the study was an analysis of business risk. Results show high business risk in the companies surveyed measured by the multiplier of assets (table 2). It was strictly dependent on the type of activity. The smallest business risk was identified in the company which was a travel agency, as it did not require maintaining a high value of fixed assets. In other cases, high capital expenditure on assets was a source of high fixed costs and business risk. This situation was most apparent in the smallest company (Interferie).

Changes in the level of risk in Orbis, Interferie and TMR were significant as the variation coefficient ranged from 37 to 51%.

The dynamic analysis did not confirm the high level of risk. A comparison of the rate of change in operating profit and the rate of change in sales indicates that smaller companies had lower average risk than larger companies. In individual terms, however, high risk was observed in each group, e.g. Orbis in 2011, the TMR in 2012, Rainbow Tours in 2013. Only Interferie throughout the study period minimized its operational risk. Therefore, it can be concluded that the achieved high financial results effectively eliminated business risk.

Table 3. Financial risk indicators in tourism companies listed on the stock exchange in the years 2010-2017

Items	Years								Mean	Coefficient of variation
	2010	2011	2012	2013	2014	2015	2016	2017 (Q2)		
Equity multiplier	Overall								1,95	0,54
Rainbow Tours S.A.	2,38	2,43	2,85	3,12	2,72	2,46	2,83	4,91	2,96	0,28
Orbis S.A.	1,22	1,11	1,10	1,06	1,07	1,39	1,47	1,54	1,25	0,15
Interferie S.A.	1,13	1,16	1,25	1,25	1,21	1,18	1,16	1,17	1,19	0,04
Tatry Mountain Resorts AS	1,12	1,16	1,16	3,40	3,51	3,49	3,54	n/d	2,48	0,51
Degree of financial leverage (dynamic formula)	Overall								0,26	8,44
Rainbow Tours S.A.	n/d	0,77	1,15	0,88	0,62	0,75	1,09	1,18	0,92	0,24
Orbis S.A.	n/d	2,14	1,12	0,96	1,10	1,02	0,87	0,95	1,17	0,37
Interferie S.A.	n/d	-0,23	-9,53	0,48	1,23	1,08	0,83	1,03	-0,73	5,37
Tatry Mountain Resorts AS	n/d	-0,64	0,30	1,38	0,15	-0,49	-3,23	n/d	-0,42	3,69

Source: authors' own work.

The results of financial risk analysis are presented in table 3. They point to the high financial risk of the surveyed companies. In terms of multipliers, it was first seen in Rainbow Tours and from 2013 in Tatra Mountain Resorts, while in leverage also Orbis in 2011 and Interferie in 2010-11 were characterized by high financial risk. In aggregate terms, however, the risk was in the medium range.

Table 4. Bankruptcy risk analysis in tourism companies listed on the stock exchange in the years 2010-2017

Items	Years							
	2010	2011	2012	2013	2014	2015	2016	2017 (Q2)
Rainbow Tours S.A.								
Mączyńska and Zawadzki model	4,68	6,15	6,49	10,00	14,64	11,88	9,11	6,63
Poznan model	1,61	1,47	1,17	1,49	2,29	2,46	1,86	0,55
Wierzba model	0,60	0,56	0,53	0,86	1,26	1,21	0,97	0,72
Orbis S.A.								
Mączyńska and Zawadzki model	3,34	9,09	7,78	9,69	9,51	5,95	6,24	5,43
Poznan model	2,88	5,39	5,57	6,92	6,79	5,44	6,72	3,64
Wierzba model	-0,38	0,57	0,37	0,51	0,64	0,46	0,63	0,55
Interferie S.A.								
Mączyńska and Zawadzki model	4,02	4,24	4,07	3,97	4,19	5,26	5,32	5,78
Poznan model	3,54	2,82	2,69	2,65	2,79	3,79	4,04	3,67
Wierzba model	0,16	0,09	-0,07	-0,07	-0,08	0,16	0,18	0,32
Tatry Mountain Resorts AS								
Mączyńska and Zawadzki model	14,37	9,29	6,54	1,80	2,18	2,31	2,70	n/d
Poznan model	28,63	14,35	7,64	0,84	4,73	4,81	5,84	n/d
Wierzba model	1,16	0,48	0,36	-0,35	-0,31	0,00	0,11	n/d

Source: authors' own work.

Results of bankruptcy risk analysis (table 4) indicates that such risk in 2010-2017 has not been identified. The model of Mączyńska and Zawadzki as well as the Poznan model always pointed to the high value of the discriminative function. It significantly exceeded the limit value of the model, i.e. 0, which indicates the financial stability of the surveyed enterprises. Only the Wierzba model in some periods indicated slight deviations from the acceptable level, which was due to the specifics of the construction of this model. These deviations were not permanent, the longest period which last 3 years was observed in Interferie.

Table 5. Indicators of business profitability in tourism companies listed on the stock exchange in the years 2010-2017

Items	Years								Mean	Coefficient of variation
	2010	2011	2012	2013	2014	2015	2016	2017 (Q2)		
Cash Return on Assets (%)	Overall								7,75	1,04
Rainbow Tours S.A.	n/d	0,92	13,77	42,41	10,34	6,09	-1,70	-0,77	10,15	1,51
Orbis S.A.	n/d	8,10	5,59	7,59	9,26	12,72	14,25	13,43	10,13	0,33
Interferie S.A.	n/d	2,85	6,69	4,92	3,21	6,49	5,41	5,90	5,07	0,30
Tatry Mountain Resorts AS	n/d	5,56	3,28	4,14	4,37	6,55	7,82	b.d.	5,29	0,32
Return on Equity (%)	Overall								10,45	1,30
Rainbow Tours S.A.	n/d	6,50	7,54	31,79	51,11	38,24	28,25	34,62	28,29	0,57
Orbis S.A.	n/d	6,37	3,53	3,36	4,59	9,72	11,10	11,21	7,13	0,49
Interferie S.A.	n/d	-0,57	3,51	2,02	2,32	5,05	3,62	4,90	2,98	0,65
Tatry Mountain Resorts AS	n/d	3,53	3,62	3,52	0,67	-0,74	2,64	b.d.	2,21	0,83

Source: authors' own work.

Analysis of the financial results – both in terms of cash return of assets and return on equity (table 5), indicates a high variability of results. Although the average score was positive, there were times when no cash was generated on sale (Rainbow Tours in the last two periods) or loss was generated (Interferie in 2011 or the TMR in 2015). The highest rates of return were achieved by larger companies, whose activities did not only perform in the valuable natural areas.

The analysed companies maintained their profitability and cash efficiency in the years 2010-2017. The average profitability of the travel agency was over 28% and exceeded the profitability of other companies several times. The lowest average profitability was observed among Interferie and Tatry Mountain Resorts companies, thus in companies operating in the valuable natural areas. In the ability to generate cash on operating activities similar trends were also observed, although the travel agency's situation began to deteriorate and there the highest volatility was observed.

The results of the systematic risk analysis (table 6) show that the beta coefficients were less than 1, so the risk of changing the return on investment in stocks of these companies was lower than market risk. In addition, the betas of smaller tourism companies were close to zero or even negative, indicating a trend reversal to the overall market. Eliminating the impact of capital structure slightly reduced the average, but not its variability. The betas of the

Table 6. Measures of synthetic risk in tourism companies listed on the stock exchange in the years 2010-2017

Items	Years								Mean	Coefficient of variation
	2010	2011	2012	2013	2014	2015	2016	2017 (Q2)		
Beta coefficient	Overall								0,31	1,59
Rainbow Tours S.A.	0,93	0,13	1,06	0,99	1,32	0,43	0,91	0,95	0,84	0,45
Orbis S.A.	1,23	0,69	0,54	0,27	0,32	0,61	0,19	0,64	0,56	0,58
Interferie S.A.	-0,02	0,06	-0,01	-0,12	0,20	-0,08	0,16	0,40	0,07	2,36
Tatry Mountain Resorts AS	-0,43	-0,15	-0,33	-0,40	0,13	-0,09	-0,19	-0,32	-0,22	-0,84
Unlevered beta coefficient	Overall								0,19	1,57
Rainbow Tours S.A.	0,44	0,06	0,42	0,36	0,55	0,20	0,37	0,23	0,33	0,48
Orbis S.A.	1,04	0,63	0,50	0,26	0,31	0,47	0,14	0,44	0,47	0,59
Interferie S.A.	-0,01	0,06	-0,01	-0,10	0,17	-0,07	0,14	0,35	0,06	2,33
Tatry Mountain Resorts AS	-0,39	-0,13	-0,29	-0,13	0,04	-0,03	-0,06	n/d	-0,14	-1,06

Source: authors' own work.

surveyed companies were still significantly different from each other, even though they came from the same industry.

Analysis of beta coefficients indicated that Rainbow Tours and Orbis tourism companies were characterized by lower systematic risk. On the other hand, companies operating in the valuable natural areas often move against market trends, which indicates that they cannot earn a lot of money, but also it is less likely to lose on them. The analysis of unlevered coefficient shows that the surveyed companies do not form a single industry on the stock market. The unlevered beta of the industry should be similar. So the separation of this stock market: Hotels and restaurants or Tourism seems to be premature. In addition, the uncertainty of beta factors indicates that the stock market in Poland is not yet mature.

Conclusions

The examined tourism companies were characterized by high business risk and medium financial risk. Two companies which concentrate their activity on the valuable natural areas had higher overall risk, which did not give higher rates of return. All the companies tried to diversify their risk. As a result, Rainbow Tours applied a high-risk financial strategy and low-risk

business strategy, and the other three companies generally adopted a high operational risk strategy, resulting from their business.

The business risk analysis indicates that the surveyed companies identified various general and specific risk. More detailed analysis of specific risks can be found in the reports of companies that have implemented a model based on corporate social responsibility. Environmental risk was rarely underline – more often it was an element of legal risk. Only one company (Tatry Mountain Resorts) focus on natural environment in which it operated, which in the tourism industry should be standard. The key postulate is therefore the implementation of corporate social responsibility reporting, which should facilitate understanding of the importance of environmental risk.

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Marianna Dębniewska, Prof. – 40% (conception, literature review, analysis and interpretation of data)

Jarosław Skorwider-Namietko, PhD – 40% (conception, literature review, acquisition of data, analysis and interpretation of data)

Karol Wojtowicz, PhD – 20% (acquisition of data, analysis and interpretation of data)

Literature

Antonowicz P. (2007), *Metody oceny i prognoza kondycji ekonomiczno-finansowej przedsiębiorstw*, Gdańsk

Balina R., Bąk M. (2016), *Analiza dyskryminacyjna jako metoda predykcji bankructwa przedsiębiorstw z uwzględnieniem aspektów branżowych*, Wałęńców

Biczysko J. (2011), *Zarządzanie finansami w przedsiębiorstwie turystycznym*, Warszawa

Brigham E., Houston J. (2012), *Zarządzanie finansami*, Warszawa

Chłapek K. (2015), *Pomiar ryzyka gospodarczego na podstawie sprawozdań finansowych*, Warszawa

Dąbrowski I. (2015), *Economics of Finance. Agency Problem and Risk in Corporate Finance*, Warszawa

Dębniewska M., Skorwider-Namietko J. (2015), *Wybrane aspekty oceny ryzyka w działalności spółek społecznie odpowiedzialnych*, „Prace Naukowe Wyższej Szkoły Bankowej w Gdańsku” No. 38

Dudycz T. (2011), *Analiza finansowa jako narzędzie zarządzania finansami przedsiębiorstwa*, Wrocław

Gładysz M. (2006), *Ryzyko w działalności gospodarczej*, „Ekonomika i Organizacja Gospodarki Żywnościowej” No. 59

Gołębiowski G. (ed.), Grycuk A., Tłaczała A., Wiśniewski P. (2014), *Analiza finansowa przedsiębiorstwa*, Warszawa

- Gos W., Hońko S., Szczypa P. (2017), *ABC sprawozdań finansowych. Jak je czytać, interpretować i analizować*, Warszawa
- Kitowski J. (2015), *Metody dyskryminacyjne jako instrument oceny zagrożenia upadłością przedsiębiorstwa*, Rzeszów
- Kurleto M. (2011), *Zarządzanie wartością w biurach podróży obsługujących ruch biznesowy*, „Zeszyty Naukowe Uniwersytetu Szczecińskiego. Finanse, Rynki Finansowe, Ubezpieczenia” No. 46
- Kurleto M. (2013), *Koncepcje ryzyka i niepewności w zarządzaniu kryzysowym przedsiębiorstw turystycznych*, „Współczesne Zarządzanie” No. 1
- Nair G. (2013), *Influence of Risk Assessment Factors on the Tourism Performance in Qatar: An Empirical Study*, „American Journal of Tourism Research” Vol. 2, No. 2
- Olkiewicz A. (2012), *Ryzyko i jego wpływ na decyzje przedsiębiorstw*, „Zeszyty Naukowe Uniwersytetu Szczecińskiego. Finanse, Rynki Finansowe, Ubezpieczenia” No. 56
- Ozimek I. (ed.) (2011), *Funkcjonowanie i rozwój współczesnej turystyki – wybrane zagadnienia*, Warszawa
- Przesmycka A., Podstawka M. (2015), *Zarządzanie ryzykiem w działalności przedsiębiorstw – wybrane zagadnienia*, „Zeszyty Naukowe Uniwersytetu Przyrodniczo-Humanistycznego w Siedlcach. Seria: Administracja i Zarządzanie” No. 105
- Simanavicius, A., Edmundas, J., Biruta, S. (2015). *Risk assessment models in the tourism sector*, „Amfiteatru Economic” No. 17(39)
- Štetić S. (2012), *Risks in Tourism (On the Example of Events)*, „QUAESTUS. Multidisciplinary Research Journal” No. 3
- Szymańska E. et al. (2017), *Innowacje w turystyce zdrowotnej*, Warszawa.



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CONVENTIONAL BIOFUELS IN RESPECTS OF SUSTAINABLE DEVELOPMENT

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ABSTRACT: The aim of this paper was to discuss the issues related to conventional biofuels in the context of the sustainable development concept. The most important legal regulations which aim is ensuring their sustainable production was presented. The literature review was conducted in three dimensions – ecological, economic and social. Theoretically, conventional biofuels are in line with discussed idea, but in reality they are controversial. As a consequence, the current EU directives aim is to reduce their use and support the transition to advanced biofuels.

KEY WORDS: conventional biofuels, advanced biofuels, sustainable development

Introduction

Dynamic economic development, despite its numerous benefits (including improving the standard of living and the safety of societies) is connected with many negative phenomena as well as threats that are a major challenge for the 21st century. Degradation and pollution of the natural environment together with overexploitation of non-renewable natural resources (e.g. hard coal, crude oil and natural gas) are among the most serious ones. Faced with that problems, a lot of attention is paid to the sustainable development concept which emphasizes the need for the economic development to be harmonious with the natural environment and social sphere. In nowadays scientific discourse, for many decades, the term has most often been defined as the development that meets the needs of modern societies in a way that does not deprive future generations of the same possibility (Komorowska, 2014). In the concept of sustainable development, the pursuit of economic growth is not the aim in itself. It also involves social development and ecological approach towards life (Poskrobko, 2011). The idea is based on taking into consideration the relationship between the environmental, economic and social spheres as well as between the present and the future (Sobal, 2013).

The functioning of civilization and further economic development are inseparably connected with transport (Olejniak, 2016) – a major energy consumer and a significant pollution emittent. In the European Union, the transport sector accounts for about a third of the total energy demand (which is mostly covered by crude oil (petroleum)) (EU, 2016) and about a quarter of total greenhouse gas emissions, the most of which is generated by road transport (Kupczyk et al., 2017a). In an attempt to minimize its negative impact on the environment, the EU promotes the use of fuels based on renewable energy (in accordance with the concept of sustainable development) for transport. Member States are obliged to ensure that by 2020 the minimum share of renewable energy in final transport energy consumption is 10%. In this context, biofuel energy¹, which can be stored and, without significant technical impediments, used in the existing transport infrastructure, seems to be of greatest importance (ECA, 2016).

In Poland, conventional biofuels, such as methyl esters of higher fatty acids and bioethanol² (mainly made from rapeseed oil and maize) constitute the largest share in achieving the sector goal. Theoretically, the production and use of conventional biofuels support the idea of sustainable develop-

¹ According to Directive 2009/28/EC 'biofuels' means liquid or gaseous fuel for transport produced from biomass.

² In practice they are biocomponents – additives for petroleum fuels – bioethanol is blended with petrol, methyl esters with diesel.

ment. However, in practice these issues, due to their complexity and interdisciplinary, are a source of controversy.

Objectives, scope and methodology of the paper

The aim of the paper is to present the aspects connected with the production and the use of conventional biofuels in transport in relation to the sustainable development concept. The most important EU legal regulations highlighting the need to ensure the sustainable production of biofuels are presented in the paper. On the basis of the available literature, the issues related to biofuels based on agricultural raw materials in three dimensions – ecological, economic and social are also discussed. Both the aspects that form the basis of the claims in the paper and the ones that contradict it, are presented. The source materials are national publications, materials posted on biofuels websites and EU directives on the use of renewable energy in transport.

The complementary purpose of the paper is to present the results of research on attractiveness of conventional biofuels sectors in Poland in 2016. The scoring, multicriterial M.E. Porter method was used in the assessment of this sectors.

Biofuels and sustainable development – EU legislation

EU legislation clearly states that biofuels production should be sustainable. Consequently, in order to avoid its potential adverse environmental effects, biofuels must meet the so-called Sustainability Criteria (SC). Sustainability Criteria are a set of requirements introduced in 2009 by Directive 2009/28/EC (EU, 2009), which must be fulfilled in order for biofuel to be classified as renewable. Sustainability Criteria cover two types of issues:

- the biofuels capacity to reduce greenhouse gas emissions in relation to conventional fuels (by setting the required minimum reduction of greenhouse gas emissions from the use of biofuels in comparison to the fossil fuels emissions³),
- the problem of the biomass cultivation place, as a result of the establishment that biofuels cannot be produced from raw materials from high biodiversity areas (e.g. primary forests), carbon-rich areas (e.g. wetlands) and peatlands (Rogowska, 2014).

³ At least 60% for biofuels produced in installations starting operation after 5 October 2015, 35% for installations that were in operation on or before 5 October 2015 and at least 50% for them from 1 January 2018.

The second area of the Sustainability Criteria refers directly to the place where biomass is cultivated but does not take into account the so-called Indirect Land Use Change (ILUC). In many scientific circles, it has been recognized that the obligation to use biofuels can lead to diverted pasture or agricultural land to biofuels production. Such situation means that the demand for the food and feed products must be satisfied by the intensification of current production or by the production on other, non-agricultural land. The last scenario is an Indirect Land Use Change (ILUC) and when it involves the conversion of carbon-rich areas, it can lead to significant emissions of greenhouse gases. Identifying this phenomenon has led to a modification of legislation and the introduction of 2015/1513/EC (EU, 2015) in 2015. In this document, in order to reduce the effects of ILUC, the raw materials used for biofuel production have been diversified and it has been stressed that it is necessary to support the development of biofuels that do not compete with food crops. The directive introduced the division of biofuels into two types that is conventional ones (raw materials: cereal crops and other high-starch plants, sugar and oil and crops primarily grown for energy purposes on arable land as main crops) and advanced ones (raw materials: waste and algae and other listed in the Annex, including straw, manure and lignocellulosic materials). The Directive indicates that the second group of fuels leads to significant reductions in greenhouse gas emissions, low ILUC risk and does not compete with food and feed markets for agricultural land. Consequently, Member States should strive to promote the use of advanced biofuels and, in order to achieve the goal, set a minimum level of use (a reference value of 0.5% in 2020). Moreover, in order to prepare for the transition to these biofuels, it was established that conventional biofuels should not exceed 7% of final energy consumption in the Member States' transport sectors by 2020.

At present, the biofuels production in Poland is based primarily on the use of food raw materials (production of conventional biofuels). In 2016, methyl esters in nearly 100% were made from rapeseed oil, while bioethanol in about 70% from maize (table 1). In addition, the operation of technologies in the country that allow economically efficient production of biofuels from raw materials which do not compete with food production (advanced biofuels) is limited. As a result, EU legislation (Directive 2015/1513/EC) represents a significant challenge for the Polish transport biofuels sector in the coming years and raises many doubts.

Table 1. The raw materials used in Poland to produce methyl esters and bioethanol in 2016 (as for 13.03.17) [Mg]

	Raw material	Amount of used raw material (Mg)	Amount of produced biocomponent (Mg)
Methyl esters	Rapeseed oil	865 736	867 410
	Used vegetable oil	1 653	
	Rendered fat cat. III	1 985	
	Other	901	
Bioethanol	Maize	416 978	201 585
	Starch slurry	57 124	
	Strach C	39 042	
	Other	83 109	

Source: author's own work based on www.arr.gov.pl [20-03-17].

The impact of conventional biofuels on the environment

The unquestionable advantage of conventional biofuels is their renewable nature. The use of such energy in transport affects the reduction of the exploitation and use of non-renewable resources, which is crude oil. What is more, according to the SC (Sustainability Criteria), biofuels must meet the limits of greenhouse gas emissions and cannot directly contribute to the valuable natural areas degradation. Moreover, in the process of producing energy from biomass, valuable by-products are created, including rape meal, which is a protein-rich ingredient and is used in farm animals feed. Furthermore, conventional biofuels are easily degraded so that they do not pose a threat to soil and groundwater, e.g. in case of uncontrolled leakage. In addition, because of a higher ignition temperature, compared to diesel, they are considered safe (Żołądkiewicz, 2016).

On the other hand, in the 2015 directive, the ecological character of conventional biofuels was challenged (which was described in the previous subsection). Moreover, the necessity to allocate land for conventional biofuel crops may also result in the emergence of crop monocultures, which in turn leads to soil depletion, reduction of its fertility and biological activity (Komorowska, 2014). Furthermore, due to the lower biofuel calorific value compared to fossil fuels (table 2), it is necessary to provide a greater amount of fuel in the combustion process. Such situation contradicts the idea of sustainable development and the postulates of reducing energy consumption (Borychowski, 2014a).

Table 2. Energy content of transport fuels

Fuel	Energy content by weight * (MJ/kg)	Energy content by volume * (MJ/l)
Bioethanol	27	21
Petrol	43	32
Methyl-ester	37	33
Diesel	43	36

* lower calorific value

Source: author's own work based on Directive 2009/28/EC.

Economic aspects of conventional biofuels

The possibility to increase the energy security of states by reducing their dependence on imported petroleum is among the most positive economic factors associated with the production and use of biofuels. This is of great importance due to the precarious political situation of countries that are the main suppliers of traditional fuels and because of the finite resource reserves. Limiting demand for fossil fuels may also indirectly affect oil prices. In addition, biofuel production is an indirect stimulus for rural development and the economy as a whole, which is part of the concept of sustainable development. The additional demand for agricultural raw materials used in the production of conventional biofuels leads to an increase in farmers' incomes and thus reduces income disparities between those working in agriculture and those in other sectors (Żołądkiewicz, 2016). In 2016 the Polish oil industry in nearly 70% worked for the biofuel production industry. It is an economically viable alternative to the development of national processing potential (Portal Spożywczy, 2016). Moreover, among the economic advantages of biofuel production, price stabilization can be identified in the markets for agricultural commodities used for their production by the possibility of developing surplus raw materials (Borychowski, 2014b).

Despite the discussed economic reasons for the production and use of conventional biofuels, there are also some negative factors associated with them. The direct costs of producing biofuels, especially methyl esters, outweigh the costs of producing petroleum fuels, which reduces their competitiveness (Wójcik-Czerniewska, 2015). The analysis indicates that the cost of producing one thousand liters of methyl esters is € 250-300 higher than the cost of producing diesel. However, the economic account of bioethanol production is more favourable. In Brazil, using sugar cane requires lower inputs than gasoline, which is due to a favourable climate and cheap labour. In the

USA, when using corn, these costs are similar, but the production of sugar beet or cereal biofuels is more expensive (Berny et al., 2015).

Conventional biofuels in relation to the social sphere

The advantages associated with conventional biofuels relating to the social area can be attributed to the creation of additional jobs in sectors related to their production. Analysis conducted in the European Union indicates that it is necessary to employ 12-14 people to produce one thousand tons of biofuels (Berny et al., 2014). It is estimated that in Poland 60-65 thousand people work in such sectors (Kupczyk et al., 2017b). What is more, increasing demand for agricultural raw materials used in the production of biofuels (as mentioned in the previous subsection) increases farm incomes, thus reducing poverty in rural areas, thereby increasing the access of local people to goods and services (Borychowski, 2014a).

