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Czasopismo Polskiego Stowarzyszenia
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THEORETICAL AND METHODOLOGICAL PROBLEMS

ENVIRONMENTAL POLICY AND MANAGEMENT

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THEORETICAL AND METHODOLOGICAL PROBLEMS

PROBLEMY TEORETYCZNE I METODYCZNE

Tomasz ŻYLICZ

URBAN GREENERY MANAGEMENT PROBLEMS

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ABSTRACT: In this paper, we look at the urban greenery management as a principal-agent (PA) problem. PA problems arise whenever the management of activity requires cooperation of at least two hierarchical levels. In the case analysed in this paper, the city mayor (the higher level) wants to maximise the pollution-mitigation capacity of trees planted; the greenery manager (the lower level) wants to maximise the municipal budget devoted to planting trees subject to some constraints on the outcome of this activity. While the higher level wants certain services to be delivered in the future actually, the lower level is interested in the potential benefits provided by the most attractive tree species, even though they will be delivered only partially and probably in the short run only. As a result, the species composition of trees planted is different from what it would have been if the PA model implemented was incentive compatible.

KEYWORDS: principal-agent models, urban trees

Introduction

Economic studies of urban greenery are carried out based on at least two approaches. First of all, they can apply cost-benefit analyses to assess whether total expenditures on maintaining green areas are justified by their effects in terms of better public health, improved tourist attractiveness, environmental protection, and so on (e.g. Tempesta, 2015); they start with a list of benefits (e.g. Braubach et al., 2017), monetise them, and compare with the cost of establishing and maintaining such areas. Alternatively, studies can assume that certain objectives with respect to urban greenery are set, and a question emerges whether they are likely to be achieved. The paper adopts this second approach. In particular, we do not check whether planting trees is economically justified; its economic efficiency has been demonstrated both with respect to urban forests (e.g., Dwyer et al., 1992), and street trees (e.g., Mullaney et al., 2015) many times. Instead, we check whether tree planting activities are organised as effectively as possible.

The aim of the paper is to analyse incentives urban greenery managers have to plant tree species that can provide the city with services expected by its inhabitants. Expectations of city inhabitants are reflected by priorities of the top management (mayor of the city or its district). They include (but they are not confined to) pollution remediation. Various tree species reveal very different characteristics with respect to the absorption of air pollutants, and – at the same time – they differ in terms of survival rates. The problem studied here is that the top management is interested (in principle) in services provided actually, that is, taking into account tree survival rates, but they have less information than greenery managers do to check whether trees planted are most suited for this purpose. As a result, greenery managers may prefer to plant trees that do not provide these services at the level expected.

Managing large cities is a complicated problem. A typical city is managed hierarchically with the top management interested in enhancing the welfare of their constituency. At the same time, lower-level officers do not have to be preoccupied with the same concerns; they are interested in maximising their utility subject to some constraints imposed by their bosses. This is a standard hierarchical agency theory model studied by economists under the heading of "principal-agent" (PA) problems. It originated in the 1970s (perhaps even in the 18th century). Many economists link it to the papers of Wilson (1968), Ross (1973), Heckerman (1975), Jensen and Meckling (1976), and – most often – Laffont and Tirole (1988), who made it a part of the standard microeconomics. The model can be kept simple by assuming that there is a two-tier structure with the top management unit – let us call it the mayor (the "principal") – supervising one of its executive branches – let us call it the greenery

manager (the "agent"). This paper aims at illustrating how this theoretical approach can be applied to improve the effectiveness of urban greenery management if the top management delegates some of its tasks to lower-level units.

Urban trees provide an example of public goods. Hence, their management is a *raison d'être* of administrative entities such as cities and states. While theoretical analyses of how public goods can be provided by them are numerous (Vahabi, 2020), there were almost no public choice studies of how urban green areas are managed.

A mismatch between the objectives of various units in urban greenery management has been identified in earlier research (e.g., Lindholst, 2008). It was also observed while talking to officers responsible for urban greenery in the city of Warsaw. The mayor is interested in having enjoyable and productive green areas, while the greenery manager is interested in being adequately rewarded by the city budget. Moreover, the information is asymmetric. The manager knows what specific steps need to be taken to improve the performance of greenery, but the mayor does not have this knowledge.

Using the notation typical for PA models (Mas-Colell et al., 1995), one can write that the mayor (principal) wants to maximize

$$B(x) - s(x), \tag{1}$$

where:
$B(x)$ – stands for net benefits provided by greenery,
$s(x)$ – stands for the salary of the greenery manager, and
x – is the level of effort put into the greenery enhancement/maintenance activities,

while the greenery manager (agent) wants to maximize

$$s(x) - c(x), \tag{2}$$

where:
$c(x)$ – stands for the cost of the effort,

subject to the usual participation constraints:

$$s(x) - c(x) \geq u^0, \tag{3}$$

where:
u^0 – is an (unknown to the principal) aspiration level.

Under the standard convexity assumptions adopted in economic modelling (concavity of functions to be maximised and constraints), an incentive compatible contract requires that the greenery manager (agent) is the "residual claimant" (Varian, 2010, 731), i.e.:

$$\partial B/\partial x = \partial c/\partial x. \tag{4}$$

In this paper, we discuss whether the residual claimant condition can be considered realistic in the management process of green areas in Warsaw. Up to the best of our knowledge, there are no studies of urban greenery using PA approach. There are a number of papers which use this analytical framework, but they aim at general land-use problems rather than planting trees in a city (e.g., Hotte et al., 2016). Kronenberg (2015) identifies institutional barriers to improving urban greenery other than the PA problems. Lindholst (2008) analyses the possibilities to improve greenery managers' performance by designing better contracts, but – again – without referring to the PA framework. Cortinovis and Geneletti (2019) look at ways to improve integration of biological and political considerations in urban planning decisions. They take into account the air purification carried out by green areas, but without analysing whether different management levels may have different incentives. Likewise, Robinson et al. (2019) admit that many different skills and backgrounds interact in taking natural resource decisions, but they do not make a distinction between various hierarchical levels.

The rest of the paper is organised as follows. In the next section, we introduce the basic conceptual model of urban greenery hierarchical management. A review of analyses of the benefits provided by urban trees follows. In section 4, we look at specific measures taken by urban greenery managers. This middle part of the paper is based on our studies of how green areas have been managed in Warsaw. The statistical quality of the data does not allow for a more comprehensive econometric analysis. Section 5 discusses what incentive incompatibility problems are faced by urban greenery management. The last one concludes and identifies directions for future research.

The problem of urban greenery management in Warsaw

The management structure can be more complicated than applied here. Analysing typical urban greenery management structures in a more detailed way is beyond the scope of this paper. A case study referring to the data collected in Warsaw serves as an illustration of problems that may affect the efficiency of management structures elsewhere too.

In Warsaw, the administrative unit which is responsible for the urban greenery, does not manage the resources directly. It hires dozens of firms who take care of designated areas and supervises district authorities who are responsible for their smaller jurisdictions. This complicated reporting structure is expected to change, and a more detailed description of the management mechanism could take into account several tiers and perhaps further

additions. Here we take a preliminary approach by assuming a simple two-tier structure.

Our model is based on several stylised facts which are derived from analyses of the urban green management in Warsaw. Most importantly, we confirm that there is a discrepancy between what the city mayor declares and what the lower-level officials care for. We observe that different tree species provide city inhabitants with different benefits. In particular, we contrast two popular species with very different pollution-absorption capacities: large Common oak (*Quercus rrobur spp.*) and Red oak (*Quercus rubra spp.*), and small Callery pear (*Pyrus calleryana*). At the same time, these species vary in terms of survival rates (with oak characterised by much lower rates). We also observe that the lower level prefers to be involved in planting trees which provide large theoretical benefits, irrespective of their survival statistics; failures are seen as a result of someone's neglect rather than natural phenomena. Finally, we assume that the lower level expects a financial premium for planting more attractive species that are characterised by poor survival rates.

One of the most controversial aspects of the PA analysis is how to measure the level of effort x. It cannot be the total area of the municipal green, since this is not under the control of the manager. The area is rather to be decided by the city mayor, and it is easy to measure. Therefore, given the exogenous area, we assume that the manager can use his/her professional knowledge to boost the potential net benefits from a specific composition of trees planted and specific processes applied to provide high ecosystem services. The actual level of services obtained can be lower than declared (expected), but it can be assessed much later – when it is too late to change planting decisions.

Benefits from urban greenery

There are many alternative approaches to analyse benefits from biological resources. Costanza et al. (1997) compiled an early classification of services provided by natural resources. They made a distinction between their "provision", "regulation" and "societal" functions. Subsequent lists retain these three major types, and they differ in the level of details. In our work, we refer to the *Common International Classification of Ecosystem Services* (CICES 2015) –widely used in the European Union (the most recent version was published in 2018) – which lists 47 such services. Sixteen of them refer to the provision of materials (and energy), twenty – to the regulation of natural processes, and eleven – to societal functions (including recreation). To keep the analysis as simple as possible, we take into account only three "regulatory services". In the original list, they were identified as:

- bio-remediation by micro-organisms, plants, algae, and animals,
- bio-chemical detoxification / decomposition / mineralisation, etc.,
- filtration / sequestration / storage / accumulation by ecosystems.

While some crops can be harvested for the benefit of the city dwellers, the most typical gains from urban greenery include regulation of natural processes and recreation. These gains are not necessarily very large in economic terms. A recent study of a major park in southern Warsaw (Zawojska et al., 2016) demonstrated that ecosystem services could be lower (in economic terms) than other benefits provided by the urban infrastructure. Besides, one needs to stress that street trees have different roles than parks and other contiguous green areas – such as urban forests – and hence each category may require different measurement methods (Giergiczny and Kronenberg, 2014).

In this paper, we emphasise the benefits of bio-remediation. Specifically, various tree species turn out to absorb air contaminants to a different degree. In addition, they can provide other ecosystem-regulatory benefits, including mitigation of surface runoff, but – again for simplicity – we do not analyse them here. Neither do we look at other diverse benefits – such as, e.g., mitigating heat island effect – analysed in urban tree planting scenarios (Bodnaruk et al., 2017) – or amenities that might be relevant for greenery management decisions too.

There are numerous empirical analyses on how much a given tree can absorb (or otherwise "avoid") of NO_2, SO_2, PM_{10}, $PM_{2.5}$, VOC, and O_3. The results suggest that – up to 100 years – the remediation benefit is roughly proportional to the age of the tree (McPherson et al., 2007). Apart from what can be found in some parks or forests, a typical urban tree is less than 100 years old, and consequently, it remediates a fraction of the maximum expected of the oldest conceivable one. Therefore, the remediation benefit is simply a percent of what can be absorbed by a 100 years old tree, and various trees of the same age provide – proportionally – the same benefits as the mature ones that belong to the same species. Table 1 lists these maximum absorption benefits for four categories – coniferous trees (1) and three types of deciduous trees (based on the diameter of the canopy): small (2), medium (3), and large (4).

As seen from the table, the physical remediation capacity of trees can vary quite a lot. The capacity depends mainly on the surface of leaves, and the numbers are based on empirical research carried out in the northern United States mainly. Of course, American species composition is not the same as in Warsaw, but the table informs about the order of magnitude of what can be expected of certain tree types.

Table 1. Annual absorption for a 100-year-old tree [in g]

	Coniferous	Deciduous		
		Small	Medium	Large
NO_2	177	93	239	544
SO_2	23	11	28	65
$PM_{2.5}$	14	8	22	48
O_3	307	160	410	933

Source: author's work based on McPherson et al., 2007, and Szkop, 2019.

Removal of toxic substances implies health and other environmental benefits. Ideally, site-specific empirical studies would be needed to estimate these benefits. Lacking the opportunity to rely on such studies, we had to apply a benefit transfer approach. To this end, the results of a number of European research programmes were used. They are summarised in standard coefficients adopted by the ExternE project. They are differentiated for various pollutants. It is also acknowledged that economic impacts depend on whether pollution affects densely or sparsely populated areas. Estimates adequate for urban environments were applied in table 2. Specifically, we used the rates 10.65€ per kg of NO_2 absorbed, 9.47 for SO_2, and 2.07 for $PM_{2.5}$. The ExternE database does not include O_3; hence table 2 omits this pollutant.

Table 2. Annual benefits provided by a 100-year-old tree [in €]

	Coniferous	Deciduous		
		Small	Medium	Large
NOx	1.89	0.99	2.55	5.79
SO_2	0.22	0.10	0.27	0.62
$PM_{2.5}$	0.03	0.02	0.05	0.99

Source: author's work based on table 1 and results of the ExternE project, http://www.externe.info/externe_d7/?q=node/2]; please note that the project calculates monetary benefits for NO_x rather than NO_2; thus numbers in the table should be regarded as rough estimates.

Table 2 demonstrates that annual monetised benefits from the absorption of acidifying substances – such as nitrogen and sulphur oxides – dominate the total. They can be more than 6€ per old large deciduous tree. For coniferous species, they are a fraction of that. Let us emphasise once again, that these numbers have to be treated with great caution. The absorption capacity depends on a number of circumstances (Jin et al., 2014), it is subject to empirical research, and it cannot be easily transferred. Besides, as the sul-

phur pollution is largely under control, nitrogen contamination – linked to the growing car traffic – emerges as one of the most important air pollution problems in cities. Table 2 suggests that small trees provide roughly four times lower benefits linked to nitrogen abatement than large ones.

Planting trees as an air protection instrument in Warsaw

The mayor of Warsaw has a detailed list of urban trees with information on their age, size, and sanitary condition. The list is too much detailed to be of practical significance for this level of management. Nevertheless, it is a valuable source of information on urban greenery. In addition, the mayor has information on which tree species provide maximum air quality benefits.

Top species recommended for remediation of acidifying substances (Nowak, 2000 and Nowak, and Heisler, 2010):

Red maple (*Acer rubrum*)
Horse chestnut (*Aesculus hippocastanum*)
Yellow birch (*Betula alleghaniensis*)
Deodar cedar (*Cedrus deodara*)
Northern hackberry (*Celtis occidentalis*)
American beech (*Fagus grandifolia*)
White ash (*Fraxinus americana*)
Ginkgo (*Ginkgo biloba*)
Kentucky coffeetree (*Gymnocladus dioicus*)
Black walnut (*Juglans nigra*)
Tulip tree (*Liriodendron tulipifera*)
Cucumber tree (*Magnolia acuminata*)
Norway spruce (*Picea abies*)
Eastern white pine (*Pinus strobus*)
London planetree (*Platanus hybrida*)
Eastern cottonwood (*Populus deltoides*)
American basswood (*Tilia americana*)
Eastern hemlock (*Tsuga canadensis*)
American elm (*Ulmus americana*)
Japanese zelkova (*Zelkova serrata*)

All these species can be found in Warsaw, but only a few of them are planted routinely. The local administration of urban greenery is expected to plant trees that are well adapted to local climatic conditions and – more recently – that were found to be allergic-friendly. Their list includes (ZOM, 2017):

Sycamore maple (*Acer pseudoplatanus*)
Common lime (*Tilia* × *europaea*)
Japanese cherry (*Prunus serrulata*)
Callery pear (*Pyrus calleryana*)
London plane (*Platanus* × *acerifolia*)
Black locust (*Robinia pseudoacacia*)
European ash (*Fraxinus excelsior*)
Common hornbeam (*Carpinus betulus*)
Common oak (*Quercus robur*)

Tree planting strategies in Warsaw

The benefits provided by living trees cannot be questioned. The problem, however, is that not every tree planted survives. The Warsaw experience is quite vast, as thousands of trees are planted every year. Many of them survive, but some do not. There are several reasons why a tree does not survive. First, it is not a native species, and unless an unprecedented (and costly) care is applied, the tree is doomed to die soon as a result of harsh climatic conditions, pest infestation or other causes. Second, it could have been planted in an inappropriate way, e.g., without a reasonable space left for the canopy or root system. Third, it could have been inappropriately maintained, e.g., insufficiently watered. Fourth, it could have been exposed to environmental contaminants such as chlorides (often used as de-icing agents by some real estate owners) (Nowocin, 2017).

Urban greenery managers tend to perceive urban trees as real capital rather than living objects thus expecting that once planted, they will provide a steady flow of benefits. Natural survival rates are perceived as close to 100%. Whereas in fact, they can be much lower. Low survival rates of urban trees have been studied widely (e.g., Nowak et al., 2004; Roman and Scatena, 2011) and linked to a number of threats the trees are exposed to. Climate change has added a new important stressing factor (Fontaine and Larson, 2016).

Specifically for Warsaw, several econometric models were estimated to check the relationship between the number of trees (of a given species) planted and their mortality rates, as well as benefits provided by absorbing air pollutants (Szkop and Żylicz, 2018). Despite numerous attempts, it proved impossible to find statistically significant relationships linking these numbers with mortality rates. The latter was estimated based on a large inventory of 162,500 trees registered in Warsaw. Planting trees seemed to be totally unrelated to their average annual mortality rates which range from

almost zero (0.77% for *Pyrus calleryana spp.*), to over 4% (4.13% for *Quercus rubra spp.*). In contrast, potential benefits – as represented by pollutants absorbed by a living tree – did prove correlated with numbers of trees planted (Szkop, 2019). Based on a smaller inventory of 2,111 street trees of 36 species planted between 2014 and 2016, this correlation turned out to be 58%. This allowed to claim that urban greenery managers ignore average annual mortality rates and prefer to plant species known for their large potential to absorb air pollutants.

Let us assume that there are two tree species which provide benefits of b_1 and b_2 per tree, respectively, with $b_1 < b_2$. Therefore, total benefits read $\beta = b_1n_1 + b_2n_2$, where n_1 and n_2, are the number of trees of the first and the second species, respectively. If x is the fraction of trees of the second (i.e. more "valuable") species ($x=n_2/N$), and N is the total number of trees, then the formula reads:

$$\beta = b_1(1-x)N + b_2xN, \tag{5}$$

and

$$\partial\beta/\partial x = N(b_2 - b_1) > 0. \tag{6}$$

From the social welfare point of view, however, as only living trees provide benefits, a more appropriate formula for the total benefits reads:

$$B = b_1(1-x)N\theta_1 + b_2xN\theta_2, \tag{7}$$

Where θ_1, θ_2 are survival rates of the first and second species, respectively. If one assumes that the survival rate of the first species is 1 (the first species always survives), then the formula reduces to:

$$B = b_1(1-x)N + b_2xN\theta_2. \tag{8}$$

It is then easy to calculate that

$$\partial B/\partial x = N(\theta_2b_2 - b_1). \tag{9}$$

If one lifts the assumption that $\theta_1=1$, then the notation becomes more complicated, and θ_2 has to be expressed as a fraction of θ_1 (we assume that the species considered more valuable has a lower survival rate).

The cost of planting a tree is likely to be higher in the case of the more "valuable" species: $c_1 < c_2$. Thus, the raw cost of tree planting activity is $c_1(1-x)N + c_2xN$, where x and N denote the same variables as before. However, tree planting agents know that the second species is more risky to be planted and hence they request a mark-up proportional to the share of the more risky trees, say, 1+x. Consequently, the cost formula reads:

$$c = c_1(1-x)N + c_2xN(1+x). \quad (10)$$

The derivative reads:

$$\partial c/\partial x = N(2c_2x + c_2 - c_1). \quad (11)$$

In other words, $\partial c/\partial x$ increases when the share of the more valuable species increases.

One needs now to check these findings against the data observed in Warsaw. $\theta_2 b_2 - b_1$ is certainly lower than $b_2 - b_1$, but its sign is not obvious immediately. Trying to estimate these expressions, we can take two typical species: Red oak (a large tree) and Callery pear (a small tree). The annual survival rate for the more "valuable" species, Red oak, is 96%, while the survival rate for the less "valuable", Callery pear, is virtually 100%. These numbers indicate that for these two typical species, over 10 years (perhaps an upper limit of what greenery managers can realistically contemplate), $\theta_2 b_2 - b_1 > 0$, since θ_2, can be assumed to be 0.66 (0.96^{10} is approximately 0.66) and as long as $b_2 > b_1/0.66$ which is obviously satisfied for the case of Red oak and Callery pear (see table 2 for large and small species, respectively).

The results are based on benefits, survival rates and cost functions collected by relevant authorities. The data inform about the knowledge these authorities rely on, which is not necessarily based on the entire statistical material characterising urban trees properly. The attempt of these analyses is not to discover an optimum composition of urban greenery, but rather to explain why certain tree species can be found in the city more frequently than others.

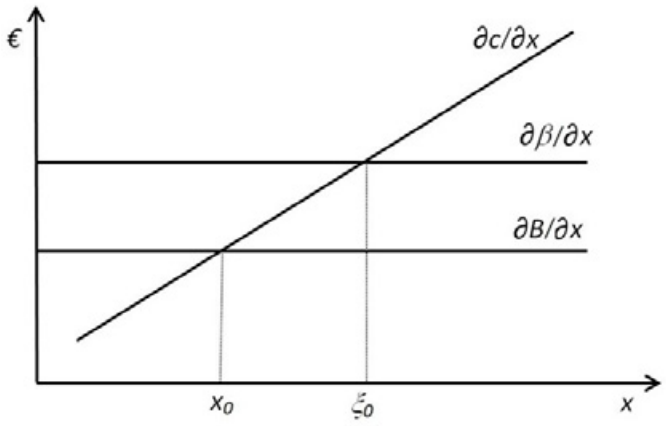

Figure 1. Preferences with respect to tree species composition

Source: author's work.

The main conclusion from these observations (figure 1) is that species composition likely to be chosen by greenery managers (ξ_0) is different from what would be preferred by the mayor (x_0). If urban greenery managers do not take into account low survival rates of the most (theoretically) valuable tree species, then these species are likely to be overrepresented in urban tree planting schedules.

Alternative quantifications of B and β require additional analyses. In our calculations, we assumed that managers look at annual absorption benefits. Actually, the decision-making process can be more complex. For instance, they can look at cumulative benefits over some time horizon, say, 10 years. Additionally, they can discount the future with a positive discount rate. It is easy to see; however, that the proportion of benefits provided by two species to be compared is exactly the same irrespective of whether the annual outcome is taken into account or the cumulative effect, and irrespective of the discount rate applied. It simply depends on the proportion of b_1 and b_2.

Survival rates are a different story. If annual survival rates are different but constant over time, they make expected annual benefits lower than the theoretical ones. Yet it may turn out that they vary over time and, say, are different for the first three years than for the next three years. In this case, the proportion of benefits obtained by planting alternative species may depend on the time horizon adopted.

Conclusions and directions for future research

The main conclusion derived from the model is – to some extent – predictable. The fact that species composition preferred by the lower level is not necessarily what the higher level would like to see is intuitively obvious. What the model can shed more light on are specific management solutions which – when implemented – can reduce the exposure to air contaminants more effectively.

PA models studied in economics suggest that the lower level should be the "residual claimant" of benefits. This is not practical in the context of urban greenery, as it is inconceivable that managers can be reimbursed with any additional benefits their extra effort implies. The model only suggests that greenery managers should be better rewarded when they choose a species composition likely to deliver actual rather than theoretical benefits. A mismatch between preferences with respect to tree species known of very high potential absorption capacity and species that are perhaps not that attractive, but less sensitive to harsh urban conditions, can be addressed by establishing more detailed guidelines for the lower level. For the time being, these

guidelines reflect potential benefits and seem to ignore survival rates. However, to arrive at more robust conclusions, more empirical research is called for.

First and foremost, more site-specific research on the absorption of air contaminants is necessary. Our conclusions largely based on the benefit transfer method, with policy-site relationships extrapolated from observations collected elsewhere. While the original data are fairly detailed and probably accurate, local climatic, economic, and environmental conditions somewhere else can be different. Second, we need much broader data on the survival of trees. It would be necessary to know to what extent poor survival rates are caused by planting species that are not fit to local conditions, and to what extent they can be controlled (either through regulations on economic activities in the neighbourhood of trees or through an incentive structure). Likewise, it would be illuminating to see how survival rates depend on the time horizon. Third, it would be interesting to deepen the study of preferences of the higher level and preferences of the lower management level. We assumed that the higher level aims at maximising the absorption capacity of the (living) trees planted. Yet other benefits provided by the urban green may play a role as well. Reviews of important policy documents and adequate in-depth surveys of city officials may help to identify more closely incentives relevant for the urban greenery management.

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ENVIRONMENTAL POLICY AND MANAGEMENT

POLITYKA EKOLOGICZNA I ZARZĄDZANIE ŚRODOWISKIEM

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EXAMINING OF PORTABLE BATTERIES EXTERNALITIES WITH FOCUS ON CONSUMPTION AND DISPOSAL PHASES

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ABSTRACT: Today, the problem of increasing negative environmental externalities related to waste management, especially electronic waste, which also includes used household batteries and accumulators, is becoming increasingly acute. They cause significant damage not only to the environment but also to public health when released into the environment without control. The purpose of this work is to study the environmental and economic aspects and determine the external effects caused by the consequences of the consumption of autonomous batteries. Correlation-regression analysis showed that there is a link between indicators of domestic market filling of household batteries and the dynamics of mortality related to cancer. The study provides simplified calculations of external effects that arise in Ukraine because of the consumption of household batteries due to the absence of a system for their collection and disposal. The sum of the total external effects is determined, excluding losses due to air pollution, water pollution, and agricultural losses.

KEYWORDS: externalities, used batteries, correlation-regression analysis

Introduction

The modern stage of development of economy-based consumption is characterized by an acute complication of the interaction between the environment and humankind and is defined as a technogenic type of economic development, for which significant externalities (external effects) are typical. All people living in the same world and using the same resources are the reason for the external effects to existing. Each person can pursue their goals, and their actions may have a spin-off that affects the condition of others.

Today, the problem of increasing negative environmental externalities related to waste management, especially electronic waste, which also includes used household batteries (batteries and accumulators), is becoming increasingly acute (Grace, 2018; Chaudhary, 2019; Bigum, 2017).

The European Union has a long-established practice of handling used household batteries. According to the Statistics Committee of the European Union, during 2012-2018, the total number of household power supplies sold was relatively constant, and the dynamics of batteries collected from the population shows a clear upward trend (Eurostat, 2020). In 2012, 173 thousand tons of batteries and accumulators were sold in the EU countries, and 64 thousand of them were sent to specialized collection points, that is, 37% of their total number, and in 2018 this percentage increased to 46% (88 thousand tons were collected out of 191 thousand tons sold) (Eurostat, 2020).

Poland, Ukraine's neighbor, has achieved particular success in managing battery and accumulator waste. In the period from 2012 to 2018, the number of batteries collected increased by more than 3.5 times (from 2.9 to 10.7 thousand tons, respectively), while the number of batteries sold increased by only a quarter (from 10.6 to 13.3 thousand tons, respectively) (Statistics Poland, 2018).

The issue of handling used batteries is extremely relevant in Ukraine, since the systems for collecting used batteries in our country do not exist, and most of them are on landfills. Over time, harmful substances contained in galvanic elements freely enter the environment and cause irreparable damage not only to the environment but also to public health.

The goal of this work is to study the environmental and economic aspects and determine the external effects caused by the consequences of the consumption of autonomous batteries.

An overview of the literature

Theoretical foundations of the problem of externalities are widely represented in the works of foreign scientists. In fact, P. Samuelson introduced the term «external effect» into scientific parlance in 1958 (Samuelson, 1954). However, A. Pigou carried out the development of basic approaches to the analysis of externalities much earlier (Pigou, 1920). He justified the difference between private and public costs and benefits and proposed government regulation of externalities through taxes and subsidies. In the 1960s, R. Coase worked on the problem of externalities and saw the neutralization of the problem of externalities in a clear distribution of property rights to resources and minimization of transactional costs.

Among modern scientists T. Litman, W. Fransen, J.M.W. Dings, R.C.N. Wit, B.A. Leurs and M.D. Davidson are noteworthy. Their works are devoted to researches of an estimation of external effects of auto- and air transport (Litman, 2009; Dings et al., 2003). Externalities of waste, including electronics, were studied by Sindhuja M., Narayanan K. and Krishnan T S. (Sindhuja, Narayanan, 2018; Krishnan, 2018). Approaches to study the external effects of spent power sources are found in the works of Tang Y., Zhang Q, Li Y., Li H., Pan X., Mclellan B. And Lamjon L.M. (Tang et al., 2019; Lamjon, 2012).

M. Fairbrother studied the concept of externalities in the social sciences (Fairbrother, 2016), and A. V Houndekon, H. De Groote, and C. Lomer carried out the study of the influence of external effects on public health (Houndekon et al., 2006).

Many publications are devoted to the study of the negative effects of e-waste on public health. In particular, the work of Zeng X., Kuchhal P., Sharma U.C. and Kuntawee, C. is devoted to the study of serious diseases caused by heavy metals contained in electronic waste, including spent batteries (Zeng et al., 2017; Kuntawee et al., 2020; Kuchhal, Sharma, 2019).