However, the issue of food security raises the most controversy surrounding conventional biofuels, in relation to the social sphere. The raw materials used for their production are included in edible agricultural raw materials, which should primarily be used for food purposes. The increasing demand for raw materials used in biofuel production can lead to competition for these raw materials between the food and feed sectors and the biofuels industry. There is therefore a risk of the so-called „the hunger for land” that is the insufficient amount of land under cultivation for the agro-food industry. A lot of scientists point to the relationship between the intensification of conventional biofuels production and the rise in prices of raw materials. In addition, the use of foodstuffs for energy purposes is considered unethical (Żołądkiewicz, 2016).

The attractiveness of the conventional biofuels sectors in Poland

Each sector, at different stages of its development, is characterized by certainty features which have influence on its attractiveness (value). The value of a given sector can be determined using the scoring, multicriterial M.E. Porter method, in which researches are based on an expert method. This means that sheets prepared by the research team (so-called assessment grids), containing the criteria which determine the attractiveness of the analyzed sector, are given to persons with extensive knowledge of it, and they evaluate this sector (Kupczyk et al., 2017a).

In order to assess the attractiveness of sectors related to the conventional production of bioethanol and methyl esters in Poland in 2016, a set of 15 selected criteria was used. These included among others: the size of the sector, the projected growth rate and the competitive intensity. It also includes the entry barriers, the raw materials availability and the profit margin as well as the favorability of EU policies and the social perception of the sector. The developed assessment grids were given to experts, who evaluated every factors in a 0-3 scale. The final value of a sectors (expressed as a percentage) are the quotient of experts grade point average and the maximum possible value.

The polish biofuels sectors attractiveness has been studied by the WULS Production Engineering Faculty research team since 2007. The results of the research were presented in numerous publications (e.g. Antczak et al., 2016) and for the purpose of this article have been compiled with the values obtained for 2016 (figure 1).

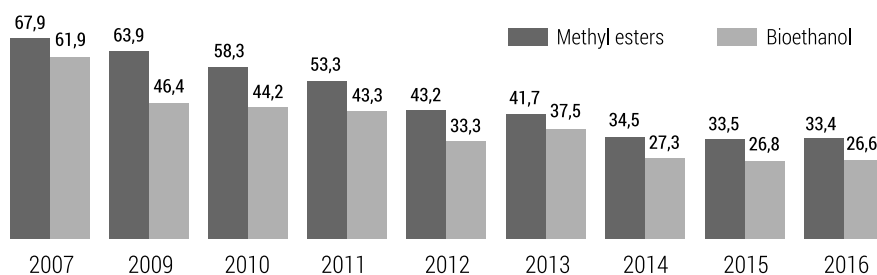


Figure 1. The attractiveness of the conventional biofuels sectors in Poland [%] [2007-2016]

Source: author's own work.

At the beginning of the analyzed period, the obtained results were very promising. However, because of the factors that undermine the conventional biofuels sustainability, the EU's legal regulations that limit the use of such fuels and, as a result, increase the interest in advanced biofuels, the attractiveness of the discussed sectors is systematically decreasing. The value of the methyl ester sector was more than twice lower in 2016 than it was in 2007, and shaped at a level of 33.4%. A similar situation occurred in the conventional bioethanol sector case, which attractiveness was assessed at 26.6%. Both of the analyzed sectors, related to the biofuels produced from food materials, are in the advanced stages of their life cycles and probably will go into the decline phase in the coming years. The current phase of their life cycle is characterized by a small and stable growth rate of the sector and also for the number of competitors as well as mature technologies.

Conclusions

The production and use of conventional biofuels in transport area are, in principle, part of the concept of sustainable development. Their use is reflected in ecological, economic and social aspects. Sectors related to the production of these biofuels are based on natural resources, limit the use of conventional fuels and greenhouse gas emissions and stimulate rural development. What is more, the production of biofuels reduces the dependence on imported mineral fuels and thus increases energy security. On the other hand, there are some aspects connected with conventional biofuels that are not in line with the postulates of the discussed issue. The main problem in this context is disputable, positive impact on the natural environment – its dubious protection due to the insignificant reduction of greenhouse gas emissions (with regard to ILUC emissions). Moreover, the demand for agricultural raw materials used in the production of biofuels can lead to competition for them between the food and feed sectors and the biofuel industry.

Initially, biofuels produced from agricultural raw materials had high hopes, but today they are a source of controversy because they do not deliver the expected environmental, economic and social effects. As a consequence, their production and use are currently undergoing a redevelopment phase, as indicated by EU legislation in order to reduce their use and support the transition to advanced biofuels (Directive 2015/1513/EC). This situation is also reflected in studies on the attractiveness of the biofuels sectors in Poland. Before 2010, the sectors related to the conventional production of bioethanol and methyl esters, were evaluated as attractive elements of the domestic economy. Since then, their attractiveness has been systematically decreasing and was more than twice lower in 2016 than it was in 2007.

National experts in the biofuels industry are of the opinion that advanced biofuels should be an important part of the energy mix of transport fuels in Poland. However, in their view, the sector ought to evolve in such a way that the current market and economic role of conventional biofuels is preserved, and that measures to support advanced biofuels include all accompanying circumstances, including their actual domestic production capacities on an industrial scale (Czubiński, 2016).

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The contribution of the authors

Joanna Mączyńska – 70%

Adam Kupczyk – 30%

Literature

- Antczak A. et al. (2016), *Wyniki wybranych badań przeprowadzonych w ramach projektu WOODTECH*, Warszawa
- Berny D. et al. (2015), *Wyzwania dla sektora biopaliw w świetle rozwijającej się biogospodarki*, "Zeszyty Naukowe Politechniki Śląskiej, Organizacja i Zarządzanie" No. 79, p. 41-55
- Borychowski M. (2014a), *Czy produkcja biopaliw w Polsce wspiera zrównoważony rozwój rolnictwa? Refleksje na marginesie perspektyw rozwoju biogospodarki*, "Roczniki Ekonomiczne Kujawsko-Pomorskiej Szkoły Wyższej w Bydgoszczy" No. 7, p. 135
- Borychowski M. (2014b), *Produkcja biopaliw w Polsce a zrównoważony rozwój rolnictwa. Dylemat biogospodarki*, "Roczniki Naukowe Ekonomistów Rolnictwa i Agrobiznesu" No. 6(16), p. 51-56
- Czubiński T. (2016), *Rzepakowcy o biopaliwach*, <https://www.topagrar.pl/articles/top-uprawa/rzepakowcy-o-biopaliwach/> [24-07-2017]
- ECA (2016), *Sprawozdanie specjalne – unijny system certyfikacji zrównoważonych ekologicznie biopaliw*, Luksemburg, p. 13
- EU (2009), *Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC*, L 140
- EU (2015), *Directive 2015/1513 of the European Parliament and of the Council of 9 September 2015 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources*, L 293
- EU (2016), *Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources (recast)*, Procedure 2016/0382/COD
- Komorowska D. (2014), *Rozwój współczesnego rolnictwa w kontekście celów zrównoważonego rozwoju*, "Wieś i Rolnictwo" No. 3(164), p. 71-84
- Kupczyk A. et al. (2017a), *Identyfikacja obecnego stanu oraz atrakcyjność sektorów biopaliw transportowych w Polsce*, "Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu" No. 2(19), p. 139-144
- Kupczyk A. et al. (2017b), *Stan i perspektywy oraz uwarunkowania prawne funkcjonowania sektorów biopaliw transportowych w Polsce*, "Roczniki Naukowe Ekonomii Rolnictwa i Rozwoju Obszarów Wiejskich" No. 1(104), p. 39-55
- Olejek K. et al. (2016), *Wybrane problemy warunków realizacji przemieszczania osób*, "Autobusy" No. 12, p. 348-353
- Portal Spożywczy (2016), *Rozwój upraw rzepaku w Polsce to dowód na pozytywny wpływ biopaliw na rolnictwo*, <https://www.portalspozywczy.pl/zboza/wiadomosci/rozwoj-upraw-rzepaku-w-polsce-to-dowod-na-pozytywny-wplyw-biopaliw-na-rolnictwo,133128.html> [24-07-2017]

- Poskrobko B. (2011), *Wstęp*, in: B. Poskrobko (ed.), *Ekonomia zrównoważonego rozwoju w świetle kanonów nauki*, Białystok, p. 8
- Rogowska D. (2014), *Przegląd dobrowolnych systemów certyfikacji biopaliw na zgodność z kryteriami zrównoważonego rozwoju*, "Nafta-Gaz", p. 256-261
- Sobal A. et al. (2013), *Gospodarka przestrzenna a lokalny rozwój zrównoważony*, "Ekonomia i Środowisko" No. 3(46), p. 70-78
- Wójcik-Czerniewska A. (2015), *Perspektywy rozwoju sektora biopaliw*, "Zeszyty Naukowe Politechniki Częstochowskiej. Zarządzanie" No. 18, p. 139.
- Żołądkiewicz A. (2016), *Ekonomiczno-ekologiczne aspekty produkcji biopaliw ciekłych*, "Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu" No. 3(18), p. 426-431

Alicja STOLARSKA

NON-AGRICULTURAL SELF-EMPLOYMENT AS A FACTOR OF ECONOMIC INCLUSION OF THE RURAL POPULATION

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ABSTRACT: The purpose of this paper was to identify and assess the economic situation of the working rural population in the years 2013-2016, with particular attention to the households of the self-employed. Unpublished unit data from BGD GUS and REGON, as well as secondary data sources were used in the paper. For each occupational group, income, expenditure and savings were compared. It was determined that the highest income in rural areas was obtained by households, composed mostly of non-physical workers, while the lowest income was generated by blue collar workers. The good economic situation of the self-employed households from outside the agricultural sector was observed, which improved significantly in the years 2013-2016, although it varied from one household to another. The importance of this form of employment in rural areas has been emphasised.

KEY WORDS: non-agricultural self-employment, rural area, income, population, inclusion

Introduction

The economic situation of the population depends on many factors, including in particular, the place of residence. In this respect, population in rural areas is constantly losing with households in cities, especially large ones, although these disparities tend to change in individual years (Stolarska, 2014, p. 5-17).

According to GUS (Central Statistical Office) data, in 2016, 39.8% of the population in Poland lived in rural areas (Bank Danych Lokalnych, 2017). Although the total number of population decreased by 0.5% compared to 2000, the number of rural population increased by over 503 thousand (from 38.2%) during that time (Sytuacja społeczno-ekonomiczna..., 2017, p. 19). The shift away from agriculture, partially forced by Poland's accession to the EU and the need for structural changes, did not result in the migration of the rural population to the cities. On the contrary, the prevailing direction in this area is the migration from cities to the country (by over 36% in 2016 and approx. 64% in 2010)¹.

The income of the population is characterised by a great diversity, as evidenced by the rate of inequality of income distribution², which stood at 4.9% in 2016 (Wskaźniki Zrównoważonego Rozwoju, 2017). Although differences exist both in the city and in the country, the average monthly disposable income is always much lower (approx. 40%) in rural households. On the other hand, the rate of the risk of extreme poverty has always been higher in the country³.

Lower incomes also result in lower levels and a different structure of consumer spending, which translates into inequalities in terms of ability to satisfy your needs, especially higher ones, and is not conducive to social cohesion promoted by sustainable development policies. As a priority, these policies emphasise the need to strengthen the economy which is coherent, both in economic and social terms, and to promote inclusive society and development contributing to social inclusion (Lorek, 2016, p. 175). This attitude seems right, regardless of whether such activities will prove to be „a rescue for our Planet” (Famielec, Famielec, 2016, p. 59), or mere „utopias and dreams” that the division into a very large number of the poor and a small elite of the rich will disappear (Zimmiewicz, 2016, p. 71).

¹ Initiated in 1999, after the introduction of the market economy, The intra-municipal migration of the population for permanent residence according to directions in the years 1998-2016, www.stat.gov.pl [25-08-2017].

² Percentage ratio of total income in the upper quintile to income in the lower quintile.

³ Minimum level of satisfaction of needs, without risks to life and psychophysical development (Wskaźniki Zrównoważonego Rozwoju, 2017).

Self-employment – the concept and methodology of research

The term self-employed/self-employment is ambiguous and may be understood differently, both in Poland and in the world (Lasocki, Skrzypek-Lubasińska, 2016, p. 1-11). A precise definition of self-employment is absent both from Polish legislation and literature, although it is becoming increasingly important in the labour market, especially in rural areas where other forms of employment have only limited development opportunities.

For the purposes of this paper, non-agricultural self-employment is defined as the pursuit by a natural person of their own registered non-agricultural economic activity, in accordance with the Act on Freedom of Economic Activity of 2 July 2004 (Ustawa..., 2004).

The self-employed conduct economic activity in their own name and on their own account, bearing personal risks and consequences related thereto. They determine their own workplace and define their own working time⁴, and perform any activities related to the management of their own business either personally or with the help of third parties. However, the contribution of the work carried out by the self-employed is superior and required for the proper operation of their business.

The purpose of this paper was to identify the economic situation, in the years 2013-2016, of rural households sustaining themselves, predominantly, from paid work, and in particular, from non-agricultural self-employment. In this respect, a comparison has been made with other households run by employed individuals. Significant differences in the socio-economic situation have been observed, both generally and among the self-employed, while emphasising the importance of this form of employment in rural areas.

For the purposes of this paper, the following information has been used: unpublished unit data obtained from the GUS surveys of household budgets for the years 2013-2016⁵; REGON information; as well as secondary and literature data.

A detailed analysis of empirical data was performed, using a variation coefficient, and broken down into quartile groups, following which, the results thus obtained were presented using descriptive and graphic methods.

⁴ They are not "hidden" employees of other economic operators.

⁵ Approx. 37 thousand households in each year, of which non-agricultural employment was the main source of living for approx. 2.5 thousand, and approx. 1 thousand of such households were located in the countryside.

Results of the research

The development of entrepreneurship in rural areas, including non-agricultural self-employment, is one of the priorities of the rural development policy, as evidenced by the “creation of the Concept of systemic support for entrepreneurship in rural areas” and financial support of EUR 13.5 billion for the implementation of activities affecting the development of entrepreneurship (Przedsiębiorczość na wsi..., 2017).

In 2016, in Poland, there were 1,783 registered economic operators per 10 thousand inhabitants in working age, of which 95.7% were micro-enterprises employing up to 9 individuals. A growing trend can be observed here (an increase by 20.8% since 2004), with a slight decline in 2009 and 2011 (www.bdl.stat.gov.pl). The majority of entrepreneurs are natural persons conducting economic activity – 71% in 2015, although their share is decreasing (www.strateg.stat.gov.pl). The percentage of private entrepreneurs, per 100 people in working age, is about 35% smaller in the rural areas than in the city, while at the same time, there is a tendency to reduce such discrepancies (Podmioty gospodarki narodowej..., 2017).

Of the total number of people working in Poland in 2016, 15.1% were employers and self-employed individuals working outside individual farms in agriculture (Mały Rocznik Statystyczny Polski, 2017, p. 126). On average, they obtained the highest income from all basic socio-economic groups (figure 1)⁶. The average monthly disposable income per person was almost 20% higher than in the households of contracted employees.

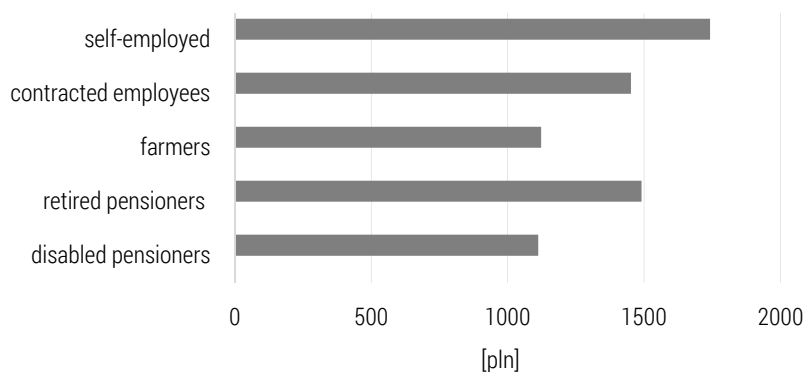


Figure 1. Average monthly disposable income per capita in households in 2016 [PLN]

Source: author's own work based on Mały Rocznik Statystyczny Polski, 2017, p. 164.

⁶ Together with “free professions”, e.g. lawyers, artists, etc. (Mały Rocznik Statystyczny Polski, 2017, p. 160).

If we compare the economic situation of the population in the country and in the city, we will find that in the years 2013 – 2016, the level of disposable income per capita in the city was on average about 40% higher than in the country (table 1), which makes the situation of the population in rural areas much worse while limiting their opportunities for equal use of social life.

Table 1. Income, expenditure and savings in cities and rural areas in the years 2013-2016

Item	2013	2014	2015	2016
disposable income per capita in the city [PLN]	1453	1516	1566	1642
expenditure per capita in the city [PLN]	1183	1211	1225	1261
savings percentage – cities [%]	18.6	20.1	21.8	23.2
disposable income per capita in rural areas [PLN]	1060	1067	1106	1214
expenditure per capita in rural areas [PLN]	873	874	883	930
savings percentage – rural areas [%]	17.6	18.1	20.2	23.4

Source: author's own work based on unpublished unit data of GUS.

In this period, total expenditure per capita was on average 37% higher in urban than in rural areas. The population in the country was not able to satisfy their needs in the same way as people living in the cities, but what is worse, by 2015 the percentage of their savings was smaller, which in turn limited their opportunities for potential investments and further development. Despite the fact that due to the slightly higher income growth rates in rural areas, in 2016, the percentage of household savings per capita was on average slightly higher than in the city, 12.8% of the surveyed households evaluated their financial situation as bad, and 1.7% declared poor satisfaction of nutritional needs.

If we compare the economic situation of the socio-occupational groups of working rural population, we will find that the highest income level was generated by mental paid work, undertaken at positions other than physical (figure 2). The average monthly disposable income per capita was not only the highest (PLN 1,513 in 2016) but also higher than the average result in this category for the country (PLN 1,475).

In previous years, these discrepancies were even larger (in 2013, by 6.7%).

Income of the self-employed ranked second but due to its fastest growth rate, in 2016, it was only by PLN 9 lower than in households of individuals in non-physical positions.

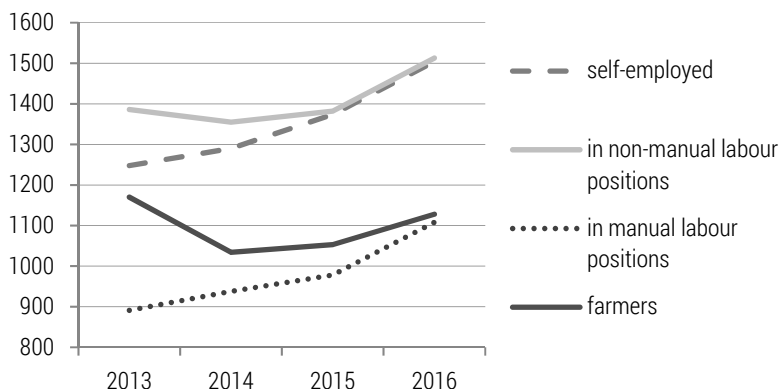


Figure 2. Disposable income per capita in rural areas in the years 2013-2016, broken down by the type of the main source of income [PLN]

Source: author's own work based on unpublished unit data of GUS.

The population with the worst economic situation in the country was the group of households of physical workers (from those obtaining income by means of paid work), although gradually they “caught up” with the income earned by farmers (in 2016, by PLN 20 lower income)⁷.

This does not confirm the conclusions ensuing from the GUS data that the lowest income was generated by farmers and the highest (Sytuacja..., 2017, p. 2) – by the self-employed – for a simple reason – i.e. failure to distinguish, from among the employed, contracted workers in physical positions and contracted workers in non-physical (mental) positions, which was incorrect according to the author⁸.

The opinions of the managers of the surveyed employees in rural households show that the self-employed give their financial situation the highest ratings, followed by those working in non-physical positions (figure 3). The worst ratings come from blue collar workers – as many as 52.7% declare that their financial situation is bad or rather bad.

Poor material situation also limits the ability to meet your own needs, the basic of which – nutrition – in 2016, was rather poorly met in 1% of households of physical workers (0.4% in households of the self-employed).

⁷ This may be partially due to the „500+ Family” Programme introduced on 1.04.2016, which represented 16.8% of disposable income per capita in those families who benefited from the programme (Sytuacja..., 2017, p. 1).

⁸ You cannot compare fees for simple physical work and salaries of senior officials or politicians as this community is too diverse.

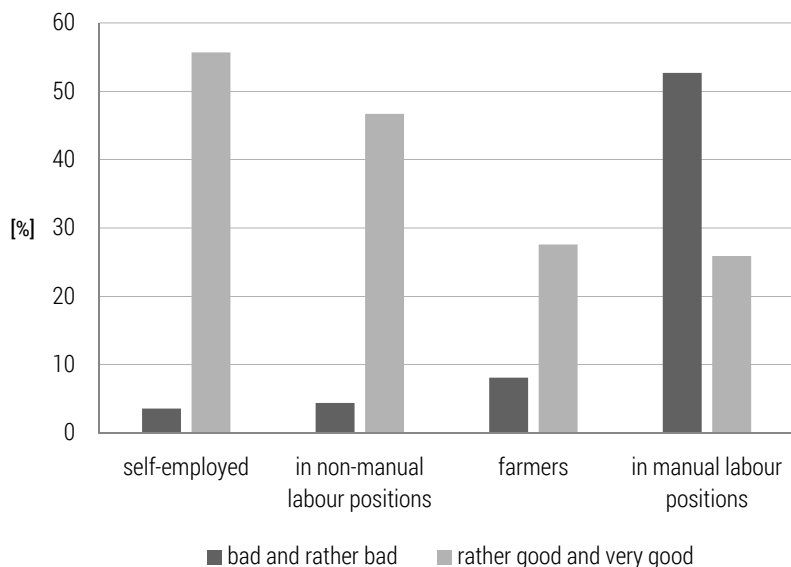


Figure 3. Percentage of rural households in 2016, broken down by evaluation of their own financial situation

Source: author's own work based on unpublished unit data of GUS.

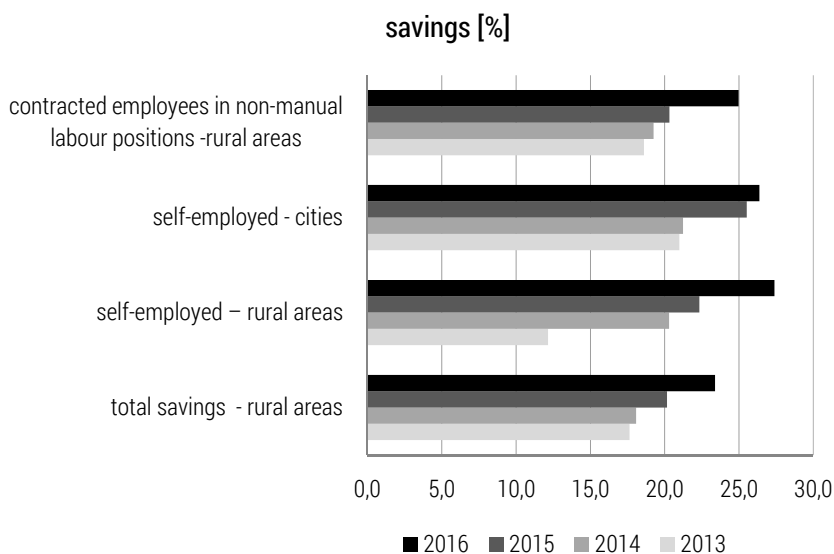


Figure 4. Savings percentage per capita in the years 2013-2016 [%]

Source: author's own work based on unpublished unit data of GUS.

The economic situation, and thus the social status of households, is largely reflected not only in their expenditure (level and structure) and possession of modern durable goods, but also in the scale of savings that they can afford. In 2016, the highest percentage of savings (27.4%) in the rural area belonged to self-employed households (figure 4). Their situation in this respect was not only better in comparison with the situation of households composed of individuals who were mainly engaged in non-physical positions (with the highest income) but also in comparison with the self-employed urban residents.

In comparison with 2013, when the savings of the self-employed rural population were much lower than on average in the rural areas, there was a significant change – an increase by over twice as much as in other occupational groups. This was due not only to the development of the scale of the activity pursued by the self-employed individuals living in rural areas and the improvement of their economic situation⁹, but also partly due to the migration of the self-employed from cities to villages.

The economic situation of the self-employed is very diverse, as evidenced by the high value of the coefficient of variation for the revenues obtained in this manner (70.9% in 2016). In 2016, the monthly income of self-employed rural households ranged between PLN 929 and as much as PLN 78.25 thousand. The average monthly disposable income per capita in the bottom quartile was PLN 808 and in the upper quartile – PLN 2,186, despite the larger number of such households (4.6 persons, and in the lower – 3.1). The group with the highest income was dominated by households earning additional income (apart from self-employment) from employment in non-physical positions (40.3%), as well as married couples with at least 1 dependent child and other persons (35.8%). As many as 52.1% of those incurred “other expenses” related to gifts, alimony and living expenses of youths studying away from home, with an average monthly expenditure for such purposes amounting to PLN 485.

The bottom quartile was dominated by households (43%) that did not have any additional sources of income, with no clear dominance in terms of family composition. The category of „Other expenses” was selected by 41% of such households and the monthly amount spent on this category in 2016 was PLN 187.

⁹ The percentage of rural households composed predominantly of the self-employed was roughly at the same level in the years (approx. 6.3%).

Conclusions

Non-agricultural self-employment in rural areas allows for a partial departure from agriculture, which in turn allows for structural changes in agriculture and rural areas. The economic situation of households is improving, which provides an opportunity to equalise the standard of living in rural and urban areas where both average income and consumption expenditure is higher.

Although self-employed individuals living in rural areas earn less than the same group living in the city, they rank second in this respect, just behind households of individuals employed in non-physical positions. The mere decision to commence an economic activity does not, however, determine the financial situation of the self-employed, as evidenced by the wide range of revenues earned (from less than PLN 1 to more than PLN 78 thousand in 2016).

In the years 2013-2016, the economic situation of the rural population improved, to the greatest extent – in the self-employed households. In 2016, as many as 55,7% of them rated their financial situation as good or very good. At the same time, those were households with the highest percentage of savings among the employed (27.4%).

Given the specific character of the labour market in rural areas, where employment opportunities are limited, especially in non-physical positions, while others provide low incomes, non-agricultural self-employment provides an opportunity to increase income levels of the rural population (especially in combination with other (additional) sources of earnings), and thus its economic and social inclusion.

Literature

- Bank Danych Lokalnych (2017), GUS, Warszawa
- Famielec J., Famielec S. (2016), *Integracja nauk ekonomicznych, technicznych i chemicznych na rzecz rozwoju zrównoważonego*, „Ekonomia i Środowisko” No. 3(58)
- Lasocki B., Skrzypek-Lubasińska M. (2016), *Samoatrudnienie w Polsce – problemy definicyjne, dostępność danych i ich interpretacja*, „Wiadomości Statystyczne” No. 7(662)
- Lorek E. (2016), *Inteligentny i trwały rozwój warunkiem wzmocnienia konkurencyjności regionu śląskiego*, „Ekonomia i Środowisko” No. 3(58)
- Mały Rocznik Statystyczny Polski (2017), GUS, Warszawa
- Migracje wewnątrzwojewódzkie ludności na pobyt stały według kierunków w latach 1998-2016, www.stat.gov.pl [25-08-2017]
- Podmioty gospodarki narodowej wpisane do rejestru REGON (2017), www.stat.gov.pl [28-03-2017]

- Przedsiębiorczość na wsi – współczesne wyzwania i koncepcja rozwoju* – publikacja pokonferencyjna, FDPA, www.bip.minrol.gov.pl [22-08-2017]
- Stolarska A. (2014), *Zmiany sytuacji dochodowej polskich rodzin na wsi po akcesji do Unii Europejskiej*, „Zeszyty Naukowe Szkoły Głównej Gospodarstwa Wiejskiego, Ekonomia i Organizacja Gospodarki Żywnościowej” No. 107
- Sytuacja gospodarstw domowych w 2016 r. w świetle wyników badania budżetów gospodarstw domowych (2017), GUS, Warszawa, www.stat.gov.pl/obszary-tematyczne/warunki-zycia [1-09-2017]
- Sytuacja społeczno-ekonomiczna gospodarstw domowych w latach 2000-2015, Zróżnicowanie miasto-wieś (2017), GUS, Warszawa
- Ustawa z dnia 2 lipca 2004 r. o swobodzie działalności gospodarczej, Dz.U. nr 173 poz. 1807
- Wskaźniki Zrównoważonego Rozwoju. Moduł krajowy, www.stat.gov.pl [23-08-2017]
- www.bdl.stat.gov.pl [26-08-2017]
- www.strateg.stat.gov.pl [26-08-2017]
- Zimniewicz K. (2016), *Zrównoważony rozwój – wizja bez szans na realizację*, „Ekonomia i Środowisko” No. 3(58)

Sławomir **JANKIEWICZ** • Dominika **MIERZWA**

RENEWABLE ENERGY SOURCES AS A BASIS FOR SUSTAINABLE DEVELOPMENT OF RURAL AREAS

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ABSTRACT: Poland has a problem with a low economic growth rate. This particularly applies to low income and quality of life in rural areas where there is a high level of unemployment (including hidden). Increasing economic development in rural areas requires the creation of jobs in non-agricultural areas. Opportunities for positive changes in this area may be the actions taken in the context of local low carbon economy plans, aimed at the development of renewable energy sources. The purpose of the study was a synthetic analysis of the situation in terms of unemployment in rural areas and identify the opportunities created by renewable energy sources in order to eliminate this unemployment.

KEY WORDS: sustainable economic development, agricultural employment

Introduction

From the beginning of the systemic transformation, the basic goal is to quickly equate the standard of living in Poland with the high-developed European countries. However, in practice, this target was reduced only to changes in the growth rate and no attention was paid to quality changes. As a result, the level of economic development is low, which manifests itself primarily in:

- poverty level (nearly 7% of the population affects extreme poverty, more than 12% statutory and almost 16% – relative) (GUS, 2016a),
- social inequalities (we have a much higher income differentiation than other European countries) (Jankiewicz, 2014, p. 98-99; Jankiewicz, Pająk, 2014),
- level of remuneration (in terms of dominant value),
- Difficult access to health care (including prevention and rehabilitation) (Jankiewicz, 2014, p. 97; Jankiewicz, 2016, p. 251-252).

From a spatial perspective, the problem of low income and quality of life occurs in the countryside. Opportunities for positive change may be the actions taken in the context of local low carbon economy plans that will increase the pace of sustainable development in these areas.

The aim of the study was synthetic analysis of unemployment in the rural and the presentation of renewable energy sources (RES) as a basis for employment growth and income growth in the rural population. Especially, that in the current financial perspective, significant EU funds have been allocated to activities related to the broadly defined reduction of emissions of harmful gases and dusts to the atmosphere. Whereas the government plans to introduce programs to support the development of RES.

The work is descriptive-analytical and based on method of observative, intuitive and critical analysis.

Characteristics of unemployment in rural areas

There is a conviction that in Poland unemployment is no longer a problem, which is not true. Despite the overall low unemployment rate, there are regions where there are considerable difficulties in finding a job (in some areas unemployment remains even three times higher than the national average). It is characteristic that for many years we have problems in the same regions (GUS and Reports: Territorial diversification of unemployment in Poland, MRPiPS).

When analyzing the labor market in the context of economic development, attention should be paid to the low level of professional activity of society (Sytuacja, 2012), relatively high hidden unemployment (GUS, 2016b; Poczta, 2013; Jóźwiak, Ziętara, 2013), low salaries, large economic emigration (estimated at 2-3 million people) and a significant (almost 20%) share of employed people with fixed-term employment contracts (which are not usually converted to permanent employment) and working only on casual work contract or specific-task contract (total about 5%) (Palczyńska, 2016).

Indicated above problems mainly concern the rural areas. Approximately 39% of the Polish population lives in rural areas, and among the unemployed, they constitute about 43-45%. At the end of 2014, unemployment in rural areas reached 812.1 thousand people, while the dynamics of decline was slower than in cities. The only exception are the villages near large cities, which de facto become urbanized urban areas while remaining villages in the administrative sense. This problem does not apply to them.

Of the 1000 people working in the countryside in 2014, even 944 were unemployed. The highest (at 85.6%), the level of occupational activity of the population living in rural areas was 40-44 years old, relatively low (37.4%) was among young people (15-24 years) and the post-working age population (60 years and more for women and 65 and more for men) – 5.9%.

Spatial differentiation of unemployment in the countryside is also important. In 2014, the percentage of rural population in the total number of unemployed people ranged from 22.0% (in Śląskie voivodeship) to 63.1% (in Podkarpackie voivodeship), where in 9 voivodships exceeded the average for the country (in Świętokrzyskie – 56.3%, Lubelskie – 55.9%, Małopolskie – 54.1% and Warmińsko-Mazurskie – 50.6%) (MPiPS, 2015).

In addition, there is a large hidden unemployment in rural areas. According to estimates, it amounts from 600 thousand to 1,500 thousand people (Kołodziejczak, p. 130; Frenkel, 2013; Karwat-Woźniak, Chmieliński, 2013; Kołodziejczak, 2015; Nurzyńska, Poczta, 2014; Bański, 2013). The surplus of labor supply in agriculture will be released in the next 10 years, regardless of the situation on the local labor market (i.e. whether non-agricultural jobs will be created or not¹). This will be the result of changes in the agricultural policy of the Community, which is promulgated (and include, inter alia, the liquidation of direct payments).

Spatial analysis shows that the „release” of labor resources in agriculture will not be uniform. Most of them will be in the Lubuskie, Podkarpackie and Małopolskie voivodeships (about 200 thousand people each). Large influxes

¹ In the latter case, unemployment will increase and will reduce the life quality of the population.

(100-150 thousand people) can also be expected in the Mazowieckie, Wielkopolska, Świętokrzyskie, Łódzkie and Podlaskie voivodships.

Without solving the problems of the rural labor market, the pace of economic development and prosperity of the majority of society will not be significantly improved. Opportunities in this case may be the development of RES, which will also ensure that it will be sustainable.

RES as a basis for increasing employment in rural areas

Primary energy production in Poland is based primarily on fossil fuels (PALIŹ, 2013, p. 4-5), what is the problem. Our country is committed to reducing carbon-based production to green energy sources (Bukowski, 2013; Górniak, Kossowska, 2013). By 2020, the share of renewable energy is expected to increase to 15% and in 2030 to reach 20% (PE, 2009). In addition, the European Union has adopted a reduction of 30% CO₂ emissions by 2020.

Another problem is the current state of the infrastructure of electricity generation and distribution, which creates a barrier to dynamic economic development. Many areas remote from the power plant experience periodic shortages in the supply of electricity, which effectively excludes them from the modern economy.

Obstacles mentioned above will be abolished due to the development of RES. This will be possible due to technological development, which results in more and more efficient power plants of this type and systematically decreasing investment costs (Krawiec, 2010). At present they are relatively high (it is estimated to be about \$ 250 per megawatt hour), which lowers the profitability of such ventures (Bloomberg, 2017). However, within a few years they should (according to forecasts) decrease significantly. The British government assumes that the investment costs for one megawatt hour will fall to £ 100 (\$ 167) to 2020)².

Similarly as in the field of renewable energy, progress will be possible in other areas of the low carbon economy (especially in the field of waste management) (Bank Światowy, 2011).

The construction of renewable energy and low-carbon economy creates an opportunity for the development of many regions in Poland, especially in rural areas. These changes will generate demand for specialists in the field of, inter alia, new energy technologies, infrastructure security, logistics and

² Many analysts (such as Sophia von Waldow, a BNEF analyst) believe that it is possible to reach costs under 110 pounds by that time, and only a few big companies such as Dong will get 100 euros (\$ 137) per megawatt hour to 2020.

energy agriculture (Matusiak, Kuciński, Gryzik, 2009, p. 14; Jankiewicz, 2014, p. 15-22). Increasing investment in a low-carbon economy will require well-educated engineering staff and qualified employees. Workplaces will be mainly created in small businesses and will be characterized by relatively high remuneration.

There are no obstacles, and it is advisable to invest in RES in rural areas. People will not have to change their place of residence to get a job. This is especially true for young people who have a technical education (even on a secondary level, because they will not need higher education) will be guaranteed long-term employment with relatively high remuneration (Węglarz, Winowska, Wójcik, 2015). It is estimated that up to a few million new jobs will be created, so-called green.

Those who remain in agriculture will gain additional income through the installation of RES on their farms. The availability of that solution will be possible thanks to financial support from the EU and national funds and the assistance of energy companies interested in the development of the market for micro-installations of RES. This will create a positive feedback loop, which will further increase the pace of sustainable economic development in the countryside.

Summary

Poland, in pursuit of further economic development, enhancing innovation, ensuring energy security and fulfilling environmental obligations (especially within the European Union), must increase the supply of electricity produced by RES. The optimum area of investment in this type of source is rural, which will allow long-term employment growth in non-agricultural activities and increase in income. It will also affect:

- improving the local environment,
- increasing the competitiveness and economic efficiency of the local economy,
- implementation of innovative technical solutions in the local energy sector,
- building social capital,
- development of distributed energy and local sources of RES,
- reducing the risk of energy poverty in rural areas.

This will lead to a development in which „the satisfaction of current social needs and the needs of future generations will be treated equally ...” and „... will harmoniously combine care for the preservation of the natural and cultural heritage of the nation with civilization and economic progress being the participation of all social groups” (Ministerstwo Środowiska, 1999). It can be called sustainable.

The contribution of the authors

Sławomir Jankiewicz, Prof. – 50%

Dominika Mierzwa, PhD – 50%

Literature

- Bank Światowy (2011), *Transformacja w kierunku gospodarki niskoemisyjnej w Polsce*, Bank Światowy, Washington
- Bański J. (ed.) (2013), *Polska wieś w perspektywie długookresowej – ujęcie regionalne*, Warszawa
- Bukowski M. (2013), *Podróż do niskoemisyjnej przyszłości*, Warszawa
- Bloomberg, New Energy Finance, <http://www.unep.org/> [15-07-2017]
- Frenkel I. (2013), *Zatrudnienie i struktura dochodów w gospodarstwach rolnych w latach 2005-2010*, Warszawa.
- Górniak J., Kossowska M. (eds) (2013), *Bilans kompetencji branży. Energetyka. Raport końcowy z przeprowadzonych badań*, Uniwersytet Jagielloński w Krakowie, Centrum Ewaluacji i Analiz Polityk Publicznych, Interdyscyplinarne Centrum Badań i Rozwoju Organizacji, Kraków
- GUS (2016a), *Zasięg ubóstwa ekonomicznego w Polsce w latach 2012-2015 – podstawowe dane*, Departament Badań Społecznych i Warunków Życia, Wydział Analiz Przekrojowych GUS, Warszawa
- GUS (2016b), *Aktywność ekonomiczna ludności Polski w latach 2013-2015*, Warszawa
- Jankiewicz S. (2014), *Ekonomia społeczna a MSP*, in: T. Bugajski (ed.), *Polityka społeczna i jej wpływ na rozwój gospodarczy województwa wielkopolskiego. Zarys problematyki*, Toruń
- Jankiewicz S. (2016), *Wpływ bezpieczeństwa energetycznego na rozwój gospodarczy w Polsce*, in: J. Sokołowski, G. Węgrzyn (eds), *Polityka ekonomiczna*, Prace Naukowe UE we Wrocławiu No. 450
- Jankiewicz S. (2014), *Uwarunkowania rozwoju polskiej gospodarki w dobie globalizacji*, „Zeszyty Naukowe WSB w Poznaniu” No. 53, p. 13-29
- Jankiewicz S., Pająk P. (eds) (2014), *Bilans Otwarcia z obszaru „Rynek Pracy”*, Gdańsk
- Jóźwiak W., Ziętara W. (eds) (2013), *Zmiany zachodzące w gospodarstwach rolnych w latach 2002-2010*, Warszawa
- Karwat-Woźniak B., Chmieliński P. (2013), *Ludność wiejska oraz jej aktywność zawodowa i sytuacja na rynku pracy*, in: M. Kiełkowska (ed.), *Rynek pracy wobec zmian demograficznych*, Warszawa
- Kołodziejczak W. (2016), *Nadwyżka zatrudnienia w polskim rolnictwie – projekcja na tle państw Unii Europejskiej*, „Zeszyty Naukowe SGGW w Warszawie” No. 1, p. 129-141
- Kołodziejczak W. (2015), *Metoda przepływów na rynku pracy (IOA) i szacowanie bezrobocia równowagi w badaniach aktywności ekonomicznej ludności wiejskiej*, in: E. Kwiatkowski, B. Liberda (eds), *Determinanty rozwoju Polski. Rynek pracy i demografia*, Warszawa
- Krawiec F. (2010), *Odnawialne źródła energii w świetle globalnego kryzysu energetycznego. Wybrane problemy*, Warszawa

- Matusiak K.B., Kuciński J., Gryzik A. (2009), *Foresight kadr nowoczesnej gospodarki*, Warszawa
- Ministerstwo Środowiska (1999), *Strategia Zrównoważonego Rozwoju Polski do 2025 roku. Wytyczne dla resortów*, Warszawa
- MPiPS (2015), *Stan i struktura rejestrowanego bezrobocia na wsi w 2014 roku*, Wydział Analiz i Statystyk, Departament Rynku Pracy MPiPS, Warszawa
- Nurzyńska I., Począ W. (eds) (2014), *Raport o stanie wsi*, Warszawa
- PaliIZ (2013), *Sektor energetyczny w Polsce. Profil sektorowy*, Departament Informacji Gospodarczej, PaliIZ, Warszawa
- Palczyńska M. (2016), *Rodzaj umowy o pracę a umiejętności i ich wykorzystywanie*, Warszawa
- PE, Dyrektywa Parlamentu Europejskiego i rady z dnia 23 kwietnia 2009 r. w sprawie promowania stosowania energii ze źródeł odnawialnych zmieniająca i w następstwie uchylająca dyrektywy 2001/77/WE oraz 2003/30/WE
- Począ W. (2013), *Gospodarstwa rolne w Polsce na tle gospodarstw Unii Europejskiej – wpływ WPR*, GUS, Warszawa
- Sytuacja demograficzna Polski. Raport 2011-2012*, Rządowa Rada Ludnościowa, Zakład Wydawnictw Statystycznych, Warszawa
- Węglarz A., Winowska E., Wójcik W. (2015), *Gospodarka niskoemisyjna zaczyna się w gminie. Podręcznik dla polskich samorządów*, Berlin

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LABOR MARKET IN POLAND IN THE CONTEXT OF RENEWABLE ENERGY SECTOR DEVELOPMENT

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ABSTRACT: The aim of this article is to assess job-creating potential of renewable energy sector development and its macroeconomic effects on the labor market in Poland. The paper focuses primarily on electricity generation technologies like wind power stations and solid biomass. Nowadays, Polish policymakers are in search of win-win solutions to the triple challenge of unemployment, climate change and international commitments. The other problem that needs to be dealt with is maintaining and restructuring Polish coal mining industry, which is and will be for the upcoming years the main source of electricity production in Poland. Those actions' aim is to create new jobs, build industries and attract new foreign investments. The following research methods were used in the article: analysis of statistical data obtained from Eurostat and organizations dealing with the collection of statistical data on RES and analysis of literature on the subject. According to the analysis, the labor market in the renewable energy sector is developing rapidly, which will result in the future development of new sectors, which will increase employment in the industry, attract new foreign investments and develop local communities.

KEY WORDS: renewable energy, labor market, economic effects, sustainable development economy

Introduction

Energetics is the key area of industry in most countries of the world in economic, social and political context and therefore fuel and energy complex is under the special supervision of state and while being quite strictly regulated. National security as a whole depends on this complex and its economic constituent elements. The increasing degree of internationalization and globalization of the energy sector and growing energy interdependence between individual countries, confirm the thesis about the countries' inability to ensure their energy security without solving the problems of international energy security at the regional and global levels with particular emphasis on renewable energy sources.

Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC which imposed on Poland the obligation to increase the share of renewable energy in the final gross energy consumption by the end of 2020. The Directive sets new conditions for the development of renewable energy production and provides a common framework for the promotion of renewable energy sources. At the same time, it establishes mandatory national general objectives in order to create a possibility to achieve 20% share of renewable energy in the gross end-use of energy throughout the EU in 2020. The goal for Poland is to achieve a 15% renewable energy (RES) share of total final energy consumption by 2020. All those actions have a huge impact on the labor market in Poland and in the EU in general.

The purpose of the article is to analyze Polish labor market in the context of renewable energy sources development, analyzing the current state and future possibilities, RES impact on regional development on an example of Kisielice community.

Results of the research

National security depends on ensuring energy security in terms of diversifying not only sources of supply (using a wide range of energy sources) but also suppliers, routes and transport mechanisms. A country's energy system, based on a few large coal power plants is more susceptible to sabotage than a system based on a dozen scattered low- and medium-power sources. The problems of Polish and EU energy dependence and employment reduction in such industries as mining can be partly solved by developing strong

renewable energy sector as well as building credible partnerships with suppliers, transit countries and buyers. International solutions are also needed to reduce global greenhouse gas emissions.

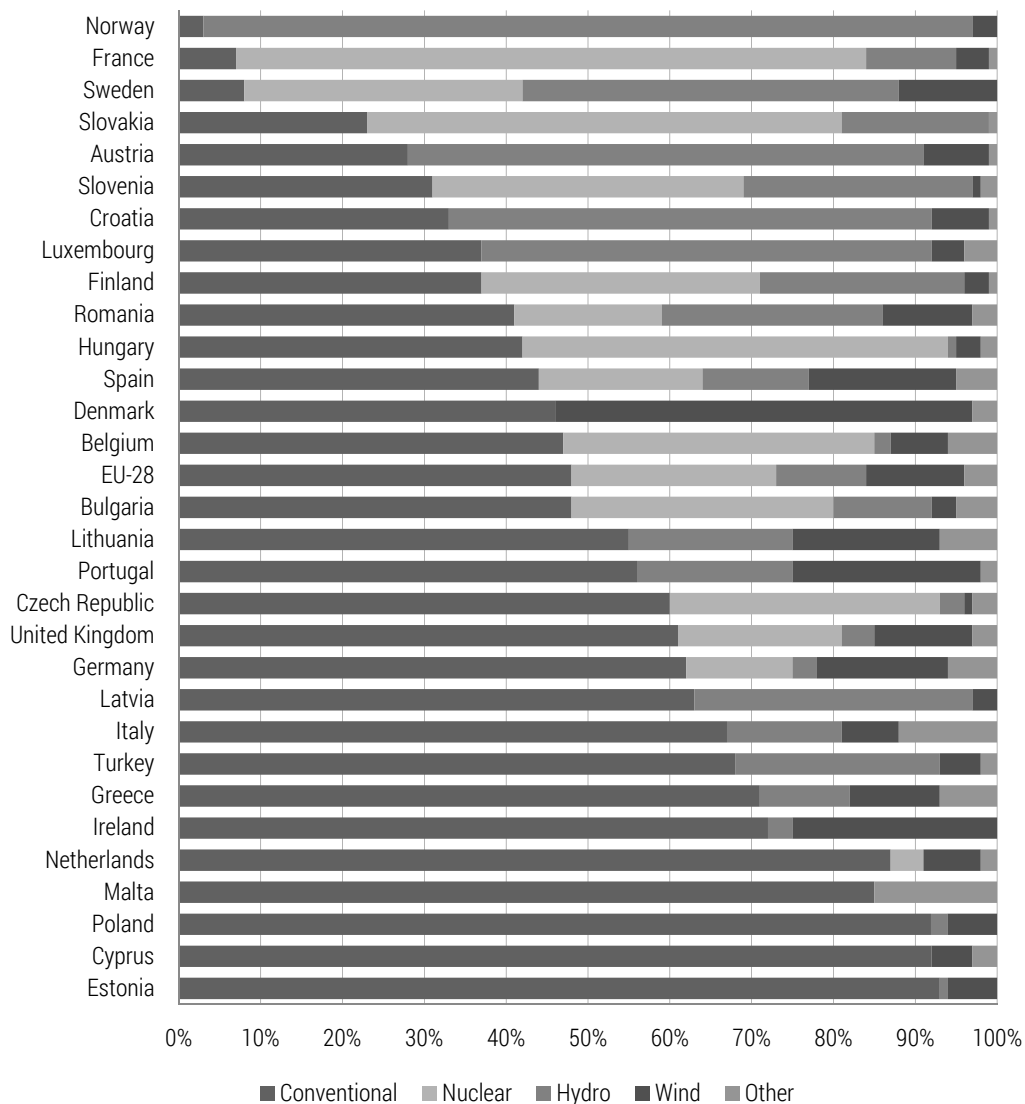


Figure 1. EU breakdown of electricity production by source in 2016 [%]

Source: author's own work based on EUROSTAT.

The diversification of electricity sources in the EU countries by energy source is shown in figure 1. According to data presented in figure 1, Poland occupies the third place in terms of using traditional energy sources, such as coal for electricity production. Poland's power industry has always been based on coal, that is why the largest power units were created near the coal and lignite mines.

Considering the actual conditions and effects of renewable energy sector development, it is important to take into account, in accordance with the constitutional guiding principles of environmental protection, the principle of sustainable development, economic and social factors that determine the development of a given energy sector. At the same time, we cannot forget about the conditions resulting from the need to protect the environment, including natural and landscape values. Poland's energy industry is faced with the need to modernize and strengthen the National Electricity Grid. Worn-out coal-fired power stations need to be replaced with new production capacity. Some of them will still be based on coal, which will continue to be the main source of energy in the next few decades, according to "Poland's Energy Policy until 2030" (Ministerstwo Gospodarki, 2009).