Ukrainian authors, who work on this topic, studied the mechanisms of distribution of public goods and the features of using government tools to avoid externalities (Krasnikova, 2009), the development of theoretical and methodological principles for assessing the economic consequences of negative external effects of environmental pollution in the field of environmentally caused diseases of the population (Kurbatko, 2017).

In addition, among the studies available, a number of important issues relating to the problem of handling used batteries that need to be addressed immediately have been neglected. In particular, it is the development of institutional support for controlling the electronic waste management system and improving the system of their statistical reporting, which will help to

harmonize the legislation of Ukraine and the EU in the field of state regulation of used batteries.

Research methods

Fundamental and modern provisions of environmental economics, economic and ecological theory of environmental management, and waste management became the basis of the theoretical and methodological foundations of this study.

In accordance with the goal, the following research methods were used: methods of logical generalization and scientific abstraction (when clarifying the conceptual framework of the study); market research methods (when identifying patterns of formation and development of the market for household batteries); comparative method (when studying trends in the field of electronic waste management); the method of correlation-regression analysis (when studying and evaluating the investigative relationships between the indicators of domestic market filling of household batteries and dynamics of mortality related to cancer).

Results of the research

Economists characterizing externalities distinguish several types, classes of these phenomena. Thus, both negative and positive external effects of production and consumption are distinguished by the criterion of the "source of occurrence". The author classifies the problem of handling used batteries as externalities of goods consumption. There are several definitions of external effects in the modern economical literature. The author proposes the following definition:

Externalities of consumption are public losses that are incurred by stakeholders of the socio-economic and ecological system because of the consumption of goods whose value does not consider these losses. External effects in the field of handling used batteries are shown in the graph (figure 1).

If used batteries go to landfills, this leads to negative externalities for the population (people incur losses associated with the treatment of water, soil, and air from harmful substances in the batteries, which are not included in their cost). The marginal social costs from used batteries landfill placement are marked by the MSC, and the marginal private costs from used batteries landfill placement are marked by the MPC. As batteries have now become an essential necessity with no alternative, the inelastic curve of demand for used batteries recycling is marked as D. Then the cause of external effects is the difference in social and private values.

$$MEC = MSC - MPC. \quad (1)$$

Used batteries pollute the environment with heavy metals, the amount of which depends on the amount of waste generated. The proposal to dispose of waste batteries in landfills without taking into account the negative impact on the population is shown by line S1. If the social costs of battery waste disposal in the landfill had been taken into account (in their price), the amount of batteries thrown into the garbage can would have been at a lower S2 level. Since Q1> Q2, there is overproduction, which is associated with negative external effects. If electronic waste producers are forced to pay for the external effect (move from equilibrium point A to equilibrium point B), prices will increase, and the amount of waste generated in the landfill will decrease.

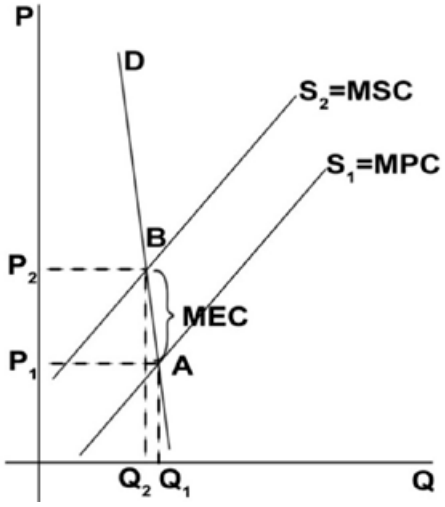

Figure 1. Negative externalities of used batteries

Source: author's work.

In landfills/dumps, used batteries become dangerous immediately after damaging the shell of a battery. Usually, this happens within 6-7 weeks, as the batteries and accumulators are affected by the elevated temperature and acidic (with pH less than 7) filtrate of the polygon. During the whole period of landfill existence, the filtrate serves as a permanent source of groundwater pollution. The disposal of used batteries in solid domestic waste landfills leads to leaching of heavy metals and increase of the concentration of heavy metals in the polygon filtrate (especially – zinc and manganese) (Smirnova, Sakulina, 2016).

Due to the unsatisfactory condition of landfills in Ukraine, landfill fires have become more frequent. For example, the last cases of fire were recorded in September 2019 on the territory of Trypillya village of Kyiv region, Berdychiv city of Zhytomyr region, and Pryluka city of Chernigiv region. The biggest tragedy at the landfill in Ukraine was the fire on May 30, 2016, at the landfill in Hrybovychi village in Lviv region. It partly lasted for two months, covered an area of 800 m^2, and killed four people.

In 5% of cases, used batteries as part of municipal solid waste are sent to incineration plants. It is established that the combustion of alkaline manganese zinc batteries causes the increase of metal concentration in slag and fly ash of incinerators. If gas treatment plants are not efficient enough, some heavy metals will also be present in the combustion gases. When one AA size nickel-cadmium accumulator, weighing about 20 g, is incinerated together with MSW, 3 g of cadmium in the form of steam and fly ash is released into gases, the treatment plants trap part of this amount, the rest is emitted to the atmosphere (12%, which is 0.36 g). The penetration of one manganese zinc battery into the incinerated MSW leads to the emission of up to 4 g of zinc into the gases, while the emission into the atmosphere is 4%, which is 0.045 g (Smirnova, Sakulina, 2016). Table 1 shows the structure of external effects in the field of handling used batteries.

Table 1. Main external effects in used batteries management

	External effect (MECi)	Description
1	Land contamination	Damage caused by contamination of land resources with toxic substances from used batteries due to lack of a system for their collection and disposal.
2	Air pollution	Damage from air pollution caused by used batteries combustion, which gets into waste incineration plants as part of MSW.
3	Contamination of water bodies	Damage from contamination of groundwater, rivers, and reservoirs with heavy metals that seep through the soil as a result of the disposal of used batteries in landfills.
4	Damage to agriculture	Losses of crop and livestock production associated with a reduced quality of soil and water because of the heavy metals that are part of the used batteries.
5	Harm to public health	Damage to public health caused by contaminated drinking water, air, and environmentally hazardous foodstuffs, which is the result of heavy metals from used food sources entering the environment. This leads to increased morbidity in the population, deteriorating working and rest conditions, and reduced life expectancy.

Source: author's work.

Thus, we can record the total social costs for the production of household food sources, taking into account externalities in the following form:

where MECi – external costs of the i-th kind (i = 1, ..., 5, see table 1).

The calculation of external effects faces serious objective and subjective difficulties. For example, human health is the result of a number of social, hygienic, environmental, and economic factors. It is difficult to characterize the role of each of them, but they cannot be ignored. Although the problem has not been sufficiently researched and there are no clear evidences of the population's disease caused by heavy metals contained in used batteries, it is impossible to ignore their harmful effect on the health of Ukrainians.

Table 2 contains a list of poisonous substances in batteries and their impact on human health.

Table 2. The impact of hazardous substances from used batteries on human health

Element	In which batteries can be founded	Health impact
Zink (Zn)	manganese zinc and alkaline batteries	Zinc has a generally toxic, irritating effect: causes nausea, cough, skin irritation, mucous membranes, and insomnia. Carcinogen.
Manganese (Mn)	manganese zinc and alkaline batteries	In the human body, excess manganese leads to neurological diseases, causes myocardial dystrophy and vegetative vascular dystonia. It affects cholesterol metabolism and atherosclerosis progression.
Cadmium (Cd)	nickel cadmium batteries	Excess cadmium in the body leads to impaired kidney function, increased blood pressure, reduced number of red blood cells. Cadmium causes reproductive disorders. It accumulates in the body. Carcinogen.
Mercury (Hg)	mercury zinc elements	Mercury has a bad effect on the kidneys, digestive organs, central nervous system, and heart, sharply reduces blood pressure, and has an extremely negative effect on human reproduction, as well as on the fetus. It accumulates in the body.
Nikel (Ni)	nickel cadmium and nickel-metal hydride batteries	Irritates deep airways, causing pneumonia and pulmonary edema, regardless of the path of entry into the body. A significant general toxic effect is also directed at the nervous system. Carcinogen.

Source: Smirnova, Sakulina, 2016.

Table 2 shows that most of the poisonous substances in batteries are carcinogens, i.e., substances that cause malignancies.

Correlation-regression analysis showed that there is a link between indicators of domestic market filling of household batteries and the dynamics of mortality related to cancer.

The data for Ukraine from 1993-2013 were used for the analysis. Starting from 2014, there are no statistical data on three oblasts (Donetsk Oblast, Lugansk Oblast, AR of Crimea).

Figure 2 shows the dynamics of mortality related to cancer of the Ukrainian population. In 1993, this figure was 332 thousand people, and by 2013, it has grown to 440 thousand people (by 32.5%) and has a clear tendency to increase.

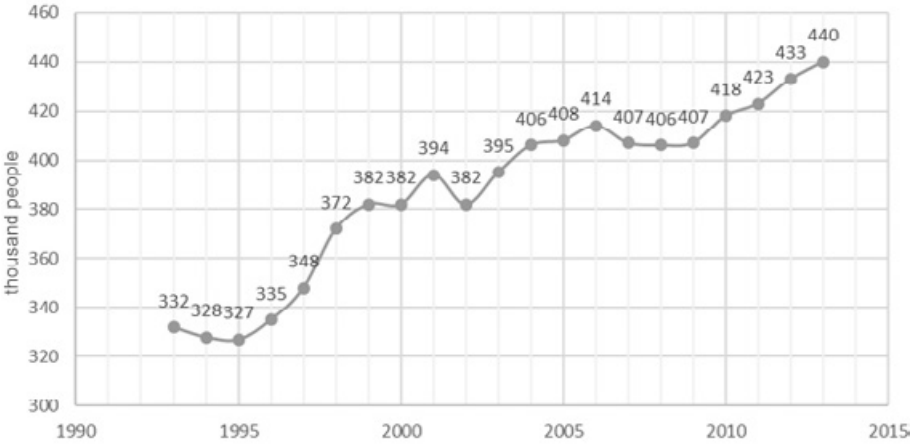

Figure 2. Statistics of cancer diseases of the population of Ukraine

Source: author's work.

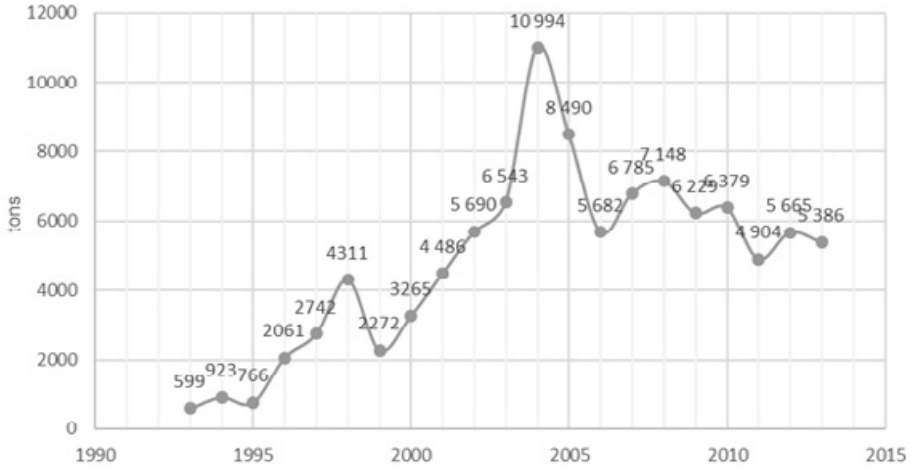

Figure 3. Battery imports in Ukraine in 1993-2013

Source: author's work.

There is also a growing number of batteries imported to Ukraine, providing the performance of portable equipment used in a variety of spheres of human activity. According to the State Fiscal Service of Ukraine, 101 320 tons of batteries were imported to our country in the period from 1993 to 2013 (figure 3).

Table 3 shows the intermediate values for calculating the correlation coefficient and correlation relation equation coefficients, where Y is the number of cancer patients; X is the number of imported batteries.

Table 3. Calculation table of intermediate values

	Year	Number of cancer patients, thousands (Y)	Y2	Number of imported batteries, tons (X)	X2	XY
1	1993	332	110224	599	358801	198868
2	1994	328	107584	923	851929	302744
3	1995	327	106929	766	586756	250482
4	1996	335	112225	2061	4247721	690435
5	1997	348	121104	2742	7518564	954216
6	1998	372	138384	4311	18584721	1603692
7	1999	382	145924	2272	5161984	867904
8	2000	382	145924	3265	10660225	1247230
9	2001	394	155236	4 486	20124196	1767484
10	2002	382	145924	5 690	32376100	2173580
11	2003	395	156025	6 543	42810849	2584485
12	2004	406	164836	10 994	120868036	4463564
13	2005	408	166464	8 490	72080100	3463920
14	2006	414	171396	5 682	32285124	2352348
15	2007	407	165649	6 785	46036225	2761495
16	2008	406	164836	7 148	51093904	2902088
17	2009	407	165649	6 229	38800441	2535203
18	2010	418	174724	6 379	40691641	2666422
19	2011	423	178929	4 904	24049216	2074392
20	2012	433	187489	5 665	32092225	2452945
21	2013	440	193600	5 386	29008996	2369840
	Σ	8139	3179055	101320	630287754	40683337

Source: author's work.

The correlation coefficient is determined by the formula:

$$r_{(X,Y)} = \frac{\sum_{i=1}^{n} X_i * Y_i - \frac{1}{n}\sum_{i=1}^{n} X_i * \sum_{i=1}^{n} Y_i}{\sqrt{\left[\sum_{i=1}^{n} X_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} X_i\right)^2\right] * \left[\sum_{i=1}^{n} Y_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} Y_i\right)^2\right]}} =$$

$$= \frac{4068337 - \frac{1}{21}101320 * 8139}{\sqrt{\left[630287754 - \frac{1}{21}(101320)^2\right] * \left[3179055 - \frac{1}{21}(8139)^2\right]}} = 0.76.$$

The obtained correlation coefficient shows that the correlation between the variables X and Y is straight, and the Chaddock scale connection force is high.

The Student's criterion was used to evaluate the significance of the correlation coefficient:

$$t_{(r)} = \frac{r_{(X,Y)}}{\sqrt{1 - (r_{(X,Y)})^2}} * \sqrt{n-2} = \frac{0.76}{\sqrt{1 - 0.76^2}} * \sqrt{21-2} = 5.097.$$

The table value of the Student's criterion for equal importance α=0.05 and the number of freedom steps f=n-2=21-2=19, t_{table} = 2,093.

Since t_{table}=2,093< t_r = 5.097, being less than 95% suggests that the studied indicators of the number of cancer patients and the number of batteries correlate, so the relationship between them has been proved.

To describe the paired linear regression equation, its coefficients were determined using the least-squares method:

$$b_0 = \frac{\sum_{i=1}^{n} x_i^2 \sum_{i=1}^{n} y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} x_i y_i}{n\sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} x_i\right)^2} =$$

$$= \frac{630287754 * 8139 - 101320 * 40683337}{21 * 630287754 - 101320^2} = 339.32$$

$$b_1 = \frac{n\sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{n\sum_{i=1}^{n} x_i^2 - (\sum_{i=1}^{n} x_i)^2} = \frac{21 * 40683337 - 101320 * 8139}{21 * 630287754 - 101320^2} = 0.01.$$

The paired linear regression equations have the following form:

$$y=339.32+0.01x$$

Analyzing the calculations, we can conclude that with the increase in the number of batteries in the Ukrainian market by 1 ton the number of cancer patients increases by 0.01 thousand people.

To analyze the overall quality of the regression model, we use the coefficient of determination R^2.

For our model, $R^2=0.58$ (58% of the variation in y can be explained by the x-variables). For reliable models, it is assumed that the coefficient of determination should be at least 0.5; therefore, we consider our model is acceptable.

Let us estimate the quality of the regression equation using the absolute approximation error. The average approximation error is the average deviation of the calculated values from the actual ones:

$$\overline{A} = \frac{\sum|y_i - y_x|: y_i}{n} * 100\%$$

$$\overline{A} = \frac{1.01}{21} * 100\% = 4.8\%$$

Since the error is less than 12%, this equation can be used as a regression.

Let us evaluate the statistical reliability of modelling using F-test. To do this, we will test the null hypothesis (H_0) about the statistical insignificance of the obtained regression equation according to the condition: if $F_{fact} > F_{table}$, then H_0 is rejected and the statistical significance, reliability of the regression equation is recognized.

To calculate the F_{fact}, we use the formula:

$$F_{fact} = \frac{R^2}{1 - R^2}(n - 2) = \frac{0.58}{0.42} * 19 = 26.23$$

The F_{table} (at a significance level of $\alpha = 0.05$) is 4.38.

Since 26.23 > 4.38, the null hypothesis H_0 is rejected, i.e., according to Fisher's test, the regression is adequate.

Conclusions

The study provides simplified calculations of external effects that arise in Ukraine because of the consumption of household batteries due to the absence of a system for their collection and disposal. Due to the imperfection of the existing statistical reporting system, these calculations were made only until 2013, because since 2014, due to the armed conflict in the East of Ukraine, there are no statistics for three regions – the Donetsk region, the Luhansk region, and the Crimea.

Based on the proposed structure of external effects in the sphere of treatment of used batteries and the correlation regression analysis, it is proposed to take into account expenditures on public health protection when determining the value of external effects.

Thus, according to the Law of Ukraine "On Approval of the National Cancer Control Program for the period until 2016" the amount of funding for the implementation of the program for 2013 amounted to 472 243.6 UAH. According to the correlation regression analysis, the increase in the number of domestic batteries by one ton leads to an increase in cancer patients by 10 people. Therefore, we concluded that the total number of cancer patients, whose disease could be caused by external effects of handling used batteries, (5386 tons were imported in 2013), is 53 860 people.

Therefore, we believe that 57 807 UAH of the total amount of state budget expenditures for the funding of the National Cancer Program, which amounts to 472 243.6 UAH in 2013, are funds for treatment of cancer patients, whose disease could be caused by external effects of handling used batteries. Adding to this amount the ecological and economic damage from the pollution of land resources by used batteries, which is 400 360 000 UAH (Shuptar, 2013), the amount of total external effects of used batteries is 458 167 UAH (excluding losses due to air pollution, water pollution, and agricultural losses).

The practical significance of the results obtained in this study can be applied in the formation of the Ukrainian system of the electronic waste management system, improvement of the methodology of state statistical monitoring of household battery waste generation, and the development of unified environmental standards for the development of cross-border cooperation between Ukraine and neighbouring states in the field of sustainable and environmentally sound development.

Taking into account the determined amount of general external effects will contribute to the effective use of economic instruments in the implementation of environmental policy, reduce public spending on health protection, and reduce economic losses from damage caused by the uncontrolled release of used batteries into the environment.

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Natalia Yosipivna Shuptar-Poryvaieva – 25% (concept and objectives, research, interpretation of data).

Elena Rostislavovna Gubanova – 25% (concept and objectives, literature review, research).

Natalia Mykolaivna Andryeyeva – 25% (concept and objectives, analysis and interpretation of data).

Tetiana Ivanivna Shevchenko – 25% (concept and objectives, literature review, acquisition of data).

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Martin **ROVNAK** • Roman **NOVOTNY** • Matus **BAKON**

ANALYTICAL STUDY OF SELECTED ECONOMIC-ENVIRONMENTAL INDICATORS OF WASTE MANAGEMENT SYSTEM IN SLOVAKIA

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ABSTRACT: The main objective of the paper was to visualize and analyze the relationships between selected economic and environmental indicators in the waste management system of Slovakia, i.e., the amount of fees for municipal waste in individual districts of Slovakia in 2019 and the amount of average monthly wage and unemployment in Slovakia in the same year. Data were visualized and analyzed on a thematic map and in a boxplot, and subsequently, they were subjected to statistical testing. Based on the performed analysis, we can confirm the statistical relationship between the average wage and the amount of fees for municipal waste collection and the statistical relation between the municipal waste fee and the unemployment rate in individual districts of Slovakia.

KEYWORDS: environmental indicators, economic indicators, municipal waste fee, wage, unemployment

Introduction

We are currently witnessing many activities at the local or global level, the aim of which is not only to increase general public interest in the environment, but to provoke efforts to take concrete measures to improve its current state. A key aspect is its deteriorating condition. In addition to the economic and social sphere, the environment is one of the pillars of sustainable development. There is a lot of evidence of the nonecological use of natural resources. Everything that threatens the environment also threatens such development. One of the biggest dangers for the environment is waste (Bosak et al., 2016). Waste generation has adverse effects on health, the environment, socio-economic conditions, and contributes to climate change. Therefore, it is important to examine the links between economic growth, waste production, and environmental degradation (Uddin et al., 2017).

In the European Union, the amount of municipal waste generated per person in 2018 amounted to 492 kg, a decrease of 5% compared to a maximum of 518 kg per person in 2008, which is roughly comparable to the 490 kg recorded in 2017. In total, the European Union generated 220 million tonnes of municipal waste in 2018. Although this was slightly higher than in 2017 (218 million tonnes), it was less than in 2008 (227 million tonnes) (Statistical Office of the European Communities, 2020). Economic and fiscal instruments, together with regulatory frameworks, play a key role in addressing these challenges as drivers of improving waste management (Nicolli and Mazzanti, 2013). Municipal waste charges are one of the instruments that are widely recognized as crucial for local waste management (Puig-Ventosa and Sastre Sanz, 2017). These charges must be paid by all entities using the environment in the field of waste generation. At the same time, a uniform rule applies to their collection (calculation and transmission) (Małecki, 2020).

The National Council of the Slovak Republic adopted the Act No. 582/2004 Coll. on Local Taxes and Local Fee for Municipal Waste and Minor Construction Waste, which is valid since 1 November 2004 and in force since 1 July 2020. The aim and subject of this law are to establish a local tax and a local fee for municipal waste and small construction waste. The National Agency for Network and Electronic Services (2013) states that the municipal waste fee is paid for the waste that is generated on the territory of a given municipality of the Slovak Republic. The taxpayer is responsible for the payment of this fee, who is considered a natural person with a permanent, resp. a temporary stay in the municipality or a person who is an authorized user of a residential space, garden, orchard, building construction, or who does business in the territory of the municipality. In addition to the individuals, the taxpayer for municipal waste can also be a legal person who is authorized to use

real estate in the municipality for another purpose, such as business activities, as well as a legal entity using the object in the territory for business activities. The taxpayer is not a person who uses the territory of the municipality for temporary housing in facilities such as hotels. The taxpayer is not a person hospitalized in a health centre due to the provision of health care. Each municipality, which determines the amount based on the frequency of waste treatment, is responsible for determining the amount of the municipal waste fee. The tax period for this fee is specified for the period of one calendar year. The decisive factor for determining the amount of the municipal waste fee is to look at the last period and the last determined fee (annual fee). If the resident is not present on the territory of the municipality for more than 90 days in a calendar year and proves this by verified documents, the municipality has the option to waive or reduce the municipal waste fee to the payer to the lowest possible fee, which means 0.01 euro/day, i.e. a fee of 3.65 euro/year. According to Collection of Laws of the Slovak Republic, in particular, Act No. 79/2015 Coll. on waste, collected funds must be used by the municipality specifically for the collection, transport, recovery, and disposal of municipal waste and small construction waste.

The management of municipalities is subject to increasing control by the public, the state and the municipalities themselves, and these local authorities around the world are being forced to deal more and more with waste management (Budică et al., 2015; Vavrek, Adamisin and Kotulic, 2017). Municipal waste management has become a challenge for local government authorities in both small and large municipalities (Starkowski and Bardzinski, 2018). Cheng et al. (2020) state that local and regional specific conditions should be taken into account when modelling the economic and environmental impacts of waste generation. Recent findings also suggest that different regional economic environments significantly affect the link between economic growth and environmental quality (Gardiner and Hajek, 2020a). For example, an increase in production factors (employment and capital) contributes not only to production and consumption but also to industrial pollution (Alam et al., 2011). The unemployment rate is another factor that is significantly correlated with solid waste generation (Namlis and Komilis, 2019). Khajevand and Tehrani (2019) also agree and state that it is essential to include an economic factor, such as the unemployment rate, in the waste disposal model, especially during economic downturns, when economic factors may outweigh the effects of population change on waste generation and thus also for its disposal. The research by Talalaj (2017) found the lack of a significant statistical relationship between the average monthly wages and the quantity of waste generated, that is contrary to the results of a study by Minelgaitėa and Liobikienė (2019), that indicated that the level of waste gen-

eration in the European Union countries significantly depends on indicators of economic development, and the results of the study carried out by Gardiner and Hajek (2020b), that provide empirical support for the existence of short-term and long-term bidirectional causality between waste generation and economic growth in EU regions. Malinowski et al. (2019) examined the relationship between the efficiency of waste segregation and fee rate imposed on residents for generated municipal solid waste and found that in those municipalities where the fee increased, the growth of segregation efficiency was hampered. Based on the results of multi-year research conducted by Bosak et al. (2018), the average fee for municipal waste and small construction waste is gradually increasing as we move from the eastern Slovakian districts to the west. At the same time, the amount of the fee depends not only on whether it is paid in the municipality or in the city, on the number of inhabitants, or on the company that collects the waste but also on the region in which the municipality is located. Assessing the dependence of various economic and environmental variables is commonly used by various researchers, e.g., Chovancová and Vavrek (2020) or Fura (2020).

Research methods

The paper visualizes and analyzes data on municipal waste fees and the average wage on a thematic map and in a boxplot, and subsequently examines the relationship between the amount of fees for municipal waste in 2019 and the average monthly wage and unemployment in individual districts of Slovakia in the same year.

Currently, the value of the fee for municipal waste collection in Slovakia depends on the following factors:

- Act no. 17/2004 Coll., Annex no. 1 Landfill fees,
- inflation, i.e., a generally constant rise in the price level,
- deflation, i.e., a general decline in the price level,
- consumer price index.

The amount of the fee for municipal waste collection is also calculated on the basis of the formula:

$$R = Q \times A \times CPI, \quad (1)$$

where:

R – contribution to the creation of a special-purpose financial reserve in €/Year,
Q – the amount of deposited waste per year in m^3,
A – the amount of fee per unit of waste calculated at the beginning of the creation of the special-purpose financial reserve,
CPI – consumer price index (amount of inflation in a given year).

The amount of the levy per unit amount of waste, which is calculated once at the beginning of the creation of the special-purpose reserve, is calculated according to the formula:

$$A = CN / K, \quad (2)$$

where:

A – the amount of fee per unit of waste calculated at the beginning of the creation of the special-purpose financial reserve,

CN – the investment costs estimated by the project documentation intended for closure, reclamation and operating costs for monitoring the landfill in €,

K – is the free capacity of the landfill at the beginning of the creation of the special-purpose financial reserve at the time of calculation in m^3.

The initial basis for the analysis and subsequent visualization was secondary data from the Statistical Office of the Slovak Republic (2020). Thematic maps were processed in the MapInfo Professional 16.0 software. Software Statistica 13.5 was used to test the relationship between variables.

Results of the research

Table 1 contains data presenting the amount of the average annual fee for municipal waste collection in Slovakia in 2019 sorted by individual districts. At the same time, it is the input data of the attribute table for the visualization of this indicator in the MapInfo Professional software.

Table 1. The average annual fee for municipal waste in individual districts of Slovakia in 2019

Bratislava Region	Average fee/year	Trnava Region	Average fee/year	Nitra Region	Average fee/year	Trenčín Region	Average fee/year
Malacky	20.18 €	Dunajská Streda	15.13 €	Komárno	13.66 €	Bánovce nad Bebravou	13.85 €
Pezinok	20.58 €	Galanta	16.19 €	Levice	11.46 €	Ilava	15.33 €
Senec	16.26 €	Hlohovec	14.56 €	Nitra	16.37 €	Myjava	13.19 €
BA I.	19.11 €	Piešťany	15.03 €	Nové Zámky	12.47 €	Nové Mesto nad Váhom	15.72 €
BA II.	19.11 €	Senica	16.16 €	Šaľa	14.17 €	Partizánske	12.84 €
BA III.	19.11 €	Skalica	15.54 €	Topoľčany	14.12 €	Považská Bystrica	17.49 €
BA IV.	19.11 €	Trnava	15.21 €	Zlaté Moravce	13.86 €	Prievidza	16.12 €
BA V.	19.11 €	**Average for region**	**15.40 €**	**Average for region**	**13.73 €**	Púchov	18.86 €
Average for region	**19.07 €**					Trenčín	17.24 €
						Average for region	**15.63 €**
Žilina Region	**Average fee/year**	**Banská Bystrica Region**	**Average fee/year**	**Prešov Region**	**Average fee/year**	**Košice Region**	**Average fee/year**
Bytča	14.86 €	Banská Bystrica	16.92 €	Bardejov	8.24 €	Gelnica	11.48 €
Čadca	14.72 €	Banská Štiavnica	11.74 €	Humenné	6.78 €	Košice - okolie	13.49 €
Dolný Kubín	13.14 €	Brezno	13.53 €	Kežmarok	10.44 €	Michalovce	8.25 €
Kysucké Nové Mesto	14.83 €	Detva	13.37 €	Levoča	11.05 €	Rožňava	10.13 €
Liptovský Mikuláš	13.36 €	Krupina	11.86 €	Medzilaborce	6.30 €	Sobrance	9.33 €
Martin	15.21 €	Lučenec	9.95 €	Poprad	12.50 €	Spišská Nová Ves	10.25 €
Námestovo	13.24 €	Poltár	10.90 €	Prešov	9.09 €	Trebišov	7.99 €
Ružomberok	15.12 €	Revúca	10.99 €	Sabinov	8.94 €	KE I.	31.35 €
Turčianske Teplice	13.25 €	Rimavská Sobota	10.45 €	Snina	7.57 €	KE II.	31.35 €
Tvrdošín	14.81 €	Veľký Krtíš	9.82 €	Stará Ľubovňa	11.81 €	KE III.	31.35 €
Žilina	14.74 €	Zvolen	14.58 €	Stropkov	7.19 €	KE IV.	31.35 €
Average for region	**14.42 €**	Žarnovica	14.50 €	Svidník	7.40 €	**Average for region**	**17.85 €**
		Žiar nad Hronom	14.77 €	Vranov nad Topľou	7.55 €		
		Average for region	**12.57 €**	**Average for region**	**8.84 €**		

Source: author's work based on slovak.statistics.sk [26-09-2020].

Figure 1 shows a thematic map that visualizes the amount of the average annual fee for municipal waste within the districts of the Slovak Republic in 2019. Based on the data analysis, the highest amount of municipal waste fee is in Košice and Bratislava. On the contrary, the lowest fee is paid by residents in the northeast parts of Slovakia.

Figure 1. The average annual fee for municipal waste in individual districts of the Slovak Republic (2019)

Source: author's work based on slovak.statistics.sk [26-09-2020].

In the analysis of the obtained data on the average fee for municipal waste and the average wage, we visualized the variance of values using descriptive statistics. The following graphs (figures 2 and 4) show the analyzed data on the average fee for municipal waste and the average monthly wage in Slovakia in 2019.

The thematic map (figure 3) shows the average wage in individual districts of Slovakia in 2019 (regardless of gender). If we look at the amount of the average wage from the point of view of particular regions, the average wage in the Bratislava region relatively highly exceeded the average of the whole country and reached almost the amount of 1,500 euro. The lowest value was recorded in the Prešov region.

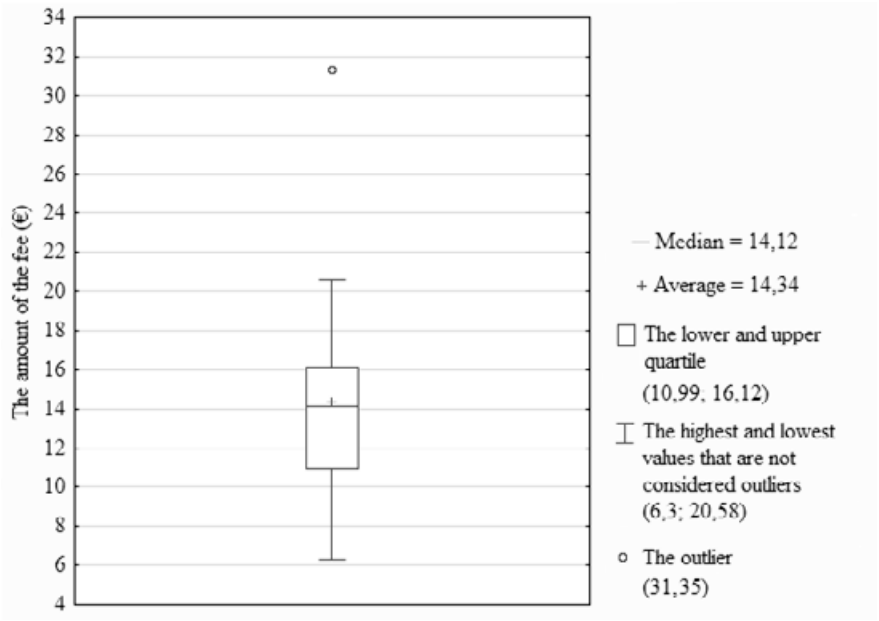

Figure 2. The average municipal waste fees in Slovakia in 2019

Source: author's work based on slovak.statistics.sk [26-09-2020].

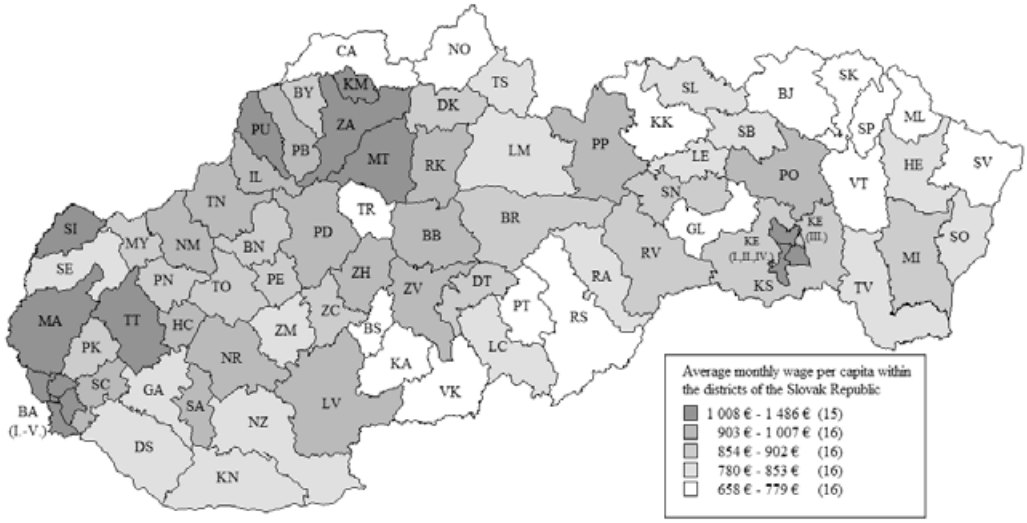

Figure 3. The average monthly wage per capita in individual districts of the Slovak Republic (2019)

Source: author's work based on slovak.statistics.sk [26-09-2020].

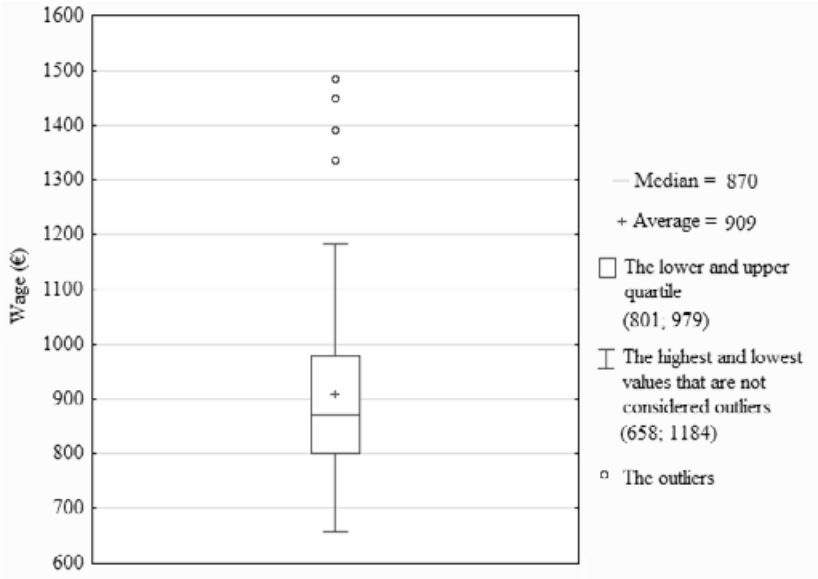

Figure 4. The average wage in Slovakia in 2019

Source: author's work based on slovak.statistics.sk [26-09-2020].

The data on unemployment rates in individual districts of Slovakia were also obtained from the Statistical Office of the Slovak Republic, which is the central body of the state administration of the Slovak Republic for the area of state statistics.

Based on the processing of secondary data, we performed a correlation analysis and verified the statistical relationship of the selected variables.

The statistical test verifies the assumption that there is no statistically significant relationship between the average monthly wage and the amount of fee for municipal waste collection in individual districts of the Slovak Republic in 2019.

H0: ρ (correlation coefficient) = 0

H1: ρ (correlation coefficient) ≠ 0

Table 2. Testing the statistical relation of the hypothesis H1

Correlation	
corr (wage, fee)	0.57439145
p-value	0.0000

Source: author's work based on slovak.statistics.sk [26-09-2020].

We reject the hypothesis H0, a linear relationship exists.

At the significance level α = 0.05, there is a relationship between the average wage and the amount of fee for municipal waste collection. Based on the value of the correlation coefficient ρ = 0.5744, we confirm that the relationship between the variables is significant.

We further assume that there is no statistically significant relationship between the amount of fee for municipal waste collection and the unemployment rate in individual districts of the Slovak Republic in 2019.

H0: ρ (correlation coefficient) = 0

H1: ρ (correlation coefficient) ≠ 0

Table 3. Testing the statistical relation of the hypothesis H2

Correlation	
corr (unemployment, fee)	-0.60482345
p-value	0.0000

Source: author's work based on slovak.statistics.sk [26-09-2020].

We reject the hypothesis H0, a linear relationship exists.

At the level of significance α = 0.05, there is a relationship between the fee for municipal waste collection in the districts of Slovakia and the unemployment rate in individual districts of Slovakia. Based on the absolute value of the correlation coefficient ρ = | 0.6048 |, we confirm that the relationship between the given variables is significant.

Conclusions

The paper aimed to visualize and analyze the relationships between selected economic and environmental indicators in the individual districts of Slovakia. Selected indicators included: municipal waste fee, an average monthly wage, and unemployment in the districts of Slovakia in 2019. Data were visualized and analyzed on a thematic map and in a boxplot. Based on the statistical testing, we can state that:

- there is a statistical relationship between the average wage and the amount of fee for municipal waste collection in the individual districts of the Slovak Republic,
- there is a statistical relationship between the municipal waste fee and the unemployment rate in the individual districts of the Slovak Republic.

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The contribution of the authors

Martin Rovnak – 65% (conception, data analysis, interpretation, discussion).
Roman Novotny – 25% (literature review, data analysis, language correction).
Matus Bakon – 10% (literature review, data collection).

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Ewa **OŁDAKOWSKA**

ESTIMATION OF PRO-ECOLOGICAL APPROACH TO ROAD CONSTRUCTION IN ECONOMIC EFFICIENCY ASSESSMENT

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ABSTRACT: The development of the road network has a positive impact on a wide range of factors determining the efficient functioning of the state and the development of its regions. At the same time, it is an interference in environmental and agricultural space and a threat to landscape and cultural values. Protection of a very diversified natural environment means preservation, sustainable use, and restoration of resources, creations, and components of nature. Hence, the environmentally friendly design and construction of road investments should include passive and active environmental protection and compensation. All effective solutions from a wide range of "good practices" minimise or eliminate the negative environmental impacts. At the same time, all those activities leading to the creation of an environmentally friendly "green" road network are "economically" estimated in economic analyses. The main goal of this paper is to indicate the "simplified" valuation of the pro-ecological approach to road construction in the assessment of economic effectiveness on the example of the Polish section of the S8 expressway (especially within protected areas). The lack of valuation in the monetary value of potential benefits resulting from avoidance, prevention or mitigation, unfortunately, has an impact on the economic result of cost-benefit analysis.

KEYWORDS: assessment of the economic effectiveness of road and bridge projects, cost-benefit analysis, environmental protection, natural environment

Introduction

The development of the road network is an economic and social benefit, but also the possibility of permanent and irreversible environmental changes. That road network interferes with protected areas in many places, and the construction of each of the roads has a negative impact on the atmospheric air, ground surface, soil, surface and underground water system, acoustic climate, fauna and flora, landscape, and cultural assets in the surroundings of the investment (Spellerberg, 1998; Forman and Alexander, 1998; Trombulak and Frissell, 2000; Seiler, 2003; Van der Ree, Smith, Grilo, 2015).

Making investment decisions in such range depends on the results of the cost-benefit analysis, which, going beyond the financial analysis, allows to assess the economic benefits. However, in its assumptions, it encounters many difficulties (Hauer, 2011; Seiler, 2016; Daniels, 2019; Pilger, 2020) and problems with monetary valuation of difficult to evaluate the effects of investment execution, among which one can mention: avoiding losses as a result of investment execution or minimising the risk.

The paper presents the assessment of economic efficiency with "economically" priced pro-environmental approaches to road construction (within protected areas). A linear road investment consisting in the reconstruction of a section of the existing national road to the standards of an expressway, constituting a fragment (38.5 km long) of the I Trans-European Transport Corridor Warsaw – Kaunas – Riga – Tallinn – Helsinki (so-called Via Baltica), was used for the analysis. The presented section of the road runs along practically the entire length within the boundaries of the Biała Forest Nature 2000 area. The economic efficiency of the project was assessed, taking into account the necessary environmental safeguards. The case of a lack of intentional environmental solutions has also been analysed, which has allowed for the comparison of economic efficiency indicators (Johansson and Kriström, 2018).

Each linear road investment should generate social and economic benefits and interfere as little as possible with the surrounding environment and natural relationships. Air pollution, initially a local problem, has now developed into a global threat leading to irreversible changes. The pollution level depends on the traffic volume, its liquidity, and the share of heavy vehicles. The issue of over-regulatory pollution is primarily a problem of large urban agglomerations, which are characterised by equally large traffic volumes. In the case of extra-urban routes, the problem may only concern the area directly adjacent to the roads, mainly in environmentally valuable areas, in which case appropriate protection should be designed to protect the environment against fumes. Ways of reducing emissions and spreading exhaust gases include technical progress in engine design, increasing the fluidity of

driving, limiting heavy vehicle traffic, proper shaping of the road surface, design of insulating green lanes, use of guards (artificial and green), and roads in tunnels.

The impact of roads on land surface and the soil is a direct occupation of land for roads causing their exclusion from agricultural production (Bohatkiewicz, 2008) and:

- pollution with heavy metal compounds (zinc, cadmium, copper, nickel, lead),
- acidification with sulphur and nitrogen compounds,
- salinating with winter road maintenance agents,
- change in hydrographic conditions,
- destruction of soil structure.

Among the methods of soil protection (as well as surface water and groundwater), there is an appropriate drainage system to prevent the ingress of harmful substances into the water and soil, and the use of planting of complex insulating greenery, consisting of appropriate species of shrubs, deciduous trees, and coniferous trees.

Road construction always means worsening of the acoustic climate in the vicinity of the investment and its improvement in the surroundings of relieved roads. The most efficient method of limiting the effects of acoustic climate deterioration in the vicinity of roads is to choose an appropriate location of the road in the areas least sensitive to the effects of exceeding the allowable noise levels. On the other hand, in the case of existing communication routes, the protection means may be located in the following zones: between the source and the receiver, in the zone of immission, in the area of emission (at the source). Among the solutions improving the acoustic climate in the areas adjacent to the traffic routes are (Buczek, 2013): acoustic screens, road tunnels, earth embankments, quiet pavements, proper traffic management, leading the road in a trench, compact dense greenery, proper location of insensitive buildings.

The most serious consequences resulting from the development of road infrastructure are the degradation and reduction of the availability of habitats and the prevention of free movement of animals – creating environmental barriers (Seiler and Bhardwaj, 2020). Those barriers may take the form of a physical barrier resulting from artificial changes in the terrain, the presence of fences or objects, or may become a psychophysical barrier resulting from vehicle traffic and related impacts (acoustic, light, and chemical emissions). Most ecological systems show a characteristic time lag (sometimes called extinction debt) between habitat degradation and the time when its ecological effects are fully detected (Tilman et al., 1994; Loehle and Li, 1996; Banks, 1997; Cowlishaw, 1999). The impact of roads is also characterised by

such "delayed response" as different effects of roads on clumping and populations of wildlife – for example, habitat loss, reduced habitat quality, mortality, and reduced cohesion – usually manifest themselves at different rates. The most rapid effects are observed in the case of habitat loss, the lack of which causes population losses. Decreases in population due to habitat quality decline appear slightly later. On the other hand, changes in population mortality resulting from collisions of animals and vehicles are evaluated along with an increase in traffic accumulation of fatal accidents, and are observed in the context of impact on the whole population, after one or two generations since the road has been built (Forman et al., 2003). The effect of the road appears as a barrier to cohesion may only be observed after several generations, when local populations will be dying out.

All those negative impacts of roads should be mitigated by designing, installing, and building all possible solutions to bring us closer to an environmentally friendly "green" road network (Iuell et al., 2003; Trocmé et al., 2003; Clevenger and Huijser, 2009; Clevenger and Ford, 2010; Huijser and McGowen, 2010; Van der Grift et al., 2013). Measures and methods minimising road hazards are an essential component of a sustainable transport strategy (Morrall and McGuire, 2000; McGuire and Morrall, 2000). Among the basic ones is to be mentioned:

- speed limitation in areas of particular risk of collision with animals (active speed-limiting systems),
- reflective elements,
- protective fences for amphibians and small mammals, as well as large and medium-sized mammals,
- anti-glare shields,
- acoustic screens,
- protective and insulating planting of vegetation,
- animal walkways.

The development of road infrastructure is also a threat to landscape and cultural values, as each investment is a foreign element in a given area. In the areas of high natural value, special attention should be paid already at the design stage to integrating the road with the surrounding landscape (shaping it properly, minimising the cutting of ecosystems). The road grade line should be adapted to the topography of the surrounding area, and all engineering structures should be designed with almost architectural asceticism. The communication routes should be planted with greenery, including planting corresponding to native tree and shrub species.

Object and methodology

Linear road investment

To indicate a pro-ecological approach to the construction of Polish roads, an analysis of solutions (applied during the reconstruction of a section of the existing national road to expressway standards, constituting a fragment (38.5 km long) of the 1st Trans-European Transport Corridor Warsaw – Kaunas – Riga – Tallinn – Helsinki (so-called Via Baltica), has been prepared. The presented section of the road runs along practically the entire length within the boundaries of the Biała Forest Nature 2000 area (Special Protection Area PLB 140007). That area extends over several dozen kilometres on both the northern and southern side of the analysed investment. On the south side of the road, there are also three other Natura 2000 areas: Dolny Bug River Valley (Special Protection Area PLB 140001) together with Nadbużańska Ostoja (Special Habitat Protection Area PLH 140011) and Liwiec River Valley (Special Protection Area PLB 140002). Approximately 63.00% of the road runs through forests, 33.86% through agricultural areas, and 3.12% through built-up areas. The need to build an expressway was a response to the ever-increasing volume of traffic and the increase in the number of accidents (resulting from the volume and lack of safety improvement solutions). The project under consideration is among those which significantly affect the environment, and in particular, adversely affect its natural value. It is located in an area where there are no other forms of nature protection: national parks, landscape parks, nature reserves, nature monuments, documentation stands, ecological sites, and nature complexes. The road is a modern communication route providing communication facilities, but at the same time, it is also equipped with the necessary environmental protection. The route in this section has 15 viaducts, 7 bridges, and 3 footbridges. In this case, the structures allowing for collision-free movement of animals across the road and at the same time preventing an increase in animal mortality and mitigating habitat fragmentation are the lower passages for large animals (5 pcs.). Those passages are designed for wolves, elks, and deer, but may also be used by medium-sized animals such as roe deer, wild boar, and small animals. In addition to those 5 passages, there are 5 more passages integrated with bridges over watercourses, and 41 facilities for small animals. Drainage is provided by drainage ditches and culverts (11 reconstructed ones are at the same time the animal passages). The areas adjacent to the crossings have been separated from the environment by a development similar to the natural one. On the edge of some of the objects, structures were made to insulate visually and partly acoustically. Passages for small animals: reptiles, amphibians, and

small amphibians, as well as rodents, are situated, if possible, at the locations of former passages. The modernised surface drainage system is supplemented by 26 retention, infiltration, and evaporation tanks (located in places that required by far the least interference with forest areas and at a distance from animal crossings), as well as cleaning devices – settling tanks and sandboxes (open ones of appropriate retention capacity, placed, among others, at outlets from road ditches). To reduce the acoustic nuisance, absorbing and reflecting acoustic screens have been made. As a result of a change in the regulations (which occurred during the investment), less than half of the proposed 14,089 m (72,616 m^2) of the area of noise protection was made. Moreover, the structures were planted with vines, which additionally made it possible to mask and incorporate them into the surrounding landscape. To prevent the accidental intrusion of migrating animals into the roads, practically the entire length the road has been protected with a fence (mesh with appropriate mesh size, hurdles for amphibians). To minimise the impact at the operation stage and in connection with the need to cut down trees for the entrusted task, lanes of insulating greenery have been made (10-15 m wide as far as possible in the field), as well as a number of compensatory plantings in the form of decorative and functional greenery, also making the forest denser.

Cost-benefit analysis and economic performance indicators

In Poland, the guidelines contained in two separate studies are used to assess the economic efficiency of road and bridge projects: the "Blue Book" (Blue Book, 2015), recommended for use in the case of investment projects in the transport sector, for which beneficiaries apply for financial aid from European Union funds and in the "Instructions for Assessing the Economic Effectiveness of Road and Bridge Undertakings", which make the detailed economic analyses dependent on the type of road, dividing them into communal, county and provincial (Instructions for economic efficiency assessment..., 2008). In the case of all projects, a cost-benefit analysis (CBA) method is adopted for the assessment of economic efficiency, taking into account the benefits of the users of the analysed investment and road costs (construction, repairs, maintenance, and all costs of works aimed at ensuring the safety of the road infrastructure in technical terms and its availability for daily operation, as well as preventing its degradation).

The basic stages of the cost-benefit analysis are (Drobniak, 2008; Foltyn-Zarychta, 2008): identification of all project costs and benefits, monetary valuation of all costs and benefits, discounting future net benefits, which makes it possible to include future costs and benefits in current prices and compare them with the investment outlay. The strength of the cost-benefit

analysis is the inclusion not only of financial expenditures and receipts but also of social, economic, and environmental results. However, the effects in the economy, the local community, or the environment are difficult to evaluate; hence the advantage becomes at the same time the basic disadvantage of the cost-benefit analysis method.

The first step of the cost-benefit analysis, according to its idea, is to identify all costs and benefits related to the implementation and operation of the investment. Table 1 shows the classification of the main costs and benefits for road infrastructure investments.

Table 1. Main categories of economic costs and benefits for road infrastructure investments

Roads and bridges costs	Costs/benefits/savings for users and environment
Investment costs	Vehicle operating costs
Maintenance costs	Time costs of infrastructure users
	Costs of road accidents and victims
	Costs related to the emission of pollutants
	Climate change and noise costs ("Blue Book")

Source: author's work.

The economic assessment of projects involves the determination of the following indicators (Blue Book, 2015; Instructions for economic efficiency assessment..., 2008):

a) the economic net present value (ENPV), i.e., the difference in total discounted benefits and costs associated with the investment; that difference should be positive for economically efficient projects,
b) economic rate of return (ERR), which should exceed the assumed discount rate,
c) relation of discounted advantages to discounted costs (NB/NC), which should be higher than one.

The calculation of economic efficiency shall be carried out upon the basis of separate input data and parameters of the elements of the economic account, which include:

- traffic measurements, calculation of average daily traffic, and forecast of average daily traffic,
- travel speed,
- road costs,
- vehicle operating costs,
- costs of time in passenger transport and costs of time in freight transport,

- costs of road accidents,
- costs of toxic exhaust emissions,
- costs of users and the environment.

The sensitivity analysis is the supplementary stage in the assessment of road and bridge investments.

Results and their evaluation

The cost-benefit analysis is based upon the incremental method consisting of comparing the project scenario for the investment variant (WI) with the base scenario for the non-investment variant (W0 – without project).

To determine the indicators of the economic assessment for the investment task consisting in rebuilding the national road to the expressway standards (the required technical data are presented in table 2), the following assumptions have been made:

- reference period – 25 years (for road projects; from the start of construction),
- a year consists of 365 days.
- Recommended forms have been developed:
- traffic forecasts,
- road costs,
- operating costs of vehicles,
- costs of time in passenger transport,
- costs of time in freight transport,
- costs of road accidents,
- costs of toxic exhaust emissions,
- summary of the user and environmental costs,
- economic analysis of costs and benefits,
- economic values and indicators (table 3 – including the necessary environmental safeguards, table 4 – excluding the necessary environmental safeguards).

The forms include costs for both variants: W0 and WI. The road net costs and savings for users and the environment have been calculated for all years of the analysed period. In the analysed case, all necessary environmental safeguards were taken into account.

A similar procedure has been carried out assuming the absence of any environmental safeguards, where values and economic indicators are presented in table 4.

Table 2. Technical data of the national road rebuilt to the major road standards

No.	SPECIFICATION	UNIT	W0	WI
1	NATIONAL	-	ROAD	
2	SEGMENT LENGTH	km	38.5	
3	TERRAIN TYPE	-	FLAT	
4	ROAD TYPE	-	COUNTRY ROAD	
5	ROAD CLASS	-	S	
6	NUMBER OF ROADWAYS	pcs.	1	2
7	NUMBER OF ROADWAY LANES	pcs.	2	2
8	ROADWAY WIDTH	m	6.50	7.00
9	SHOULDER WIDTH	m	1.50	0.75
10	AVERAGE ALLOWABLE SPEED	km/h	90	120
11	PAVEMENT TECHNICAL CONDITION ACC. TO SOSN		B	A
12	BUS BAYS		yes	yes
13	TRAFFIC CHARACTER		ECONOMIC	
14	INVESTMENT NET COST	PLN	-	1,033,800,000.00
15	TRAFFIC CATEGORY	KR	6	6
16	BRIDGE OBJECTS, VIADUCTS AND FOOTBRIDGES	CONDITION	4	5

Source: author's work.

Table 3. Value and economic indices for the investment task consisting in rebuilding the national road to the expressway standards [thousands of PLN]

DESCRIPTION		VALUE OR INDEX FOR DISCOUNT RATE r			
		0.01	0.05	0.10	0.13216
NC	DISCOUNTED INVESTMENT NET COSTS	-1,045,909,172	-964,719,351	-893,437,757	-856,857,912
NB	DISCOUNTED NET ENVIRONMENTAL COST SAVINGS	3,844,466,393	2,176,258,231	1,192,791,556	856,857,912
ENPV	ECONOMIC NET PRESENT VALUE [-]	2,798,557,219	1,211,538,879	299,353,799	0
NB/NC	ADVANTAGES – COSTS INDEX [-]	3.68	2.26	1.34	1.00
EIRR	ECONOMIC INTERNAL RATE OF RETURN [%]	13.216			

Source: author's work.

Table 4. Value and economic indicators for the investment task consisting in the reconstruction of the national road to the expressway standards without taking the necessary environmental safeguards into account [PLN]

DESCRIPTION		VALUE OR INDEX FOR DISCOUNT RATE r			
		0.01	0.05	0.10	0.13407
NC	DISCOUNTED INVESTMENT NET COSTS	-977,805,001	-926,837,009	-873,447,672	-841,237,417
NB	DISCOUNTED NET ENVIRONMENTAL COST SAVINGS	3,844,466,393	2,176,258,231	1,192,791,556	841,237,417
ENPV	ECONOMIC NET PRESENT VALUE [-]	2,866,661,393	1,249,421,222	319,343,885	0
NB/NC	ADVANTAGES – COSTS INDEX [-]	3.93	2.35	1.37	1.00
EIRR	ECONOMIC INTERNAL RATE OF RETURN [%]	13.407			

Source: author's work.

The realised procedure has revealed, for various values of the discount rate, that in each of the analysed variants:

- the project consisting in the reconstruction of a national road to the expressway standards (both in case of applying for the necessary environmental protection and in the absence thereof) is economically justified – the discounted savings exceed the discounted net costs including all investment, repair, and maintenance expenditures (ENPV is positive), and the sum of the discounted savings divided by the sum of the discounted net costs is higher than 1 (Blue Book, 2015; Instructions for economic efficiency assessment..., 2008),
- the interest rate, at which the economic net present value of benefits expected from a given investment will be equal to the value of outlays, is 13.216% in the case of an investment task including the necessary environmental safeguards and 13.407% in the variant without the necessary environmental safeguards (the difference is 0.191%),
- the discounted savings of environmental costs in both analysed cases are identical, which means that the necessary environmental safeguards are only included in the investment costs, which is a much-simplified approach,
- the absence of monetisation of the potential benefits of avoidance, prevention, or mitigation of results has an impact on the economic outcome of a cost-benefit analysis, a thorough analysis should include a discussion/description of costs and benefits that cannot be quantified,
- the selected discount rates applied to all items are identical, which affects similar "discounting of the future" and indeed some benefits may increase over time,

- a targeted analysis would be a BCA ex-post, carried out at a certain time after the implementation of the project to assess the extent to which the project is giving results and to help identify "areas" for improvement in the BCA ex-ante (Kelly et al., 2015; Odeck and Kjerkreit, 2019).