Development of the labor market

The effects of renewable energy industry on the labor market can be observed on the scale of the whole country and the European Union in general. In the European Union, renewable energy sector in 2015 provided employment for 1 139 050 people, including 43 300 people in Poland. In this country, there are many more people employed in RES sector per unit of energy produced as opposed to the average in the UE (table 1). The reason for that might be lower technological sophistication relatively to the leading European countries, for example, in case of Germany – regarding new photovoltaic or wind energy technologies (Graczyk, 2014), or Norway – where its electricity generation is 97% renewable and the Norwegian government is planning on increasing sustainable energy use even more (Invest in Norway, 2017).

Table 1. Energy production and employment in renewable energy sources (RES) sector in Poland and EU in 2016

Technology	European Union			Poland		
	Energy production (ktoe)	Employment (jobs)	Number of employees per unit of production	Energy production (ktoe)	Employment (jobs)	Number of employees per unit of production
Hydropower	30053.0	46150	1.54	202.4	1450	7.16
Wind energy	24491.8	332350	13.57	833.0	11500	13.81
Solar PV, CSP and water heaters	9279.8	148050	15.95	4.9	3850	785.71
Solid biomass	7800.9	314700	40.34	776.2	18800	24.22
Biofuels in transport	13239.3	95900	7.24	780.3	6000	7.69
Heat pumps	8607.1	110900	12.88	25.7	750	29.18
All other renewables	8100.4	91000	112.34	77.9	950	12.2
Overall	101572.3	1139050	203.86	2700.4	43300	879.97

Source: author's own work based on EurObserv'ER, 2017b; EurObserv'ER, 2017c.

It can therefore be assumed, that dissemination of renewable energy technologies will result in increased employment in absolute terms but also in decreasing employment per unit of production, which means increased productivity, and consequently a decrease in unit costs.

The scale of the phenomenon above depends on the current advancement in the application of the technology. The data presented in table 2 indicates, that for example in the case of solid biomass technology and wind energy, in which Poland has a considerable scale of production and experience, employment per unit of production is already lower than the European average. This means that the Polish experience makes it possible to produce more electricity and heat with lower labor input, which makes Poland's RES competitive and attractive for foreign investments. Furthermore, calculations from table 2 and predicted data on the electricity production in Poland till 2030, presented in "Poland's energy policy until 2030" in attachment #2 (Ministry of Finance, 2009) obviously prove, that in 2015 Poland had already outperformed the forecasts.

Table 2. Employment in the sectors of solid biomass (SB), wind energy (WE) and solar energy (SE) in terms of primary energy production in selected EU countries (2015)

Country	Employment (jobs)			Energy production			Number of employees per unit of production		
	SB (2015) – direct & indirect	WE (2015) – direct & indirect	SE (2015) – direct & indirect	SB (2015 Mtoe)	WE (2015 TWh)	SE (2015 MWh)	SB	WE	SE
Germany	45 400	142 900	10 600	12.062	79.206	13 038	3763.88	1804.15	0.81
France	50 000	22 000	5 900	9.661	21.249	2 059	5175.44	1035.34	2.86
Sweden	27 400	6 500	100	9.129	16.268	327	3001.42	399.55	0.30
Italy	22 000	26 000	3 000	7.340	14.844	2 809	2997.27	1751.54	1.07
Finland	23 700	3 300	50	7.901	2.327	37	2999.62	1418.13	1.35
Poland	18 800	11 500	2 750	6.268	10.858	1 413	2999.36	1059.12	1.94
UK	22 300	41 100	750	3.824	40.310	492	5831.58	1019.59	1.52
Spain	15 800	22 500	4000	5.260	49.325	2 586	3003.80	456.15	1.55
Austria	15 450	5 500	2 800	4.474	4.840	3 655	3453.28	1136.36	0.77
Portugal	7 800	2 500	450	2.603	11.608	826	2996.54	215.36	0.54
Romania	11 100	1 100	200	3.521	7.045	136	3152.51	156.13	1.48
UE	314 700	332 350	37 300	91.444	301.893	34 332	3441.45	1100.88	1.09

Source: author's own work based on EurObserv'ER, 2017, p.64; EurObserv'ER, 2017a, p. 10.

The worldwide renewable energy sector employed 9.8 million people, directly and indirectly (with a 1.1% increase in 2016 over 2015). The most consistent increase has come from jobs in the solar PV and wind categories, it has more than doubled since 2012. In contrast, employment in solar heating and cooling and large hydropower has declined. These employment trends can be attributed to several underlying factors. Falling costs and supportive policies in several countries, for instance, have spurred deployment of renewables at a record pace, and have resulted in job creation. However, these positive changes were moderated by lower investments, rising automation and policy changes, resulting in job losses in some major markets, including Brazil, Japan, Germany and France (International Renewable..., 2017).

The shape of the EU climate and energy policy clearly indicates the need to further increase the share of RES in the national energy mix. However, the dynamics of change, the specific value of the national RES target for 2030 and

the contribution of wind energy to its fulfillment still depend on future political decisions. Therefore, the potential impact of wind energy on the Polish labor market until 2030, based for example on the study "Impact of wind energy on the Polish labor market" (Bukowski, Śniegocki, 2015) was determined on the basis of a scenario analysis, where three development scenarios of the sector in Poland: central, low and high were analyzed. It was assumed, that during 2018-2030 investments in onshore wind farms will be as follows: 400 MW/year in central scenario, 200 MW/year in low scenario, and 600 MW/year in large scenario. It should be stressed that the re-acceleration of the development of wind energy sector is a prerequisite for the realization by Poland a binding target for the development of RES till 2020. Therefore, the realization of a low scenario means not only Poland's extinction the development impetus for wind energy, but also a high risk of incurring the costs of failing to comply with the provisions of the EU climate change package.

Polish RES sector reforms, introduced by the Renewable Energy Sources Act 2015 (the 'RES Act'), which came into force on 1 July 2016 marked a significant step forward, however, subsequent amendments to the RES Act have illustrated that the Polish government is in a difficult position of striking a balance between developing RES for energy diversification and rescuing its coal industry. It is estimated that around 80% of Polish coals mines (mainly concentrated in the south-west region of Silesia) are unprofitable, the sector employs around 104000 people, with another 208000 people on miners' pensions (Pacula, 2017). Poland has Europe's largest hard coal reserves, thermal coal and lignite accounted for 84% of the country's electricity generation in 2015 (Easton, 2016). Despite governmental subsidies, Poland's coal mining industry debts are still huge (Wood, Broom, 2017).

It is to be expected that despite the increased productivity of the industry, wind energy in Poland will generate more jobs per unit of energy than coal energy sector in subsequent decades, especially after employment restructuring in hard coal mining.

Comparing employment level for RES sector with other sectors shows the scale of the impact of renewable energy development on the labor market in Poland and on the country's economy overall. Currently, the total number of jobs (table 2) created because of the development of wind energy (11 500), solid biomass (18 800) and solar energy (2 750) exceeds employment in the coke industry (4 000), cement (6 000) and lignite mines (5 000). In 2030 wind energy might create more jobs than coal mining which, after the inevitable restructuring, according to Warsaw Institute of Economic Studies (Bukowski, Śniegocki, 2015) will employ about 4 to 16 thousand people. In contrast to the mining industry, the long-term perspectives arise from factors, which are beyond national control (for example the situation on the

global coal market, the ban on unprofitable mines in the EU and other). The development of wind power sector will depend, to a large extent, on the shape of the regulations introduced in Poland. It is worth noticing, that jobs that are dependent on wind energy sector are not concentrated in large industrial plants, and therefore less visible than employment in traditional heavy industry and mining. It should also be taken into account that rising automation in extraction, overcapacity, industry consolidation, regional shifts, and the substitution of coal by natural gas in the power sector result in job losses in the fossil-fuel sector in some countries. Poland has two options in this sector – either to invest in the mining sector (for example in new technologies) to increase efficiency and reduce costs, in order to be competitive on local and international levels – which would lead to a reduction in the number of employees or to continuously subsidize the mining industry in order to artificially sustain the sector and its employment. Moreover, climate policies and the rise of renewable energy usage may add pressure on the sector. In some power markets, the increased integration of variable renewable energy in the grid is already creating financial issues for incumbent fossil fuel based generators (IRENA, 2017).

Employment in the coal industry is decreasing due to several factors such as power plants closing, overcapacity and improved mining technologies. China, for example, produces nearly half the world's coal, but excess supply and a slowing economy have led the government to plan closing of 5600 mines (Stanway, 2017) as well as cancelling plans to build more than 100 coal-fired power plants (Forsythe, 2017) which can lead to the loss of 1.3 million coal mining jobs, which equals 20% of the total workforce in the Chinese coal sector (Yan, 2017). The Chinese government intends to spend more than \$360 billion through 2020 on renewable power sources and to increase employment in this sector to 13 mln people (Total investment..., 2017).

The solar energy sector in Poland is one of the few exceptions with a rising statistics. According to the data presented in table 2, Polish solar industry employs 2 750 people and generates a turnover of 230 million euros.

According to the author's research (Wasiuta, 2014), the construction of different types of RES sources in communities provides an additional source of income for them. The results of the study indicate that the construction of – for example – wind power plants is not only an opportunity for the local community to create additional employment, but it is also an opportunity to enrich the community with various types of taxes.

In the times of frequent protests organized by local community members against the construction of wind turbines it is worth looking at places where wind farms coexist with the residents. The Kisielice community (*Gmina Kisielice*) in Poland is an interesting example of such situation. The local authori-

ties have found a way for a modern, ecological direction of change while ensuring a continuous flow of financial resources, also being the first and only energy self-sufficient community in Poland. Wind energy has been implemented there consequently since the late 1990s. The local community is happy, farmers are happy when their land is chosen for an investment, because they get a fair salary. Also the protection of the environment is a positive aspect for everyone while using RES sources. Projects aimed at using biomass and cogeneration for heating in the community have been implemented since 2003, led to the closure of coal-fired boiler houses, coal and oil heating systems in detached houses are being abolished successively. According to authors research (Wasiuta, 2013) – 80% of respondents consider it to be significant or moderately significant that the development of renewable energy will contribute to regional development in the forms of self-employment and increasing jobs in that region which contribute to the development of different economic sectors, the development of transport infrastructure. Furthermore, according to authors research (Wasiuta, 2013) – more than 96% of analyzed communities consider tax revenues to the municipal budget to be one of the biggest benefits of RES development for the municipalities.

Summary and conclusions

Renewable energy sources sector creates diverse jobs in production, services and construction, requiring a variety of qualification and skills. Its development not only increases but also improves the quality of jobs in the industry.

The slowdown in the development of second biggest Polish RES sector, which is wind energy sector resulted from regulatory uncertainty when working on a law on renewable energy sources has led to a reduction in the scale of the related employment by 3.5 thousand people (Bukowski, Śniegocki, 2015) in 2012-2014. Due to the unfavorable regulatory environment, this trend will probably continue over the next few years.

Increase in employment requires a new impetus of investments, which in the next decade the dynamics of jobs created for example by wind energy sector, primarily will be determined by the size of expenditures for the construction of offshore wind farms.

Dissemination of any renewable energy technology will result in an increase in employment in absolute terms, but the decrease in employment per unit of production. Employment in relation to installed capacity in Poland is higher than the average in the EU (table 1). There is considerable potential for growth in revenues from renewable energy production (for example from income tax) and increasing employment in this sector.

Literature

- Bukowski M., Śniegocki A. (2015), *Wpływ energetyki wiatrowej na polski rynek pracy*, Warszawa
- Easton A. (2016), *Poland will miss 2020 RES Target*, "Power in Europe", Platts McGraw Hill Financial [14-03-2016]
- Forsythe M. (2017), *China Cancels 103 Coal Plants, Mindful of Smog and Wasted Capacity*, <https://www.nytimes.com/2017/01/18/world/asia/china-coal-power-plants-pollution.html> [28-08-2017]
- Graczyk A. (2014), *A study of the labour market of renewable sources of energy in Poland*, "Ekonomia XXI Wieku", p. 116-125
- International Renewable Energy Agency (2017), *Renewable Energy and Jobs, Annual Review 2017*, Masdar
- Invest in Norway (2017), *Energy & Cleantech*, <http://www.innovasjon Norge.no/en/start-page/invest-in-norway/industries/energy--environment> [13-10-2017]
- IRENA (2017), *REthinking Energy 2017: Accelerating the global energy transformation*, Abu Dhabi
- Ministerstwo Gospodarki (2009), *Polityka energetyczna Polski do 2030 roku*, <http://www.me.gov.pl/files/upload/8134/Polityka%20energetyczna%20ost.pdf> [25-10-2017]
- Ministry of Finance (2009), *Poland's energy policy until 2030. Attachment #2: Forecast of fuel and energy demand until 2030*, Warsaw
- Pacula P. (2017), *Poland's love affair with coal won't end soon*, <https://euobserver.com/regions/130319> [27-08-2017]
- Stanway D. (2017), *China to close more than 1,000 coal mines in 2016: energy bureau*, <http://www.reuters.com/article/us-china-energy-coal/china-to-close-more-than-1000-coal-mines-in-2016-energy-bureau-idUSKCN0VV0U5> [27-08-2017]
- Total investment in renewable energy will reach 2.5 trillion yuan* (2017), http://www.nea.gov.cn/2017-01/05/c_135956835.htm [28-08-2017]
- Wasiuta A. (2013), *Uwarunkowania ekonomiczne rozwoju energetyki wiatrowej*, PhD thesis, UWM in Olsztyn, typescript
- Wasiuta A. (2014), *Ekonomiczne uwarunkowania rozwoju energetyki wiatrowej*, Wydział Dziennikarstwa i Nauk Politycznych Uniwersytetu Warszawskiego, Warszawa
- Wood I., Broom R., (2017), *Reforming Poland's renewable industry*, <http://www.renewableenergyfocus.com/view/44664/reforming-poland-s-renewable-industry> [27-08-2017]
- Yan S. (2017), *China plans to cut 1.8 million coal and steel jobs*, <http://money.cnn.com/2016/02/29/news/economy/china-steel-coal-jobs> [27-08-2017]
- EurObserv'ER (2017), *État des énergies renouvelables en Europe, édition 2016*, <https://www.eurobserv-er.org/pdf/EtatdesENR-2017-FR.pdf> [14-10-2017]
- EurObserv'ER (2017a) *Wind energy barometer*, <https://www.eurobserv-er.org/pdf/wind-energy-barometer-2017-en> [14-10-2017]
- EurObserv'ER (2017b), *Renewable Energy Policy Factsheet (European Union)*, <https://www.eurobserv-er.org/pdf/renewable-energy-policy-factsheet-2017-european-union> [27-08-2017]
- EurObserv'ER (2017c), *Renewable Energy Policy Factsheet (Poland)*, <https://www.eurobserv-er.org/pdf/renewable-energy-policy-factsheet-2017-poland> [27-08-2017]



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POLLINATION VALUE AS AN ECOSYSTEM SERVICE

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ABSTRACT: The objective of this study is to present the issues associated with insect pollination as an environmental service. Moreover, it presents the methods of estimating the value of pollination and the results of the research into that value.

Research indicates a significant value of pollination – between 153 and 167 billion dollars in the world. Depending on the estimation method, the value of plant pollination by insects may vary. The differences reach as much as several dozen percent. The discrepancies result from different understanding of the term “value”, and in the case of cultivated plants – from significant diversification of the data on the impact of pollination on the crops (available in the subject literature). The literature is dominated by research in determining the value of pollination for cultivated plants. The research into the economic value of pollination for maintaining biodiversity is conducted at a very small scale.

KEY WORDS: pollination, value, ecosystem service, pollination value estimation methods

Introduction

The use of natural resources by people has been the subject of interest of multiple scientific disciplines. It is addressed by representatives of natural, social and economic sciences. The directions of the research in that scope are often associated with interdisciplinary issues on the borderline of sciences, such as assessments of the ecosystems' reactions to being used by people, specification of the needs of various social groups associated with using the natural resources, analysis of the awareness among the society of the relationships between people and nature, optimization of the landscape structure from the point of view of social needs and recommendations of sustainable development, etc. (see Solon, 2008). One of the main directions of research in that field is considered to be the monetary valuation of the respective services provided by nature (Solon, 2008) which is addressed by environmental economy.

Ecosystem services may be perceived and assessed from two points of view, i.e. biological-ecological and social-economic. In the former case, a service is any natural process, due to which people obtain high quality of the natural foundations for their life and development. In turn, from the socio-economic point of view, an environmental service is significant for management processes (Poskrobko, 2010).

The ecosystem services are difficult to estimate, among others because of the direct, but also indirect, impact on people's lives. The difficulty is additionally exacerbated by the fact that those services have many functions. In turn, the diversity of the ecosystem services make it impossible, or at least difficult, to develop one universal method of specifying their monetary value.

This study attempts to characterize one of the ecosystem services, i.e. pollination. Apart from characterization of pollination, the objective of this study is to demonstrate its functions and to present and assess the methods of estimating the value of pollination. The assessment was made on the basis of subject literature as well as the results of other authors' research. Moreover, the study includes a review of the results of the research into pollination value.

Ecosystem services – division, value and need for valuation

Ecosystems and biological diversity provide people with multiple goods and services. Ecosystem services accompany people in every activity. The literature contains many definitions of the term ecosystem services, both in Polish (Michałowski, 2011; Poskrobko, 2010; Solon, 2008; Żylicz, 2017), and

foreign (Constanza et al., 1997; MEA, 2005) literature. The differences are visible in the attitude to that issue, but also in the use of synonyms of the terms, i.e. the Polish word świadczenia (or *usługi* (services)) of the ecosystem (or of the environment), but the researchers do not share one opinion in that regard.

As indicated above, the ecosystem and its services affect every person. Constanza and his colleagues (1997) listed 17 key ecosystem services, associated with practically every area of our lives. Further research was aimed at grouping the ecosystem services. Kośmicki (2005) listed the following types of environmental services:

- raw material, production and transformation services;
- regulation and disposal services;
- preparation to anthropogenic use services;
- information services.

Each type of services includes between several and more than a dozen types of ecosystem services. The first type includes the services associated with production of oxygen, water, food, fodder, fertilizers, medical supplies, biochemical substances, raw materials for the industry and construction, goods for households and development of a gene pool reserve. The regulation and disposal services includes the highest number of ecosystem services. These include, among others, regulation of energy balances, water flows and climate, protection against harmful space radiations, consumption of solar energy, regulation of biological control mechanisms, maintenance of soil richness, collection and recycling of organic substances, food elements and anthropogenic wastes, cleaning and retention of waters and supplementation of underground waters, maintenance of biological biodiversity and living space for organisms, and stabilization of ecosystems. In turn, the preparation to anthropogenic use services included the following types of services: use of energy, residence, cultivation, tourism and recreation. Information services were divided into the services associated with: esthetics of nature, obtaining of models for incentives and remuneration, models for learning processes, assigning of sense and socialization models, historical and scientific information, as well as storage of the genetic pool reserve (Kośmicki, 2005).

Similarly, four groups of ecosystem services were listed by C. Hanson and his team (2012), who indicated the following types of environmental services (Hanson et al., 2012):

- supply – associated with obtaining products from ecosystems, e.g. food, biological materials, drinking water, biomass, biochemical or with preserving genetic resources;

- control – associated with the benefits obtained from managing the ecosystems and the natural processes taking place within them, i.e. maintenance of quality of air and water, control of the climate, water flows, limitation of water and wind erosion, maintenance of soil quality, control of pollution, biological control, limitation of the prevalence of diseases and extreme phenomena, pollination;
- cultural – consisting in the intangible benefits from the ecosystems, including educational, ethical and spiritual values, benefits from tourism, recreation and inspiration;
- support – being the natural processes assisting the other services provided by ecosystems – which include the services associated with primary production (production of matter as a result of photosynthesis and assimilation), flow of elements and water and development of natural habitats for the organisms that support the capacity of ecosystems to maintain balance of the environment.

The division into groups of environmental services facilitates the specification of their significance for people and their hierarchization. This, in turn, may facilitate their valuation, because people often do not incur costs associated with benefiting from ecosystem services and so do not perceive them as economic goods, but as natural goods which do not require recovery or protection (Graczyk, 2010). This may cause excessive use of those services, which may lead to excessive hardship for the environment.

According to the researchers dealing with the theory of environmental and natural resource economy, the need to research the environmental services results from the following premises (Michałowski, 2008):

- the environmental services constitute one of the fundamentals of the concept of permanent and sustainable development;
- they are based on complex natural mechanisms which are often impossible to replace by technology;
- people's activities destroy natural ecosystems, thus deteriorating environmental services;
- the quality of environmental services is limited by short-term economic benefits.

These premises indicate the significance of environmental services in development of the economy, and the fact that it is improbable, and often impossible, to replace them by technologies – people simply depend on the environment. This, in turn, directly indicates the value of the ecosystem services and the need to notice the conditions which need to be taken into account when considering the economic properties of ecosystem services, i.e. (Graczyk, 2010):

- understanding of the ecological functions of an ecosystem, which result in development of environmental goods and services,
- identification of the direct and indirect impact of the ecosystem services on the management process, i.e. their ecological and economic impact,
- quantitative specification of the economic costs and benefits of ecosystem benefits,
- specification of the value and manner of distribution of ecosystem services among beneficiaries.

It is not easy to estimate ecosystem services. It requires extensive knowledge, not only in economy, but also in natural or social sciences. That is why there exists a number of limitations and conditions for entering and using ecosystem services in the economic balance. Becla, Czaja and Zielińska (2013) specify the following:

- cognitive conditions and barriers – the need to possess the knowledge on the given services and the scope of its prevalence;
- information conditions – the need to possess certain information on the service;
- institutional and legal conditions – lack of or limited possibility to apply the solutions proposed in business practice;
- economic and accounting conditions – limited possibility to apply the methods of service valorization or absence of such methods;
- axiological conditions – acceptance of natural environmental services as economic values or lack thereof.

The difficulties with determining the total value of ecosystem services are also connected with the difficulty with specifying the respective components of that value, i.e. the use and non-use value. The use value may be divided into direct and indirect use value. In turn, non-use value is divided into the value of existence and of inheritance. A detailed division and description of those values was presented, among others, by Żylicz (2013, 2017).

Pollination as an environmental service

Pollination is necessary for obtaining seeds, and so lack thereof would mean disappearance of the flora from our planet. In terms of the origin of the pollen, plants are classified as autogamous or allogamous. Autogamous plants use for pollination the pollen from the same flower or from a different flower of the same plant, while allogamous plants use the pollen from another plant of the same species. However, in the case of autogamous plants, pollination with the pollen from another flower results in better seeds and yields. In the case of allogamous plants, for pollination they need an external factor,

such as wind, water or animals. Of animals, it is insects that play a dominant role in that regard. In Poland, almost 80% species of allogamous plants are pollinated by insects and over 20% by wind. Among pollinating animals, western honey bee (*Apis mellifera*) is responsible for ca. 90-95% of insect pollinations (Jabłoński, 1997; Jabłoński, 1998; Kołtowski, Jabłoński, 2008). Apart from western honey bees, it is also bumblebees and solitary bees that play a relatively important role in plant pollination. In our climate zone, plants are also pollinated by flies, butterflies, beetles, thrips and bugs.

However, it is western honey bee that plays the most important role in insect pollination. Its participation in plant pollination is increasing due to the following factors (Majewski, 2011):

- decreasing number of wild pollinators in the natural environment,
- large areas of croplands which make the access for wild pollinating insects difficult,
- pollution of the natural environment,
- improper use of plant protection products and other chemicals in farming,
- reduction in non-production areas.

These factors result in limitation of the population of pollinators in the natural environment, but also cause losses in bee keeping, e.g. through poisoning with plant protection products.

The advantage of western honey bees over other pollinators also results from the fact that that species is kept by people in large numbers. In a bee family, a significant number of specimens overwinter and, in early spring, they are ready to pollinate the plants. The populations of other insects are small in spring because, for example in the case of bumblebees, it is only a pregnant female that overwinters. Another advantage of western honey bees is that they may be transported to pollinate the crops. They may also be encouraged to pollinate the given plant species. These insects demonstrate the so-called flower fidelity, i.e. the tendency to visit the plants of one species during one flight, which increases the chances for correct pollination of plants. Western honey bees visit flowers during the whole period of their blossoming, collecting nectar and pollen (Skowronek, 2001).