Conclusions

The implementation of all road projects entails a number of environmental effects and impacts, which include, among others, direct impacts associated with the stage of construction and use, indirect impacts, usually limited to the immediate vicinity of the investment and secondary impacts. However, all those impacts can be minimised or completely eliminated by using a wide range of "good practices" and appropriate design, technical, technological, and organisational solutions, consisting in the construction of passages and culverts for animals, use of acoustic screens, screening greenery, buffer zones, taking into account the protection periods for animals and birds, environmental supervision over the works, number of activities limiting the occurrence of pollution, use of appropriate environmental protection devices and methods of conducting construction works and modern technologies.

The assessment of economic efficiency is a practical and multilateral evaluation of an investment project and whether it "deserves" to be implemented from a social point of view. To that end, the social, environmental, and health advantages/savings are evaluated, and the economic efficiency indices are determined being the basis for the investment decision. The costs and social and economic advantages of the road infrastructure projects are estimated dividing them into categories including vehicle operational costs, time costs of the road infrastructure users, costs of the road accidents and victims, costs connected with the emission of pollutants, or costs of excessive noise influence. When making an assessment, it is a serious problem to reliably quantify or monetise a certain part of the costs and benefits, especially those that are not measurable (life) or difficult to estimate (environmental costs). The lack of valuation in the monetary value of potential benefits resulting from avoidance, prevention, or mitigation of results has an impact on the economic result of cost-benefit analysis, unfortunately. There is, therefore, a need to modify and advance the CBA, especially regarding "road projects".

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STUDIES AND MATERIALS

STUDIA I MATERIAŁY

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SPATIAL DIVERSIFICATION OF THE IMPLEMENTATION OF PLANNING AND INVESTMENT PROCESSES IN THE POZNAŃ METROPOLITAN AREA

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ABSTRACT: This paper aimed to access the changes that appeared between 2009 and 2018 in the context of progress in the spatial planning process at the local planning level. The study also attempts to classify communes in the metropolitan area due to the diversification of the degree of implementation in the spatial planning process. The research was conducted on the example of Poznań Metropolitan Area (PMA), which covers 45 communes. The analysis was based on data from the Local Data Bank of Statistics, Poland. The communes in PMA were classified into 12 groups. The most numerous group (almost half of the analysed units) are communes with small coverage of local spatial development plans and very low dynamics of issuing of decisions on building conditions. These are communes where the urbanisation pressure, due to the distance from Poznań, is lower than in the administrative units located near or in the immediate vicinity of Poznań.

KEYWORDS: spatial management, local spatial development plans, metropolitan area, commune, suburbanisation

Introduction

The greatest intensity of spatial changes in Poland is characteristic of metropolitan areas (Gałka and Warych-Jura, 2018), especially of rural communes directly adjacent to the largest urban centres (Mrozik et al., 2012; Idczak and Mrozik, 2018). The changes are the result of various types of suburbanisation (Zębik, 2011; Wolny et al., 2017; Tokarczyk-Dorociak et al., 2018).

One of the weak points of spatial planning in Poland is no binding features of the study on conditions and directions of spatial development (SUiKZP, i.e., an act of internal management that defines the spatial policy of the commune and local development rules) in the perspective of the spatial management system, weaknesses of local spatial development plans (MPZP – constituting local law) (e.g. small share of areas covered by MPZP, optional preparation of plans, lack of sufficient protection against urbanisation) and a wrong idea of decisions on building conditions (DoWZ), which in the absence of MPZP allows for the development of buildings based on the assessment of the situation in the immediate vicinity (Mrozik and Wiśniewska, 2013; Śleszyński et al., 2020).

For spatial development planning consistent with the principles of sustainable development and spatial order, local development plans are of particular importance. Compared to the decision on building conditions, they are positively distinguished by, among others, the obligation to conduct a strategic environmental assessment and ensure public participation. For this reason, it is so important to monitor the issuing of decisions on building conditions and the adoption of local development plans, especially in the context of intensively occurring suburbanisation (Mrozik, 2016).

Numerous authors have monitored progress in the planning process – both in rural and municipal districts – and published the results in articles or annual reports. The pace of change in MPZP coverage in Poland was assessed as slow, and the statistical values are regionally and functionally differentiated. Usually, the coverage is not sufficient from the point of view of investment plans and does not address the intensity of land-use (e.g., Feltynowski, 2013; Śleszyński et al., 2015; Podawca et al., 2019). Podawca and Mrozik (2019) attempted to classify communes on the example of the Warsaw Metropolitan Area (WMA). They distinguished 13 types of communes in terms of the degree of implementation of location decisions and in terms of coverage of local spatial development plans.

In the case of Poznań and its functional area, the majority of papers focused on the analysis of the city of Poznań and Poznań district or the Poznań Agglomeration covering the city of Poznań and 17 communes of Poznań

(Zydroń and Szczepański, 2012; Kaczmarek, 2017; Wdowicka and Mierzejewska, 2020). In turn, Mrozik et al. (2020) focused on functional urban areas (FUAs), where the so-called integrated territorial investments (ITI) are implemented. The discussed issue for Poznań Metropolitan Area (PMA), which was delimited by the WBPP, is less recognised.

This paper aimed to access the changes that appeared between 2009 and 2018 in the context of progress in the spatial planning process at the local (communal) planning level. In this case, the planning process is understood as actions concerning formulating and enacting local spatial development and issuing decisions on building conditions, which are documents allowing for obtaining a building permit. The study also attempts to classify communes in the metropolitan area due to the diversification of the degree of implementation of the spatial planning process.

Research methods

The research were conducted on example of Poznań Metropolitan Area, which covers 45 communes including 6 urban (Gniezno, Kościan, Luboń, Poznań, Puszczykowo, Wągrowiec), 21 urban-rural (Buk, Czempiń, Czerniejewo, Grodzisk Wielkopolski, Kostrzyn, Kórnik, Mosina, Murowana Goślina, Nekla, Nowy Tomyśl, Oborniki, Opalenica, Pobiedziska, Rogoźno, Skoki, Stęszew, Swarzędz, Szamotuły, Śrem, Środa Wielkopolska, Września) and 18 rural ones (Brodnica, Czerwonak, Dominowo, Dopiewo, Duszniki, Gniezno Granowo, Kaźmierz, Kiszkowo, Kleszczewo, Komorniki, Kościan, Łubowo, Rokietnica, Suchy Las, Tarnowo Podgórne, Wągrowiec, Zaniemyśl). It occupies an area of about 6.2 thousand km^2 and a population of approx. 1.4 million, which is, respectively, 21% of the area of Wielkopolska (Greater Poland) Region, and 41% of the region's population. Delimitation of the PMA was performed by regional planning office Wielkopolskie Biuro Planowania Przestrzennego (WBPP). It includes also 10 cities – centers of the district and 15 other small towns (Mrozik et al., 2015).

The analysis was based on data from the Local Data Bank of Statistics Poland collected in the section local government (subgroup spatial planning). The time range of the analysis was chosen on the basis of data availability.

To characterise the realisation of spatial planning tasks in a commune, the following features have been taken into account:

- the area of the commune covered by binding local development plans in 2018 – A_{MPZP} [ha],
- the total number of binding local development plans in 2018 – N_{MPZP} [pcs],

- the number of decisions on the localisation of public purpose investments issued between 2009 and 2018 – $\sum N_{DICP}$ [pcs],
- the number of decisions on building conditions issued between 2009 and 2018 – $\sum N_{DWZ}$ [pcs],
- the total area of the commune – A [ha].

For assessing the spatial scale of the planning process and comparing administrative units, the following indicators have been used:

1) the coverage with local development plans in 2018 expressed by the formula:

$$W_{MPZP} = (A_{MPZP} / A) *100\% \text{ [\%]}, \quad (1)$$

2) the density of MPZP (W_{D_MPZP}) in 2018 (the ratio of the number of MPZP to the area of the commune) expressed by the formula:

$$W_{D\_MPZP} = N_{MPZP} / (A / 100) \text{ [pcs/km}^2\text{]}, \quad (2)$$

3) the density of decisions on establishing the location of public purpose investment (W_{DICP}) between 2009 and 2018 (the ratio of the number of issued decisions to the commune area) expressed by the formula:

$$W_{DICP} = \sum N_{DICP} / (A / 100) \text{ [pcs/km}^2\text{]}, \quad (3)$$

4) the density of decisions on building conditions (W_{DWZ}) between 2009 and 2018 (the ratio of the number of issued decision to commune area): expressed by the formula:

$$W_{DWZ} = \sum N_{DWZ} / (A/100) \text{ [pcs/km}^2\text{]}. \quad (4)$$

The evaluation of the realization of the planning process and the investment interest in particular communes has been done using indicators in a period of 10 years:

1) the dynamics of change in the area of land covered by the local development plans between 2009 and 2018 (P_{A_MPZP}) expressed by the formula:

$$P_{A\_MPZP} = (A_{MPZP2018} - A_{MPZP2009}) /100 \text{ [\%]}, \quad (5)$$

2) the change in coverage with local development plans between 2009 and 2018 (PP_{A_MPZP}) expressed by the formula:

$$PP_{A\_MPZP} = (A_{MPZP2018} - A_{MPZP2009})/A *100 \text{ [p.p.]}, \quad (6)$$

3) the indicator of the intensity of issuing decisions on establishing the location of public purpose investments, given by the formula:

$$W_{I\_ICP} = (\sum N_{DICP2009\text{-}2018}/10) / [(A - A_{MPZP2018})/100] \text{ [pcs/km}^2\text{]}, \quad (7)$$

4) the indicator of the intensity of issuing decisions on buildings conditions, given by the formula:

$$W_{I\_WZ} = (\sum N_{DWZ2009\text{-}2018}/10) \,/\, [(A - A_{MPZP2018})/100] \text{ [pcs/km}^2\text{]}. \quad (8)$$

During analysing and interpreting the results of the research problem, the following steps have been taken:

1) filtering data gathered in the Local Data Bank, based on features from the category local government and subgroup spatial planning,
2) obtaining spatial data on the borders of administrative units from the Head Office of Geodesy and Cartography (GUGiK),
3) aggregation of data for particular subgroups together with determining indicators using the ArcGIS 10.5.1 and QGIS 2.12.1 based on a created spatial data set,
4) designation of types of communes in terms of the degree of implementation of the planning process.

Results of the research

The most important feature determining the level of realisation of documents on spatial planning is the percentage of the MPZP coverage in a commune. In PMA local spatial development plans cover only in one case (rural commune Kleszczewo) the whole commune. In two cases (urban commune Luboń and urban-rural commune Pobiedziska) the coverage is bigger than 80%.

A good situation (comparing to other communes in PMA) in terms of MPZP coverage was observed in another two rural communes (Suchy Las, Tarnowo Podgórne), where it is maintained at 50-80%. The moderate situation with coverage at 20-50% is present in 13 communes (Komorniki, urban commune Gniezno, Poznań, Kórnik, Czempiń, Puszczykowo, Swarzędz, Śrem, Czerwonak, Rokietnica, Łubowo, Mosina and urban commune Wągrowiec). Unsatisfactory level of coverage (below 20%) was shown in 27 administrative units. Additionally, in 11 of them, the level of coverage is below 5%). In the rural communes Brodnica and Dominowo, with the coverage below 1%, the situation was assessed as extremely bad (table 1, figure 2).

While analysing the gain in the area covered by MPZP, it can be assumed that the smaller the percentage of the commune was included in the 2009 plans, the greater should be the dynamics of its issuing. However, this is not confirmed in the results (figure 1).

While in three communes with substantial MPZP coverage in 2009 (Kleszczewo, Luboń, Suchy Las) the dynamics of developing a new MPZP

might be weak or non-existent, it can be significant in communes with little coverage.

The highest dynamics of changes were observed in urban-rural commune Pobiedziska (120%), and a high dynamic was found in urban-rural commune Kórnik (67%), urban commune Poznań (55%) and urban-rural commune Śrem (52%). Moreover, the biggest changes in the area covered with the local development plans are observed in Pobiedziska (63%). The new MPZP covered an additional 11956 ha of the commune's area within 10 years, which means an average annual increase of 1196 ha. Intensive work on subsequent local spatial development plans in the commune is also continued during the Covid-19 pandemic.

Out of 21 communes, which in 2009 had a share of the area covered with local spatial development plans below 5%, only 5 recorded dynamics of changes of over 10% in the next 10 years, and 5 – changes by more than 5%. The greatest dynamics of changes in this group of communes was observed in the urban-rural commune of Swarzędz (36%) and the rural commune of Duszniki (24%). In turn, the largest changes were also recorded in Swarzędz (35p.p.), Duszniki (15 p.p.), and Granowo (14 p.p.).

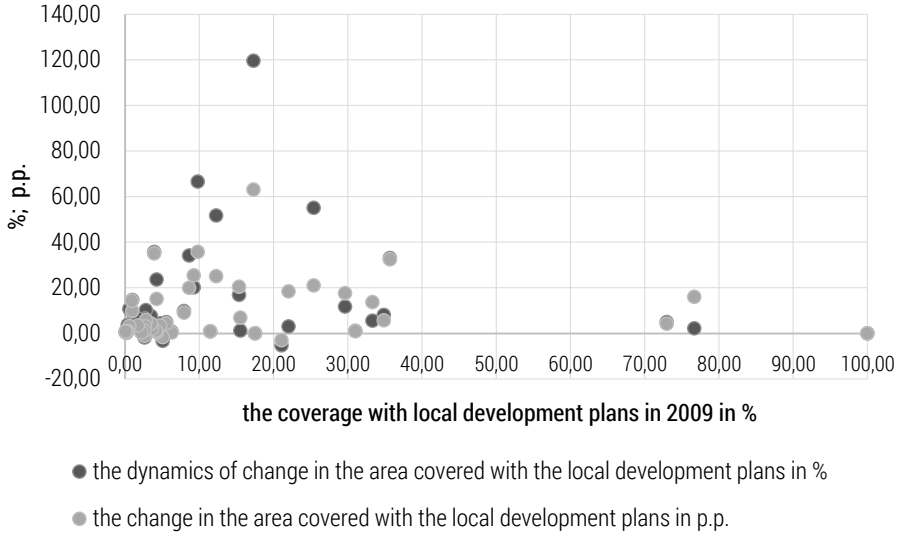

Figure 1. The change and dynamics of change in the area covered with the local development plans in communes in PMA in the years 2009-2018

Source: author's work.

Table 1. Features and indicators connected with local spatial development plans in municipalities of PMA

Community (Type: 1 – urban, 2 – rural, 3 – urban-rural)	No.	A* [ha]	A_{MPZP}		N_{MPZP}		W_{MPZP}	W_{D_MPZP}	P_{A_MPZP}	P_{PA_MPZP}
			[ha]		[pcs]		[%]	[pcs/km^2]	[%]	[p.p.]
			2009	2018	2009	2018	2018	2018	2018 to 2009	2018 to 2009
Gniezno (1)	1	4060.00	1 353	1 909	64	88	47.02	2.17	5.56	13.69
Gniezno (2)	2	17816.00	471	289	38	45	1.62	0.25	-1.82	-1.02
Czerniejewo (3)	3	11194.00	620	1 109	73	240	9.91	2.14	4.89	4.37
Kiszkowo (2)	4	11449.00	252	301	39	49	2.63	0.43	0.49	0.43
Łubowo (2)	5	11354.00	3 523	3 631	83	136	31.98	1.20	1.08	0.95
Granowo (2)	6	6687.00	61	1 015	29	53	15.18	0.79	9.54	14.27
Grodzisk Wlkp. (3)	7	13259.00	549	658	45	52	4.96	0.39	1.09	0.82
Kościan (1)	8	879.00	154	154	42	42	17.52	4.78	0.00	0.00
Kościan (2)	9	20272.00	66	250	11	20	1.23	0.10	1.84	0.91
Czempiń (3)	10	14219.00	4 958	5 763	32	40	40.53	0.28	8.05	5.66
Nowy Tomyśl (3)	11	18645.00	324	970	23	57	5.20	0.31	6.46	3.46
Opalenica (3)	12	14891.00	144	1 608	34	61	10.80	0.41	14.64	9.83
Oborniki (3)	13	34004.00	203	1 277	55	88	3.76	0.26	10.74	3.16
Rogoźno (3)	14	21624.00	579	1 230	58	75	5.69	0.35	6.51	3.01
Luboń(1)	15	1351.00	1 036	1 252	18	41	92.67	3.03	2.16	15.99
Puszczykowo (1)	16	1639.00	361	663	26	36	40.45	2.20	3.02	18.43
Buk (3)	17	9058.00	375	481	21	31	5.31	0.34	1.06	1.17
Czerwonak (2)	18	8248.00	1 267	2 950	42	54	35.77	0.65	16.83	20.40
Dopiewo (2)	19	10802.00	857	1 834	122	179	16.98	1.66	9.77	9.04
Kleszczewo (2)	20	7446.00	7 446	7 476	4	30	100.00	0.40	0.00	0.00
Komorniki (2)	21	6641.00	1 969	3 139	77	134	47.27	2.02	11.70	17.62
Kostrzyn (3)	22	15481.00	669	745	61	75	4.81	0.48	0.76	0.49
Kórnik (3)	23	18612.00	1 824	8 480	218	249	45.56	1.34	66.56	35.76
Mosina (3)	24	17143.00	1 481	4 895	125	115	28.55	0.67	34.14	19.91
Murowana Goślina (3)	25	17223.00	3 632	3 109	35	102	18.05	0.59	-5.23	-3.04
Pobiedziska (3)	26	18958.00	3 280	15 236	89	121	80.37	0.64	119.56	63.07
Rokietnica (2)	27	7930.00	734	2 749	73	123	34.67	1.55	20.15	25.41
Stęszew (3)	28	17502.00	611	1 367	26	51	7.81	0.29	7.56	4.32
Suchy Las (2)	29	11601.00	8 465	8 956	133	166	77.20	1.43	4.91	4.23
Swarzędz (3)	30	10178.00	401	3 970	129	117	39.01	1.15	35.69	35.07
Tarnowo Podgórne (2)	31	10175.00	3 631	6 933	111	244	68.14	2.40	33.02	32.45
Duszniki (2)	32	15630.00	664	3 024	76	109	19.35	0.70	23.60	15.10
Kaźmierz (2)	33	12790.00	605	1 040	35	78	8.13	0.61	4.35	3.40
Szamotuły (3)	34	17552.00	492	1 511	91	95	8.61	0.54	10.19	5.81
Dominowo (2)	35	7936.00	5	65	2	6	0.82	0.08	0.60	0.76

Środa Wielkopolska (3)	36	20716.00	1 300	1 371	71	88	6.62	0.42	0.71	0.34
Zaniemyśl (2)	37	10655.00	276	394	29	40	3.70	0.38	1.18	1.11
Brodnica (2)	38	9583.00	19	44	9	13	0.46	0.14	0.25	0.26
Śrem (3)	39	20587.00	2 527	7 695	74	128	37.38	0.62	51.68	25.10
Skoki (3)	40	19849.00	1 005	678	21	37	3.42	0.19	-3.27	-1.65
Wągrowiec (1)	41	1783.00	277	400	27	36	22.43	2.02	1.23	6.90
Wągrowiec (2)	42	34785.00	126	500	24	41	1.44	0.12	3.74	1.08
Nekla (3)	43	9586.00	1 100	1 186	43	62	12.37	0.65	0.86	0.90
Września (3)	44	22185.00	805	1 263	66	96	5.69	0.43	4.58	2.06
Poznań (1)	45	26191.00	6 656	12 160	111	241	46.43	0.92	55.04	21.01

* symbols as described in the research methodology

Source: author's work based on www.bdl.stat.gov.pl.

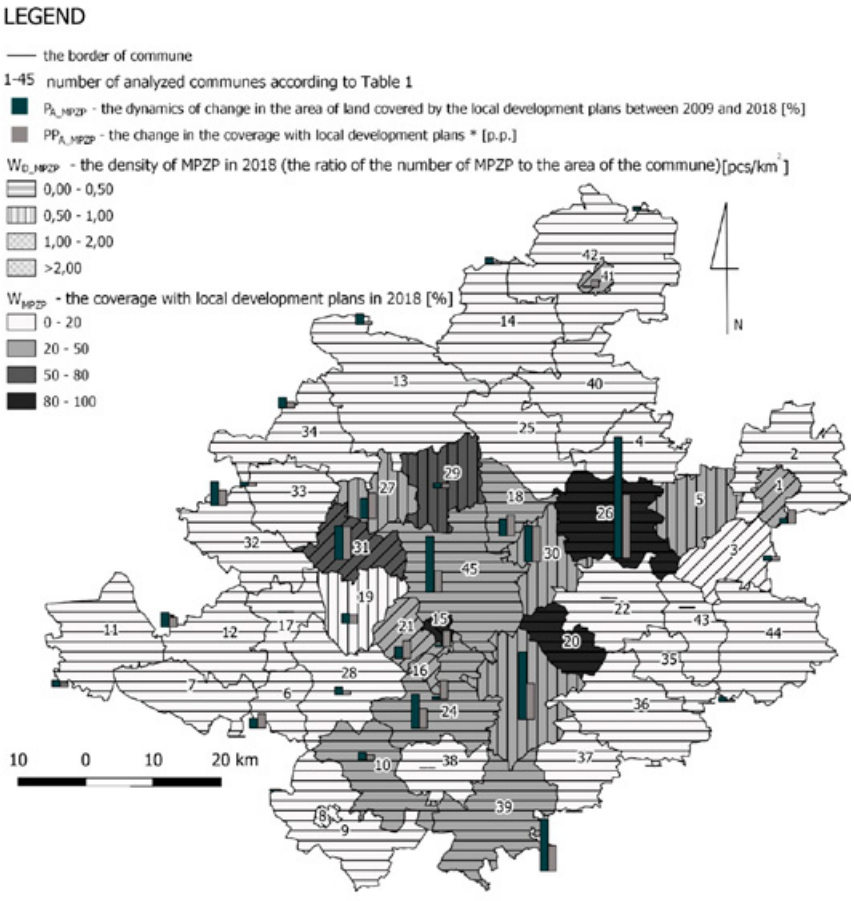

Figure 2. Spatial diversification of the planning process in relation to local spatial development plans in the communes of PMA

Source: author's work.

Analysing indicators concerning decisions on the localisation of public purpose investments (DICP) and on building conditions (DWZ) does not make sense in communes with a maximal coverage of local spatial development plans (Kleszczewo). On the other hand, in municipalities with very high coverage of the local development plan (Luboń, Pobiedziska), only careful conclusions must be drawn.

The lowest number of DWZ was issued in 2009-2018 in the urban commune Puszczykowo, where forests, forest land, wooded, and shrubby land cover approx. 49% of the city area. On the other hand, built-up areas constitute only slightly more than a quarter of the area of Puszczykowo. Overall, 55% of the city's area is covered by the national park, and another 43% is the park's buffer zone. For this reason, the investment activity in Puszczykowo is so limited. As indicated by Podawca et al. (2018), the Wielkopolska National Park is one of the two national parks in Poland located in close proximity to the urban agglomeration.

Within 10 years, almost 1,800 DWZ and ca. 360 DICP were issued on average in each PMA commune. Both Tarnowo Podgórne and Pobiedziska, despite the high share of the area covered by the local spatial development plan, exceeded this average.

The smallest number of decisions on building conditions per km^2 was observed in the Suchy Las commune. On the other hand, the highest values were achieved by urban communes (Kościan, Wągrowiec, Poznań, Luboń Gniezno) or in communes situated in the immediate vicinity of Poznań (urban-rural commune Kórnik, rural communes Rokietnica and Dopiewo). Moreover, the number of decisions on the localisation of public purpose investments per km^2 appears the most in the aforementioned municipalities as well as Rokietnica, Dopiewo, Kórnik, and in the urban-rural commune of Swarzędz (table 2, figure 3).

At the last stage of the work, the division of communes in PMA into groups was proposed. In terms of the degree of MPZP realisation, the following administrative units types were selected:

1) communes with very large MPZP coverage ($W_{MPZP} \geq 80\%$),
2) communes with large MPZP coverage ($50\% \leq W_{MPZP} < 80\%$),
3) communes with medium MPZP coverage ($20\% \leq W_{MPZP} < 50\%$),
4) communes with small MPZP coverage ($W_{MPZP} < 20\%$) (figure 2).

Table 2. Features and indicators connected with decisions on the localisation of public purpose investments (DICP) and on building conditions (DWZ) in municipalities of PMA

Community (Type: 1 – urban, 2 – rural, 3 – urban-rural)	No.	A* [ha]	N_{DICP} [pcs] 2009-2018	N_{DWZ} [pcs] 2009-2018	W_{DICP} pcs/km^2	W_{DWZ} pcs/km^2	$W_{I\text{-}ICP}$ pcs/km^2	$W_{I\text{-}WZ}$ pcs/km^2
Gniezno (1)	1	4060.00	282	1 196	6.95	29.46	1.31	5.56
Gniezno (2)	2	17816.00	295	2 244	1.66	12.60	0.17	1.28
Czerniejewo (3)	3	11194.00	92	449	0.82	4.01	0.09	0.45
Kiszkowo (2)	4	11449.00	66	667	0.58	5.83	0.06	0.60
Łubowo (2)	5	11354.00	92	662	0.81	5.83	0.12	0.86
Granowo (2)	6	6687.00	84	488	1.26	7.30	0.15	0.86
Grodzisk Wlkp. (3)	7	13259.00	441	2194	3.33	16.55	0.35	1.74
Kościan (1)	8	879.00	227	833	25.82	94.77	3.13	11.49
Kościan (2)	9	20272.00	187	1 617	0.92	7.98	0.09	0.81
Czempiń (3)	10	14219.00	131	907	0.92	6.38	0.15	1.07
Nowy Tomyśl (3)	11	18645.00	560	4001	3.00	21.46	0.32	2.26
Opalenica (3)	12	14891.00	156	1046	1.05	7.02	0.12	0.79
Oborniki (3)	13	34004.00	503	3139	1.48	9.23	0.15	0.96
Rogoźno (3)	14	21624.00	134	1202	0.62	5.56	0.07	0.59
Luboń(1)	15	1351.00	90	498	6.66	36.86	9.09	50.30
Puszczykowo (1)	16	1639.00	72	346	4.39	21.11	0.74	3.55
Buk (3)	17	9058.00	233	1169	2.57	12.91	0.27	1.36
Czerwonak (2)	18	8248.00	375	1045	4.55	12.67	0.71	1.97
Dopiewo (2)	19	10802.00	748	3103	6.92	28.73	0.83	3.46
Kleszczewo (2)	20	7446.00	bd.	bd.	bd.	bd.	bd.	bd.
Komorniki (2)	21	6641.00	140	463	2.11	6.97	0.40	1.32
Kostrzyn (3)	22	15481.00	489	1602	3.16	10.35	0.33	1.09
Kórnik (3)	23	18612.00	2234	6080	12.00	32.67	2.20	6.00
Mosina (3)	24	17143.00	484	2255	2.82	13.15	0.40	1.84
Murowana Goślina (3)	25	17223.00	211	1063	1.23	6.17	0.15	0.75
Pobiedziska (3)	26	18958.00	363	1918	1.91	10.12	0.98	5.15
Rokietnica (2)	27	7930.00	492	3008	6.20	37.93	0.95	5.81
Stęszew (3)	28	17502.00	233	1386	1.33	7.92	0.14	0.86
Suchy Las (2)	29	11601.00	173	363	1.49	3.13	0.65	1.37
Swarzędz (3)	30	10178.00	789	2379	7.75	23.37	1.27	3.83
Tarnowo Podgórne (2)	31	10175.00	320	1845	3.14	18.13	0.99	5.69

Duszniki (2)	32	15630.00	184	1878	1.18	12.02	0.15	1.49
Kaźmierz (2)	33	12790.00	90	1164	0.70	9.10	0.08	0.99
Szamotuły (3)	34	17552.00	445	3328	2.54	18.96	0.28	2.07
Dominowo (2)	35	7936.00	71	534	0.89	6.73	0.09	0.68
Środa Wielkopolska (3)	36	20716.00	443	2034	2.14	9.82	0.23	1.05
Zaniemyśl (2)	37	10655.00	124	671	1.16	6.30	0.12	0.65
Brodnica (2)	38	9583.00	65	727	0.68	7.59	0.07	0.76
Śrem (3)	39	20587.00	318	1688	1.54	8.20	0.25	1.31
Skoki (3)	40	19849.00	190	1 460	0.96	7.36	0.10	0.76
Wągrowiec (1)	41	1783.00	161	780	9.03	43.75	1.16	5.64
Wągrowiec (2)	42	34785.00	186	2 061	0.53	5.92	0.05	0.60
Nekla (3)	43	9586.00	123	923	1.28	9.63	0.15	1.10
Września (3)	44	22185.00	466	3 567	2.10	16.08	0.22	1.70
Poznań (1)	45	26191.00	2 530	10 920	9.66	41.69	1.80	7.78

* symbols as described in the research methodology

Source: author's work based on www.bdl.stat.gov.pl.

Regarding the issued location decisions, it is assumed that the degree of the planning process realisation will be determined according to the following division:

A) communes with very high dynamics of DWZ issuing, where the mean of W_{I_ICP} and W_{I_WZ} sum is greater than 3 – type A,
B) communes with high dynamics of DWZ issuing, where the mean of W_{I_ICP} and W_{I_WZ} sum is between 2 and 3 – type B,
C) communes with medium dynamics of DWZ issuing, where the mean of W_{I_ICP} and W_{I_WZ} sum is between 1 and 2 – type C,
D) communes with very low dynamics of DWZ issuing, where the mean of W_{I_ICP} and W_{I_WZ} sum is <1 – type D (figure 3).

On the basis of the isolated groups, 16 types of administrative units showing the diversity of the degree of implementation of the spatial planning process in PMA communes were created. The communes in PMA were classified into 12 types (table 3).

Summing up the commune typology in terms of the level of realisation of the planning process between 2009-2018, it should be concluded that the most numerous type is 4.D. It accounts for almost half of the analysed communes. Together with type 3.D, they constitute 58% of the examined communes.

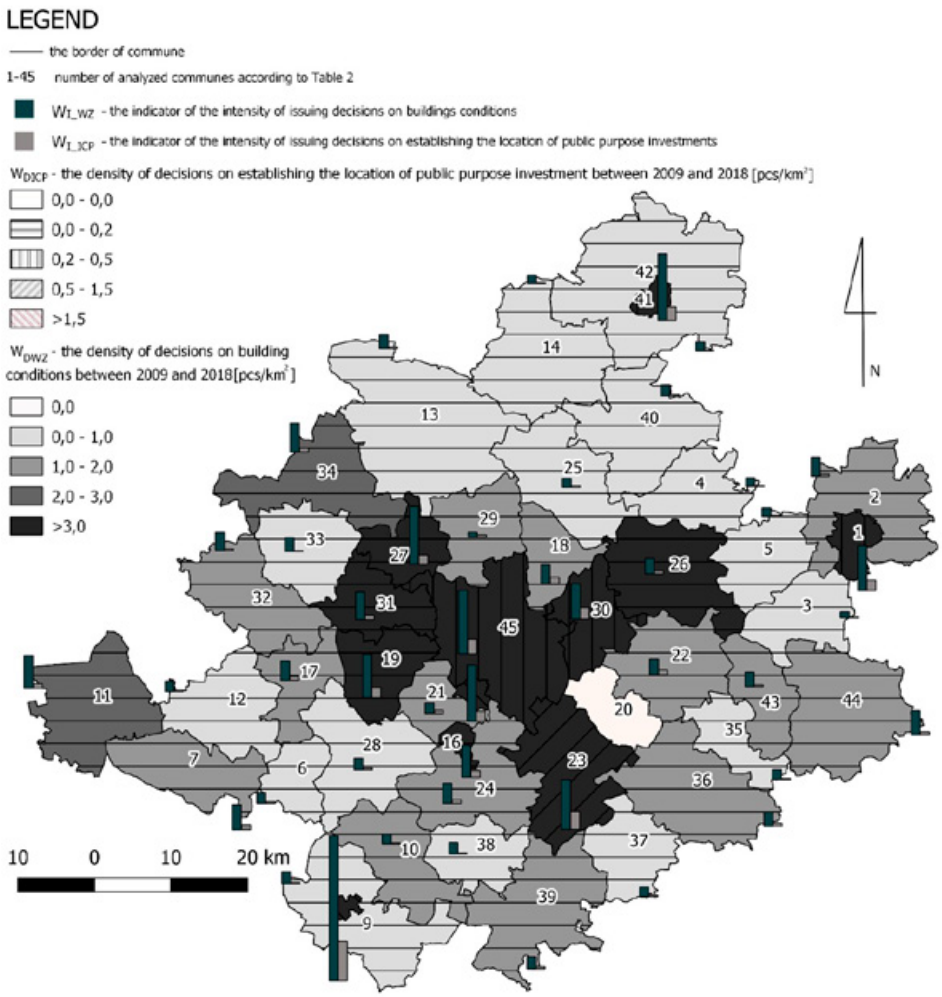

Figure 3. Spatial diversification of the planning process in relation to decisions on the localisation of public purpose investments (DICP) and on building conditions (DWZ) in the communes of PMA

Source: author's work.

These are units where small (even very small) or medium coverage of MPZP and very low dynamics of DWZ issuing can be observed. These are communes where the urbanisation pressure, due to the distance from Poznań, is lower than in the administrative units located near or in the immediate vicinity of Poznań. The highest dynamics of planning processes entailing investment realisation is present in the 1.A and 2.A communes. In these municipalities, in addition to the significant MPZP coverage, there is also a very intensive issuing of location decisions.

Table 3. Types of PMA communes in terms of the degree of implementation of the planning process

		Types of communes in terms of the degree of implementation of location decisions			
		A	B	C	D
Types of communes in terms of coverage of local spatial development plans	1	Pobiedziska, Luboń	-	-	Kleszczewo
	2	Tarnowo Podgórne	-	Suchy Las	-
	3	Rokietnica, Wągrowiec-miasto, Gniezno-miasto, Kórnik, Poznań	Puszczykowo, Swarzędz	Mosina, Czerwonak	Komorniki, Czempiń, Śrem, Łubowo
	4	Kościan-miasto	Dopiewo	Grodzisk Wlkp., Szamotuły, Nowy Tomyśl	Czerniejewo, Rogoźno, Wągrowiec-gmina, Kiszkowo, Dominowo, Zaniemyśl, Brodnica, Skoki, Kościan-gmina, Murowana Goślina, Opalenica, Stęszew, Granowo, Kaźmierz, Oborniki, Nekla, Środa Wlkp., Kostrzyn, Gniezno-gmina, Buk, Duszniki, Września

Source: author's work.

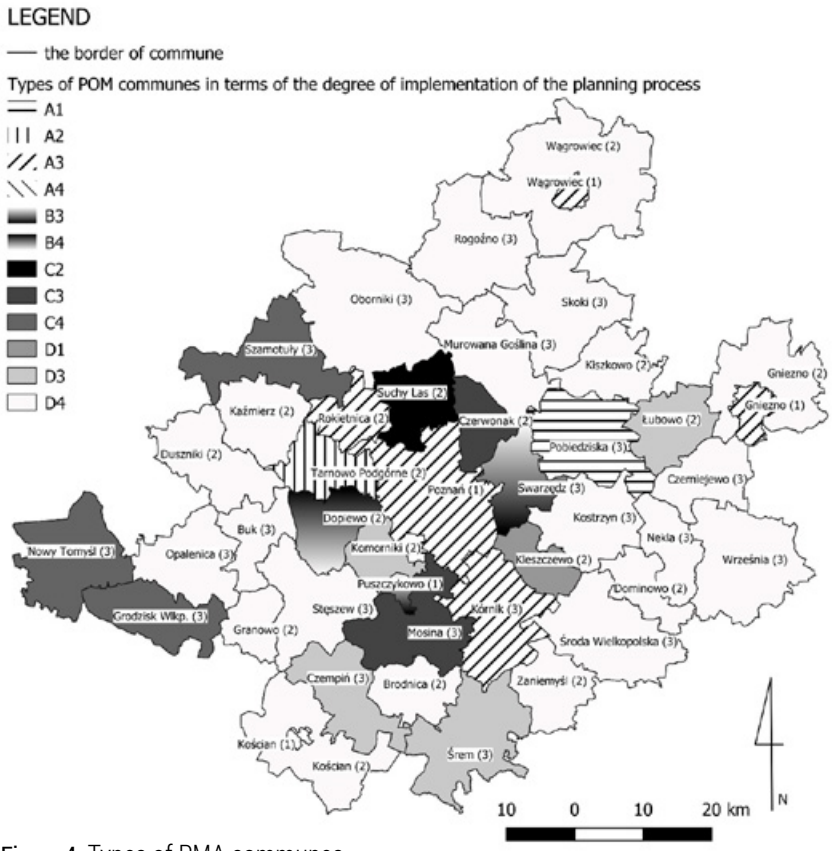

Figure 4. Types of PMA communes

Source: author's work.

Type A communes only include cities and communes in the immediate vicinity of Poznań, i.e., rural commune Tarnowo Podgórne and Rokietnica and urban-rural commune Kórnik (figure 4).

Group 4a is also distinguished. It brings together 3 urban-rural communes, seats of poviats (districts), which were also district towns in the former Poznań Province in the years 1975-1998. The population of these urban-rural communes ranges from 20,1 thousand. (acc. to Statistics Poland in 2019) in Grodzisk Wielkopolski to 30,3 thous. in Szamotuły. The population of the cities themselves (excluding rural areas) ranges only from 14,4 thous. (Nowy Tomyśl) to 18,9 thous. in Szamotuły. The population density of built-up and urbanised areas ranges from 2356 (Nowy Tomyśl) to 2628 pop./km^2 (Grodzisk Wielkopolski), and the total population density ranges from 145 (Nowy Tomyśl) to 172 (Szamotuły) pop./km2. The common feature is also the distance from Poznań (from 39 km – Szamotuły to 65 km – Nowy Tomyśl).

Among the communes belonging to PMA, the rural commune Suchy Las, apart from Kleszczewo, fared best in the assessment carried out in the study (both in the immediate vicinity of Poznań).

Similar studies carried out on the example of Warsaw Functional Area (WOF) gave different results (Podawca and Mrozik, 2019). The authors performed analyses for 39 communes in the WOF, based on statistical data from 2009-2016. They concluded that in WOF the most numerous type 1.D together with type 2.D constitute 30% of examined communes. On the other hand, comparing to Puszczykowo (group B3), the Izabelin commune, located in 90% of the protected areas, was included in group D4. In total, in group D4, the most numerous group in PMA, there are only 3 communes included in the group.

In previous research, the dependence of MPZP coverage on the number of issued decisions on building condition (on the example of communes and municipalities in the Bydgoszcz-Torun Metropolitan Area) was observed (Mrozik and Idczak, 2015). The authors also stated that in the Polish conditions, the dynamic development of rural communes in metropolitan areas is taking place without the use of appropriate (predicted) instruments, i.e., local plans since it is a development based on the issuance of administrative decisions, which due to their characteristics significantly limit the possibility of maintaining the basic principles of spatial planning, i.e. spatial order and sustainable development in the rural commune areas subject to suburbanisation (Mrozik and Noskowiak, 2018; Mrozik and Idczak, 2015).

Conclusions

The analysis conducted on the example of Poznań Metropolitan Area showed the possibility of classifying communes according to the degree of implementation of the planning process.

The analyses performed in this work showed that the distance from the regional capital city and the type of commune determine the degree of implementation of the planning process. The type of commune is significant in the case of urban communes and urban-rural communes, being the seat of poviats (districts). It should be emphasised, however, that the similarity of urban communes results mainly from the degree of implementation of location decisions.

The most numerous group in the proposed classification (almost half of the analysed administrative units) are communes with small coverage of MPZP and very low dynamics of DWZ issuing. These are communes where the urbanisation pressure, due to the distance from Poznań, is lower than in the administrative units located near or in the immediate vicinity of Poznań.

The limited planning coverage is a big challenge for most PMA communes. At the same time, the example of Swarzędz shows that with the high activity of local authorities, it is possible to make up for many years of delays quickly.

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The contribution of the authors

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

Konrad Podawca – 25% (concept of the paper, literature review, data collection, data analysis, drafting the text).

Daria Drożyńska – 25% (concept of the paper, literature review, data interpretation, drafting the text).

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Piotr **BOŁTRYK**

THE REQUIREMENT OF OBTAINING AN ENVIRONMENTAL DECISION IN THE CASE OF AN INVESTMENT CONCERNING A ROAD RECONSTRUCTION – CASE STUDY

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ABSTRACT: The goal of this article is to present the procedure for obtaining an environmental decision using the example of an investment involving the reconstruction of a road. The case study concerned the reconstruction of a public municipal road No. 178044N Prostki – Ostrykół – Lipińskie Małe, Prostki municipality, Ełcki poviat, Warmińsko-Mazurskie voivodeship of the length of 4308.50m against legal regulations of obtaining environmental decisions. Through the interpretation of legal regulations, it was established that the described investment – under certain conditions – does not require obtaining an environmental decision. Based on literature studies, basic concepts and activities pertaining to the procedure of obtaining environmental decisions in Poland were presented. Moreover, the conclusions obtained as part of the research may prove useful to public investors who are obligated to verify their investments in terms of their legal compliance during the planning stage.

KEYWORDS: decision, environment, procedure, evaluation

Introduction

The investment process in Poland consists of several stages. Some of them are obligatory, while others depend on the type of construction goals that were undertaken. The latter is the so-called environmental proceedings, nevertheless, the assessment of whether their investment will have an environmental impact must be carried out by each investor intending to commit to an investment in Poland, to confirm or eliminate the need to conduct an environmental impact assessment for the project under development.

Environmental proceedings are based on predicting potential environmental risks at the investment planning stage, as well as the scale of these risks, and – as a result – counteracting or limiting these threats and minimizing the negative impact of the planned investment. It is an administrative procedure initiated at the investor's request and concluded with the issuance of a decision on environmental conditions for the investment's development.

Investments in the field of road infrastructure undoubtedly affect the environment, both at the construction and operation stages. In most cases, the impact is mostly negative, such as destruction of plant and animal sites, fragmentation of these habitats, landscape fragmentation, changes in hydrological processes, increased noise levels or the need to demolish existing buildings (Karlson, Mörtberg, Balfors, 2014; Broniewicz, Ogrodnik, 2020). Of course, the number and scale of this impact depend directly on the location and the parameters of a given investment.

Due to the enormous socio-economic importance of road investments and their potential impact on virtually all components of the environment (fauna and flora, atmospheric air, acoustic climate, landscape, etc.), environmental proceedings play a unique role in this group of investments.

The main objective of this paper is to present the procedure for obtaining environmental decisions, based on the example of an investment pertaining to road reconstruction. The work consists of a theoretical part, in which literature studies have been conducted primarily in the field of the selected provisions of the Construction Law. In the empirical part, a case study was presented, which concerned an investment pertaining to a reconstruction of a public municipality road No. 178044N Prostki – Ostrykół – Lipińskie Małe, Prostki municipality, Ełcki poviat, Warmińsko-Mazurskie voivodeship with a length of 4,308.50 m. The author of this article participated in court proceedings concerning this investment, in which a dispute arose as to the need to obtain an environmental decision for this type of project. The current authorities of the municipality were of the opinion that an environmental investigation was necessary in this case, whereas the previous administration decided to the contrary. On the other hand, the provisions on obtaining

an environmental decision for road reconstruction are imprecise to the degree that makes it impossible to – after only a cursory reading – support any of the two positions. Hence arose the need for an in-depth analysis of the problem to dispel doubts and avoid similar problems in the future, especially as road investments in municipalities are usually the most frequently undertaken, due to their importance and value for local communities.

Literature review

The main research problem discussed in this paper concerns the investment pertaining to the reconstruction of a municipal road. Therefore, during the first stage, it was necessary to determine whether this type of investment requires a building permit. According to Art. 28 sec. 1 of the Act from May 21, 2019, Construction Law (Journal of Laws from 2019, item 1186 – hereinafter referred to as Construction Law), construction works in Poland can generally commence on the basis of a building permit. It is a principle, from which there are exceptions specified in further provisions of the Construction Law. Exceptions were introduced because, in accordance with the will of the legislator, building permits are required for the most complex projects, whereas those with a lower degree of complexity only need to be reported, or can even be implemented without notifying the architectural and construction authorities (responsible for accepting building permit applications and notifications – Articles 82-82b of the Construction Law).

According to the legal definition, a building permit is an administrative decision allowing for the commencement and conduct of the construction process or the performance of construction works other than the construction of a civil structure. Construction works other than construction include works pertaining to, inter alia, reconstruction, assembly, renovation, or demolition of a building object (Niewiadomski, 2021).

A building permit may be issued after the project's environmental impact assessment has been carried out and the investor has obtained permits, approvals or opinions of authorities required by specific regulations, including decisions on environmental conditions for the implementation of the investment (Strzelczyk, 2019).

That is why, whether the reconstruction of a municipal road requires a construction permit and whether the requirement to obtain an environmental decision is in force, always depends on the procedure of obtaining a construction permit. Considerations should begin with the definition of a municipal road. According to Art. 2 clause 1 point 4 and Art. 1 and Art. 4 sec. 1 point 2 of the Act from March 21, 1985, on public roads (Journal of

Laws from 2013, item 260 – hereinafter referred to as the Public Roads Act), a municipal road is a structure together with road-like engineering structures, equipment and installations, constituting a technical and operational entity, intended for road traffic, located within a road lane, which can be used by anyone, in accordance with its intended purpose, within the limitations and exceptions specified in relevant acts.

However, according to Art. 3 point 7a of the Construction Law, redevelopment is defined as "performance of construction works that result in operational or technical parameters of an existing object being changed, except for characteristic parameters such as cubature, building area, height, length, width or number of storeys. In the case of roads, changes in characteristic parameters are allowed within the scope that does not require changes to the boundaries of the road lane. The reconstruction of a road is also defined as: "performance of work that results in an increase in the technical and operational parameters of the existing road, which do not require changing the boundaries of the road lane" (Article 4 (18) of the Public Roads Act).

Taking into account the above legal definitions, we should therefore state that the reconstruction of roads in Poland (including municipal roads), in accordance with Art. 29 sec. 3 point 1 lit. 2 of the Construction Law, does not require a building permit. However, it requires issuing a notification. The reconstruction of the municipal road No. 178044N Prostki-Ostrykół-Lipińskie Małe in the municipality of Prostki, therefore, belongs to the category of projects that only require notification, as this investment is limited to the reconstruction (not construction) of a road, with the provision that, if the reconstruction included a change in the boundaries of the road lane, it would be necessary to obtain a construction permit.

The term "road lane" is defined in Art. 4 point 1 of the Public Roads Act, and it is described as land separated by borderlines together with the space above and below its surface, on which the following are located: the road and construction facilities and technical equipment related to the management, security and service of traffic, as well as devices designed to meet the requirements of road management. The term "road lane" is therefore much broader than "road". Voivodeship Administrative Court in Krakow, in its judgment from January 7, 2010, file ref. Act I SA / Kr 1666/09 indicated that a road has to constitute a structure, but the road lane is a land on which that structure is located. In addition, the Supreme Administrative Court in a judgment from January 13, 2009, file ref. II GSK 614/08 stated that: "Taking into account the functional role of a road lane – in the context of its scope, both above and below the designated area – it should be stated that these boundaries define facilities and devices used to achieve objectives pertaining to driving, securing and managing traffic, as well as road management. "The boundaries of

the road lane should be clearly delineated with borderlines on the land plan. Therefore, to present the boundaries of a road lane, it is necessary to submit a land plan with clearly marked boundary lines of this land (judgment of the Supreme Administrative Court in Warsaw from June 17, 2008, file reference: II GSK 171/08). It is not sufficient to define the strip of land only with the boundaries of registration plots (Sadkowski, 2017). The road, as a structure, must therefore be built on specific land. The construction of a road requires the acquisition of appropriate land, necessary for its foundation, along with other facilities needed for road traffic. This area is what is defined as a road lane (Morawiec, 2013).

It is undeniable that the undertaking that is subject to this analysis did not interfere with the boundaries of the road lane. This was apparent not only from the master map attached to the design documentation (included in the case files) but also from the lack of objections raised by the County Administrative Office in Ełk (acting as an architectural and construction administration body). The investment was submitted for construction pursuant to Art. 29 sec. 3 point 1 lit. 2 of the Construction Law by the previous municipal authorities and the County Administrative Office did not raise any objections. If the reconstruction reported to the County Administrative Office required a building permit (and thus interfered with the road lane), the County Administrative Office would be obligated to raise an objection to the notification (Article 30 (6) (2) of the Construction Law), which was not done in the analyzed case.

Pursuant to Art. 30 sec. 6 point 2 of the Construction Law, architectural and construction administration authorities are obligated to raise an objection if:

- the application concerns construction or performance of construction works that are required to obtain a building permit,
- the construction or performance of construction works covered by the notification violates the provisions of the local spatial development plan, stands against the decisions on development conditions, or is in breach of other acts of local law or other provisions.

The notification is a *sui generis* application for tacit approval by the authorities of the construction project that is subject to that notification. In this situation, the silence of the authorities, i.e., failure to raise an objection (which takes the form of an administrative decision), entitles the notifying party to commence construction works. The architectural and construction administration body that received the notification is required to assess the project from the point of view of its legal compliance (Niewiadomski, 2021).

Environmental impact assessment in the case of road reconstruction

As indicated above, in the case of the investment pertaining to the reconstruction of the municipal public road No. 178044N Prostki – Ostrykół – Lipińskie Małe, Prostki municipality, Ełcki poviat, Warmińsko-Mazurskie voivodeship with a length of 4,308.50 m, according to Polish architectural and construction administration authorities, no construction permit was required. Moreover, according to the County Administrative Office in Ełk, it did not require obtaining an environmental decision.

According to Art. 30 sec. 2a of the Construction Law, the notification must be accompanied by, inter alia, permits, arrangements, and opinions. The obligation stems from the provisions of separate acts, in particular the decision on environmental conditions.

The responsibility of the County Administrative Office in Ełk was, therefore, to verify the notification in terms of its compliance with the law. If it was found that any of the attachments is missing, it was the obligation of the Office to impose on the investor, by way of a decision, the obligation to supplement the notification with the necessary documents within a specified period (Article 30 (5c) of the Construction Law). Then, in case of a failure to deliver such supplements, the County Administrative Office would be obligated to raise an objection regarding the documentation submitted by the investor (judgment of the Provincial Administrative Court in Bydgoszcz from February 4, 2020, II SA/Bd 1046/19). This was not done, however, which effectively served as an administrative sanction of the fact that the reconstruction of that road (in the scope indicated in the application) does not require an additional procedure that would conclude with an environmental decision. The new authorities of the Prostki municipality did not agree with this interpretation.

Therefore, the key research problem of this article was to verify the correctness of the actions undertaken by the County Administrative Office, within the discussed scope and to answer the question whether reconstructing a road in Poland does not, in fact, require an environmental assessment of the investment.

Generally speaking, in Poland, the assessment of whether a given investment requires environmental proceedings is based on two legal acts:

- the Act from October 3, 2008, on the provision of information on the environment and its protection, public participation in environmental protection and environmental impact assessments (Journal of Laws from 2020, item 283 – hereinafter also u.i.o.ś.),

- Regulation of the Council of Ministers from September 10, 2019, on projects that may have a significant impact on the environment (Journal of Laws of 2019, item 1839 – hereinafter also: Regulation).

Pursuant to Art. 71 sec. 1 u.i.o.ś., the decision on environmental conditions specifies the environmental conditions of the project. The pending proceeding regarding its issuance concerns the planned project and is focused on determining whether the investment – in the scope described by the investor in the application – poses a threat to the environment and whether it meets the requirements and parameters of environmental protection (Tomaszewska, 2018). Moreover, pursuant to Art. 72 sec. 1a, and sec. 3 u.i.o.ś., the decision must be issued prior to the notification of the execution of construction works, and such a decision constitutes a required motion that supplements such a notification.

Obtaining an environmental decision is required only for the projects that (Art. 71 (2) of the Environmental Protection Act):

- typically have a significant impact on the environment,
- may potentially have a significant impact on the environment.

Consequently, it should be determined whether the reconstruction of a municipal road falls into one of the two categories: projects that typically have a significant impact on the environment, and projects that can potentially have a significant impact on the environment. The above-mentioned regulation, which contains a list of projects belonging to both categories, is particularly helpful in that regard.

The Regulation in § 2 sec. 1 indicates a list of projects that typically have a significant impact on the environment, while in § 3 par. 1 it describes investments that potentially have a significant impact on the environment. The fact that both lists are closed sets does not require further comment (Siwkowska, 2018).

According to the author of this study, the following provisions of this law should be subject to analysis:

- § 2 (1) point 31: (construction of) motorways and expressways,
- § 2 clause 1 point 32: (construction of) roads different than those mentioned in point 31, not less than four lanes and of length not less than 10 km in a single section or a route change or the extension of an existing two-lane road to at least four lanes along with a distance no shorter than 10 km in a single section,
- § 2 clause 2: included among projects that typically have a significant impact on the environment are ones involving the extension, reconstruction or assembly of implemented or completed projects listed in:
  - paragraph 1, if this extension, reconstruction or assembly reaches the thresholds specified in sec. 1, provided they have been specified,

  - § 3 clause 1, if this extension, reconstruction or assembly results in reaching the thresholds specified in sec. 1, provided they have been specified,
  - § 3 clause 1 ones not meeting the thresholds referred to in § 3 subpara. 1, provided they have been specified, if the extension, reconstruction or assembly will result in reaching the thresholds specified in par. 1.
- § 3 clause 1 pt. 62: (construction of) paved roads with a total project length exceeding 1 km, other than those mentioned in § 2 par. 1 paragraphs 31 and 32 or bridges along the road with a hard surface, with the exception of the reconstruction of roads or bridges used to service power substations and located outside the areas covered by the various forms of nature protection referred to in article 1. 6 sec. 1 points 1-5, 8 and 9 of the Act from April 16, 2004, on nature protection (Journal of Laws from 2020, item 55 – hereinafter: the Nature Conservation Act).

When analyzing the wording of the above regulations in terms of the investment pertaining to the reconstruction of the public municipal road No. 178044N Prostki – Ostrykół – Lipińskie Małe, Prostki municipality, Ełcki poviat, Warmińsko-Mazurskie voivodeship with a length of 4308.50 m, the following conclusions can be drawn:

- § 2 (1) (31) of the regulation will certainly not apply in this case. The analyzed investment does not pertain to an expressway or a motorway – the subject of the investment is a road which does not meet the requirements of either a motorway or an expressway. A motorway is a road intended exclusively for motor vehicle traffic: equipped with at least two permanently separated one-way carriageways, with multi-level intersections and including all land and water transport routes that cross it, equipped with passenger, vehicle and parcel service facilities intended exclusively for users of that motorway (Article 4 (11) of the Act on public roads). On the other hand, an express road is a road intended exclusively for motor vehicle traffic, equipped with one or two carriageways, with multi-level intersections and including other land and water transport routes that intersect it, with the exceptional admission of single-level intersections with other public roads, equipped with passenger, vehicle and parcel service facilities intended exclusively for users of that expressway; (Article 4 (10) of the Act on Public Roads). What is equally important, the municipality cannot be the manager of motorways or expressways, ergo: it does not perform the function of an investor in this respect (Art. 19 (2) in conjunction with Art. 20 (3) of the Act on Public Roads); therefore, it cannot move for their reconstruction.

- There also exists a lack of premises to apply § 2 para. 1 point 32 of the regulation to the subject of this paper, due to the fact that the planned road section is 4308.50m in length, so it is shorter than the minimum indicated in the provision, i.e. 10 km (10,000 m). The provision will also apply only to roads with at least four lanes, while road no. 178044N Prostki – Ostrykół – Lipińskie Małe, according to its design documentation, is only a two-lane road.
- It is the opinion of the author that there are also no grounds to apply the disposition of § 2 sec. 2 of the regulation, although the interpretation is not as obvious as in previous cases. The regulation mentions reconstruction, which is relevant to the case of this investment. However, a reference is also made here to the thresholds measured in kilometers and indicated in the regulations discussed above. Therefore, if the municipal road was to be subject to a single rebuild (in accordance with the design documentation) over a section longer than 10 km, then it would be necessary to obtain an environmental decision.

By applying the principle of elimination, it should be concluded that the most likely application is the disposition of § 3 para. 1 point 62 of the regulation. The circumstances indicated in the discussed paragraph will be applicable in the case of an investment pertaining to the reconstruction of a municipal road in a section shorter than 10 km, and thus:

- Municipal road No. 178044N Prostki – Ostrykół – Lipińskie Małe is made of a hard (asphalt) surface. Its reconstruction was designed in such a way that the new surface would also be a bituminous one. The concept of a road with a hard surface should be understood as a road made of hard materials and one that uses relevant technology which impacts the hardening of the road. Therefore, it will not be only understood as a road whose types of surfaces are listed in Art. 2 point 2 of the Road Traffic Law (bituminous, concrete, paver blocks, clinker or paving stone, and concrete or stone-concrete slabs). A different assessment of this issue would lead to the possibility of easily circumventing the requirement to obtain an environmental conditions decision for projects including the construction of a hard surface road, since the types of road surface other than those listed in the Road Traffic Act would exclude such a requirement (judgment of the Provincial Administrative Court in Kraków of August 7, 2017 II SA / Kr 608/17).
- The total length of the reconstructed road is 4,308.50m. Thus, the condition of the project's length being more than 1 km (1000 m) was also met.