In terms of classification of the ecosystem services, pollination belongs to control services, as a natural process occurring in ecosystems. Pollination also plays an important role in the group of supply services, because that process is necessary for obtaining food and it impacts the genetic resources. The other groups listed by Hanson and others (2012) may also cover the role of pollination. This indicates that the classification of environmental services presented by the above-mentioned authors, is blurred. However, the classification presented by Kośmicki (2005) is also blurred. It is not a weakness of

those classifications, but just confirms the complexity of the impact of environmental services on our lives.

Pollination by insects, especially honey bees, as an environmental service, provides people with multiple direct and indirect benefits. The main one that is relatively easy to estimate, is the benefit associated with obtaining food. In the case of insect-pollinated plants, that element is necessary for obtaining crops, or to increase and quantity and quality of crops. In the case of western honey bees, the benefit associated with pollination is the possibility to produce bee products. It is the possibility to obtain such products, in particular honey, that people started to keep bees. These products are eaten by people, but are also used in medicine or cosmetology. Another advantage of pollination is biodiversity. A total absence of pollinators would cause such changes in the environment as elimination of species of allogamous plants. In turn, the extinction of one species of pollinators might result in extinction of certain plant species. Such a situation may occur when, as a result of the process of coevolution, the given plant species may only be pollinated by the given species of pollinator.

The indirect benefits of pollination are mainly due to pollinators. With the example of western honey bees, two main advantages may be demonstrated: a) the insects are eaten by other animals, and in some human societies, bee larvae are eaten by people; b) bees may also play the role of a bioindicator, because that common species may reach practically any place and it accumulates pollution in its body, thus demonstrating the quality of the natural environment.

Pollination Valuation Methods

As a rule, valuation of the environment or of its respective elements, is not easy. Among others, it results from the fact that it delivers public goods without market prices. Environmental economy lists the following groups of methods (Navrud, Pruckner, 1997):

- market price methods,
- methods of avoidance and recovery cost,
- methods of valuation of non-market goods,

The first two groups are relatively obvious, because they are based on objective information. Controversies may result from the valuation of non-market goods which results from lack of market prices of those goods, and thus from the specific approach to their valuation, which may be difficult and controversial.

In turn, Żylicz (2013), in the cases of appearance of ecosystem services being public goods, indicates the possibility to estimate them using direct or

indirect techniques. The direct methods include reference to hypothetical markets, in which you may buy or sell the given goods. The value of a service may be determined by asking how much would the people be willing to pay for it (willingness to pay – WTP) or how much they would want for such goods (willingness to accept – WTA). In turn, in indirect techniques, economic value is obtained by checking the so-called replacement markets, where the goods that are complementary to our goods, are purchased and sold.

Specification of the value of pollination results from the function it plays and from whether the plants are cultivated or wild. In the case of occurrence of market prices for leasing pollinating insects (western honey bee) or for purchasing insects for crop pollination (bumblebees, solitary bees), the value of pollination may be determined on the basis of market prices. The value of pollination in the case of agricultural crops is often determined in combination with the size and value of the given production. That valuation may also use cost-based methods, such as the replacement cost method. It is much more difficult to estimate the pollination of wild plants (maintenance of biodiversity). The WTP or WTA methods may be applied here, but their credibility would be low.

The literature of pollination valuation is dominated by publications regarding agricultural production. The characteristics and assessment of the methods of valuation of the pollination service was presented by Mburu et al. (2006), Breeze et al. (2016) and Majewski (2016b).

Pollination value – results of world and Polish research

The economic value of the global ecosystem services is huge and rising. Their value (stated in fixed prices from 2007) for the year 1995 was estimated at USD 46 billion (46×10^{12}), and for 2011, taking into account the changes in the area of the respective ecosystems, at USD 125 trillion (Constanza et al., 2014). That value exceeds the world GDP, which demonstrates the role of those services. The economic value of pollination only constituted less than 0.4% of the value of services of all the ecosystems (ca. USD 167 billion: in 1995). However, the study lacks specific information on the manner of determining that value, which makes it difficult to compare it with other results.

The literature concerning pollination value is dominated by the publications associated with that value from the point of view of agriculture (including vegetable raising, gardening and horticulture). In the world, about 35% of food production depends on insect pollination. The plants pollinated by

animals provide people with ca. 74% of the global production of fats and 35-65% of vitamin E (Klein et al., 2007). About 22.6% of agricultural production in developing countries and 14.7% in developed countries, depends on insect pollination, and those levels are rising. Since 1961, the area of insect-pollinated plants in the world has risen by over 300% (Aizen et al., 2008).

The value of cultivated plant pollination in the world was estimated at USD 153 billion (Gallai et al., 2009). The order of magnitude is the same as in the research of Constanza et al. (1997, 2014), which may suggest that those researchers underestimated the value of pollination of wild plants. Gallai et al. (2009) estimated the value of pollination in Europe for ca. USD 22 billion, i.e. 15% of the total value.

If we compare the results of the estimated value of cultivated plant pollination in the European Union, prepared by Gallai et al. (2009) as well as Leonhardt et al. (2013), we will find that the obtained results are not significantly different (EUR 14.2 and 14.6 billion, respectively). This may indicate lack of subjectivity in the methods used.

In turn, according to the research conducted for the USA, the value of cultivated plant pollination, taking into account the value of fruits, vegetables and plants obtained from pollination, increased in that country from USD 9.3 billion in 1989 to USD 14.6 billion in 2000 (Morse, Calderone, 2000).

In Poland, the research into the value of pollination was only associated with cultivated plants. The value of insect pollination of the 19 most important insect-pollinated plants was estimated at ca. EUR 720 million, on the basis of the data from 2004 (Zych, Jakubiec, 2006). In turn, for 2012, that value for the main cultivated insect-pollinated plants, i.e. rapeseed and agromony, orchards, fruit bushes and permanent plantations, was specified at over EUR 825 million, and for 2015 – almost EUR 1.8 billion (Majewski, 2014, 2016b). The difference mainly results from the fact that the 2015 estimation took into account more insect-pollinated plants. If we assumed the same plants, the value specified for 2015 would be higher by less than EUR 400 million than the pollination value estimated for 2012. On the other hand, the values obtained were impacted by the market prices of the agricultural products generated with the use of pollination, which prices are characterized by a high degree of variation, which also affects the values obtained, because the estimation was based on the method of production value obtained due to pollinators.

By analyzing 27 studies estimating the value of pollination, almost half of them were based on the method of value of production obtained due to pollinators (dependence ratio). In seven cases, yield analysis was used to determine that value. Other methods, such as replacement costs or consumer surplus, were applied to a small degree (Hanley et al., 2015). The methods most

frequently used for estimating the value of pollination may only be applied to cultivated plants. To determine the value of pollination of wild plants, we should apply more advanced methods which have not been applied in the analyzed publications.

As indicated, the pollination value estimation method affects the results obtained. This is proven by the research of Majewski (2016a) who determined the value of pollination of apple orchards in Poland using three methods (value of production, value of production obtained with pollination, and replacement cost). Depending on the method applied, the differences in value were almost 50%, with values from over PLN 1.5 billion for the method of valuation of the production obtained due to pollination to over PLN 2.2 billion for the method of replacement costs (Majewski, 2016a). The results obtained depend both on the method applied and on the assumptions made in the research (specification of the impact of pollinators on the value of production, specification of the average salary, etc.). A change in assumptions may sometimes change the results, and thus the conclusions drawn from them, beyond recognition.

Conclusion

Ecosystem services are estimated higher than the world GDP, which shows that the environment plays the main role in people's lives. Pollination constitutes a small share of those services (less than 0.4%). Despite that, the global economic value of pollination, as an environmental services, is counted in billions of dollars, and, as of now, would be impossible to substitute.

It is not easy to determine the economic value of pollination or of other ecosystem services, because it is difficult to determine all the effects of that service. It is relatively easy to estimate the value of pollination of cultivated plants, on the basis of the increase in the size and quality of production. However, in this case it should be mentioned that pollination is not the only and sufficient phenomenon. It only increases the production potential of plants, while other activities are to make use of that potential. The problem with estimating the value of cultivated plant pollination is the determination of the degree, to which pollination has increased the size and quality of crops. It is much more difficult to specify the value of pollination as a service that allows to maintain biodiversity. It is a complex issue, because insects are elements of the environment, and apart pollination, they also produce food, but also constitute food for other animals, and make soils richer.

The literature is dominated by the publications on the value of pollination of cultivated crops, which may also indicate better recognition of that issue than in the case of the impact of insects on biodiversity. The methods

applied in the studies were usually based on the crops obtained due to pollination. The replacement cost method has been applied relatively seldom. In the age of threats to the natural environment and dying out of pollinating insects, that method might prove useful in demonstrating the significance of those insects. Especially that, at the current level of technology development, it would be impossible to replace insects with machines (although research is pending), and the only replacement method is manual pollination by people.

It seems that the research into valuation of pollination is developing. The impact of pollinating insects on crops has been specified for most cultivated plants. The main challenge before the researchers is specification of the economic value of pollination for maintenance of biodiversity.

Literature

- Aizen M.A., Garibaldi L.M., Cunningham S.A., Klein A.M. (2008), *Long-term trends in crop yield and production reveal no current pollination shortage but increasing pollination dependency*, „Current Biology” No. 18(20), p. 1572-1575
- Becla A., Czaja S., Zielińska A. (2013), *Pozaeconomiczne użytki środowiska a usługi ekosystemów w świetle współczesnego rachunku ekonomicznego*, „Ekonomia i Środowisko” No. 2(45), p. 10-22
- Breeze T.D., Gallai N., Garibaldi L.A., Li X.S. (2016), *Economic measures of pollination services: shortcomings and future directions*, „Trends in Ecology and Evolution” Vol. 31(12), p. 927-939
- Buks J., Prandecki K. (2015), *Usługi środowiska w rolnictwie*, „Europa Regionum” t. 21, p. 127-137
- Constanza R. et al. (1997), *The value of the world's ecosystem services and natural capital*, „Nature” Vol. 387, p. 253-260
- Constanza R. et al. (2014), *Changes in the global value of ecosystem services*, „Global Environmental Change” Vol. 26, p. 152-158
- Gallai M., Salles J.M., Settele J., Vaissière B.E. (2009), *Economic valuation of the vulnerability of world agriculture confronted with pollinator decline*, „Ecological Economics” Vol. 68, p. 810-821
- Graczyk A. (2010), *Świadczenia ekosystemów jako dobra ekonomiczne*, „Ekonomia i Środowisko” No. 1(37), p. 6476
- Hanley N., Breeze T.D., Ellis C., Goulson D. (2015), *Measuring the economic value of pollination services: principles, evidence and knowledge gaps*, „Ecosystem Services” Vol. 14, p. 124-132
- Hanson C., Finisdore J., Ranganathan J., Iceland C. (2012), *The corporate ecosystem services review: guidelines for identifying business risk and opportunities arising from ecosystem change*. Version 2.0, http://pdf.wri.org/corporate_ecosystem_services_review.pdf [13-06-2017]
- Jabłoński B. (1997), *Potrzeby zapylania i wartość pszczelarska owadopylnych roślin uprawnych*, Puławy
- Jabłoński B. (1998), *Wiadomości z botaniki pszczelarskiej*, in: J. Prabucki (ed.), *Pszczelnictwo*, Szczecin, p. 775-858

- Klein A.M. et al. (2007), *Importance of Pollinators in Changing Landscapes for World Crops*, „Proceedings of the Royal Society B: Biological Sciences” Vol. 274, p. 303-313
- Kołtowski Z., Jabłoński B. (2008), *Botanika pszczelarska*, in: J. Wilde, J. Prabucki (eds.), *Hodowla pszczół*, p. 431-480
- Kośmicki E. (2005), *Zrównoważony rozwój w warunkach globalnych zagrożeń i integracji europejskiej*, in: S. Czaja (ed.), *Zrównoważony rozwój*, Wrocław, p. 227-248
- Leonhardt S.D., Gallai N., Garibaldi L.A., Kuhlmann M., Klein A.M. (2013), *Economic gain, stability of pollination and bee diversity decrease from southern to northern Europe*, „Basic and Applied Ecology” Vol. 14(6), p. 461-471
- Majewski J. (2011), *Wartość zapylania upraw w województwie mazowieckim; próba szacunku*, „Zeszyty Naukowe SGGW Problemy Rolnictwa Światowego” t. 11(1), p. 112-120
- Majewski J. (2014), *Economic value of pollination of major crops in Poland in 2012*, „Economic Science for Rural Development” Vol. 34, p. 14-21
- Majewski J. (2016a), *Problem wyceny zapylania jako usługi środowiskowej*, „Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu” No. 450, p. 369-377
- Majewski J. (2016b), *Ekonomiczna wycena roli owadów zapylających w polskim rolnictwie*, in: K. Prandecki (ed.), *Z badań nad rolnictwem społecznie zrównoważonym [36] Internalizacja efektów zewnętrznych w rolnictwie – europejskie doświadczenia*, No 42, Warszawa, p. 80-97
- Mburu J., Hein L.G., Gemmill B., Collette L. (2006), *Economic valuation of pollination services: review of methods*, Food and Agriculture Organization of the United Nations, Roma
- MEA (2005), *Millennium Ecosystem Assessment. Ecosystem and Human Well-being; A Framework for Assessment*, <https://millenniumassessment.org/en/Framework.html> [13-06-2017]
- Michałowski A. (2008), *Ekosystemowe procesy regulacji atmosfery i klimatu jako usługi środowiska*, „Ekonomia i Środowisko” No. 1(33), p. 39-50
- Michałowski A. (2011), *Przestrzenne usługi środowiska w świetle założeń ekonomii zrównoważonego rozwoju*, „Problemy Ekorozwoju” Vol. 6 No. 2, p. 117-126
- Michałowski A. (2013), *Usługi środowiska w badaniach ekonomiczno-ekologicznych*, „Ekonomia i Środowisko” No. 1(44), p. 29-51
- Morse R.A., Calderone N.W. (2000), *The value of honey bees as pollinators of U.S. crops in 2000*, „Bee Culture” Vol. 128, p. 1-15
- Navrud S., Pruckner G. (1997), *Environmental valuation – to use or not to use?*, „Environmental and Resource Economics” Vol. 10, p. 1-26
- Poskrobko B. (2010), *Usługi środowiska jako kategoria ekonomii zrównoważonego rozwoju*, „Ekonomia i Środowisko” No. 1(37), p. 20-30
- Skowronek W. (2001), *Pszczelnictwo*, Puławy
- Solon J. (2008), *Koncepcja „Ecosystem Services” i jej zastosowanie w badaniach ekologiczno-krajobrazowych*, „Problemy Ekologii Krajobrazu” No. 21, p. 25-44
- Zych M., Jakubiec A. (2006), *How much is a bee worth? Economic aspects of pollination of selected crops in Poland*, „Acta Agrobotanica” Vol. 59(1), p. 289-299
- Żylicz T. (2013), *Wycena usług ekosystemów leśnych*, Panel Ekspertów „Wartość”, Lasy jako czynnik rozwoju cywilizacji: współczesna i przyszła wartość lasów, http://www.npl.ibles.pl/sites/default/files/referat/referat_zylicz_t.pdf [11-04-2017]
- Żylicz T. (2017), *Wartość ekonomiczna przyrody*, „Zarządzanie Publiczne” No. 1(39), p. 114-124

Marian FLIS

PREVENTIVE VACCINATION OF FOXES AGAINST RABIES – ECONOMIC AND ENVIRONMENTAL ASPECTS

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ABSTRACT: The thesis presents the analysis of the oral immunization effectiveness, taking cognizance of wild foxes. The preventive measures conducted 15 years ago have significantly contributed to the substantial decline in the number of verified cases of rabies among wild and domestic animals. Despite the fact, that aforementioned measures have been generating high costs covered by the state's funds, they dramatically reduced the risk of epizootic danger, thus epidemiological risks. Undertaken actions also led to the dynamic growth of population of foxes, which resulted in a kind of disruption of natural ecological system concerning the 'predator – prey' relation, therefore they have indirectly contributed to the deepening of the already ongoing contraction of the basic small animals.

KEY WORDS: fox, rabies, immunization, cost, effectiveness of vaccination

Introduction

One of the most dangerous animal-origin diseases, called zoonoses that accompany the man almost always, is rabies. As an infectious disease caused by RNA virus of the family *Rhabdoviridae*, genus *Lyssavirus*, that occurs in 7 biotypes, it is strongly pathogenic for humans, because it may lead to death due to respiratory failure. In ancient Greece, in the writings of Democritus and Aristotle, there is information about its occurrence and course. However, the first mention of the disorder, that in its symptoms resembled rabies, can be found in the Code of Hammurabi (1700 years BC). All warm-blooded animals are sensitive to infection, which is transmitted through bites of an animal excreting the virus with saliva. Thus, it is defined as a disease with a global reach and plays an important epizootic and epidemiological role (Smreczak 2007; Gliński 2016; Flis 2016).

It is the most common in developing countries in Africa and Asia, where the mortality rate among people reaches up to 96% of cases. In these areas, the access to health care is generally limited, while the estimates of incidence and mortality are not very accurate and usually do not reflect the scale of the problem. The presence of rabies is also quite a serious economic problem. Estimated losses on a global scale, associated with the occurrence of rabies, its diagnosis, prevention, treatment and loss of income due to illness, are estimated at more than 8.5 billion dollars a year (Hampson et al., 2015). Due to the fact of quite significant risk of occurrence and the wide possibilities of the spread of the virus, multidirectional attempts of preventive activities were undertaken for many years. Undoubtedly, the turning point was the second half of the nineteenth century, when the first vaccination of human chewed by a dog with symptoms of rabies, was performed in 1885 (Buczek, 1999; Flis et al. 2017; Smreczak, 2007).

In our country, the first attempts to limit so-called street rabies, were undertaken after the end of World War II. The compulsory vaccination of dogs, that were the primary reservoir for the virus, was introduced then. Within the 8 years, more than 900 thousand dogs were subject to vaccination, each year. During this period, the number of rabies cases decreased from 3682 in 1949 to 65 in 1956 (Stryszak, 1957). Despite the high efficiency of operations, they have proved to be ineffective in the long term. In the second half of the 60s, there was observed yearly increase in the number of ascertained rabies cases, especially in wild animals, mostly foxes. Due to the shift of the virus reservoir towards wild animals (so-called forest rabies) and the lack of effective instruments of prevention, the main methods of containment and eradication of rabies was the creation of protection and surveillance zones. The circles were marked, and prohibition to release domestic

animals was used in subsequent years, especially dogs and cats. In addition, sanitation hunting was organized on these areas. These treatments were not very effective, and the annual number of cases ascertained in animals was high, and some fatalities were reported in humans. Therefore, the pilot program of oral immunization of wild foxes, combined with the screening activities towards efficiency of its use, has been introduced since 1993 in western Poland. Due to the high efficiency, the program has covered all over the country since 2002 (Buczek, 1999; Mól, 2001; Mól, 2004; Flis, 2009; Flis et al., 2017). The effectiveness of oral immunization of foxes is high, since from its inception the number of ascertained cases of rabies in the country, despite the intrinsic fluctuations between years and regions of the country, shows a downward trend (Buczek, 1999; Bombik et al., 2014; Flis, 2016). At the same time, these activities are associated with relatively high costs of purchase and lining the vaccine (Flis et al., 2016).

Prevention efforts conducted over a period of fifteen years, have contributed to a significant reduction in the number of the virus cases in wild animals and virtually eliminated its occurrence in domestic animals. At the same time, they also contributed to a significant increase in the population of free-living foxes. Despite the increasing hunting pressure on this species, during the past four decades, the state of this species population in the country increased by slightly more than 3-fold (Bombik et al., 2014; Flis, 2013, Flis et al., 2016; Flis et al., 2017; Goszczyński et al., 2008; Kamieniarz et al., 2008; Panek, Bresiński, 2002).

Material and methods

Material for study consisted of data from the Central Veterinary Inspectorate on the preventive vaccination in Poland over the last five years. These vaccinations are carried out twice a year. When no rabies cases are not indicated in a given province for subsequent two years, they are limited to one immunization annually. On the other hand, when the province does not note the rabies cases over subsequent three years, immunization treatments are not carried out until finding the first case in a given area. Vaccine in the form of blisters surrounded by a bait mass, which includes fish meal, coconut oil and paraffin, as well as tetracycline as a biomarker, is discharged from the aircraft. Where conditions do not allow, it is manually distributed. Two vaccines are the most commonly used for vaccination: Fuchsoral (SAD B19) or Lysvulpen (SAD Bern). The number of vaccine doses is dependent on the afforestation degree and terrain sculpture, estimated population of wild animals – especially foxes, and the method of delivery. It is recommended not less than 20 doses per 1 km² area covered by the immunization action

(Florczuk, Jarmuż-Pietrasik, 2016; Rozp. Min. Rol. i Roz. Wsi z dnia 17 grudnia 2013 roku).

Collected data included the monitoring results on the number of ascertained rabies cases in wild and domestic animals, as well as costs of vaccination and subsequent monitoring of their effectiveness. This monitoring is conducted on a sample of 8 foxes culled from every 100 km², where an immunization is carried out. Foxes necessary for the analyses are provided by hunters. The research is based on three methods. The first allows to determine the presence of rabies virus in the collected material and is based on immunofluorescence of the brain imprints. Second, checking the presence of a biomarker contained in the vaccine bait confirming its acceptance, is based on the facets of the jaw bone at acquired foxes. And determination of antibody titers of the rabies virus in serum collected from heart blood clots or chest fluid, through the use of serological tests (RFFIT or ELISA), allows for the conclusion that animals are immune. These tests allow to determine the number of animals that are the virus vector and those that have been in contact with the vaccine and acquired the immunity by producing antibodies. Analysis of the vaccination costs and subsequent monitoring was carried out on the basis of individual groups of expenditure incurred on these projects.

The effectiveness of vaccination in terms of ecology was also assessed. The analysis included issues related to the functioning of fox population in the changing ecological systems.

Results

The presence of rabies in Poland

In the last five years, rabies was found in both wild and domestic animals. In wild animals, after an increase between the first two years of studies, a gradual decrease in the number of ascertained cases was noted in the following years. It can be confirmed by the equation of the trend line $y = -22.4x + 202.2$ and determination coefficient $R^2 = 0.3825$. The main reservoir of the virus were wild foxes, at which during the evaluation period were diagnosed almost 86% of cases among wild animals and just over 70% of all findings of rabies in animals in this period (figure. 1). In addition, rabies was diagnosed in other species of carnivores and 11 cases in wild ruminants (fallow and roe deer), as well as 26 cases in bats. In the same period in pets, the primary reservoir of the virus were dogs and cats with 2/3 of all diagnosed virus cases (figure 2). Rabies has also been found in 35 cattle, one sheep and one pig. At domestic as well as wild animals, a downward trend in the virus prevalence occurred ($y = -5.4x + 45.8$; $R^2 = 0.5178$).

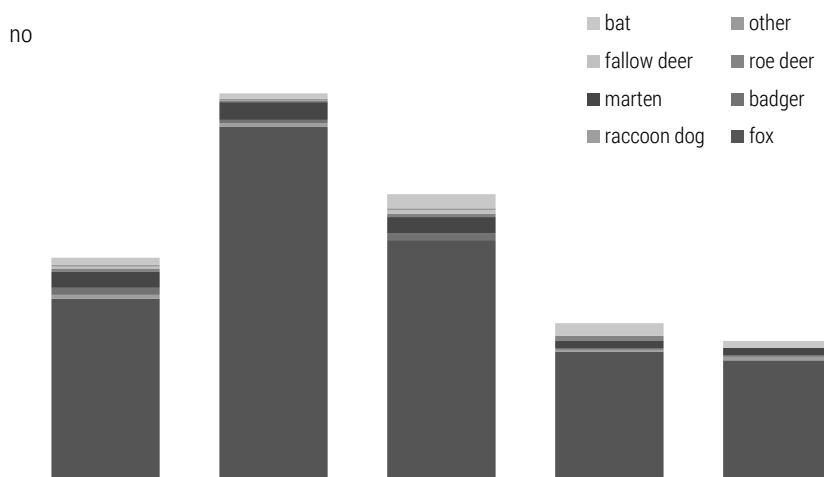


Figure 1. Presence of rabies in wild animals in Poland in 2011-2015

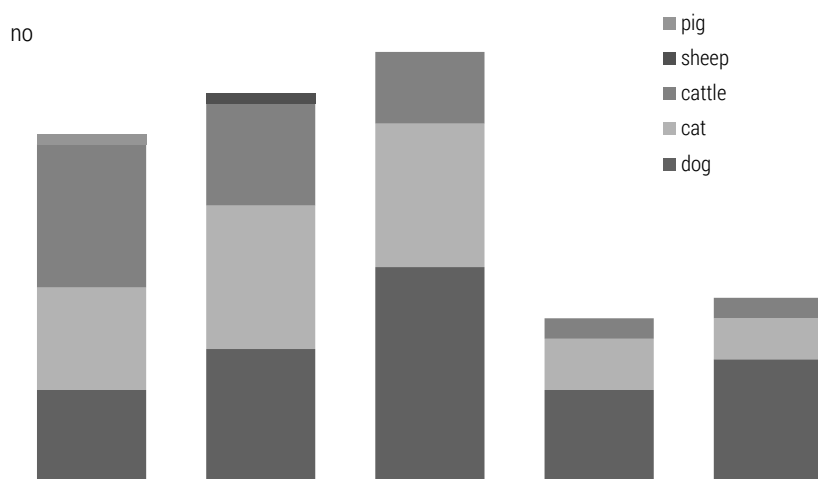


Figure 2. Presence of rabies in domestic animals in Poland in 2011-2015

The effectiveness of immunization

In the last five years, the efficacy of the immunization should be considered as high. The vaccine uptake indicator assessed by the presence of bio-marker contained in the vaccine bait ranged from 86.04% to 89.09% in the last five years (figure 3). These results confirm that only every 10 fox had no

contact with the vaccine. On the other hand, fox immunization index values assessed by the presence of antibodies in the serum from heart clots and thoracic fluid showed a decreasing tendency of seropositive results in terms of antibodies against the rabies virus. In the first four years of evaluation, the percentage of foxes, with detected antibodies ranged within 75.11-79.49%. In the last year of assessment, when the study was conducted only by ELISA test, this ratio decreased to the level of 54.1%. The results of the last year are clearly different from previous ones, yet it can be determined by the type of the test used, which has higher sensitivity and slightly less specificity. Thus, despite the fact that this test is widely used in most European countries, its use can lead to an increased risk of false negative results. In addition, the cause of decline in immunization of foxes in the last year of the study may be that in some provinces only autumn immunization was carried out in this period, and thus juveniles obtained for testing during summer and early fall, could not have any contact with the vaccine.