Therefore, it should be considered whether, in such a case, an investment pertaining to the reconstruction of the public municipal road No. 178044N Prostki – Ostrykół – Lipińskie Małe, Prostki municipality, Ełcki poviat, Warmińsko-Mazurskie voivodeship of the length of 4308.50m actually meets the requirement of § 3 par. 1 point 62 of the said regulation. If that is the case, then it is a project that has a potentially significant impact on the environment, i.e., it is necessary to obtain an environmental decision and possibly to conduct a full environmental impact assessment. Assuming that the above thesis is true, it should also be stated that the ruling of the architectural and construction administration authority (County Administrative Office in Ełk), which sanctioned the above investment without the requirement to submit an environmental decision was incorrect.

In the opinion of the author of this article, however, the action of the County Administrative Office in Ełk was correct, with certain reservations that should be made as part of this study.

The provisions of § 3 sec. 1 point 62 of the regulation exclude the need to obtain an environmental decision in the case of road reconstruction (or bridge structures) used for servicing power substations and located outside of areas covered by forms of nature protection, referred to in Art. 6 sec. 1 points 1-5, 8 and 9 of the Nature Conservation Act, i.e., national parks, nature reserves, landscape parks, protected landscape areas, Natura 2000 areas, ecological sites, and nature and landscape complexes.

The difficulty in interpreting the above provision is rooted in need to determine whether the two cases should be interpreted jointly or separately. The understanding of the above provision is at least ambiguous, i.e.

- investments pertaining to the reconstruction of roads are exempt from the obligation to obtain an environmental decision, provided that the following conditions are jointly met:
  - they are used to service power substations, and
  - are located outside of areas covered by the forms of nature protection referred to in the Nature Conservation Act,
- investments pertaining to the reconstruction of roads are exempt from the obligation to obtain an environmental decision, provided that one of the two conditions is met:
  - they are used to service a power substation,
  - they are located outside of areas covered by the forms of nature protection referred to in the Nature Conservation Act.

Selecting the appropriate interpretation of the wording of the above provision is not an easy task, especially since there are no publications on this subject. The judicial practice also failed to develop a position on the discussed

matter. However, in the opinion of the author of this article, one should support the second of the presented positions, due to the arguments given below.

The presented position is supported primarily by the logical and purpose-based interpretation of the provision in question. It should not be forgotten that the investment analyzed in the article pertains only to the reconstruction of a road, not its construction. The very construction of the road No. 178044N Prostki – Ostrykół – Lipińskie Małe had to be preceded by obtaining an environmental decision. The planned reconstruction does not extend beyond the existing road lane. Therefore, there is no change in the scope of the investment's impact, which would require its reverification in terms of environmental solutions, subject to the reconstruction carried out in the areas covered by the forms of nature protection referred to in the regulation.

The separate nature of both conditions may also be demonstrated by the application of a systemic and functional interpretation of the wording of the regulation. If it were to be said otherwise, this provision would most likely not apply. It is difficult to find an investment which would meet both conditions jointly, pursuant to the provisions of the Nature Conservation Act, which:

- prohibit the construction or reconstruction of buildings and technical devices in national parks and nature reserves, except for facilities and devices serving the purposes of the national park or nature reserve – Art. 15 sec. 1 of the Nature Conservation Act,
- generally, prohibit the implementation of projects in areas of a landscape park and in areas of the protected landscape that may significantly affect the environment – Art. 17 sec. 1 of the Nature Conservation Act,
- prohibit the performance of earthworks that permanently deform the topography in the areas of nature and landscape complexes and ecological areas, – Art. 45 sec. 1 of the Nature Conservation Act.

The above regulations effectively prohibit locating buildings, such as power substations, in areas of natural value. There is also no functional connection between the operation of a power substation and the areas covered by forms of nature protection. At the same time, it is logical that the reconstruction of a road located within the area of, e.g., a national park, requires an environmental procedure due to the principle of inviolability of naturally valuable areas.

Moreover, the combination of both exclusions with the conjunctive functor (conjunction) "and" does not mean that they should be understood as only applied jointly. According to the principles of legal logic: "conjunction is true only if both sentences joined by a conjunction (called factors) are true. (...) This means that, for the purposes of analyzing the logical properties of a statement which is a complex sentence, in which the 'and' functor appears,

it is not important whether there is any content relationship between the sentences joined by this functor. The sentence 'On September 11, 2001, there was a terrorist attack in New York, and Stanisław August Poniatowski abdicated in Petersburg' is logically true, because both sentences joined by a conjunction functor are true '(Lewandowski et al., 2010, pp. 98-99). The Supreme Court also commented on the "and" function in the provision on "weapons and ammunition" – the judgment of the Supreme Court of March 2, 2015, file ref. act IV KK 382/14.

The truthfulness of the thesis pertaining to the "and" conjunction used in the regulation is also supported by the conclusions from the legal inference by analogy with respect to other provisions of the legal act in question, where "and" was also used within the scope of the following exclusions:

- Art. 3 sec. 1 point 6: (construction of) installations using wind energy to generate electricity, located in areas covered by forms of nature protection, (...) with the exception of installations intended exclusively for powering road and railway signs,
- Art. 3 sec. 1 point 31: (construction of) gas transmission installations other than those mentioned in § 2 sec. 1 point 20 and the accompanying compressor stations or pressure reduction stations, with the exception of gas pipelines with a pressure of not more than 0.5 MPa and connections to buildings.

It seems that, when analyzing the above provisions, there is no doubt that the use of the conjunction "and" means that we do not deal with two conditions that must be met jointly to apply for a given exemption. It is difficult to imagine that only the following can take advantage of the exemption from the obligation to obtain an environmental decision:

- wind installations that simultaneously supply power to both road and rail signs,
- gas connection to a building, which also serves as a gas pipeline – which in itself is an absurd statement, in particular, that both terms have separate legal definitions contained in § 2 point 6 and § 2 point 24 of the Regulation of the Minister of Economy from April 26, 2013, on the technical requirements to be met by gas networks and their locations (Journal of Laws from 2013, item 640). In accordance with the above-mentioned regulations, a gas pipeline is used to transport gas, and a connection is used for connecting the gas installation to the gas valve.

Bearing in mind the wording of the above arguments, it is necessary to confirm the thesis that it is not necessary to obtain an environmental decision for the investment pertaining to the reconstruction of the public municipal road No. 178044N Prostki – Ostrykół – Lipińskie Małe, Prostki municipality, Ełcki poviat, Warmińsko-Mazurskie voivodeship of a length of 4,308.50

m, unless it is located within areas covered by the forms of nature protection referred to in Art. 6 sec. 1 items 1-5, 8 and 9 of the Nature Conservation Act (§ 3 section 1 item 62 of the Regulation of the Council of Ministers from September 10, 2019, on projects that may significantly affect the environment (Journal of Laws from 2019, item 1839).

Conclusions

Environmental proceedings are an important element of the investment process in Poland, especially in the case of road investments, due to their socio-economic importance and the scale of their impact. Environmental proceedings are a complex procedure that requires many regulations to be correctly interpreted. In general, the assessment of whether a given investment requires environmental proceedings is based in Poland on two legal acts: the Act from October 3, 2008, on the provision of information on the environment and its protection, public participation in environmental protection and environmental impact assessments (Journal U. from 2020, item 283) and the regulation of the Council of Ministers from September 10, 2019, on projects that may significantly affect the environment (Journal of Laws from 2019, item 1839). The appropriate classification of the project, in accordance with the provisions of the above-mentioned regulations, is of crucial importance.

In the case of an investment selected for this case study, the ruling of the previous authorities of the Prostki municipality shall be deemed correct. This position is also supported by the actions of the architectural and construction administration body (County Administrative Office in Ełk), which did not raise any objections. However, no decision on the environmental conditions for the project was attached to the construction application. The verification of the authority's activities additionally led to the conclusion that the proceedings in this regard, despite the correctness of the decision, were incomplete. There was no unequivocal determination whether the proposed road reconstruction was located in protected areas. Such circumstances could, however, be easily verified by asking the Regional Director for Environmental Protection for information in this regard. According to the author of the article, such an obligation rested with the architectural and construction administration body. Obligating the investor to submit such information would go beyond the scope of Art. 30 sec. 2a of the Construction Law.

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COSTS AND ECONOMIC BENEFITS OF RECYCLING ELECTRICAL INSULATORS IN SPECIAL CONCRETES PRODUCTION

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ABSTRACT: The article is a continuation of the research work undertaken to indicate the economically and ecologically justified recycling of ceramic waste material from used electrical insulators. During the renovation works of old electric lines, relatively large amounts of insulators are obtained, the disposal of which is now quite a costly undertaking. Based on previous experiences (Zegardło, Ogrodnik, Woliński, 2016; Zegardło et al., 2018), the authors of this article indicate the potential possibility of using the used insulators in the production of aggregates for special concretes. Such aggregates meet all parameters and requirements, and the concretes obtained from them have parameters higher than those obtained from traditional aggregates. Based on the analysis of data taken from the archives of the company dealing with electrical and repair works, the areas from which insulators are obtained were presented. The scale of the said project on a national scale was discussed. The aim of the study is to estimate the costs and economic benefits related to the disposal of insulators and their reuse as aggregates for special concretes. Despite the calculations that show that such a project would not be associated with significant financial profits, the authors indicate other benefits that would flow from this type of management of the mentioned waste.

KEYWORDS: electrical insulators, recycling, special concretes

Introduction

The guidelines of environmental protection authorities require that all new products manufactured should be provided with effective recycling methods. The best way to recycle products is to use them in primary production – as is the case, for example, with steel products. However, there are many industries in which these products cannot be reused for the production of new products. Ceramic products are an example of such an industry. Due to the specificity of the production of fired clays, processes occur during their production that cannot be reversed. Such a production system means that the used products cannot be reused for the production of new products. One of the ceramic products covered by the described procedure is electrical insulators. Despite the fact that these products are very durable while modernizing electric lines, relatively large amounts of this matter are produced. For this reason, new and innovative solutions for their recycling are sought. In this article, referring to previous research works, the authors present the possibility of using used insulators for the production of aggregates for concrete. The work describes this issue in economic terms. The article presents an analysis of the costs and economic benefits that would be associated with the disposal of insulators by using them as aggregates for concrete. Despite the fact that the conclusions confirm that such activity would not be associated with large financial profits, other benefits of this type of solutions were presented.

Motivation and purpose of the analysis

Various mineralogical compositions, aggregate states and colours of clays from which ceramic products are made (Awgustinik, 1980; Haase, 1961) give a wide possibility of their classification. The basic division of clays (Zegardło et al., 2018; Węgrowski, Przeździecka, 1979) in terms of their use for the production of products is the division into common clays (brown to yellow in colour, widely used in the production of construction products such as bricks, wall and ceiling blocks, chimney fittings, roof tiles) and precious clays (white in colour, for the production of porcelain or similar porcelain products, of which, inter alia, ceramic electrical insulators). The production process of these products consists of several stages, as a result of which the ceramic material receives its unusual features. The first stage of production is the preparation of ground components from which insulators are formed. The next stage is the drying stage, in which the elements are subjected to a temperature of about 45 °C, thanks to which the ingredients become solid, and the product receives its final shape. This process is followed by glazing, i.e.,

covering the elements with a thin layer of glaze. The final process that decides about posting products of the final characteristics is a firing stage, carried out at a temperature of approx. 1280 °C, during which the final processes of formation of ceramic bonds occur. Thanks to them, the ceramic material has high strength parameters, up to 400 MPa, compressive strength, and is resistant to high temperatures. Ceramic electrical insulators are elements used in the power industry to support and insulate conductive elements (Maksymiuk, 1997; PN-IEC 60050-151:2003). Despite the fact that in the production technology of electrical insulators, there are modern materials (Zegardło et al., 2016). such as resin composites or silicone rubbers, which also meet the requirements, the largest percentage of insulators is still produced, and the largest amount of waste electrical insulators associated with it is made of ceramic. The entities undertake activities aimed, for energy and ecological reasons, to fully manage all waste, including ceramic waste. Here, in addition to simple, non-structural applications, such as land levelling, the aim is to ensure that the waste substances can also be implemented on the wider market of load-bearing materials. However, this issue is quite complex, and many areas of this type of possibility have not yet been explored. Preliminary results show that concretes produced with ceramic waste products can be used, for example, in communication construction (Ogrodnik, Zegardło, 2015; Zegardło et al., 2016) for the production of asphalt concretes for use in road binding layers and wearing courses. Another type of use of waste electrical insulators is presented in (Zegardło et al., 2016), where the conducted tests proved that the aggregate obtained from ceramic electrical insulators is a suitable aggregate for cement concrete, and the concretes made with its use exceed the strength characteristics of concretes prepared using traditional aggregates. The results of these studies are presented in table 1.

Table 1. Average values of the examined properties of the compared concrete

Feature	Unit	Concrete on aggregate from electrical insulators	Concrete on basalt aggregate	Concrete on traditional gravel aggregate
Tensile strength	MPa	7.20	6.70	4.30
Compressive strength	MPa	86.40	76.50	49.90

Source: author's work based on research results.

The results of endurance tests carried out according to (Jamrozy, 2016; Neville, 2012) showed a clear improvement in the properties of the obtained concrete after replacing the traditional aggregate with ceramic aggregate obtained from crushing waste ceramic insulators. Despite obtaining excellent parameters for the recipe concrete containing basalt aggregate in its

composition (compressive strength 76.50 MPa, tensile strength 6.7 MPa), the results for the recycling aggregate were 12% for compressive strength and 7% for tensile strength, respectively higher (compressive strength 86.40 MPa, tensile strength 7.2 MPa). Similar results of research studies in which concrete was used for the production of ceramic aggregates were presented in the works (German construction standard 1951-DIN 4163; De Brito and et al., 2005; Senthamarai et al., 2011; Halicka, Ogrodnik, Zegardło, 2013; Lopez et al., 2007; Guerra et al., 2009). The results of these tests confirmed that the higher the addition of ceramic materials, the better the parameters of the concretes obtained with them. In the summary of the above-mentioned articles, the authors emphasize that the use of recycling aggregates from ceramic insulators for concrete may have a double effect. Concrete producers can obtain cheap aggregate from waste difficult to utilize, thanks to which such disposal will be economically justified. On the other hand, such action may bring about an ecological effect, the residual waste will be disposed of, and the extraction of natural aggregate resources will decrease.

Estimating the costs and economic benefits of recycled waste

Cost-benefit analysis is a complex method of assessing the effectiveness of investments and projects, taking into account all expected benefits and costs, including qualitative and quantitative elements, allowing to determine the degree of effectiveness of a given investment in the environment (Becla, Czaja, Zielińska, 2012). Apart from the economic aspects of the project, the cost-benefit analysis also takes into account social, cultural, and environmental areas, classified as external costs (Boardman et al., 2006). Cost-benefit analysis is particularly useful in assessing projects whose implementation involves a significant number of stakeholders, and where the main selection criterion is not profit maximization. The theoretical basis of the above analysis is welfare economics (Szot-Gabryś, 2013). The article estimates the costs and potential economic benefits of recycling electrical insulators; a detailed analysis is part of a separate study.

The solution proposed in this article for the utilization of the said waste was to transfer it to companies dealing in commercial production of concrete. The assumption was that this aggregate is provided free of charge – which was a profit for electric companies that would not pay for waste disposal. It was assumed that concrete companies equipped with crushers would be able to crush the waste and use it for concrete as a substitute for traditional aggregates. The table below presents the costs of transport, aggregate crushing, standardization, and other additional expenses that would have to be incurred by entrepreneurs producing concrete based on waste aggregate.

Table 2. Analysis of the prices of recycling aggregates

Aggregate type / Feature	Unit	Traditional aggregate (sand, gravel)	Concrete destruct of low class concretes	Concrete destruct of high class concretes	Basalt grit	Aggregate from recycled ceramics	
						Traditional red ceramics	Fine ceramics – insulators
Character in the deposit	–	aggregate directly for use	large-size elements	large-size elements	the aggregate produced directly for use	medium-sized elements	medium-sized elements
Price in the deposit (gross at the seller)	PLN/ton	36.9	18.45	30.75	61	18.45	0
Estimated transport distance	km	50	50	80	300	80	50
Price of transport	PLN/ ton	12	12	19.2	72	19.2	12
Need to adapt to commodity production	yes/no	no	yes	yes	no	yes	yes
Type of customization	–	–	cleaning and crushing	crushing	–	cleaning and crushing	cleaning and crushing
Estimated cost of adaptation	PLN/ton	–	21.07	14.76	–	21.07	34.15
Total cost in the concrete plant	PLN/ton	48.9	51.52	64.71	133	58.72	46.15
Special requirements in the production of concrete mix	type	–	increasing the amount of cement	increasing the amount of cement	–	increasing the amount of cement	increasing the amount of cement
The cost of the outlay on a scale of 1 ton of aggregate	PLN/ton	–	12.3	12.3	–	12.3	12.3
Total cost including additional expenditure	PLN/ton	48.9	63.82	77.01	133	71.02	58.45

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

The presented average costs related to 1 ton of waste were obtained from entrepreneurs providing these services. The additional cost of increasing the amount of cement during the production of concrete with recycled aggregates resulted from the fact confirmed by tests (Halicka, Ogrodnik and Zegardło, 2013). The analysis of the prices of recycling aggregates, taking into account the cost of purchase, transport, standardization, and additional expenditure compared to the prices of traditional aggregates is presented in table 2.

When analyzing the data included in the list, it is noted that the most economically justified in the production of traditional concretes is the use of sand and gravel aggregates. These aggregates have the lowest price, i.e., about PLN 49/ton (total cost in the concrete factory) and the broadest range of applications. The presented prices of insulating ceramic aggregates, despite relatively high rates, may be an interesting object for entrepreneurs. Their main advantage is that they can be used to produce concrete of higher classes and concretes with special properties such as resistance to high temperatures or abrasion resistance. For this type of application, commodity concrete plants currently buy aggregates in the form of basalt grits, the price of which, after being transported to the concrete plant, is higher and amounts to approximately PLN 133/ton. The limitations of the use of traditional sand and gravel aggregates, in this case, are significant, as the maximum concrete classes that can be obtained with their use reach about 40-50 MPa. These aggregates also do not work well at high temperatures and high abrasive loads, where electrical insulators can be used in these applications. The final price of electrical insulators crushed to the aggregate form is also more favourable than other recycled aggregates. It should be noted, however, that the tests proved that its parameters are better than those tested for aggregates made of red ceramics or recycled concrete.

Conclusions

As can be seen from the considerations presented above, the market of recycling aggregates from electrical insulators can be economically justified, but not in the case of large-scale production of traditional concretes. These aggregates require additional logistics both in their acquisition, adaptation and in the production process itself (crushing), which discourages entrepreneurs from using them. The use of insulators for the production of special concretes would be economically justified – however, such activities are carried out on a small scale; therefore, it is claimed that such activities would not be associated with significant financial profits. However, for the sake of the

good of the environment and the desire to effectively manage unwanted waste or reduce the amount of natural aggregate extraction, it is more and more often claimed that even non-economic measures should be used here. The only possibility is seen in the apparatus of state authorities. The forced, non-economic use of waste in construction in Poland is already taking place, although – so far only theoretical. This is possible thanks to the compact system of environmental law and the increasing activity of the Ministry of Environment, provincial and local environmental protection departments and building supervision departments. Building permit decisions may require the use of local waste material and enforce this condition with the full force of law – this solution, however, is not used on a larger scale. Along with the disappearance of sources of natural aggregates and their depletion of resources, their prices are expected to increase over the years. An alternative solution will be the desire to use aggregates from unconventional – recycling sources. Taking into account the fact that a large amount of natural resources and energy are consumed, which is used to produce electrical insulators, it can be concluded that the potential of this waste is currently unused. In this situation, the proposed solution is to search for more advanced recycling methods than the use of aggregates for hardening areas. Research should be carried out to use the specific features of insulators, such as their high strength or presumed resistance to high temperatures or chemically aggressive environments. The possibility of producing, for example, special concrete, e.g. heat-resistant, from this material, would make the waste a valuable substrate in production. The use of recycled electrical insulators as a substitute for the sophisticated and expensive special aggregates currently used would make them a sought-after material and perhaps there would be no need to pay for their disposal. For this purpose, it is necessary to intensify the research work that will prepare the necessary state of knowledge for recycling aggregates, including those from ceramic electrical insulators, to be implemented without restrictions in the production of concrete.

The contribution of the authors

Daniel Tokarski – 50% (conception, analysis, and interpretation of data).
Bartosz Zegardło – 50% (literature review, acquisition of data).

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GENERAL ENVIRONMENTAL AND SOCIAL PROBLEMS

PROBLEMATYKA OGÓLNOEKOLOGICZNA I SPOŁECZNA

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SOCIAL ATTITUDES TOWARDS PLANNED LIGNITE MINING – THE CASE OF SOUTH-WESTERN WIELKOPOLSKA REGION

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ABSTRACT: Lignite is a raw material considered a strategic fuel in the Polish energy sector. One of the prognostic lignite deposits is located in the south-western Wielkopolska (Krobia, Miejska Górka and Poniec communes). However, the perspective of exploitation causes concern to the local community. In this context, the paper aimed to identify the attitudes towards lignite mining in this area. In the research procedure aimed at statistical verification of factors differentiating these attitudes, a survey was conducted. The results of the study showed that the inhabitants of the analysed communes had indecisive attitudes, yet with a very clear tendency towards negative assessments of the subject issue. Farmers and rural residents were the most sceptical, while entrepreneurs, town dwellers and young people had the most conciliatory attitudes. Moreover, it has been proved that professional status, place of residence (town-village) and age can be considered as factors affecting these attitudes.

KEYWORDS: social attitudes, lignite, deposit exploitation, Wielkopolska

Introduction

Lignite opencast mining is an example of an investment that significantly interferes with the environment, transforming the landscape and changing the structure of the local economy. Poland, acquiring lignite in Konin, Turoszowskie and Bełchatów coalfields, is one of the world leaders in the exploitation of this raw material (following Germany, China, USA, Russia, Australia, Greece and Turkey). One of the prospective deposits, which, due to its parameters, boasts balance characteristics, is located in the south-western part of Wielkopolska region, in the communes of Krobia, Poniec and Miejska Górka. Due to the favourable environmental and economic conditions, as much as 85% of their area is used for agriculture. Therefore, the deposit is characterised by a high level of potential exploitation conflict in relation to the environment and a lack of social acceptance (Kasiński, Mazurek, and Piwocki, 2006). Despite this fact, these areas were classified as prognostic lignite deposits. In the analysed communes, lignite resources are estimated at approx. one billion tons. Therefore, it is potentially one of the richest lignite deposits in Poland (Wielkopolskie Biuro Planowania Przestrzennego, 2015).

The aim of this article is to identify the attitudes of the local communities of the three analysed communes towards lignite mining. The research material was obtained through a survey of the inhabitants of Krobia, Miejska Górka and Poniec communes. The research was conducted at the turn of 2018 and 2019. The obtained data were subjected to statistical analysis, which included, on the one hand, the proprietary method of quantifying respondents' attitudes based on synthetic indicators, and, on the other hand, a one-way analysis of variance to verify the factors influencing the identified attitudes.

The article begins with a review of the existing body of literature concerning the attitudes of residents towards investments negatively affecting the environment and living conditions, with particular emphasis on mining activities in rural areas. The empirical part encompasses the description of the spatial scope of the research, survey construction, and the sample. The description of the research results includes an analysis of the factors shaping the attitudes of the local community towards lignite mining.

Literature review

The issues of shaping and changing the attitudes of the local community in rural areas and the ones related to lignite mining may be analysed in various dimensions. In the Polish and international literature on the subject,

changes in rural areas related to mining activities, or more broadly industrial activities, are described, among others by Walkiewicz (2013). He emphasises the landscape aspects, forms of land use and development, impact on the natural environment or the structure of the local economy (see also Jawecki and Jawecka, 2011). In the international literature, the health impact of the mining industry is often raised (Hendryx, 2009; Hendryx et al., 2012; Boyles et al., 2017; Ishitiaq et al., 2018; Werner et al., 2018; von der Goltz and Barnwal, 2019) as well as the landscape changes (Hendrychova and Kabrna, 2016; Popelkova and Mulkova, 2018; Fagiewicz and Łowicki, 2019) and environmental pressure (Caballero Espejo et al., 2018; Nendel et al., 2018; Čech and Krokusová, 2017). Some researchers focus on the issues of further use and management of degraded areas (Sawicki and Łyszczarz, 2009; Kwiatkowska-Malina and Wyszomierska, 2014; Mańkowski et al., 2013; Rachwał et al., 2009). Research on the attitudes of rural residents is not so extensive. Perepeczko (2012) draws attention to the lack of broader research on the attitudes of residents concerning the natural environment, pointing to studies focused on partial and exiguous publications. An interesting study was presented by Bader (2010), identifying approximately 40 examples of socio-environmental conflicts related to the development of domestic mineral deposits in the period of 2004-2009. He also indicated that the key motivators for the attitudes of the local community are the fear of losing the possibility of satisfying needs with the use of specific elements of the environment, as well as the fear of deteriorating quality of life. Other researchers (e.g., Majewski, Fiszka Borzyszkowska and Florek (2018) or Kwiatkowska-Malina and Wyszomierska (2014)), focus on the ecological and economic dimension of social and environmental conflicts, which affect the shape of development policy created by the local authorities, as well as on the attitudes of the local community and people visiting the municipality, e.g. for tourist purposes. Nieć and Radwanek-Bąk (2009) argue that strong opposition from the local government authorities, local nature conservation activists or local lobbying, not always reasonably justified, may constitute a significant obstacle to the investment process.

The main issues related to mining that cause concerns of the local community in the areas previously used for agricultural purposes include: transformation of the landscape and topography, change of lithological, hydrological and soil conditions, which may limit the values of biodiversity and geodiversity (Sawicki and Łyszczarz, 2009; Sobczyk, Kowalska and Sobczyk, 2014; Uberman, Pietrzyk-Sokulska and Kulczycka, 2014; Majewski, Fiszka Borzyszkowska and Florek, 2018; Kucharska, 2018; Przybyszewski and Kruszyńska, 2019; Schackelton, 2020; Ofosu et al., 2020).

Temporary nuisances related to the emission of noise, vibrations, dust or road destruction or the occurrence of threats in the form of tremors, sinkholes, landslides are also addressed (Badera, 2010; Sobczyk, 2007; Jawecki and Jawecka, 2011). At the same time, activity in this area constitutes a significant source of the commune's income and the income of individual residents (lease or sale of land), it may influence the creation of jobs in emerging enterprises or modify the commune's economic profile. Moreover, it is worth mentioning that the effects of possible or existing exploitation of raw materials, not necessarily within rural areas, were the subject of analyses as early as in the 1980s when Kozłowski (1989) classified the deposits in terms of the negative effects of their exploitation. He divided the deposits into three classes: A – low-conflict deposits – can be mined without major problems, located outside the protected areas, away from residential estates, B – conflict deposits – can be mined after meeting specific environmental protection requirements, C – highly conflicting – impossible to exploit due to environmental hazards or the land use of the deposit itself or its surroundings. Currently, in addition to the protection of mineral resources, the environment, economic priorities and goals, and spatial development regulations, the social factor gained attention for determining the current or future exploitation of minerals (Nieć and Radwanek-Bąk, 2014; Sikorska-Maykowska, Walentek and Andrzejewska-Kubrak, 2017).

Resolving conflicts regarding the use of space, including the problem of social resistance to mining activities expressed in the NIMBA syndrome (characteristic of local communities), less often in the BANANA syndrome (typical for supra-local ecological organisations), are the main issues that should be addressed (NIMBY – Not In My Backyard, BANANA – Build Absolutely Nothing Anywhere Near Anything). Radwanek-Bąk (2010) even emphasises that mitigating conflicts and counteracting the syndromes mentioned above are indispensable conditions for the sustainable management of mineral resources. The tools mentioned as possible to use for this purpose are information campaigns, clarifying disputable issues, public consultations or broadly understood ecological education (Naworyta, 2010; Frączek, 2011). Both the purposefulness of taking these actions and their potential effectiveness must be analysed each time concerning individual social and spatial conditions. They should be preceded using social research tools to determine the state of knowledge and attitudes of the local community.

Lignite deposits of south-western Wielopolska

The Poniec-Krobia-Miejska Górka deposit was documented during geological works conducted at the turn of the 1960s and 1970s (Piwocki, 1979). The total area of the deposit is 106.2 sq. km, of which approximately 100 sq. km are the so-called balance resources. The Krobia-Poniec-Miejska Górka deposit is a multi-decay deposit consisting of five layers. The technological and chemical properties of lignite that characterise the deposit classify the raw material into the groups of energy coals. In the analysed communes, lignite deposits lie at a depth of 115-160 m, and their size is estimated at approximately one billion tons, which shows that it is potentially one of the richest lignite deposits in Poland. Therefore, the deposit located in south-western Wielkopolska has been classified as the so-called prognostic deposit.