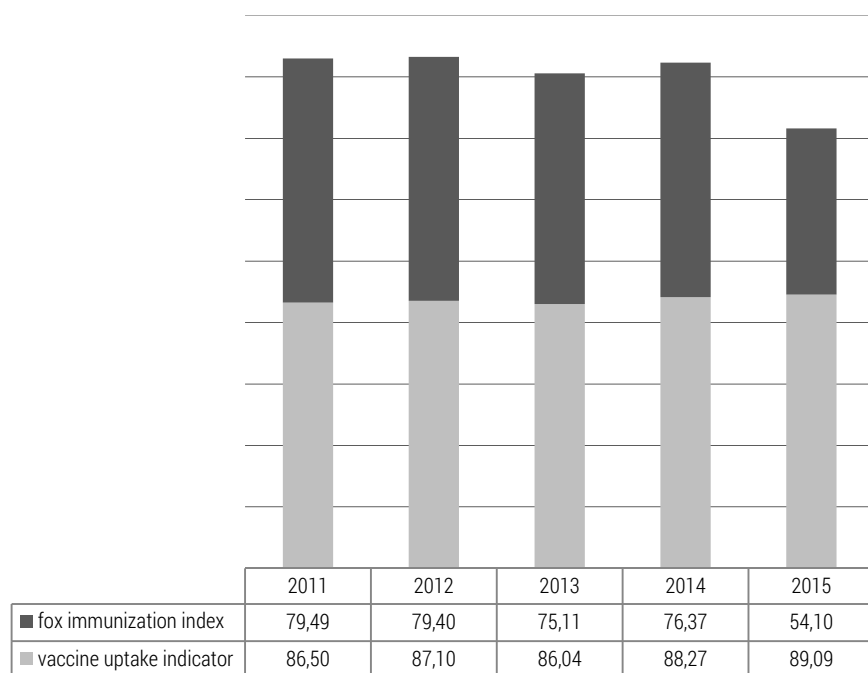


Figure 3. Effectiveness indicators [%] of oral immunization of free-living foxes

The costs of vaccination and monitoring

During the last five years, the costs associated with the oral immunization of foxes decreased (figure 4). This was due to the decrease in the number of provinces, where vaccinations were carried out, as well as in some of them, the actions were performed only once a year. In the first three years of the study, the average annual costs of carrying out the action were slightly higher than 48 million PLN. In 2010, they decreased to 32.4 million PLN, while in the last year, they amounted to 20.1 million PLN. Overall, in the group of expenses incurred to carry out the immunization, slightly more than 60% are expenses related to the purchase of vaccines.

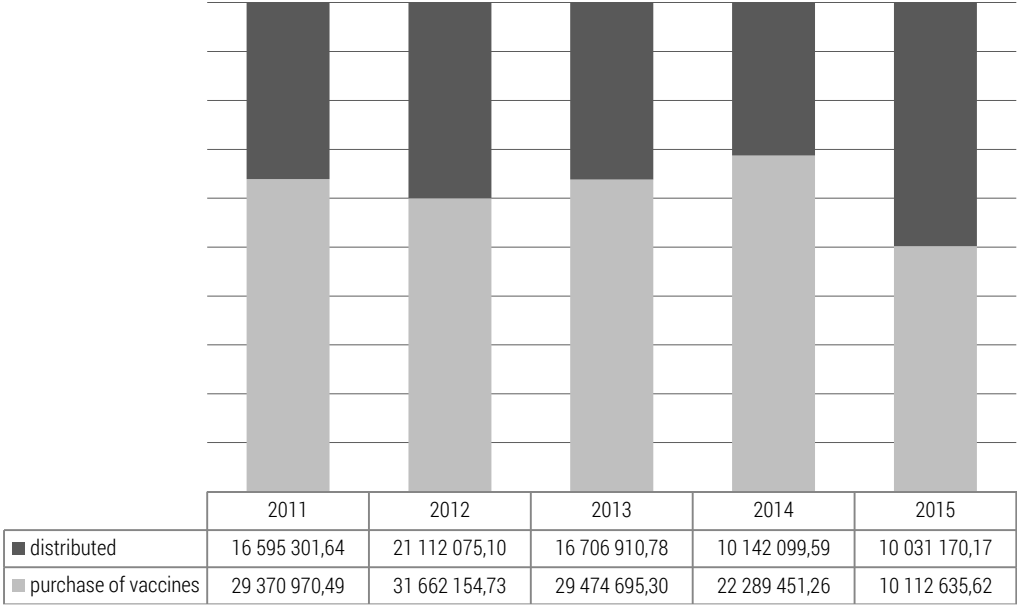


Figure 4. Costs [% and PLN] of purchase and distribution of vaccine during the study

Second, no less important group of costs necessary for the annual preventive measures, are those related to monitoring. These include the payment for foxes provided by hunters for testing, as well as costs of carrying out various tests and laboratory analyses by the veterinary hygiene centers. During the study period, the overall rate of these costs decreased slightly more than 1.5-fold (figure 5). On average, they were shaped at 2.7 million PLN annually. In this group of expenditures for monitoring, the share of costs associated with laboratory tests ranged from 71.4% to 80.3%. The remaining group consisted of costs for paying for foxes delivered for testing. Overall,

during the five-year study period, the total cost of monitoring the effectiveness of vaccination amounted to 13.5 million PLN and in the general pool of all costs associated with immunization, they accounted for less than 7%.

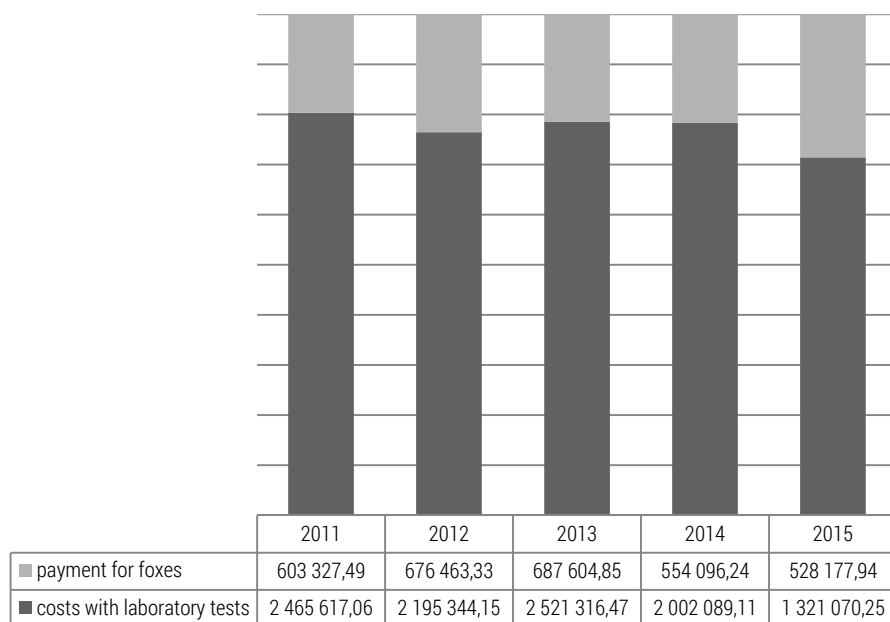


Figure 5. Costs of biological material and laboratory tests [% and PLN] in the five-year study period

Ecological effects

Evaluation of the vaccination effectiveness through the ecological lens reveals that conducted operations significantly affected the dynamics of fox population. This was due to the fact that through the immunization of animals, the basic factor of mortality in this species, which until recently was rabies, was eliminated. In the past five years, the size of fox population remained at a high level exceeding 200 thousand individuals (figure 6). This resulted in the enhancement of hunting pressure on this species. The intensification of culling assessed by increasing value of the indicator of hunting exploitation of that species by 17.4%, limited further growth, and even contributed to a slight decline. This is supported by the equation of the trend line and determination coefficient ($y = -2.57x + 213.83$; $R^2 = 0.6667$). Despite of this, persistently high numerical states of this species negatively affect the

functioning of many populations of small animals. Predation by foxes is mentioned as the primary factor contributing to ongoing for a number of years, recourse of hare, partridges and pheasants population.

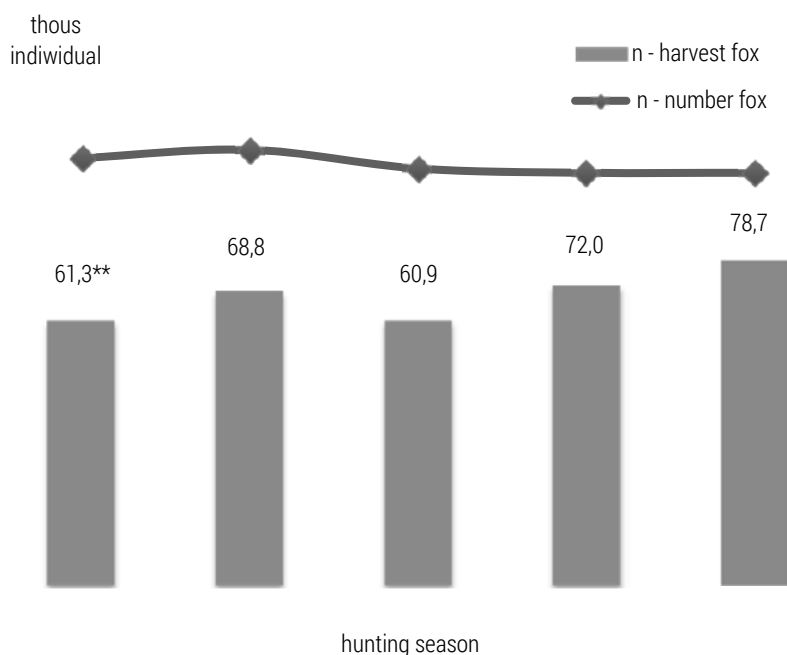


Figure 6. The dynamics of abundance and hunting acquiring of foxes in Poland during the study period*

* – according to data GUS

61,3** – indicator of hunting population exploitation

Conclusions

Conducted research and analysis made it possible to formulate the following statements and conclusions:

1. Oral immunization of wild foxes against rabies is characterized by high efficiency, which is confirmed by the continued decline in the number of annually ascertained cases of rabies in wild and domestic animals. This is also confirmed by indicators of the vaccine uptake and the immunization level of foxes annually examined in the framework of the monitoring.
2. Analysis of fairly high cost of vaccination policy, which is covered by the state budget, suggests that its level depends on the size of area they cover

and the number of actions held on an annual basis. The highest component of these costs are related to the purchase of vaccines and their distribution. On the other hand, costs of monitoring tests accounted for only 7% of the overall incurred costs to carry out the immunization.

3. Analysis of the vaccination effectiveness in ecological terms suggests that protective immunization effectively eliminated the virus from environment. The negative aspect is an excessive increase in the number of foxes, which resulted from the elimination of recently basic mortality factor, which was the rabies virus. In turn, the high numerical states of foxes contribute to increased predation on small animals that for many years has been experiencing a population regression
4. The oral immunization of foxes performed for fifteen years, has contributed to the decrease in epizootic and thus epidemiological risk, and also contributed indirectly to undermined the ecological system predator-victim. In this situation, the only solution seems to be to continue the initiated, annual intensification of fox acquiring by culling.

Literature

- Bombik E. et al. (2014), *The dynamics of fox (*Vulpes vulpes* L.) populations in selected hunting region of the central-eastern Poland in relation to effectiveness of rabies vaccination*, "Veterinarija ir Zootechnika" No. 68, p. 9-15
- Buczek J. (1999), *Wścieklizna – historia, stan obecny, kontrola epidemiologiczna*, „Medycyna Weterynaryjna” No. 55, p. 783-787
- Flis M. (2009), *Efekt szczepień przeciw wściekliznie a dynamika liczebności lisów*, „Medycyna Weterynaryjna” No. 65, p. 175-178
- Flis M. (2013), *Sytuacja epizootyczna i epidemiologiczna wścieklizny w Polsce w latach 2002-2011 na tle dynamiki liczebności lisów wolno żyjących*, „Życie Weterynaryjne” No. 88, p. 657-660
- Flis M. (2016), *Sytuacja epizootyczna wścieklizny u zwierząt domowych w Polsce w latach 2006-2015*, „Wiadomości Zootechniczne” No. LIV, p. 55-60
- Flis M., Zarzeczny J., Grela E.R., Gugąła D. (2016), *Rabies in Lublin Voivodeship: Effectiveness of prophylactic vaccination of free-living foxes and its impact on wild animal population in the last decade*, „Medycyna Weterynaryjna” No. 72, p. 511-515
- Flis M., Grela E.R., Gugąła D. (2017), *Występowanie wścieklizny w Polsce w latach 2011-2015 na tle populacji lisów wolno żyjących*, „Medycyna Weterynaryjna” No. 73, p. 43-47
- Florczuk P., Jarmuż-Pietraszczyk J. (2016), *Wścieklizna ludzi i zwierząt – metody zapobiegania oraz wykorzystywane szczepionki*, „Przegląd Hodowlany” No. 2, p. 30-33
- Gliński Z. (2016), *Zoonotyczne choroby zwierząt łownych. Część I. Włośnica, wścieklizna, tularemia, borelioza*, „Życie Weterynaryjne” No. 91, p. 560-564
- Goszczyński J., Misiorowska M., Juszko S. (2008), *Changes in the density and spatial distribution of red fox dens and cub numbers in central Poland following rabies vaccination*, „Acta Theriologica” No. 55, p. 121-127

- Hampson K. et al. (2015), *Estimating the global burden of endemic canine rabies*, „PLOS Neglected Tropical Diseases” No. 9, e0003786
- Kamieniarz R., Kryński A., Wielich T. (2008), *Wyniki szczepień lisów przeciw wściekliznie na tle danych o populacji tego gatunku w Wielkopolsce*, „Medycyna Weterynaryjna” No. 4, p. 318-321
- Mól H. (2001), *Wścieklizna zwierząt w Polsce w latach 1999-2000 w przyrodniczej i urzędniczej inwentaryzacji na koniec wieku*, „Życie Weterynaryjne” No. 76, p. 270-273
- Mól H. (2004), *Od wścieklizny ulicznej psów do leśnej lisów*, „Życie Weterynaryjne” No. 79, p. 502-505
- Panek M., Bresiński W. (2002), *Red fox *Vulpes vulpes* density and habitat use in rural area of Western Poland in the end of 1990s, compared with the turn of 1970s*, „Acta Theriologica” No. 47, p. 433-442
- Rozporządzenie Ministra Rolnictwa i Rozwoju Wsi z dnia 17 grudnia 2013 roku w sprawie przeprowadzania ochronnych szczepień lisów wolno żyjących przeciw wściekliznie, Dz.U. poz. 1737
- Smreczak M. (2007), *Efekty doustnego uodporniania lisów przeciwko wściekliznie*, in: *Nauka łowiectwu cz. 1. Kryzys zwierzyny drobnej i sposoby przeciwdziałania*, Warszawa, p. 39-47
- Stryszak A. (1957), *Sytuacja epizootyczna po 6 latach szczepień psów przeciw wściekliznie*, „Medycyna Weterynaryjna” No. 13, p. 705-707

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TAXATION OF TOURISM ENTERPRISES IN POLAND IN THE YEARS 2010-2015

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ABSTRACT: Taxes affect a tourism company in a different range. Income taxes affect the profitability of an enterprise. The amount of tax depends on the legal form and size of the company. The literature of the subject has not paid much attention to the taxation of tourist companies in the country. The article attempts to estimate the effective tax rate of personal income tax and corporate income tax levied on tourist companies in Poland in the years 2010-2015. Analysis shows that the tax burden was not particularly low in comparison to non-agricultural business sector and generally increased with the size of the company. Effective rates of lump-sum tax and personal income tax were lower than the rates of corporate income tax. The effective tax burden of corporations has turned out to be in many cases, especially for large companies, higher than nominal.

KEY WORDS: tourist companies, income taxes, effective taxation

Introduction

Taxes affect a tourism company in a different range. Income taxes affect the profitability of the company, indirect taxes shape prices, demand for tourism services and turnover, and property taxes can affect the location of a business. The amount of tax depends also on the legal form and size of the enterprise. The literature of the subject has not paid much attention to the taxation of tourist companies in the country.

The article attempts to estimate the effective tax rate of personal income tax and corporate income tax levied on tourist companies in Poland in the years 2010-2015. In this article, a tourist company is understood as an organizer (tour operator), broker and tourist agent. The analysis was conducted for micro, small, medium-sized and large enterprises.

An overview of literature

The literature on the economics of the tourism sector in Poland, in its various dimensions, is very extensive. A perfect overview of research and teaching achievements in this area is given by Gołębski (2013). However, relatively little work is concerned with the role of taxes in the development of this sector in terms of micro, mezo and macroeconomic scale. For the majority of these works, authors only indicate taxes as important tools of state and local government influence on the supply and demand side of the tourist services market (e.g. Hadzik, Tomik, Ryśnik, 2016, p. 294; Panasiuk, 2014, p. 168; Przybylska, 2012, p. 80; Meyer, Gardzińska, 2014, p. 215). In addition Jalinik (2012, p. 63) points out that the preferences in personal income tax and VAT (Value Added Tax) were important factors for the increase in the number of agri-tourism farms in the Podlaskie Voivodeship between 1990 and 2011. Kizielewicz (2012) shows the significant role of local taxes and charges in development of tourist services on the example of Gdańsk, Gdynia and Sopot communes in 2009 and 2010, and also discusses the importance of VAT in these services. In a series of studies on satellite tourism for Poland, the authors give aggregate data on the share of indirect taxes in tourist value added (RST 2017, p. 81 and 92). In turn Szyszka-Olejowska (2014) discusses the rules of taxation of tourist services in Poland according to the legal status for 2014, but does not conduct empirical research. Literature of the subject does not provide information on the tax burden of tourist companies in Poland.

Research methods

The analysis, with some exceptions, covered the period of 2010-2015. The research procedure consists of the following stages:

- presentation of the general rules of income taxation of tourism companies in Poland on the basis of the legal acts in force in the analyzed period,
- presentation of the number and structure of tourist businesses broken down into:
 - activity (tourist organizer, tourist broker and tourist agent); This division is based on the Act on Tourist Services (Act 2017, Article 3),
 - legal and organizational form; The analysis is based on data from the Central Register of Tourist Organizers and Travel Agents (CEOTiPT) conducted by the Minister of Sport and Recreation,
 - the size (micro, small, medium and large) as recommended by the European Commission (Commission, 2003, annex); Eurostat data was used in the analysis,
 - turnover; Eurostat data was used in the analysis. The amounts in euro were converted into Polish zloty according to the average annual NPB exchange rate.
- analysis of enterprise effective tax rate broken down into the following groups:
 - natural persons (micro companies) taxed with a lump-sum tax (RE),
 - natural persons (micro companies) taxed with flat income tax (PL),
 - legal persons (micro companies) taxed with corporate income tax (CIT),
 - legal persons (small companies) taxed with corporate income tax (CIT),
 - legal persons (medium companies) taxed with corporate income tax (CIT),
 - legal persons (large corporations) taxed with corporate income tax (CIT).

The effective lump-sum tax in a given year is understood as the quotient of the tax paid and the amount of gross income (turnover) earned (excluding VAT and before tax deductions). The effective rate of income tax for individuals in a given year is understood as the quotient of the tax paid and the amount of income earned. The analysis is based on the annual information on the lump-sum tax (MF 2011, 2012, 2013, 2014, 2015 and 2016) and personal income tax (MF 2011a, 2012a, 2013a, 2014a, 2015a and 2016a) published by the Ministry of Finance. Some important assumptions were made in the analysis:

- the share of income of tourism companies liable to a lump-sum tax in total income of non-agricultural business activities liable to a lump-sum tax was determined on the basis of the share of PKWiU (Polish Classification of Goods and Services) numbers related to the activity of the organizer (79.12.Z), broker (79.11.B) and agent (79.11.A) in the number of PKWiU numbers indicated for taxation at the rate of 17% in the law on the lump-sum tax (Law 1998, Article 12, point 2). In total, 56 types of such activities were identified in the law and three of them are connected with surveyed entities,
- the annual income of natural persons is taxed at a flat rate of 19%,
- entrepreneurs in a given year benefit from tax discounts and deductions according to the actual scheme for all taxpayers subject to the form (RE or PL) given in the annual tax information by the Ministry of Finance. Deductions are proportional to the share of income of the surveyed companies in the income of all taxpayers conducting non-agricultural business activity.

The effective rate of corporation tax for a given year is understood as the quotient of the tax paid and the amount of gross profit earned. The tax burden was determined on the basis of financial data of tourist companies included in the database of companies Emis obtained under the following PKWiU numbers: organizers 79.12.Z, brokers 79.11.B and agents 79.11.A (www.emis.com). The analysis was not subject to erroneous and incomplete events.

In addition, annual information from the Ministry of Finance on corporate income tax (MF 2011b, 2012b, 2013b, 2014b, 2015b and 2016b) was also used, as well as Eurostat and Central Statistical Office data. As a result of limited aggregate data, the analysis of CIT imposed on micro and small companies has been narrowed down to 2012-2015.

Results of the research

Principles of taxation of tourism companies income

Tax payers are tourist organizers (tour operators), brokers and agents. The tour operator is organizing the so-called tourist events (Act 2017, Article 3). The tourist event includes at least two tourist services that make up a single program and are subject to a shared price, provided that the service includes accommodation or stays for more than 24 hours or if the program provides for a change of location. A tourist broker is an entrepreneur, whose business consists in executing, on behalf of the client, actual and legal activities connected with concluding contracts for the provision of tourist services.

The activity of the organizer and broker is regulated (Act 2004) and requires entry into the register of tour operators and travel brokers (ROTiPT). These entities are also required, among others to insure their business against insolvency, to enter into a guarantee agreement and to pay contributions to the Tourist Guarantee Fund (TFG).

On the other hand, a travel agent is an entrepreneur whose business consists in a permanent intermediary in the conclusion of contracts for the provision of tourist services to tour operators authorized in the country or to other service providers established in the country. The agency business is not regulated and does not require a permit. These entities are not subject to compulsory entry into the ROTiPT, are not obliged to insure themselves and are not covered by the TFG guarantee.

The mentioned entities may operate in any legal and organizational form as permitted by the national regulations for the conduct of broadly defined economic activity for profit and non-profit. Individuals who pursue a one-person business activity, partners in a civil or public company, and earn income from the provision of tourist services may be subject to personal income tax (Law 2000) or lump-sum tax (Law 1998). Company partners are separate taxpayers. The income of natural persons may be taxed under the so-called general rules or with a flat tax. General rules rely on the use of progressive tax scale (table 1), while the flat tax is at the rate of 19%.

Table 1. Progressive scale in personal income tax in the years 2010 – 2015 [in PLN]

Tax base (income) in PLN		Tax
more than	below	
	85 528	18%
		minus amount 556,02
85 528		14 839,02+ 32% of surplus over 85 528

Source: Law 2000, art. 27.