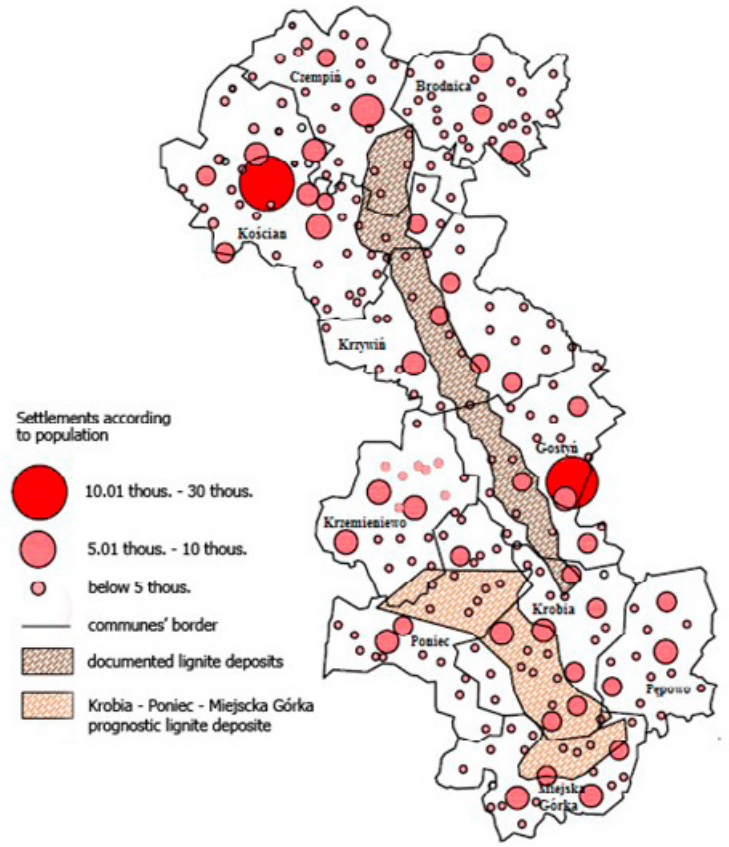

Figure 1. Documented and prognostic lignite deposits in Wielkopolska region

Source: author's work based on the report published by the Wielkopolska Spatial Planning Office (Wielkopolskie Biuro Planowania Przestrzennego, 2015).

These areas are adjacent to the documented deposits of lignite within the so-called Poznań Trench (a coal-bearing region about 130 km long, stretching from Czarnków and Szamotuły to Gostyń and Krobia) (figure 1).

In Wielkopolska region, the opencast mining plans that assumed converting thousands of hectares of first-class agricultural land in an area inhabited by over 150,000 people, with predominant employment in agriculture, faced mass protests not only from residents but also from entrepreneurs. Geologists estimated that a depression crater would cause groundwater to fall within a distance of 20-30 kilometres. This is more than in the case of the open pit in Bełchatów (the depression crater there was as long as 20 kilometres). There are 22 settlements in the Krobia-Poniec-Miejska Górka deposit (figure 2), which would be closed as a result of lignite mining (Sutowski, 2015).

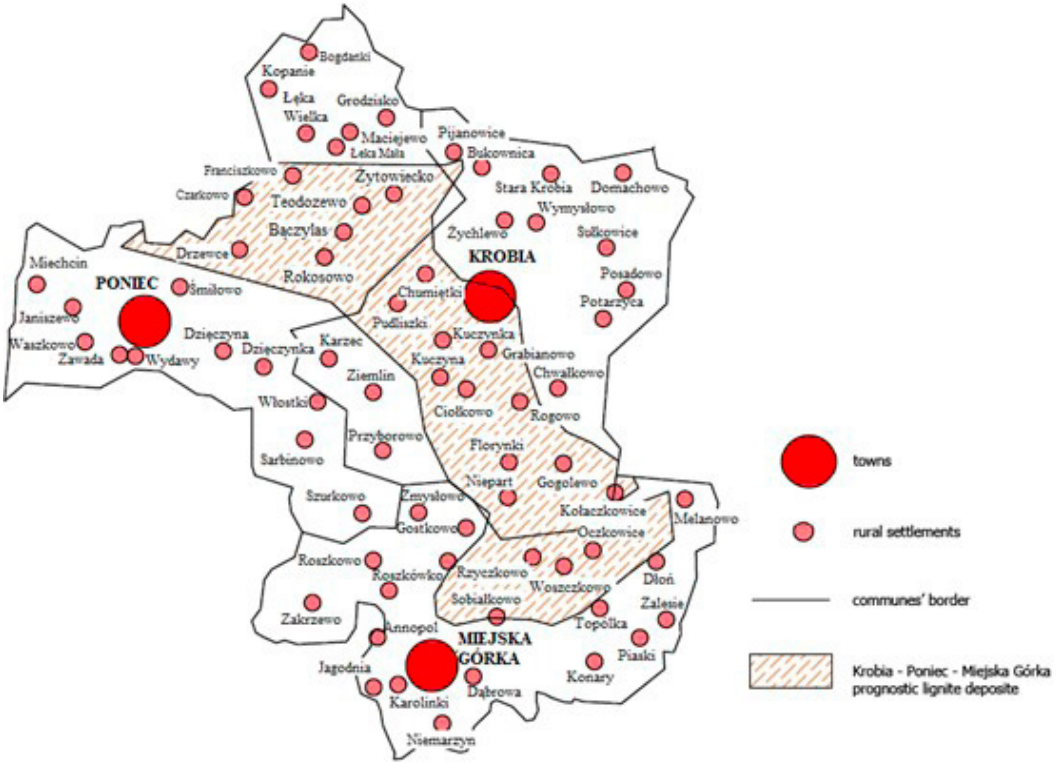

Figure 2. The prognostic lignite deposite in the Krobia, Poniec and Miejska Górka communes

Source: author's work based on the report published by the Wielkopolska Spatial Planning Office (Wielkopolskie Biuro Planowania Przestrzennego, 2015).

Local communities' attitudes towards lignite mining

The structure of the study and research sample

Public opinion research on the potential lignite mining was carried out with the use of a diagnostic survey method. The purpose of this method is to acquire knowledge about social phenomena as well as opinions and views of a specific community (Łobocki, 1984). In the survey, a paper questionnaire (PAPI technique) was used. The survey was conducted among the inhabitants of Krobia, Poniec and Miejska Górka communes, both in towns and in rural areas. The questionnaires were handed out to the respondents in person in two rounds – between December 2016 and February 2017 (285 questionnaires) and in the period from October 2018 to January 2019 (265 questionnaires).

In total, out of 550 distributed forms, 442 complete questionnaires were included in the final study. Most respondents lived in Krobia commune (43%), Miejska Górka (31%), and Poniec (27%). The population of the surveyed sample was dominated by inhabitants of rural areas (65%), women (52%), and people aged 31-50 (48%), which resulted from the dominant share of these demographic groups in the population of the three surveyed communes. More than one-third of the surveyed people are full-time employees (38%). Farmers were also well represented (27%). The share of retirees and disability pensioners among the respondents reached 10.5%. Entrepreneurs, students, and unemployed accounted for the smallest groups (8% each). The reason for such a high share of middle-aged adults, farmers and employees may be the fact that it is these people who are most familiar with the subject of the research problem, they appreciated the importance of researching the problem and therefore were more willing to answer.

The comparison of the structure of the studied sample with the structure of the population of the examined communes shows many similarities (table 1). The sample used in the study mirrors the population directly in terms of the inhabited commune, sex and place of residence understood as a town or rural area. More profound differences were identified in the case of the age structure due to the lack of control over the survey questionnaires – they were delivered to random households. Moreover, children and adolescents were excluded from the study, as evidenced by the below-proportional share of people from the youngest age group (in relation to the share of this group in the population). Nevertheless, it can be concluded that the structure of the surveyed inhabitants corresponded to the structure of the entire population in communes.

Table 1. The structure of the research sample vs population of the communes under analysis

Category and specification	Research sample		Population	
	number	%	number	%
Commune:				
Krobia	189	42.8	13 086	43.2
Miejska Górka	135	30.6	9 389	31.0
Poniec	118	26.7	7 849	25.9
Sex:				
Women	227	51.4	15 288	50.4
Men	215	48.6	15 036	49.6
Place of residence:				
Town	154	34.8	10 390	34.3
Rural area	288	65.2	19 934	65.7
Age:				
up to 30 years old	122	27.6	11 483	34.9
31-50 years old	214	48.4	8 730	26.5
over 50 years old	106	24.0	12 687	38.6

Source: author's work.

Research procedure

The survey results were subjected to statistical analysis, the aim of which was to quantify the attitudes of the local community towards the potential exploitation of lignite and to identify the factors shaping (differentiating) these attitudes. The research procedure resulted from the structural definition of attitude, according to which its final shape consists of 1) cognitive (knowledge, beliefs), 2) emotional-evaluating (emotions, evaluations), and 3) behavioural (action program) components (Brzeziński, 1980). Therefore, the identification of the attitudes of the local community towards the analysed phenomenon required, first of all, the selection of a set of questions relating to the above-mentioned components of the attitude, the calculation of a synthetic indicator, which is the resultant of the expressed beliefs, assessments and preferences, and finally the use of statistical tests checking whether a given factor influences the attitudes declared.

When analysing the attitudes of the local community, a set of questions was used based on the Likert attitude scale (see table 2). Through the content

of the questions, the respondents were expected to declare their opinions on the plans for the exploitation of lignite deposits in the municipalities of Krobia, Poniec and Miejska Górka. The respondents expressed their views on a five-point estimation scale, in which the variants of answers were evenly distributed along the continuum of attitudes, from extremely favourable to extremely negative (see Brzeziński, 1980; Mayntz, Holm and Hubner, 1985). The answers to individual questions were assigned points according to the set of assumptions. Five possible variants of the answer could be chosen in integers in the range [-2; +2]. Positive values were assigned to the categories of responses expressing an enthusiastic (positive) attitude, zero – to the category adequate to the passive (neutral/undecided) attitude, while negative values were assigned for responses showing a negative attitude towards the analysed issue.

Table 2. Set of questions and response evaluation scales applied in testing the respondents' attitudes

1. Do you agree with the statement that the communes where lignite mining is carried out are among the richest in Poland?				
strongly agree (+2)	agree (+1)	neutral (0)	disagree (-1)	strongly disagree (-2)
2. Do you agree with the statement that only public institutions and private companies benefit from lignite mining, not residents?				
strongly disagree (+2)	diagree (+1)	neutral (0)	agree (-1)	strongly agree (-2)
3. Do you agree with the statement that lignite contributes to a reduction in unemployment?				
strongly agree (+2)	agree (+1)	neutral (0)	disagree (-1)	strongly disagree (-2)
4. Do you agree with the statement that the economic benefits of lignite mining outweigh the environmental losses?				
strongly agree (+2)	agree (+1)	neutral (0)	disagree (-1)	strongly disagree (-2)
5. Would you consider changing your place of residence and moving to another commune/town due to lignite mining?				
strongly agree (+2)	agree (+1)	neutral (0)	disagree (-1)	strongly disagree (-2)
6. Would you consider changing your professional status or job (e.g., taking up a job in the mine or its offices) due to the planned mining investment in your neighbourhood?				
strongly agree (+2)	agree (+1)	neutral (0)	disagree (-1)	strongly disagree (-2)

Source: author's work.

In the next step of the research procedure, the respondents were divided into complementary groups, adopting the following socio-demographic division criteria:

- gender (female, male),
- age (up to 30 years old, 31-50 years old, over 50 years old),
- education (primary or no education, basic vocational, secondary, higher),
- professional status (full-time employee, entrepreneur, farmer, retired/pensioner, unemployed, student),
- place of residence (town, rural area),
- commune (Krobia, Miejska Górka, Poniec).

Then, the synthetic index A was calculated for the Likert Attitude Scale. For this purpose, each of the respondents was assigned an average number of points, calculated based on previously given answers. Similar averages were also calculated for pre-selected groups of respondents. The research procedure was limited to calculating the values resulting from the formulas:

$$A_j = \frac{2a + b - d - 2e}{r} \quad \text{– for } j\text{-th respondent,} \tag{1}$$

$$A_k = \frac{2 \times \sum_{i=1}^{r} a + 1 \times \sum_{i=1}^{r} b + (-1) \times \sum_{i=1}^{r} d + (-2) \times \sum_{i=1}^{r} e}{rn}$$

– for k-th respondent group, (2)

where:
a – number of extremely favourable responses,
b – number of moderately favourable responses,
d – number of moderately negative answers,
e – number of extremely negative answers,
i – question number,
r – number of questions used to test attitudes,
n – number of respondents in the k-th group.

The calculated A_k values made it possible to rank groups of respondents depending on the attitude (bias) towards the prospective lignite mining. Similarly to the method of calculating the synthetic index, three categories of attitudes (positive, negative, and neutral) were distinguished, and each category was assigned an equal part of the interval [-2; +2] (see figure 3).

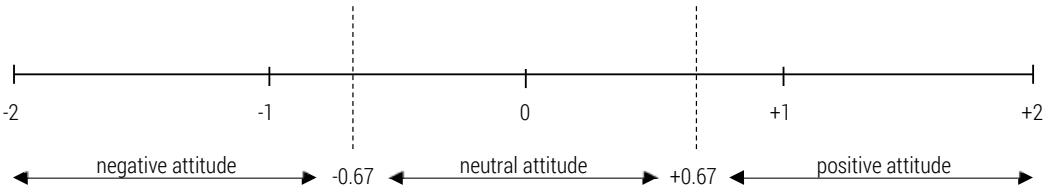

Figure 3. Dependence of the type of attitude on the value of the synthetic index
Source: author's work.

In the final part of the analysis, the one-way ANOVA was used to verify the differences between the synthetic indicators for individual groups of respondents. The essence of variance analysis is to divide the total variance into two components measuring the variability within and between the analysed groups. By comparing the variance between groups with the within-group variance, it can be determined whether the group means differed significantly from each other or not (McClave and Benson, 1988). Thus, the analysis of variance leads to the identification of factors differentiating the attitudes of the local community.

Factors influencing the attitudes of the local community towards lignite mining plans

Based on the analysis of synthetic indicators A_k for particular groups of respondents, it was found that these indicators fell within the range [-0.69; -0.06]. Therefore, they indicate the indecisive attitudes of the local community and reveal clear tendencies towards negative assessments of the analysed issue (figure 4, table 3).

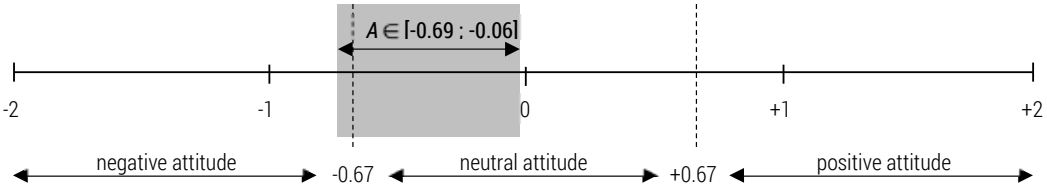

Figure 4. The area covered by the values of synthetic indicators A for individual groups of respondents
Source: author's work.

Table 3. A_k synthetic indicators ranking for individual groups of respondents

Group of respondents	value Ak
farmers	-0.692
rural residents	-0.675
31-50 years old	-0.649
full-time employees	-0.637
the inhabitants of Krobia commune	-0.606
the inhabitants of Miejska Górka commune	-0.597
secondary education	-0.594
retirees/pensioners	-0.589
men	-0.569
primary education and lack of education	-0.552
over 50 years old	-0.531
women	-0.531
basic vocational education	-0.515
the inhabitants of Poniec commune	-0.403
higher education	-0.390
unemployed	-0.389
students	-0.375
up to 30 years old	-0.360
city dwellers	-0.315
entrepreneurs	-0.063

Source: author's work.

Although the inhabitants were aware of the economic benefits of lignite mining in other communes, they feared the need to change their residence and workplace. The area of the open-pit mine could cover about 10,000 hectares, i.e., the area where 22 towns are located in Krobia, Poniec and Miejska Górka communes. The inhabitants expressed their doubts about the degradation of the natural environment and the collapse of agriculture. In their opinion, mining would destroy the surrounding crops, and local agriculture would not be restored to the previous state. A common effect of an open-pit mine is a lowering of the groundwater level, which could lead to the drying out of wells, rivers and soil in the mine's surroundings.

The obtained results showed that farmers and rural residents were the most sceptical of the lignite mining plans (in both cases the A_k value was lower than the -0.67 threshold, which indicates a negative attitude).

Rural residents are usually very resistant to change, which in this case may be aggravated by the fear of losing their property, deterioration of the environment and living conditions, uncertainty to compensation payments, the need to change jobs and even place of residence.

In turn, farmers perceive the threat to the functioning of their farms and production activities, resulting, for example, from lowering the groundwater level that usually accompanies open-pit mining. In the traditionally agricul-

tural area of southern Wielkopolska, the problem of the coexistence of mines and agricultural seems to be one of the key factors for the success of a potential investment.

Entrepreneurs were among the most enthusiastic groups of respondents (although still expressing views indicating a neutral attitude with a tendency for a negative one). This group was primarily aware of the financial benefits for communes where natural resources are exploited. Local entrepreneurs also saw an opportunity for their companies regarding the mine construction plans. They accepted the possibility of changing the profile of their activity and adapting to the changing market needs.

Moreover, among the groups of respondents with the lowest level of scepticism towards lignite mining plans were town dwellers (A_k = -0.32), people up to 30 years old (A_k = -0.36), students (A_k = -0.38), unemployed (A_k = -0.39) and people with higher education (A_k = -0.39). Young and educated town dwellers are in the group of people who absorb changes most easily and are able to take advantage of the opportunities that a potential investment would bring. However, it should be remembered that although these categories of respondents were the least sceptical, the level of non-acceptance of the analysed issue among their representatives was still significant.

Analysing indicators A_k in the groups complementary to the total of surveyed residents, the greatest difference in the attitude dimension can be noticed between the respondents separated based on their professional status (entrepreneurs -0.06 vs farmers -0.69), as well as the place of residence in the town-rural area (-0.32 vs -0.68) and the age of the respondents (up to 30 years old -0.36 vs 31-50 years old -0.65). The attitudes of the respondents distinguished on the basis of sex and education were much less diversified, as evidenced by the value of synthetic indicators within [-0.53; -0.57] in the first case and [-0.39; -0.59] in the second (table 3).

On this basis, it could be assumed that the attitudes of the local community of south-western Wielkopolska towards the potential exploitation of lignite depend to the greatest extent on the professional status and place of residence. The role of such factors as sex and education is less important. These hypotheses were verified based on the single-factor analysis of variance ANOVA (table 4).

The calculated F test statistics made it possible to assess the statistical significance of differences between the groups of respondents separated within the examined factors. In the light of the obtained results, it could be concluded that the factors differentiating the attitudes of the local community were primarily the place of residence (town – rural area) (p <0.000), professional status ($p \approx 0.001$) and the age of the respondents ($p \approx 0.03$). However, no statistically significant differences were found between the

declared opinions of the groups of respondents classified by gender or education ($p > 0.6$). The role of the commune, where the respondents live, as a factor differentiating attitudes, was noticeable, although the statistical significance of the differences could only be confirmed at the level of $\alpha = 0.1$.

Table 4. Results of single-factor variance analysis

Factor	Variants of answers	F	Value p
Sex	man, woman	0.228	0.63341
Age	up to 30 years old, 31-50 years old, over 50 years old	3.665	0.02714
Education	primary education and lack of education, basic vocational education, secondary education, higher education	0.548	0.64983
Professional status	full-time employee, entrepreneur, farmer, unemployed, retiree/pensioner, student	4.243	0.00105
Place of residence	town, rural area	19.329	0.00002
Commune	Krobia, Miejska Górka, Poniec	2.383	0.09458

Source: author's work.

Conclusions

In the light of the research results obtained, it was observed that the respondents' attitudes were dominated by "local" thinking and the fear of functional, environmental, and socio-economic changes caused by lignite mining. Therefore, the inhabitants of the analysed communes were cautious about the plans of lignite mining and mostly did not see the benefits for their households and entire communes. In particular, they were reluctant to the possible necessity to change their place of residence and professional status. Such attitudes were understandable considering the specificity of the region – its agricultural character, multi-generational traditions of farming and the indigenous local community.

The largest differences in attitudes could be observed within the groups of respondents distinguished on the basis of their professional status, place of residence (town – rural area), and age. The conducted analysis of variance statistically confirmed that it was these socio-demographic features that could be considered as factors shaping the attitudes of the local community towards the plans for lignite mining in the studied area.

The negative opinions on the potential exploitation of lignite, in particular those declared by farmers and those dwelling rural areas, can be explained by fears of environmental degradation and the liquidation of numerous

farms. A frequent effect of launching an opencast mine is a lowering of the groundwater level, which may lead to drying out of wells, rivers and soils within a radius of up to 50 kilometres from the mine. The reduction of agricultural activity would result in inhabitants suffering financial losses, and the necessity to expropriate the land for the mine would lead to the loss of a significant part of the property.

The inhabitants may have been concerned about the prospect of rising unemployment. Although the mine and its operation would generate new jobs, the new stands would be for external experts, not the local community. As a consequence of the deterioration of farming conditions, the losses could affect the local enterprises whose activities are mainly based on agriculture. An example is Heinz – a fruit and vegetable processing plant in Pudliszki (Krobia commune) or a sugar factory in Miejska Górka, which are currently an important link in the local labour market.

The identified attitudes of the local community prove that one of the significant problems of the potential investment will be to convince the inhabitants of the benefits that may result from the exploitation of lignite. At the same time, when planning the investment, in addition to activities and programs for the protection of the natural environment and landscape values, the economic interests of the inhabitants should be secured, including local farms and enterprises in particular. Without any conciliation action, the implementation of the investment could be considered against the will of the local community.

The contribution of the authors

Anna Bernaciak – 25% (conception; literature review).

Wojciech Kisiała – 25% (conception; analysis and interpretation of data).

Natalia Sołtysiak – 25% (acquisition of data; analysis and interpretation of data).

Katarzyna Suszyńska – 25% (conception; acquisition of data).

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ENVIRONMENTAL PROTECTION IN THE PERSPECTIVE OF CSR ACTIVITIES UNDERTAKEN BY POLISH ENTERPRISES OF THE CONSTRUCTION INDUSTRY

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ABSTRACT: The article aims to show the level of involvement of Polish enterprises from the construction industry in the implementation of CSR programmes, with particular emphasis on environmental protection tasks. The survey, carried out with the use of a questionnaire technique, covered 177 enterprises, including their division into large, medium, and small ones. The survey was carried out using CAVI and PAPI techniques with the use of a proprietary questionnaire form. The results of the research indicate that environmental protection is not a priority CSR area for construction enterprises. The activities undertaken in the field of environmental protection are dominated by those which are directly related to the construction activities conducted. For them, activities going beyond that scope, such as supporting initiatives or promoting pro-ecological behaviour, are much less important. There is a visible difference between large enterprises and entities belonging to the two remaining groups. Large enterprises are more inclined to take universal measures which go beyond their construction site. This indicates their important role as potential creators of good practice, setting behaviour patterns throughout the construction sector.

KEY WORDS: CSR, environmental protection, industry sector

Introduction

Environmental degradation, together with other threats from increasing globalisation poses numerous challenges for the construction industry. These include, above all, the risk of losing financial liquidity, the limited supply of skilled labour and the volatility of material prices. These are accompanied by problems relating to the efficiency of natural resources management and the amount of waste and pollution produced. The construction industry is also burdened with numerous health risks for workers. According to the statistics of Statistics Poland (GUS, 2020), it is in the construction industry sector that the highest number of severe and fatal accidents at work occurs. At the same time business partners of construction companies, such as investors, co-operators, banks, insurance companies, and public administration entities more and more often perceive economic entities in terms of their pro-social and environmental activities. Apart from a price, they are guided by confidence in a given company, its image and the manner it operates on the market and in its environment. In pursuing their business goals, enterprises are forced to consider social and environmental issues as equivalent areas of their activity. One of the instruments enabling the integration of the above objectives is the concept of Corporate Social Responsibility (CSR). The implementation of its assumptions may be a source of opportunities to increase competitive advantage, leading at the same time to social and environmental benefits.

The article aims to present the results of research showing the activity of Polish enterprises in the construction industry in implementing the CSR principles. The areas of involvement of these enterprises are analysed, with particular emphasis on activities concerning environmental protection. The article attempts to determine the extent to which construction sector enterprises in Poland undertake CSR activities, what are the types of these activities, and what is the place of actions aimed at limiting the pressure on the natural environment in relation to other CSR activities. Research results show the real importance attached by various size companies of the construction sector to contemporary environmental problems.

An overview of the literature

One of the management instruments, creating conditions for reducing the pressure of the economic system on the environment, is the CSR concept. There are numerous definitions of this concept in the literature (Carroll, 1991, p. 39-48; Aarts, 2011, p. 207-211; Griffin, 2004, p. 118-119). Their

common feature is the reference of business activities to the social needs and requirements of the natural environment. The European Commission defines CSR as the responsibility of enterprises for their impact on society (Commission Communication, p. 7). The ISO 26000 standard defines CSR as the impact of an organisation's decisions and actions on society and the environment through transparent and ethical behaviour in seven areas: 1) organisational governance, 2) human rights, 3) labour practices, 4) environment, 5) fair operating practices, 6) consumer issues, 7) community involvement and development.

Taking actions to reduce the negative impact on society and the environment is particularly important in the case of enterprises belonging to the most burdensome sectors. One of such sectors is construction (Adamczyk and Dylewski, 2010, p. 127). Environmental risks are present at all stages of the construction process from planning and design to operation and finally, demolition. Stawicka-Wałkowska (1998, p. 81) indicates that problems in the construction-environment relations are concentrated around two areas: 1) obtaining natural raw materials in the production process of construction materials and products, and 2) soil, water and air pollution during the operation and disposal of construction works. According to Salih (2013), almost half of the final energy consumption and extracted raw materials, and about one-third of water consumption in the European Union are related to the construction and operation of buildings.

To reduce the negative environmental impact, companies in the construction sector take numerous measures. The most important of these include (Deszcz, 2006; Nauman, 2016, pp. 7-10): proper management of the construction site, making connections, preparing storage yards, dehydrating the construction site, minimising noise and vibrations associated with the use of heavy machinery and equipment, and waste management.

In Poland, the concept of corporate social responsibility has become the subject of consideration and research by many authors. Jung (2010) has attempted to identify the main barriers that hinder the pro-social activity of small enterprises. According to her, the problems result both from the specificity of small enterprises and from the inadequacy of CSR tools to them. The Author stresses that it is necessary to individually adjust actions in the area of corporate social responsibility to how small organisations are managed as well as their economic and human resources. Many studies have been conducted to determine the level of implementation of the social responsibility concept in Polish enterprises (Bartkowiak, 2010, Oczkowska, 2012; Ratajczak, 2015; Wołoszyn, Stawicka and Ratajczak, 2012; Rogowski, 2016; Piskalski, 2015). Wildowicz-Giegiel (2010) presents examples of good practices undertaken in the implementation of CSR principles. The results of the

research conducted by the Author confirmed that in the case of small and medium-sized enterprises, the CSR concept still plays a secondary role. The degree of advancement of the CSR concept implementation in Polish enterprises was included in the continuum model (Rojek-Nowosielska, 2017, p. 103).

Despite the significant impact of construction companies on the social and natural environment and analyses carried out in other countries (e.g. Barnes, Croker, 2013; Duman, Giritli, McDermott, 2016; Petrovic-Lazarevic, 2010; Seriki, 2020; Zahidy, Sorooshian, Hamid, 2019), comprehensive research has not been undertaken so far to identify the involvement of Polish enterprises of this industry in the implementation of the CSR concept and, in particular, to take action to reduce their pressure on ecosystems.

Research methods

The survey covered companies in the construction industry:

- conducting a registered business activity,
- whose activities, in accordance with the Polish Classification of Activities, are carried out under section F, division 41: works related to the erection of buildings,
- are not in bankruptcy or liquidation,
- operating in Poland.

The study investigated companies from three size categories: small (with 10-49 employees), medium (50-249 employees) and large (250 and more employees).

Data on the size of the population were obtained from the studies of Statistics Poland. The sample, due to the lack of an appropriate sampling frame, was selected using a targeted method. The sample size was determined based on two key premises: possibilities of data acquisition and fulfilment of statistical rigour. It was assumed that the minimum sample size in the survey to achieve the objectives of the survey is 100-200 units (Bazarnik et al., 1992, p. 16). Based on the data obtained from EMIS, Amadeus and ALEO databases, a database of enterprises was created, to which invitations to participate in the survey were sent (by mail and e-mail), together with a questionnaire form. Two thousand forty-seven invitations were sent out. Replies were received from 177 companies. The return rate of the questionnaire was 8.65%. The sample was dominated by small enterprises, which constituted almost 60% of the total number of respondents (106 entities). The share of medium-sized enterprises was slightly over 27% (49 entities) and large enterprises, over 12% of the research sample (22 entities) (table 1).