Taxpayers who choose a flat tax cannot benefit from a number of tax preferences provided for general rules (table 2). In both cases, taxpayers carry out a taxable income and expense account solely on the basis of tax legislation, but after exceeding net income (without VAT) of € 1.2 million from sales of goods, products and financial transactions are obliged to complete the accounting books (Law 2016, Article 2).

Individuals can choose the lump-sum tax if their yearly sales income does not exceed 150 thousand euro. The tax is imposed on income without costs deduction. The tax includes several rates for different non-agricultural busi-

ness activities (from 2 to 20%) and for tourism companies the rate is 17%. Tax payers can benefit from some tax deductions and reliefs.

The income of legal persons is subject to corporate income tax (CIT) (Law 2000). In this case (as well as in the case of natural persons keeping accounting books) it is important to keep double records for accounting and tax purposes. For the purpose of determining the tax base, gross profit is adjusted for non-taxable income and expenses. The amount of tax also may be adjusted with possible reliefs or increases (table 2).

Table 2. Characteristics of taxation of tourist companies income in Poland in the years 2010-2015

Characteristics	Personal income tax (general rules)	Personal income tax (flat tax)	Lump-sum tax registered	Corporate income tax
Turnover (income)	x	x	Sales income (without VAT) up to 150 thousand euro per year	x
Costs	x	x		x
Tax deductions from turnover/income:				
- social security contributions	x	x	x	
- losses from previous years	x	x	x	x
- donations	x		x	x
- rehabilitation expenses	x		x	
- Internet expenses	x			
- expenses on new technologies	x			x
- IKZE (individual pension insurance account)	x	x	x	
Joint settlement with your spouse	x			
Joint settlement with the child (single parents)	x			
Tax	Tax scale	19%	17%	19%
Tax deductions:				
- tax paid abroad	x	x		x
- health contributions	x	x	x	
- relief for children	x			
- selected income earned abroad (Article 27g Act 2000)	x	x	x	

Source: author's own work based on: Act 2000; Act 2000; Act 1998.

It should be noted that joint stock companies and limited companies can create both tax groups (Law 2000, Article 1a). The tax is calculated separately by each company and then consolidated and transferred to the tax office by the tax representative. The tax group allows you to reduce the administrative costs associated with tax settlements and compensate for the current tax losses of companies that bore them with the tax profits of other companies, reducing the tax burden of the entire group. The benefits of offsetting tax losses with tax profits are distributed between the companies under the terms of the agreement between the members of the tax group and reduce their tax burden.

Number and structure of tourist companies in Poland in 2010-2015

During the period considered, the number of tourist enterprises fluctuated and eventually increased slightly from 4428 to 4664 (table 3). Tour operators generally acted as brokers, so together they accounted for almost 48.3% of the total number of tourist companies on the market. Relatively few companies provided separate services as the organizer and broker. Table 3 also shows that the number of operators and brokers has almost doubled during the period considered as opposed to the number of agents.

Table 3. Number and structure of tourism enterprises in Poland in the years 2010-2015

Specification	2010	2011	2012	2013	2014	2015
Broker	7	7	7	7	9	11
Tour Operator	383	419	449	494	547	604
Tour Operator/Broker	1549	1726	1952	2189	2440	2781
Travel Agent	2 489	2 170	2 216	1 268	1 185	1 268
Total	4428	4322	4624	3958	4181	4664

Source: author's own work based on www.pit.org.pl; www.ec.europa.eu/eurostat [10-07;2017].

Taking into account the legal form, the enterprises were clearly dominated by natural persons (table 4), which constituted 81.6% of the total number of entities surveyed. Individuals generally held one-person business activities (over 93.3% of all natural persons) and were mainly tourist agencies. They owned more than 92.3% of the agencies on the market. In the second place private limited companies were (over 12.0% of the total number), while relatively few companies operated in other legal and organizational

form. Among them are: general partnerships, associations, joint stock companies, co-operatives, branches of foreign companies.

Table 4. Number of tourist enterprises in Poland in 2010-2015 broken down into legal and organizational form

	2010	2011	2012	2013	2014	2015
Natural person	3 783	3 619	3 796	3 060	3 173	3 572
Privet limited company	437	460	489	536	590	657
General partnership	62	66	72	77	78	82
Association	60	63	65	68	73	77
Join-stock company	29	37	44	46	47	49
Other forms	57	77	158	171	220	227
Total	4 428	4 322	4 624	3 958	4 181	4 664

Source: author's own work based on www.pit.org.pl; www.ec.europa.eu/eurostat; www.emis.com [10-07-2017].

Tourist enterprises were mainly micro-companies and accounted for over 97.1% of total tourism enterprises (table 5). They also recorded the highest turnover (33.5% of total turnover), although slightly above the result of medium-sized companies (31.7% of total turnover) (table 6).

Table 5. Number of tourism enterprises in the years 2010-2015 according to the size classes

Size of enterprise (persons employed)	2010	2011	2012	2013	2014	2015
Large (250 and more)	4	4	5	6	4	4
Medium (50 – 249)	22	24	18	17	17	19
Small (10 – 45)	96	98	107	110	98	101
Micro (2-9)	1 964	1 308	1 930	1 564	1 718	2 088
Micro (0 or 1)	2 342	2 888	2 564	2 261	2 344	2 452
Total	4 428	4 322	4 624	3 958	4 181	4 664

Source: author's own work based on www.ec.europa.eu/eurostat [20-07-2017].

Table 6. Turnover of enterprises in the years 2010-2015 according to the size classes [thousand PLN]

Size of enterprise (persons employed)	2010	2011	2012	2013	2014	2015
Large (250 and more)	473 603	582 954	789 228	2 348 054	2 694 558	2 875 376
Medium (50 – 249)	2 387 635	3 455 080	2 984 124	1 886 528	2 269 344	2 714 261
Small (10 – 45)	1 253 238*	1 235 880*	1 168 608	1 278 460	1 401 740	1 087 211
Micro (2-9)	1 646 176	1 699 179	1 937 385	1 477 219	2 027 202	2 962 420
Micro (0 or 1)	720 652	1 032 177	788 810	658 600	807 697	815 618
Total	6 481 305	8 005 270	7 668 155	7 648 860	9 200 541	10 454 886

* Travel agency, tour operator reservation service and related activities

Source: author's own work based on www.ec.europa.eu/eurostat; www.emis.com [20-07-2017].

High share of the relatively small group of medium-sized companies was due to the fact that the group consisted of the most dynamically developing and well-known brands, including TUI Poland, Grecos Holiday (since 2014), Wezyr Holidays, Neckerman Polska, Net Holiday, Almatour Group, Logos Tour, Ecco Holiday. In addition, there were two companies listed on the Warsaw Stock Exchange (GPW), namely Net Media and Travelplanet.

Small companies accounted for 2.3% of the total number of enterprises, and large ones – 0.1% of this number. The share of turnover of these companies in total turnover was respectively 15.0 and 19.7%.

However, in regard with the size of turnover per entity the market was dominated by large companies. In this group there were two joint stock companies listed on the Warsaw Stock Exchange (Rainbow Tours and Interferie), Geovita Joint Stock Company, three limited liability companies (Natura Tours, TUI Poland Distribution, New Itaka) and Gromada (social cooperative). Some of these entities have reached the required employment threshold in various time bands. For example, New Itaka could be qualified for large companies from 2013.

Taxation of natural persons income with a lump-sum tax

Table 7 shows the effective lump-sum tax imposed on natural persons operating tourist businesses. The effective rate of this tax (over 14.0%), due to the use of tax reliefs, was lower than the nominal rate (17.0%). However, it was significantly higher than the effective rate for non-agricultural business income (at least 3.6%). This was mainly due to the relatively high nominal

rate for services provided by tourist companies compared to other business activities (20%, 8.5%, 5.5%, 3% and 2%). As a result, the surveyed entrepreneurs also paid a higher average lump sum tax compared to the average lump sum tax of non-agricultural business activity.

Table 7. Effective rate of lump-sum tax (RE) imposed on micro tourist enterprises in Poland in 2010-2015

Specification		2010	2011	2012	2013	2014	2015
Turnover OBA* (thousand PLN)	1	9 032	10 953	10 996	11 096	12 118	13 463
Share of turnover OBA in business turnover	2	0,028%	0,032%	0,032%	0,033%	0,034%	0,036%
Deductions from turnover OBA (thousand PLN)	3	325	394	436	464	490	555
Tax base OBA (thousand PLN)	4=1-3	8 707	10 559	10 560	10 632	11 628	12 908
Lump-sum tax OBA (17%) before deductions (thousand PLN)	5=4*17%	1 480	1 795	1 795	1 807	1 977	2 194
Tax deductions OBA (thousand PLN)	6	169	199	205	211	229	257
Lump-sum tax OBA (thousand PLN)	7=5-6	1 311	1 596	1 590	1 596	1 747	1 937
Nominal tax rate of non-agricultural business activity	8	5,70%	5,70%	5,70%	5,80%	5,80%	5,80%
Nominal rate OBA	9	17,00%	17,00%	17,00%	17,00%	17,00%	17,00%
Effective tax rate of non-agricultural business activity	10	3,60%	3,70%	3,60%	3,60%	3,60%	3,60%
Effective lump-sum tax rate OBA	11=7/1	14,51%	14,57%	14,46%	14,39%	14,42%	14,39%
Number of taxpayers OBA	12	395	493	495	474	478	524
Average tax on non-agricultural business activities (PLN)	13	2 097	2 341	2 263	2 179	2 378	2 514
Average OPA tax (PLN)	14=7/12	3 317	3 235	3 215	3 371	3 653	3 699

* Operator, Broker, Agent.

Source: author's own work based on MF 2011, 2012, 2013, 2014, 2015 and 2016; www.ec.europa.eu/eurostat; www.stat.gov.pl [20- 07-2017].

Taxation of natural persons income with the flat tax 19%

Table 8 presents an effective linear tax rate of 19.0% on the income of natural persons operating tourist businesses. As a result of applying tax deductions, it turned out to be lower than the nominal rate and ranged between 17.16 and 17.36% in the audited period. The entrepreneur also paid much lower average tax on income from non-agricultural business activity. The big difference was due to the relatively small number of taxpayers and

Table 8. Effective taxation of linear tax 19% [PLN] imposed on income of natural persons conducting tourist businesses in Poland in the years 2010-2015

Specification		2010	2011	2012	2013	2014	2015
Turnover OBA* (thousand PLN)	1	2 014 351	2 277 912	1 766 068	1 241 591	1 753 439	3 076 336
Share of costs in turnover OBA	2	98,47%	98,47%	99,68%	97,86%	98,02%	98,30%
Costs OBA (thousand PLN)	3=1*2	1 983 430	2 242 946	1 760 417	1 215 021	1 718 721	3 024 039
Income OBA (thousand PLN)	4=1-3	30 920	34 966	5 651	26 570	34 718	52 298
Share of income OPA in business income	5	0,04%	0,04%	0,01%	0,03%	0,04%	0,05%
Tax deductions from income OBA (thousand PLN)	6	822	968	166	854	1 037	1 499
Tax base OBA (thousand PLN)	7=4-6	30 098	33 998	5 485	25 716	33 681	50 799
Flat tax (19%) OBA	8=7*19%	5 719	6 460	1 042	4 886	6 399	9 652
Tax deductions OBA (thousand PLN)	9	352	396	70	327	418	619
Flat tax after deductions OBA (thousand PLN)	10=8-9	5 367	6 064	972	4 559	5 981	9 032
Effective tax rate OBA	11=10/4	17,36%	17,34%	17,21%	17,16%	17,23%	17,27%
Number of taxpayers OBA	12	3 512	3 258	3 446	2 740	2 851	3 212
Average tax on non-agricultural business activities (PLN)	13	36 096	34 660	32 200	33 228	35 375	38 000
Average OBA tax (PLN)	14=7/12	1 528	1 861	282	1 664	2 098	2 812

Source: author's own work based on MF 2011a, 2012a, 2013a, 2014a, 2015a and 2016a; www.ec.europa.eu/eurostat; www.emis.com[20- 07-2017].

the specific nature of the tourist enterprises. For example, in 2015, a total of 506,648 entrepreneurs paid the flattax, while only 3,212 were engaged in tourism business. Let's also remind you that the main source of income for tourism companies is the margin added to the cost of buying tourist services (hotel, catering, leisure, etc.) from other companies, so they have limited opportunity to reduce costs. As a result, the companies surveyed had a low tax base and paid a low tax.

Adopting the assumption of tax deductions consistent with the deduction structure given in annual tax information has made the effective rate of the surveyed companies and the effective rate of all taxpayers gaining income from non-agricultural business activity equal.

Taxation of micro business income with corporate income tax (CIT)

Table 9 shows the effective CIT rate imposed on tourism micro enterprises. The effective tax rate was higher than the nominal one in 2012 only. In the remaining years the rate was lower. Particularly in the year 2015 micro-firms recorded high profits but paid a relatively low tax. The average tax imposed on tourism micro businesses was significantly lower than the average tax on non-agricultural businesses (without banks and financial institutions).

Table 9. Effective CIT rate of micro tourist companies in Poland in the years 2012- 2015

Specification		2012	2013	2014	2015
Turnover OBA (thousand PLN)	1	949 131	883 132	1 069 342	688 238
Gross profit OBA (thousand PLN)	2	12 108	15 964	19 850	25 293
CIT OBA (thousand PLN)	3	2 591	2 906	2 881	3 073
Net profit OBA (thousand PLN)	4=2-3	9 517	13 058	16 969	22 220
Nominal CIT rate	5	19,0%	19,0%	19,0%	19,0%
Effective CIT rate OBA	6=3/2	21,4%	18,2%	14,5%	12,1%
Number of taxpayers OBA surveyed	7	235	246	238	203
Average effective CIT rate OBA (thousand PLN)	8=3/7	11	12	12	15
Average CIT on non-agricultural business activities (without banks and financial institutions) (thousand PLN)	9	172	155	150	152

Source: author's own work based on www.ec.europa.eu/eurostat; www.emis.com [20-07-2017]; MF 2011b, 2012b, 2013b, 2014b, 2015b and 2016b.

Taxation of small business income with corporate income tax (CIT)

Almost all small tourism companies were legal persons and paid CIT. Table 10 presents the effective CIT rate of small businesses. The effective tax rate was lower than nominal in 2012 only. In the remaining years the rate was slightly higher. Unfortunately, legal persons did not have many options for lowering the tax base and tax amount. The average tax imposed on surveyed companies was, however, significantly lower than the average tax of non-agricultural businesses (without banks and financial institutions). This was due to the same reasons as in the case of taxation of individuals with a flat tax, i.e. a small number of taxpayers, a high share of costs in revenue and taxation of the margin.

Table 10. Effective CIT rate imposed on small tourist companies in Poland in the years 2012-2015

Specification		2012	2013	2014	2015
Turnover OBA (thousand PLN)	1	1 237 488	1 430 308	1 583 155	994 617
Gross profit OBA (thousand PLN)	2	29 418	41 550	25 293	29 670
CIT OBA (thousand PLN)	3	5 503	8 645	4 992	6 647
Net profit OBA (thousand PLN)	4=2-3	23 915	32 905	20 301	23 023
Nominal CIT rate	5	19,0%	19,0%	19,0%	19,0%
Effective CIT rate OBA	6=3/2	18,7%	20,8%	19,7%	22,4%
Number of taxpayers OBA surveyed	7	95	98	95	72
Average effective CIT rate OBA(thousand PLN)	8=3/7	58	88	53	92
Average CIT on non-agricultural business activities (without banks and financial institutions) (thousand PLN)	9	172	155	150	152

Source: author's own work based on www.ec.europa.eu/eurostat; www.emis.com [20-07-2017]; MF 2011b, 2012b, 2013b, 2014b, 2015b and 2016b.

Taxation of medium-sized business income with corporate income tax (CIT)

Table 11 shows the effective CIT rate of the medium-sized tourist business. The effective tax rate was lower than the nominal one in 2013 and 2014 respectively. In 2013, there was also a sharp fall in the income of the surveyed companies. Both phenomena were related to leaving the group of medium-sized companies by Itaka, which has been included in the group of large companies since 2013. The amount of average tax, except for 2010 and 2012,

was significantly higher than the average income tax on non-agricultural businesses (excluding banks and financial institutions). In 2010, the industry as a total recorded a loss, however, mainly due to very high losses of two companies – TUI Poland (over PLN 21 million) and Coral Travel (over PLN 15 million). In turn, in 2012 high losses were noted by Neckerman and again TUI Poland. Hence, the average tax in these years was very low.

Table 11. Effective CIT rate imposed on medium-sized tourist companies in Poland in the years 2010-2015

Specification		2010	2011	2012	2013	2014	2015
Turnover OBA (thousand PLN)	1	2 351 431	3 019 912	2 753 530	1 764 804	2 175 196	2 624 987
Gross profit OBA (thousand PLN)	2	-9 164	37 529	5 247	32 434	80 305	58 889
CIT OBA (thousand PLN)	3	1 250	7 539	1 394	5 761	13 576	13 423
Net profit OBA (thousand PLN)	4=2-3	-10 414	34 660	3 853	26 673	66 729	45 466
Nominal CIT rate	5	19,0%	19,0%	19,0%	19,0%	19,0%	19,0%
Effective CIT rate OBA	6=3/2	-13,6%	20,1%	26,6%	17,8%	16,9%	22,8%
Number of taxpayers OPA surveyed	7	20	22	17	15	16	18
Average effective CIT rate OBA (thousand PLN)	8=3/7	62	343	82	274	849	746
Average CIT on non-agricultural business activities (without banks and financial institutions) (thousand PLN)	9	190	201	172	155	150	152

Source: author's own work based on www.ec.europa.eu/eurostat; www.emis.com [20-07-2017]; MF 2011b, 2012b, 2013b, 2014b, 2015b and 2016b.

Taxation of large business income with corporate income tax (CIT)

Table 12 presents an effective CIT rate of large tourism companies. The effective rate was in the audited period, except for 2011, much higher than the nominal rate. At the same time, the average CIT imposed on the surveyed companies was significantly higher than the average CIT for total non-agricultural business income (excluding banks and financial institutions). The high burden was due to the specifics of a small group of investigated entities. In selected companies (Rainbow, Itaka and Nature Tour) there was a dynamic increase of sales income and a clearly lower share of costs in this income. As a result, this translates into a higher tax. Gromada and Geovita recorded a high negative gross profit in 2011. The group also recorded very high losses in 2014 and 2015 (35.3 and 20.8 million PLN respectively), but they were compensated by the high gross profit of Itaka, which was included in the analysis from 2013. Nature Tour was included in the analysis only in 2013.

Table 12. Effective CIT rate of large tourist companies in Poland in the years 2010-2015

Specification		2 010	2 011	2 012	2 013	2 014	2 015
Turnover OBA (thousand PLN)	1	473 603	582 188	810 801	2 351 904	2 698 673	2 882 012
Gross profit OBA (thousand PLN)	2	19 218	-4 548	11 951	41 866	44 693	45 302
CIT OBA (thousand PLN)	3	5 523	1 606	2 805	10 783	14 913	14 119
Net profit OBA (thousand PLN)	4=2-3	15 326	-6 153	8 883	30 369	29 781	31 183
Nominal CIT rate	5	19,0%	19,0%	19,0%	19,0%	19,0%	19,0%
Effective CIT rate OBA	6=4/2	28,7%	-35,3%	23,5%	25,8%	33,4%	31,2%
Number of taxpayers OPA surveyed	7	4	4	5	6	4	4
Average effective CIT rate OBA (thousand PLN)	8=3/7	1 381	401	561	1 797	3 728	3 530
Average CIT on non-agricultural business activities (without banks and financial institutions) (thousand PLN)	9	190	201	172	155	150	152

Source: author's own work based on www.emis.com, [20-08-2017].

Conclusions

On the basis of the analysis of taxation of tourist companies in Poland in the years 2010-2015, we can draw some conclusions:

- 1) tourist companies in Poland, in terms of numbers, were dominated by micro companies of natural persons, which mainly operated tourist agencies. All of these entrepreneurs also recorded higher income in comparison with small, medium and large enterprises,
- 2) small, medium and large companies generally paid only CIT, whereas micro companies paid all types of surveyed taxes,
- 3) effective tax burden depended on the legal form and size of the surveyed companies and it grew with the growth of the size of the companies. However effective tax rates were not low in comparison to average effective tax rates of non-agricultural business (table 13). Individuals had lower tax burden than legal persons. This was mainly due to the more possibilities of applying tax deductions. Effective lump-sum tax and flat tax rates were lower than nominal ones and were lower than effective CIT rates,

Table 13. Effective tax rates imposed on surveyed companies in Poland in the years 2010-2015 [%]

Type of tax	2010	2011	2012	2013	2014	2015
Lump-sum tax (17%)	14,51%	14,57%	14,46%	14,39%	14,42%	14,39%
Linear tax (19%)	17,36%	17,34%	17,21%	17,16%	17,23%	17,27%
CIT (micro firms) (19%)	-	-	21,40%	18,20%	14,51%	12,15%
CIT (small firms) (19%)	-	-	18,71%	20,81%	19,74%	22,40%
CIT (medium-sized firms) (19%)	-13,64%	20,09%	26,57%	17,76%	16,91%	22,79%
CIT (large firms) (19%)	28,74%	-35,30%	23,47%	25,76%	33,37%	31,17%
Average effective lump-sum tax rate of non-agricultural business	3,60%	3,70%	3,60%	3,60%	3,60%	3,60%
Average effective linear tax rate of non-agricultural business	17,36%	17,34%	17,21%	17,16%	17,23%	17,27%
Average effective CIT rate of non-agricultural business	17,60%	17,40%	17,30%	17,00%	17,20%	17,40%

Source: author's own work based on tables 7-12.

- 4) it is successfully investigated the effective taxation of micro and small corporations only between 2012 and 2015. This was due to the limitation of access to aggregated financial data of companies in 2010 and 2011. The effective taxation of the income of these companies was quite variable. This also resulted from the change in size of some companies during the analysis period,
- 5) relatively few medium-sized companies and only a few large ones worked in the tourism industry. Negative effective rates in the years 2010 and 2011 resulted from the very large losses of several companies as well as the change in the size of companies. Medium and large companies generally recorded higher effective CIT rates than effective CIT rates for all non-agricultural companies (excluding banks and financial institutions).

Literature

- Gołębski G. (2013), *Badania i edukacja w sektorze turystyki w Polsce – wyzwania dla środowiska naukowego*, in: R. Pawlusiński (ed.), *Współczesne uwarunkowania i problemy rozwoju turystyki*, Kraków. p. 23-40
- Hadzik A., Tomik R., Ryśnik J. (2016), *Determinanty rozwoju turystyki zdrowotnej*, „Ekonomiczne Problemy Turystyki” No. 1(33), p. 287-300
- Jalinik M. (2012), *Instytucje i organizacje wpływające na rozwój agroturystyki w województwie podlaskim*, in: *Roczniki Naukowe SERiA*, Warszawa-Poznań-Białystok, t. XIV, z. 2, p. 59-64
- Kizielewicz J. (2012), *Wpływ polityki fiskalnej państwa i władz samorządowych na rozwój rynku turystycznego*, „Ekonomiczne Problemy Usług” No. 82, p. 385-397
- Komisja (2003), *Zalecenie Komisji z dnia 6 maja 2003 r. dotyczące definicji mikro-przedsiębiorstw oraz małych i średnich przedsiębiorstw*, nr C 1422, 2003/361/WE, załącznik
- Meyer B., Gardzińska A. (2014), *Znaczenie współpracy podmiotów samorządowych w procesie kreowania transgranicznego produktu turystycznego (na przykładzie województwa zachodniopomorskiego i Meklemburgii-pomorza przedniego*, „Ekonomiczne Problemy Turystyki” No. 3(27), p. 209-225
- MF (2011), *Informacja dotycząca ryczałtu od przychodów ewidencjonowanych za 2010 rok*, Ministerstwo Finansów, Departament Podatków Dochodowych, Warszawa
- MF (2012), *Informacja dotycząca ryczałtu od przychodów ewidencjonowanych za 2011 rok*, Ministerstwo Finansów, Departament Podatków Dochodowych, Warszawa
- MF (2013), *Informacja dotycząca ryczałtu od przychodów ewidencjonowanych za 2012 rok*, Ministerstwo Finansów, Departament Podatków Dochodowych, Warszawa
- MF (2014), *Informacja dotycząca ryczałtu od przychodów ewidencjonowanych za 2013 rok*, Ministerstwo Finansów, Departament Podatków Dochodowych, Warszawa
- MF (2015), *Informacja dotycząca ryczałtu od przychodów ewidencjonowanych za 2014 rok*, Ministerstwo Finansów, Departament Podatków Dochodowych, Warszawa
- MF (2016), *Informacja dotycząca ryczałtu od przychodów ewidencjonowanych za 2015 rok*, Ministerstwo Finansów, Departament Podatków Dochodowych, Warszawa

- MF (2011a), *Informacja dotycząca rozliczenia podatku dochodowego od osób fizycznych za 2010 rok*, Ministerstwo Finansów, Departament Podatków Dochodowych, Warszawa.
- MF (2012a), *Informacja dotycząca rozliczenia podatku dochodowego od osób fizycznych za 2011 rok*, Ministerstwo Finansów, Departament Podatków Dochodowych, Warszawa.
- MF (2013a), *Informacja dotycząca rozliczenia podatku dochodowego od osób fizycznych za 2012 rok*, Ministerstwo Finansów, Departament Podatków Dochodowych, Warszawa.
- MF (2014a), *Informacja dotycząca rozliczenia podatku dochodowego od osób fizycznych za 2013 rok*, Ministerstwo Finansów, Departament Podatków Dochodowych, Warszawa.
- MF (2015a), *Informacja dotycząca rozliczenia podatku dochodowego od osób fizycznych za 2014 rok*, Ministerstwo Finansów, Departament Podatków Dochodowych, Warszawa.
- MF (2016a), *Informacja dotycząca rozliczenia podatku dochodowego od osób fizycznych za 2015 rok*, Ministerstwo Finansów, Departament Podatków Dochodowych, Warszawa.
- MF (2011b), *Informacja dotycząca rozliczenia podatku dochodowego od osób prawnych za 2010 rok*, Ministerstwo Finansów, Departament Podatków Dochodowych, Warszawa.
- MF (2012b), *Informacja dotycząca rozliczenia podatku dochodowego od osób prawnych za 2011 rok*, dotycząca Finansów, Departament Podatków Dochodowych, Warszawa.
- MF (2013b), *Informacja dotycząca rozliczenia podatku dochodowego od osób prawnych za 2012 rok*, Ministerstwo Finansów, Departament Podatków Dochodowych, Warszawa.
- MF (2014b), *Informacja dotycząca rozliczenia podatku dochodowego od osób prawnych za 2013 rok*, Ministerstwo Finansów, Departament Podatków Dochodowych, Warszawa.
- MF (2015b), *Informacja dotycząca rozliczenia podatku dochodowego od osób prawnych za 2014 rok*, Ministerstwo Finansów, Departament Podatków Dochodowych, Warszawa.
- MF (2016b), *Informacja dotycząca rozliczenia podatku dochodowego od osób prawnych za 2015 rok*, Ministerstwo Finansów, Departament Podatków Dochodowych, Warszawa.
- Panasiuk A. (2014), *Determinanty i modele kształtowania roli państwa w gospodarce turystycznej*, „Polskie Towarzystwo Naukowe, Zeszyty naukowe” No. 16, Kraków, p. 159 – 174
- Przybylska A (2012), *Stymulowanie rozwoju turystyki na przykładzie wybranych gmin w dolinie Obry*, Poznań, p. 80
- RST (2017), *Rachunek satelitarny turystyki dla Polski za rok 2013 i oszacowania za rok 2015*, Warszawa
- Ustawa o podatku dochodowym od osób fizycznych (2000), Dz.U. nr 51, poz. 307 ze zm.
- Ustawa o podatku dochodowym od osób prawnych (2000), Dz.U. nr 54, poz. 654 ze zm.
- Ustawa o rachunkowości (2016), Dz.U. poz. 1047

Ustawa o swobodzie działalności gospodarczej (2004), Dz.U. nr 173 poz. 1807 ze zm.

Ustawa o usługach turystycznych (2017), Dz.U. poz. 1553

Ustawa o zryczałtowanym podatku dochodowym od niektórych przychodów osiąganych przez osoby fizyczne (1998), Dz.U. nr 144 poz. 930 ze zm.

DISCUSSION AND REVIEWS

RECENZJE
OMÓWIENIA, PRZEGLĄDY

PROFESSOR HANS CHRISTOPH BINSWANGER

LIFE AND WORK OF AN OUTSTANDING SWISS ECONOMIST

(19 June 1929 – 18 January 2018)

OBITUARY

On 18 January 2018, Prof. Hans Christoph Binswanger died unexpectedly, despite his advanced age. He was scientifically and socially active for the rest of his life.

Hans Christoph Binswanger was one of the most eminent contemporary economists in Europe and the world. He was known for treating economics as part of socio-cultural life. From 1969 to 1995 he was a full professor of economics at St. Gallen University in Switzerland. In addition, he held various honorable positions at the same University as the Director of the National Economy Research Community (Forschungsgemeinschaft für Nationalökonomie) in 1962-1992, and in 1992-1995 as the Director of the Institute of Economy and Ecology (the first scientific institute in the German-speaking countries, combining economic, environmental and social issues). Professor H. Ch. Binswanger was primarily concerned with the economy of the environment and natural resources, the theory of money, European integration and the history of economic thought. The key practical achievements of H. Ch. Binswanger were the concept of agricultural direct payment in Switzerland and the European Union, the concept of environmental taxes in Germany and the concept of the European Union's Ecological Council, which has not yet been implemented in practice.

Professor Binswanger's life path deserves attention. He was born on 19 June 1929 in Zurich as the son of writer R. Binswanger and painter M. Binswanger (nee Goetz). He spent his childhood and youth in Zurich, as well as in Ascona, Überlingen, Kreuzlingen and Zaton on the Dalmatian coast. H. Ch. Binswanger came from a well-known scientific dynasty, which since 1850 has produced a few generations of well-known psychiatrists and doctors. The private clinic "Bellevue" in Kreuzlingen was the basis for the economic life of the Binswanger family for several generations. The Binswanger's family came from Ostenberg in Bavaria and the Professor's great-grandfather, Ludwig Binswanger (the Elder) went from Judaism to Christianity, baptizing in a Protestant faith.

Despite the medical and psychiatric traditions in the family, the parents of H. Ch. Binswanger were artists, creating an artistic colony in Arsona and Überlingen by Lake Constance (Kley, 2010).

The undertaking of studies in economics by Hans Christoph Binswanger was a big surprise, and the future prominent economist studied "social economy" at the University of Zurich. There he also wrote his doctoral thesis on the European Union. Since 1959 took up a job at the College of Commerce (now University) in St. Gallen, Eastern Switzerland. He also wrote there his habilitation dissertation on the relationship between the real economy and money. He took care of 30 doctoral dissertations and about 100 diploma papers. Since the early seventies of the twentieth century, his works had been dominated by environmental issues. At the end of the 1970s and in the 1980s, his Swiss and European position was consolidated. However, the work "Money and Magic" brought him world fame, where he undertook the economic interpretation of Goethe's work "Faust". Thanks to his activity, it was founded in 1992 the Institute for Economy and Ecology at the University of St. Gallen, where he was its director together with professor Th. Dyllik for two years. Simultaneously in the years 1969-1980 H. Ch. Binswanger was a member of the Municipal Council of St. Gallen, representing the moderate liberal party Freisinnig – Demokratischen Partei (FDP).

The considerations of professor Binswanger focused on the following understanding of economics as science: (1) the subject matter of economics; (2) the recognition of also non-scientific forms of economic knowledge; (3) the diversification of the human image; (4) philosophical-ethical nature of the problems posed by economists; (5) practical-political orientation of this discipline. Hans Christoph Binswanger wanted to have a broader understanding of the subject matter of economics, because it could not be confined to the economy alone. Economic research must necessarily take into account the state, law, society, culture and the environment. Since the economy is part – and increasingly more important – of the whole contemporary culture and the world in which people live. Moreover, the economy must be taken into account in its historical, institutional and cultural context. Such a postulate concerning economy was also close to the Historical School of Economics, which was very well-known in the German-speaking area. In H. Ch. Binswanger's point of view, economic knowledge cannot come from economics alone, as there are also non-scientific forms of economic knowledge. According to Professor, such knowledge includes myths, philosophy, literature, poetry and ethnographic knowledge. Such economic knowledge is also offered by belles-lettres. It was shown by H. Ch. Binswanger on the example of Goethe's "Faust". This is because the "world of interests" require a critical observation and expressing doubts in the scope of its operation. H. Ch. Binswanger, based on different sources of knowledge, represented a broader, more diverse human image. The neoclassical theory represents a "picture of man" who maximizes only his own benefits. Therefore, *homo oeconomicus* – apart from many human aspirations – is only a theoretical construction.

Economists in their scientific studies usually refer to philosophical-ethical problems. Although there is usually an instrumental understanding of economics, normative questions cannot be avoided. Economic policy should take into account management objectives such as price stability, full employment, the balance of payments sustainability, the stabilization of environmental conditions and quantitative economic growth. H. Ch. Binswanger supported the ethical approach in economics as a co-author of the so-called "the oath of economist", where knowledge, abilities and the influence of economists should serve increasing the prosperity of one's own country and the world; whereas prosperity should enable every human being to live in conditions of dignity and economic independence, and natural resources as well as productive capital should be used so that future generations can find for themselves a world worthy of a dignified life (Kley, 2010, s. 90). For H. Ch. Binswanger economics was primarily a practically targeted discipline, and the development of economic theories should not be an end in itself. Such a practically targeted economics was also political in its nature. H. Ch. Binswanger understood his activities as "political", in which he was engaged for over forty years. In his view, economics should give new impulses to political activity by conveying new ideas. H. Ch. Binswanger considered himself to be a moderate liberal, and more broadly as a pragmatically oriented, liberal humanist.

In H. G. Nutzinger's view, the basic problems characteristic of the whole work of H. Ch. Binswanger were already included in his book *"Money and Nature"* published in 1991 (Nutzinger, 2010, p. 122). In the context of these views we should also consider the book *"Money and Magic"* (1985), where the author undertook not only the economic interpretation of Goethe's "Faust", but he also sees in Faust the prototype of a "modern man", who treated the whole world as his "dominion", and thus accepted the pursuit of the world's mastery for his own benefit (Nutzinger, 2010, p. 122; cf. Binswanger, 1991; see Binswanger, 1985, 2005). However, this point of view ultimately has led to a global socio-economic and environmental crisis. According to H. Ch. Binswanger, the basic problems of economy are associated with stabilized energy consumption, the reduced use of natural resources and devastation of the environment, as well as job security. Professor also critically assessed the development of agriculture, as a supporter of shaping agriculture and agricultural policy towards organic farming. He demanded the introduction of qualitative growth in the conditions of taking into account natural and social constraints. The postulate of moderation for sustainable management is indicated by his basic assumptions in the book "Towards Moderation" (Binswanger, 2010; Binswanger, 2016, pp. 55-78). In his view, institutional developments in the monetary and financial sector, as well as low, but globally stable growth rates, should prevent economic growth from turning into a variety of speculative bubbles. Since the dark side of the coercion of growth is the periodic contraction (collapse) of the economy and economic crises and, above all, financial crises, as well as the low level of economic stability. Economic sectors such as agriculture and energy management also demanded significant changes.

It has become necessary to make a rational transition from the postulate of maximum economic growth to "moderate economics". The spiral of money proliferation,

economic growth and environmental damage must be avoided. In his view, it is nowadays possible to protect the sustainable basis of management of, among others, energy reserves and sustainable meeting of needs. The current economic crisis is present in three areas: in the monetary field, in the real economy and, finally, in the natural foundations of social life and management. A new institutional and legal framework for the economy of moderation has become necessary.

In the case of Binswanger's work, it was characteristic to deal with the history of economic thought. He was one of the outstanding experts in economic thought history. Binswanger studied the history of the introduction of paper money, including the failure to introduce paper money, in the experiment of a banker J. Law in the seventeenth century. Another important issue for Binswanger was the theory of George Schlosser's imaginary needs, as well as Johann Heinrich von Thünen's theory of equitable pay. However, H. Ch. Binswanger devoted much attention to interpretation of Goethe's "Faust" its main character's actions. Three aspects of "Faust's" work seemed to H. Ch. Binswanger the most important: the creation of paper money, the institutionalization of the Roman concept of ownership and the possibility of extensive use of mechanical energy in economy. In "Faust" H. Ch. Binswanger indicates that the development of capitalism was associated with the absolute expropriation of small owners (Filomen and Baucis), the destruction of nature, as well as an illusion of the boundless possibilities of technical and economic, and even civilization achievements.

L. Ribaux briefly characterized H. Ch. Binswanger as a politician. He was politically involved as a member of the Municipality Council of St. Gallen, as well as in the proposal of the EU Ecological Council to interrupt the dynamic of "blind" growth and development that was not in line with environmental and social requirements. H. Ch. Binswanger linked "the material world of economy to social phenomena. His work and effects are characterized by ideological openness and human dimension" (Ribaux, 2010, p. 157).

In 2006 H. Ch. Binswanger published the book "Growth Spiral. Money, energy and creativity in the dynamics of market processes" (Binswanger, 2011). This book, which is in a way a summary of Professor's rich scientific achievements, explained the phenomenon of economic growth characteristic of contemporary capitalism, or rather its continuous growth, having the character of a spiral development. Economic growth began to be one of the best known economic concepts of only from the 1960s onwards. It is characteristic that in the neoclassical theory of economics, on the one hand money, and on the other hand nature (including energy and other natural resources) played a very small role. However, it was only the inclusion of these factors of production that led to a new approach in the scientific and political discussion about the conditions and opportunities for economic growth. The real reason for the postulate of growth was also the way in which the entire modern economy operated, which was oriented towards continuous growth. However, it is not a matter of keeping the growth rate as high as possible, but of maintaining a minimum global growth rate. The minimum growth rate for the global economy is estimated at 1.8%, assuming a single currency area and not taking natural differences into account (Binswanger, 2011, p. 2950).

Without taking nature into account, in particular energy, the importance of money and human creativity, growth would then remain unexplained, as could be seen in neo-classical theory.

In H. Ch. Binswanger's view, the goal of unrestricted economic growth has been a mere illusion, leading to increasingly difficult economic and social problems. This threatens the current and future generations' ability to achieve their objectives on a more secure basis. There is a need for further systematic development of economic theory. It became necessary to link money and nature in the theory of economics, as well as polemics with the current neoclassical theory of environment in economics. Nowadays, speculative bubbles are emerging more and more often, and their "bursting" has led to, through financial crises, to economic crises, as well as environmental crises.

The lack of self-regulation of the market for resources and environmental benefits makes an ecological policy necessary. Market failure was mainly due to two factors: external costs and the need to maintain public goods. The problem of environmental protection is facing today's demands of economy, which according to Binswanger, have been very widespread in the assumptions of economics; cheap and sufficient energy supply; securing increasing mobility and the continuous development of communication routes; cheap and rapid waste disposal; the problem of large risks being taken by companies and private individuals only up to a certain upper limit. This has led to the development of high-income economic strategies in economy. These economic claims are diametrically opposed to environmental protection and the rights of employees. This is why: "More comprehensive reforms are needed to stop these tendencies to burden the environment and put the economy on a modest path" (Binswanger, 2011, p. 201).

H. Ch. Binswanger pointed to the possibility of getting out of the crisis and on the path to the moderate (sustainable) economy. These included the following actions (Binswanger, 2011): (1) establishing new structure of the monetary system; (2) sustainability-oriented enterprises; (3) long-term preservation of food supplies; (4) sustainable management of natural resources; (5) the ownership obliges – patrimony versus dominion; (6) community services as a complement to wage services; (7) the principle of subsidiarity in environmental protection; (8) the EU Ecological Council as a representative of future generations.

Continuous economic growth after the Second World War has led to a huge increase in wealth. However, it is increasingly triggering speculative financial bubbles, which are being transferred to the real economy and are manifested in economic crises. According to Binswanger, effective control of money creation implies an appropriate reform of the monetary system, namely the idea of 100% money coverage (proposed already by Irving Fisher), in accordance with which the central bank would have the exclusive right to create money and the other banks would be obliged to cover their claims with 100% by the central bank. The banks would then be able to grant loans within their central bank money. Such a situation would exclude inflation and deflation, a speculative increase in the amount of money. This would increase the economy within the limits of sustainable use of natural resources. The reform of the money system would be the starting point for the strategy of moderation and thus sustainable development.

Gradually, in the twentieth century, economy was dominated by joint-stock companies, this has resulted in oligopolization and monopolization of markets linked to the increase in business profits at the expense of consumers. The joint-stock companies not only restricted competition, but also increased the tendency to speculative activities, i. e. to create financial bubbles. Such actions were, in Binswanger's view, in fact co-responsible for the various economic crises in the past (e. g. in 1929), but also for the crisis of 2007-2010. Speculative share purchases are extremely dangerous, although they are only successful if bank interest rates remain low. There is a need to transform public limited companies into alternative forms of enterprise. Such measures would enable a new way of management: maintaining competition, greater stability of economy, and target economy towards environmental protection and workers' rights. The reform of public limited companies could be seen in the light of the limitations that still were applied to them in the 19th century. However, partnerships, cooperatives and companies in the form of foundations are more oriented towards sustainable development.

It has become necessary to maintain a food supply close to the consumer. Agricultural policy is currently based solely on transfer payments. They are essential because agriculture cannot be based solely on maximizing product development, but on sustainable development. In agriculture, soil is at the same time a place of location and a basis for production, while for industry it is only a place of location. Particularly endangered has been the continued existence of agriculture in exporting countries, but also in economically highly developed countries, Agriculture is in a way doomed to sustainable development because the basis of production, so the soil is reclaimed every year.

Sustainable development is also associated with a more cost-effective use of renewable and non-renewable resources. The industrial revolution has led to an enormous use of natural resources. In the case of non-renewable resources, it is possible to postulate an exponential rule of saving in order to preserve such resources as long as possible. Reduction of energy consumption is essential here, as well as various activities related to efficiency and saving energy and raw materials.

The problem of proper ownership is also important in the use of natural resources. Traditional cultures were dominated by the notion of ownership as 'patrimony' and nowadays there is 'dominion' of Roman origin. In the case of 'patrimony' ownership is considered in terms of generation, while maintaining appropriate natural and social conditions. The principle of durability is important not only for the preservation of nature, but also for previously created buildings and works.

Many economic activities continue to be carried out outside paid employment, in the form of community service. The activities on the labor market are characterized by increasing automation and computerization of economic activity. Benefits for the community should include: welfare and social assistance, activities for the family, the care for the elderly, public safety, environment protection, agriculture, sport, the integration of foreigners, education and upbringing, youth work and development work.

According to Binswanger, future generations still do not have their representatives in society, as the modern political and economic system is based on the short-term behavior of citizens and businesses. The possibility of change is would be linked to the

creation of the Ecological Council as a body of the European Union. Its members would be recognized specialists in the field of environmental protection. It would be important for the ecological Council to be part of a democratic system and have adequate social legitimacy. In addition to its role as a catalyst for the general environmental interests and political control body, the Ecological Council would also have a basic advisory role. The Ecological Council should be autonomy, responsibility and competence in the preservation of natural resources in the EU. It would be an important body of the European Union. In H. CH. Binswanger's view: "the Ecological Council must be equipped with the appropriate infrastructure to enable it to fulfil its tasks, and in the political system it will serve as a signpost for sustainable development" (Binswanger, 2011, p. 201; more broadly: Binswanger, 1994; Kośmicki, 1995, pp. 195-201). Unfortunately, it has not been created so far in the European Union because the dominance of short-term economic interests.

In 2016 it was published Professor Binswanger's latest book entitled ***"Reality as a Challenge. Crossing the borders of a certain economist. 12 essays"*** (Binswanger, 2016). In the "Preface" he points out that in scientific studies it is not possible to take a holistic view of reality. The main question is the possibility of deepening and expanding knowledge. At the same time, the author's sources of research were inspired by Bible deliberations, the art of poetry and, above all by the works of Johann Wolfgang von Goethe, especially "Faust". M. Meyer-Schwarzenberger, the author of ***"About the Introduction: Hans Christoph Binswanger as a representative of the rationalism of the present"*** made a significant contribution to the development of this work. In his view, Professor Binswanger assumed that the world could be analyzed in a consistent and systematic way, where the laws of nature and the awareness of the universe as a whole exist. What is more, Professor Binswanger was a humanist almost classic representative of modernity, who made the subjective and rational experience of human existence a measure of all things. For H. Ch. Binswanger responsibility was the most important value, which was the essence of his views, and this is what human "wisdom" obliges to some extent.

Prof. Hans Christoph Binswanger was a great friend of Poland and Poles. Since 1962 he visited Poland many times. His wife Elisabeth also participated in some of his stays in Poland. Together with me, he visited many times Poznań, Białystok and Eastern Poland, Wrocław and Kobierzyce, as well as Ukraine with Lviv. With a group of friends, he visited various European countries every year, including the countries of the former Yugoslavia and the Soviet Union (including the Caucasus countries). He was also a keen supporter of European integration, the integration of refugees into European societies, and an opponent of the arms race and aggressive nationalism as well as all forms of social discrimination. The most important task for him was comprehensive environmental protection in Europe and worldwide.

Literature

- Binswanger H.Ch. (1985), *Geld und Magie. Deutung und Kritik der modernen Wirtschaft anhand von Goethes Faust*, Stuttgart (2., Ausgabe 2005)
- Binswanger H.Ch. (1991), *Geld und Natur. Das wirtschaftliche Wachstum im Spannungsfeld zwischen Ökonomie und Ökologie*, Stuttgart
- Binswanger H.Ch. (1994), *Europäische Umweltunion*, "GAIA" No. 3
- Binswanger H.Ch. (2010), *Vorwärts zur Mässigung. Perspektiven einer nachhaltigen Wirtschaft*, 2., Aufl., Hamburg
- Binswanger H.Ch. (2011), *Spirala wzrostu. Pieniądz, energia i kreatywność w dynamice procesów rynkowych*, Gilewicz J. (przekł.), Poznań, tytuł oryginału: Binswanger H.Ch (2006), *Die Wachstumsspirale. Geld, Energie und Imagination in der Dynamik des Marktprozesses*, Marburg
- Binswanger H.Ch. (2016), *Die Wirklichkeit als Herausforderung*
- Binswanger H.Ch. (2016), *Die Wirklichkeit als Herausforderung, Grenzgänge eines Ökonomen*. 12 Essays, Hamburg
- Kley R. (2010), *Der Ökonom Hans Christoph Binswanger*, in: *Wachstum, Geld und Geist: Der Ökonom Hans Christoph Binswanger*, Hrsg. von R. Kley in der VGS Verlagsgenossenschaft St. Gallen
- Kośmicki E. (1995), *O konieczności rozszerzenia Unii Europejskiej o cele i zadania ekologiczne*, "Ekonomia i Środowisko" No. 1, p. 195-201
- Nutzinger H.G. (2010), *Hans Christoph Binswanger Ökonomisches Werk*, in: *Wachstum, Geld und Geist: Der Ökonom Hans Christoph Binswanger*, Hrsg. von R. Kley in der VGS Verlagsgenossenschaft St. Gallen
- Ribaux L. (2010), *<Antworten kommen oft von anderswo> – Gedanken eines politischen Weggefährten Hans Christoph Binswanger*, in: *Wachstum, Geld und Geist: Der Ökonom Hans Christoph Binswanger*, Hrsg. von R. Kley in der VGS Verlagsgenossenschaft St. Gallen

The list of the most important studies by Prof. H. Ch. Binswanger

- Binswanger H.Ch (1957), *Die europäische Wirtschaftsintegration durch partielle Unionem. Mit besonderer Berücksichtigung der Kohle und Stahlindustrie*, Dissertation der Rechts- und Staatswissenschaftlichen Fakultät der Universität Zürich, Winterthur
- Binswanger H.Ch. (1969), *Markt und internationale Währungsordnung. Ein Beitrag zur Integration von allgemeiner Gleichgewichtstheorie*, Tübingen (Habilitationsschrift)
- Binswanger H.Ch. (1978), *Eigentum und Eigentumspolitik. Ein Beitrag zur Totalrevision der Schweizerischen Bundesverfassung*, Zürich
- Binswanger H.Ch. (1985), *Geld und Magie, Deutung und Kritik der modernen Wirtschaft anhand von Goethes Faust*, Stuttgart
- Binswanger H.Ch. (1991), *Geld und Natur. Das wirtschaftliche Wachstum im Spannungsfeld zwischen Ökonomie und Ökologie*, Stuttgart
- Binswanger H.Ch. (1998), *Die Glaubensgemeinschaft der Ökonomen. Essays zur Kultur der Wirtschaft*, München
- Binswanger H.Ch. (2006), *Die Wachstumsspirale. Geld, Energie und Imagination in der Dynamik des Marktprozesses*, Marburg
- Binswanger H.Ch. (2009), *Vorwärts zur Mässigung. Perspektiven einer nachhaltigen Wirtschaft*, Hamburg

- Binswanger H.Ch. (2011), *Spirala wzrostu. Pieniądz, energia i kreatywność w dynamice procesów rynkowych*, Gilewicz J. (trans.), Poznań
- Binswanger H.Ch. (2016), *Die Wirklichkeit als Herausforderung. Grenzgänge eines Ökonomen. 12 Essays*, Hamburg

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