Table 1. Comparison of the structure of the general population and the research sample

Employment volume	Size of the general population	Share of enterprises in the general population [%]	Number of enterprises surveyed	Share of enterprises in the test sample [%]
from 10 to 49	6543	88.55	106	59.89
from 50 to 249	794	10.75	49	27.68
250 and above	52	0.70	22	12.43
Σ	7389	100	177	100

Source: author's work based on GUS (Statistics Poland), 2019.

A diagnostic survey method was used in the study. CAWI (computer-assisted web interview) and PAPI (paper and pen personal interview) techniques were used. The research tool was an original questionnaire form. The research was conducted from February to November 2019. The subject of the research was the corporate social responsibility activities undertaken by enterprises. The analyses were carried out by grouping individual activities into areas distinguished by the ISO 26000 standard and an original set of activities in environmental protection.

Results of the research

In Poland, only 37% of enterprises in the construction sector declare the implementation of CSR principles. Taking into account the size of the company, the CSR concept is implemented primarily in large companies (77%). In the case of medium-sized companies, 43% of the respondents confirmed their involvement in implementing socially responsible activities. Definitely, the lowest number (25%) of companies implementing CSR postulates is in the group of small entities.

Environmental protection is an area of interest declared by 82% of Polish enterprises in the construction industry, which implement the CSR demands. In comparison to other areas, the result should be considered relatively low. The highest percentages of respondents declare undertaking activities in the area of human rights (96%). A slightly smaller group of respondents (91%) declared involvement in activities in the area of organisational governance. Fair operating practices and consumer issues are areas of activity declared by 84% of the respondents. To a lesser extent (67%), activities concerning labour practices are implemented in companies. The least frequently declared are activities in the area of community involvement and development (figure 1).

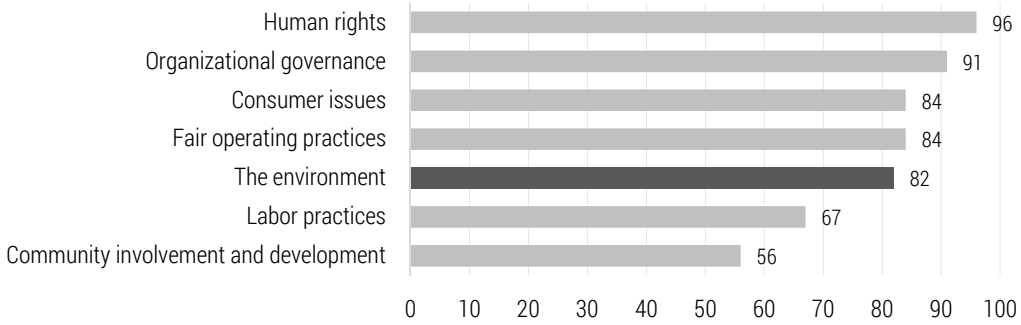

Figure 1. Areas of activity undertaken by construction enterprises implementing CSR principles [% of enterprises declaring activity in particular areas]

Source: author's work.

Environmental protection activities, most often undertaken by the surveyed companies, are those directly related to construction works: proper management of the generated waste, proper preparation of the construction site, securing greenery and selection of appropriate materials. Over 90% of the surveyed enterprises declare that they take conscious actions in this area. Slightly fewer indications were given for other activities, also directly related to the construction works: the selection of environmentally friendly technologies, saving resources (energy, water), reduction of noise emission, and reduction of waste and pollution. These activities were indicated by over 80% of the surveyed entities. The remaining activities, not directly related to construction works, received fewer indications. Offering environmentally friendly services, restrictive observance of environmental regulations and standards, ongoing monitoring of environmental regulations and promoting pro-environmental behaviour among employees, customers, subcontractors and suppliers were indicated by about 70% of the surveyed entities. Support for pro-environmental activities undertaken by other entities received the fewest indications. 68% of the respondents declare actions in this area (figure 2).

The size of the company affects the type of environmental protection measures taken. The smallest variation can be seen in waste management and site development. The percentage of companies declaring to take action in this respect is close to 95% in each size category. In turn, the most significant differences are revealed in the tendency to reduce the amount of generated waste and pollution and in the ongoing monitoring of legal regulations related to environmental protection. In the first case, 100% of large enterprises, 90% of medium-sized, and only 70% of small enterprises declare to take action. In the second case, 91% of large companies, 70% of small, and only 61% of medium-sized enterprises (figure 3).

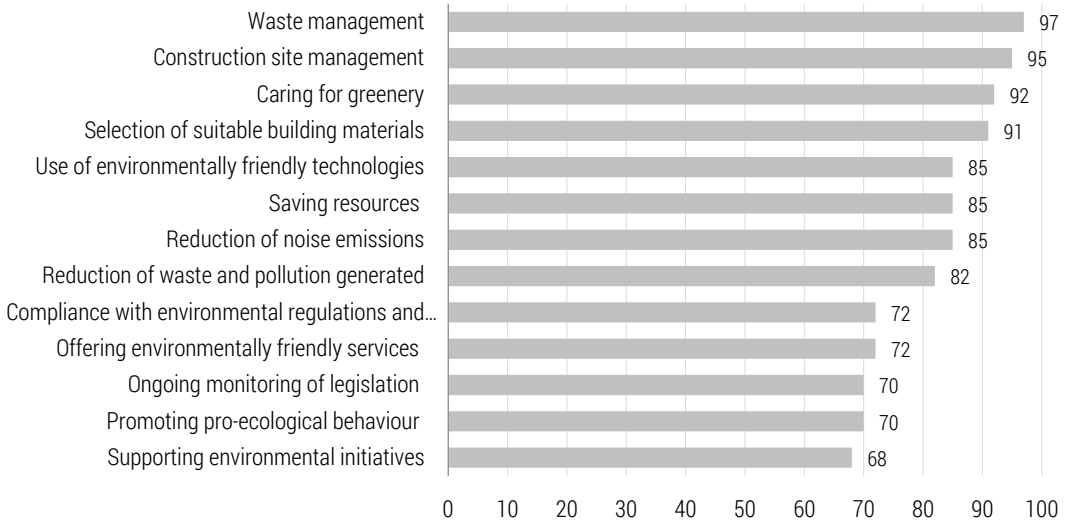

Figure 2. Environmental protection activities declared by construction enterprises implementing CSR principles [% of enterprises declaring individual activities]

Source: author's work.

In the four categories of activity, large companies are much more committed than others. These are reduction of generated waste and pollution, promotion of pro-environmental behaviour among employees, customers, subcontractors and suppliers, ongoing monitoring of environmental regulations and support for environmental initiatives. In these areas, the activity of small and medium-sized enterprises is relatively small.

An essential aspect for small companies is the proper management of waste, including hazardous waste. Socially responsible behaviour was confirmed in this respect by as many as 96% of respondents. Equally important is the proper management of the construction site, making connections and preparing storage yards (94%). Moreover, representatives of small companies declare the use of appropriate building materials (92%). Rarely undertaken activities include: reduction of harmful waste, gases, etc. (75%), promoting pro-environmental behaviour among employees, customers, subcontractors and suppliers (69%), offering environmentally friendly services (72%), ongoing monitoring of new environmental regulations/legislation (70%), compliance with standards, regulations (69%), supporting environmental initiatives (68%).

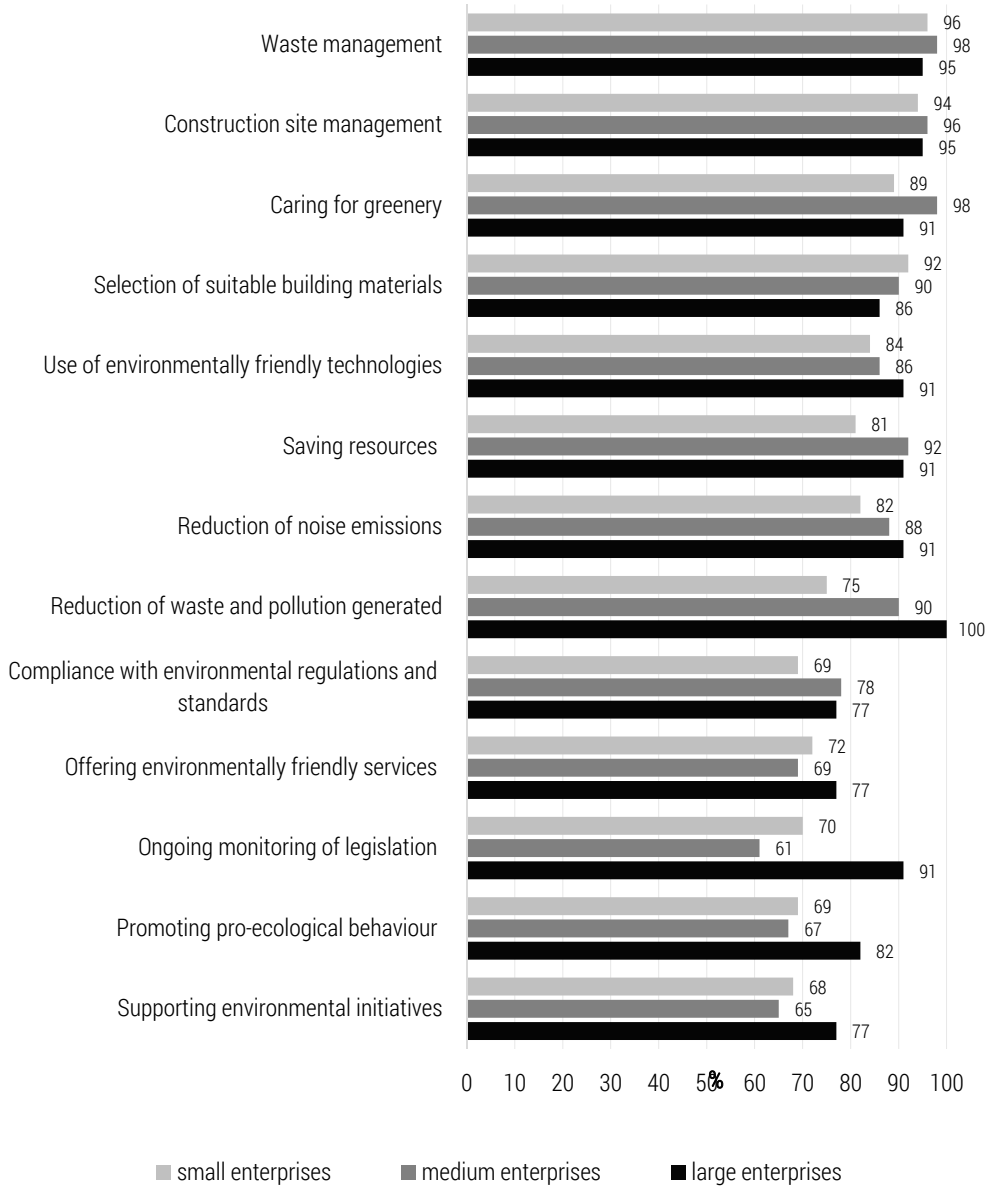

Figure 3. Diversification of environmental protection activities declared by construction enterprises implementing CSR principles, by size categories [% of enterprises declaring individual activities]

Source: author's work.

In medium-sized enterprises, the most widespread activity in the field of environmental protection is taking care of greenery and waste management (98%). The least frequently used methods to reduce the negative impact of the activities of medium-sized companies on the environment are: promoting pro-environmental behaviour among employees, customers, subcontractors, suppliers (67%), offering environmentally friendly services (69%), ongoing monitoring of new environmental laws and regulations (61%), and supporting environmental initiatives (65%).

In large companies, almost all environmental activities are carried out to a huge extent. The most significant involvement of these companies is visible in the reduction of harmful waste and gases, which was confirmed by as much as 100% of the respondents. It is a less common practice among large entities to offer environmentally friendly services, to comply with standards and regulations and to support environmental initiatives. 77% of companies in this category have indicated that they are doing so.

Conclusions

Despite the significant impact of construction sector enterprises on the social and natural environment, CSR principles have so far been of little interest. Enterprises in this sector that implement CSR principles focus on other areas rather than on environmental protection.

The undertaking of environmental protection activities by Polish enterprises in the construction industry should be considered as fulfilling their formal and legal obligations rather than, as one of the definitions of CSR, consciously "taking responsibility for actions for a cleaner environment" (Commission of the European Communities 2001, p. 5). Therefore, the most popular among enterprises in the construction industry, declaring the implementation of CSR principles, are activities directly related to operational processes: proper preparation of the construction site, proper management of the generated waste, or securing greenery facilities. To a much lesser extent, these companies declare undertaking activities not directly related to their current operations: supporting environmental initiatives or promoting pro-ecological behaviour.

Large companies are the leaders in terms of the pro-ecological approach to their entire activity. They are the driving force behind socially responsible activities and activity in the field of environmental protection in the whole sector. Apart from the high level of operational activities related to environmental protection, they also declare other activities in this area. The declarations concerning attempts to minimise the amount of waste and pollution

produced or to seek environmentally friendly technologies are much higher than in the other two categories of enterprises. They also carry out much greater image activities: they support the promotion of pro-ecological behaviour or independent support initiatives in this area. Large companies can play an essential role as a source of good practice and a model of behaviour in this area for the whole industry. Their impact on small and medium-sized entities may manifest itself as a result of direct requirements addressed to smaller business partners within the framework of the agreements concluded, as well as examples of business models that combine the achievement of competitive advantage with the creation of values important for the socio-economic environment.

Among the most important findings made as a result of the research performed are the following:

- identification of the differentiation in the commitment to implementing CSR principles, and the types of CSR activities undertaken by enterprises in the construction sector according to their size,
- establishment of the importance attached by the enterprises surveyed to environmental protection in relation to other areas of CSR,
- identification of types of pro-ecological activities undertaken by the analysed entities,
- definition of the role of large construction companies as a carrier of good practice in this area,
- identification of the needs of enterprises in the construction sector in terms of awareness of CSR principles and the benefits of applying them.

The contribution of the authors

Arnold Bernaciak – 50% (conception), 50% (literature review), 40% (acquisition of data), 60% (analysis and interpretation of data).

Małgorzata Halaburda – 50% (conception), 50% (literature review), 60% (acquisition of data), 40% (analysis and interpretation of data).

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SUMMARIES IN POLISH

STRESZCZENIA POLSKOJĘZYCZNE

Tomasz ŻYLICZ

PROBLEMY ZARZĄDZANIA ZIELENIĄ MIEJSKĄ

STRESZCZENIE: W artykule analizowane jest zarządzanie zielenią miejską jako problem „przełożony-podwładny". Problemy tego typu pojawiają się jeśli działanie wymaga współpracy dwóch (lub więcej) szczebli hierarchicznych. W analizowanym przypadku prezydent miasta (szczebel wyższy) oczekuje, że posadzone drzewa maksymalizują potencjał neutralizacji zanieczyszczeń, natomiast zarząd zieleni miejskiej (szczebel niższy) chciałby zmaksymalizować wydatki budżetowe przy spełnieniu pewnych warunków brzegowych. O ile szczebel wyższy chciałby, aby korzyści zostały w przyszłości dostarczone faktycznie, o tyle szczebel niższy jest zainteresowany sadzeniem najbardziej atrakcyjnych drzew, nie bacząc na to, że owe korzyści zostaną dostarczone tylko częściowo i zapewne tylko w krótkim okresie. W konsekwencji skład gatunkowy nasadzeń odbiega od tego, który miałby miejsce, gdyby struktura zarządzania była poprawna motywacyjnie.

SŁOWA KLUCZOWE: modele przełożony-podwładny, drzewa miejskie

Natalia Yosipivna SHUPTAR-PORYVAIEVA, Elena Rostislavovna GUBANOVA, Natalia Mykolaivna ANDRYEYEVA, Tetiana Ivanivna SHEVCHENKO

BADANIE EFEKTÓW ZEWNĘTRZNYCH AKUMULATORÓW PRZENOŚNYCH Z UWZGLĘDNIENIEM ETAPÓW ZUŻYCIA I UTYLIZACJI

STRESZCZENIE: Obecnie coraz bardziej dotkliwy staje się problem negatywnych środowiskowych efektów zewnętrznych związanych z gospodarką odpadami, zwłaszcza elektroodpadami, które obejmują również zużyte baterie i akumulatory z gospodarstw domowych. W przypadku niekontrolowanego ich uwolnienia do środowiska, powodują znaczne szkody nie tylko dla środowiska, ale także dla zdrowia publicznego. Celem artykułu jest zbadanie środowiskowych oraz ekonomicznych aspektów, jak również określenie zewnętrznych skutków związanych z używaniem baterii. Analiza korelacji i regresji wykazała, że istnieje związek pomiędzy wskaźnikami wypełnienia rynku krajowego bateriami dla gospodarstw domowych a dynamiką umieralności związanej z rakiem. W opracowaniu przedstawiono uproszczone obliczenia skutków zewnętrznych, które pojawiają się na Ukrainie w wyniku zużycia baterii domowych z powodu braku systemu ich zbierania i utylizacji. Suma całkowitych skutków zewnętrznych jest określana z wyłączeniem strat spowodowanych zanieczyszczeniem powietrza, wody i strat w rolnictwie.

SŁOWA KLUCZOWE: efekty zewnętrzne, zużyte baterie, analiza korelacji i regresji

Martin ROVNAK, Roman NOVOTNY, Matus BAKON

ANALIZA WYBRANYCH WSKAŹNIKÓW EKONOMICZNO-ŚRODOWISKOWYCH SYSTEMU GOSPODARKI ODPADAMI NA SŁOWACJI

STRESZCZENIE: Głównym celem artykułu była wizualizacja oraz analiza zależności pomiędzy wybranymi wskaźnikami ekonomiczno-środowiskowymi systemu gospodarki odpadami na Słowacji, tj. pomiędzy wysokością opłaty za odpady komunalne w poszczególnych rejonach Słowacji a wysokością średniego miesięcznego wynagrodzenia oraz poziomem bezrobocia w 2019 roku. Dane zostały zwizualizowane przy użyciu mapy tematycznej oraz wykresu typu boxplot, następnie zostały poddane testom statystycznym. Na podstawie przeprowadzonej analizy potwierdzono statystyczną zależność pomiędzy średnim wynagrodzeniem a wysokością opłaty za wywóz odpadów komunalnych oraz statystyczną zależność pomiędzy opłatą za odpady komunalne a stopą bezrobocia w poszczególnych rejonach Słowacji.

SŁOWA KLUCZOWE: wskaźniki środowiskowe, wskaźniki ekonomiczne, opłata za odpady komunalne, wynagrodzenie, bezrobocie

Ewa OŁDAKOWSKA

SZACOWANIE PROEKOLOGICZNEGO PODEJŚCIA DO BUDOWY DRÓG W OCENACH EFEKTYWNOŚCI EKONOMICZNEJ

STRESZCZENIE: Rozbudowa sieci połączeń drogowych wpływa korzystnie na szerokie spektrum czynników warunkujących sprawne funkcjonowanie państwa oraz rozwój jego regionów. Jednocześnie jest ingerencją w przestrzeń środowiskową i rolniczą oraz zagrożeniem dla walorów krajobrazowych i kulturowych. Ochrona niezwykle urozmaiconego środowiska przyrodniczego to zachowanie, zrównoważone użytkowanie oraz odnawianie zasobów, tworów i składników przyrody. Stąd przyjazne środowisku projektowanie i budowa inwestycji drogowych powinny uwzględniać bierną i czynną ochronę środowiska oraz kompensację. Wszystkie skuteczne rozwiązania z szerokiego zakresu „dobrych praktyk" minimalizują bądź eliminują negatywne skutki wyrządzone środowisku. Jednocześnie wszystkie działania prowadzące do stworzenia przyjaznej środowisku, „zielonej" sieci dróg są „oszczędnie" szacowane w analizach ekonomicznych. Głównym celem artykułu jest wskazanie „uproszczonej" wyceny proekologicznego podejścia do budowy dróg w ocenach efektywności ekonomicznej na przykładzie polskiego odcinka drogi ekspresowej S8 (szczególnie w granicach obszarów chronionych). Brak wyceny w wartościach pieniężnych potencjalnych korzyści wynikających z unikania, zapobiegania czy łagodzenia skutków ma niestety wpływ na ekonomiczny wynik analizy kosztów i korzyści.

SŁOWA KLUCZOWE: ocena efektywności ekonomicznej projektów drogowo-mostowych, analiza kosztów i korzyści, ochrona środowiska, środowisko naturalne

Karol MROZIK, Konrad PODAWCA, Daria DROŻYŃSKA

PRZESTRZENNE ZRÓŻNICOWANIE REALIZACJI PROCESÓW PLANISTYCZNO-INWESTYCYJNYCH W POZNAŃSKIM OBSZARZE METROPOLITALNYM

STRESZCZENIE: Celem artykułu była ocena dynamiki procesów planistycznych na poziomie lokalnym w latach 2009-2018. W opracowaniu podjęto również próbę sklasyfikowania gmin w obszarze metropolitalnym ze względu na zróżnicowanie stopnia postępujących procesów planistycznych. Badania przeprowadzono na przykładzie Poznańskiego Obszaru Metropolitalnego (POM), który obejmuje 45 gmin. Analiza została oparta na danych Banku Danych Lokalnych GUS. W wyniku przeprowadzonych analiz gminy w POM zostały podzielone na 12 grup. Najliczniejszą grupę (obejmującą prawie połowę analizowanych jednostek administracyjnych) stanowią gminy o niewielkim pokryciu miejscowymi planami zagospodarowania przestrzennego i bardzo niskiej intensywności wydawania decyzji o warunkach zabudowy. Są to gminy, w których presja urbanizacyjna ze względu na odległość od Poznania, jest mniejsza niż w jednostkach administracyjnych położonych blisko lub w bezpośrednim sąsiedztwie Poznania.

SŁOWA KLUCZOWE: gospodarka przestrzenna, miejscowy plan zagospodarowania przestrzennego, obszar metropolitalny, gmina, suburbanizacja

Piotr BOŁTRYK

KONIECZNOŚĆ UZYSKANIA DECYZJI ŚRODOWISKOWEJ W PRZYPADKU INWESTYCJI POLEGAJĄCEJ NA PRZEBUDOWIE DROGI – STUDIUM PRZYPADKU

STRESZCZENIE: Celem niniejszego artykułu jest przedstawienie procedury uzyskania decyzji środowiskowej na przykładzie inwestycji polegającej na przebudowie drogi. Studium przypadku dotyczyło przebudowy drogi gminnej publicznej nr 178044N Prostki – Ostrykół – Lipińskie Małe, gmina Prostki, powiat Ełcki, województwo Warmińsko-Mazurskie na długości 4308,5 m pod kątem przepisów dotyczących uzyskiwania decyzji środowiskowych. Poprzez interpretacje przepisów prawnych ustalono, że opisana inwestycja, pod pewnymi warunkami, nie wymaga uzyskania decyzji środowiskowej. Na podstawie studiów literaturowych przedstawiono podstawowe pojęcia oraz czynności związane z procedurą uzyskiwania decyzji środowiskowej w Polsce. Uzyskane w ramach badań wnioski mogą okazać się przydatne inwestorom publicznym, którzy są obowiązani do weryfikacji swoich inwestycji pod kątem ich zgodności z prawem na etapie planowania.

SŁOWA KLUCZOWE: decyzja, środowisko, procedura, ocena

Daniel TOKARSKI, Bartosz ZEGARDŁO

KOSZTY I KORZYŚCI EKONOMICZNE RECYKLINGU IZOLATORÓW ELEKTRYCZNYCH W PRODUKCJI BETONÓW SPECJALNYCH

STRESZCZENIE: Artykuł stanowi kontynuację podjętych prac badawczych mających na celu wskazanie uzasadnionego, pod względem ekonomicznym oraz ekologicznym, recyklingu odpadowej materii ceramicznej pochodzącej ze zużytych izolatorów elektrycznych. Podczas prac remontowych starych linii elektrycznych pozyskuje się stosunkowo duże ilości izolatorów, których obecna utylizacja jest dość kosztownym przedsięwzięciem. Opierając się na wcześniejszych doświadczeniach autorzy niniejszego artykułu wskazują potencjalną możliwość wykorzystania zużytych izolatorów w produkcji kruszyw do betonów specjalnych. Kruszywa takie spełniają wszelkie parametry i wymagania, a betony z nich uzyskane posiadają parametry wyższe od tych, jakie otrzymywano z kruszyw tradycyjnych. Na podstawie analizy danych zaczerpniętych z archiwów przedsiębiorstwa zajmującego się prowadzeniem prac remontowo-elektrycznych przedstawiono, z jakich obszarów pozyskuje się izolatory. Omówiono, jaka jest skala wymienionego przedsięwzięcia w skali kraju. Celem opracowania jest oszacowanie kosztów i korzyści ekonomicznych związanych z utylizacją izolatorów oraz ponownym ich zastosowaniu, jako kruszyw do betonów specjalnych. Pomimo kalkulacji, które wskazują, że przedsięwzięcie takie nie wiązałoby się ze znaczącymi zyskami finansowymi autorzy wskazują inne korzyści, jakie płynęłyby z tego rodzaju zagospodarowania wymienionych odpadów.

SŁOWA KLUCZOWE: izolatory elektryczne, recykling, betony specjalne

Anna BERNACIAK, Wojciech KISIAŁA, Natalia SOŁTYSIAK, Katarzyna SUSZYŃSKA

POSTAWY SPOŁECZNOŚCI LOKALNEJ WOBEC PLANÓW EKSPLOATACJI ZŁÓŻ WĘGLA BRUNATNEGO – PRZYKŁAD POŁUDNIOWO-ZACHODNIEJ WIELKOPOLSKI

STRESZCZENIE: Węgiel brunatny jest surowcem, który w polskiej energetyce od lat pełnił rolę strategicznego paliwa. Jedno z prognostycznych złóż węgla brunatnego położone jest w południowo-zachodniej Wielkopolsce (gminy Krobia, Miejska Górka oraz Poniec). Jednak plany eksploatacji wywołują duże obawy społeczności lokalnej. W tym kontekście celem pracy była diagnoza postaw społeczności lokalnej wobec planów eksploatacji węgla brunatnego na tym terenie. W postępowaniu badawczym zmierzającym do statystycznej weryfikacji czynników różnicujących te postawy, wykorzystano dane zgromadzone w wyniku sondażu diagnostycznego. Wyniki badania wskazują, że mieszkańców badanych gmin cechowały niezdecydowane postawy, jednak z bardzo wyraźnymi tendencjami do negatywnych ocen analizowanego zagadnienia. Najbardziej sceptycznie do planów eksploatacji węgla brunatnego nastawieni byli rolnicy oraz mieszkańcy wsi, a do grup respondentów o postawach

najbardziej przychylnych zaliczono przedsiębiorców, mieszkańców miast oraz ludzi młodych. Dowiedziono ponadto, że status zawodowy, miejsce zamieszkania (miasto-wieś) oraz wiek można uznać za czynniki kształtujące postawy społeczności lokalnej wobec planów eksploatacji węgla brunatnego na badanym terenie.

SŁOWA KLUCZOWE: postawy społeczne, węgiel brunatny, eksploatacja złóż, Wielkopolska

Małgorzata HALABURDA, Arnold BERNACIAK

OCHRONA ŚRODOWISKA W PERSPEKTYWIE DZIAŁAŃ CSR PODEJMOWANYCH PRZEZ POLSKIE PRZEDSIĘBIORSTWA SEKTORA BUDOWLANEGO

STRESZCZENIE: Celem artykułu jest ukazanie poziomu zaangażowania polskich przedsiębiorstw sektora budowlanego w realizację programów CSR, ze szczególnym uwzględnieniem zadań z zakresu ochrony środowiska. Badaniem, przeprowadzonym techniką ankietową objęto 177 przedsiębiorstw, z uwzględnieniem ich podziału na jednostki duże, średnie i małe. Badania przeprowadzono technikami CAVI i PAPI z wykorzystaniem autorskiego formularza ankiety. Wyniki badań wskazują, iż ochrona środowiska nie jest dla przedsiębiorstw budowlanych priorytetowym obszarem CSR. Wśród działań podejmowanych z zakresu ochrony środowiska dominują te, które związane są bezpośrednio z prowadzonymi działaniami budowlanymi. Dużo mniejsze znaczenie mają dla nich działania wychodzące poza ten zakres, jak np. wspieranie inicjatyw czy promowanie zachowań proekologicznych. Widoczne jest zróżnicowanie między przedsiębiorstwami dużymi a podmiotami należącymi do dwóch pozostałych grup. Przedsiębiorstwa duże, są bardziej skłonne do podejmowania działań uniwersalnych. Wskazuje to na ich ważną rolę jako potencjalnych kreatorów dobrych praktyk, wyznaczających wzorce zachowań w całym sektorze budowlanym.

SŁOWA KLUCZOWE: społeczna odpowiedzialność biznesu, ochrona środowiska, sektor budowlany

Prof. Natalya **Andryeyeva**, Ukraine
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