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THEORETICAL AND METHODOLOGICAL PROBLEMS

ENVIRONMENTAL POLICY AND MANAGEMENT

STUDIES AND MATERIALS

GENERAL ENVIRONMENTAL AND SOCIAL PROBLEMS

THEORETICAL AND METHODOLOGICAL PROBLEMS

Agnieszka BECLA • STANISŁAW CZAJA

A SYSTEM FOR ACCOUNTING COSTS OF CONTEMPORARY NEGATIVE ENVIRONMENTAL PHENOMENA – SOME METHODOLOGICAL REMARKS

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ABSTRACT: The article contains an idea of building a cost accounting system for contemporary negative phenomena of natural and anthropogenic disasters, including ecological ones. These phenomena are treated as "black swans", that is, phenomena with a high level of threat and wide, diverse, mainly negative effects. The authors presented selected methodological suggestions for including different types of effects of such phenomena in the system of records and their monetary valorization (i.e. cost recognition). The article is intended as an introduction to further in-depth discussion of these challenges. Considering the emerging problems (phenomena and processes), they belong to the most important issues for economics, ecological economics and environmental economics. However, they are not very often addressed in the literature.

KEYWORDS: cost system, effects and costs of negative phenomena, negative environmental phenomena, black swan type phenomena

Introduction

The contemporary human civilization has arrived at a difficult point in its development, which can be called, according to the theory of deterministic chaos, the point of bifurcation, characterized by a growing significance of sensitive parameters, to an extent that is often difficult to identify. This kind of point means a situation where a civilization will make a conscious choice, or where a path of further evolution will be imposed upon it (Jakimowicz, 2017). In cybernetics, system theory, as well as in socioeconomic growth theory, many such paths are distinguished, some of which are desirable, and some of which are undesirable. Most people are not even conscious of this or evaluate the situation in a manner that is convenient to them. It can be noticed not only in everyday utterances, but also in serious scientific research. For example, in economic sciences, it is still assumed that socioeconomic issues will best be solved by a perfectly competitive market and agents such as *homo oeconomicus*, and that economic growth in the traditional form can only be regarded positively („growth mania"), (Ayres, 1998). Similarly, the following slogan is accepted without reflection: „the failures of technology will be solved by technology".

Because most scientific works present an optimistic assessment of the perspectives of development of human civilization, even under conditions of globalization, we, as exponents of "reality-based economics" postulate that it is worth it to look at the problem of barriers to global development, and in particular at the costs of overcoming them (Becla, Czaja, & Graczyk, 2020).

The purpose of this article is to present the idea of a system of recording the costs of "black swan" events, that is events that (1) are highly unexpected, or low in predictability, (2) have a wide scope of negative consequences, which are complex and diverse, (3) have high social, economic and ecological costs tied to their occurrence, and (4) leave significantly deep marks on the human-society-economy-natural-environment system, and also have consequences that are difficult to identify, quantify, and evaluate. The notion of a "black swan" and the related type of phenomena was introduced into literature by Nassim Taleb.

The last element is of particular interest to the authors, as it appears useful and attainable with the current state of knowledge and with the functioning of global computerized information systems. It can be treated as a call to create a system of recording the costs of contemporary environmental phenomena. Such environmental threats may be treated as the best possible exemplifications of "black swan" events.

The purpose of this paper is not to quantify the size of such costs, because that is a task for large research teams with adequate economic and financial

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resources to carry out the studies, with access to the appropriate sources of information, and even to an appropriate system for record keeping and statistical analysis. The authors of this paper could only afford to determine the varieties of costs that are tied to global economic challenges, and to formulate the arguments for building a system meant to record them on a macroeconomic scale.

Brief review of literature

The losses (defined as the loss of physical and/or functional qualities of something) and costs (understood as a monetary expression of expenditures for the implementation of a specific action) of natural and man-made disasters are among the most important challenges of modern economy. There are many interesting studies on this problem in the world and in Polish literature. They emphasize the need to deepen and broaden the scope and increase the precision of calculating the effects of such phenomena. The source of the needs is the issues of insurance, accounting records and accounting estimates. Three approaches can be distinguished:

- based on *a priori* accepted values, popular in insurance; an example is the value of statistical life (VSL), indicator used in American insurance statistics;
- using accounting values and the scope of incurred losses, popular in accounting of enterprises and households;
- and using methodologically unclear estimates of cash-indexed losses.

There are also snapshots showing the effects of disasters, for example psychological or social, without estimating their economic value (Kanisty, 2003). Therefore, it is not possible to introduce them into the economic account, without preparing appropriate valuation techniques and methods.

An even more dominant group are studies based on mathematical models to assess the risk of natural disasters (for example, global climate change) and its effects on the economy and society (Stern & Stiglitz, 2022). Sub-analyses on, for example, floods (Kuźmiński, 2018) or cultural heritage assets are interesting but do not connect to the possibilities of assessing or estimating the losses of natural disasters. However, they are not useful for constructing a system of cost accounting for natural disasters.

A significant number of studies focus on the evaluation of existing solutions for financing and organizing emergency management and disaster recovery at different levels, from local to national (Galinski, 2018). There is no proposal to unify methods and techniques for estimating losses and costs of natural disasters (Ficoń, 2019).

However, there are fewer methodological studies on the precise identification of losses, costs and avoided costs (and therefore benefits) of natural

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disasters, catastrophes and long-term negative impacts (for example, ecological, health or social). An interesting exception might be the World Bank study "Investment in Disaster Risk Management in Europe Makes Economic Sense," 2021. It looked at the costs and benefits of preventing natural disasters in Europe. The study weighed the benefits of disaster prevention and/or mitigation against the costs of necessary investments. The analysis covered more than one hundred investment projects. Four groups of benefits were identified: (1) reduction of human casualties, (2) avoidance of quantifiable losses, (3) stimulation of the economy by preventive investments, and (4) derived benefits in the economy. Based on these, the benefit-cost ratio (BCR) of the profitability of preventive investment was developed. In a similar direction are considerations of Nicholas Stern in the work "Global deal" (Stern, 2010), where the issue of rationalization of disaster risk estimation is exposed.

Another good starting point for developing attitudes for loss identification and disaster cost accounting systems can be the Stern Report (*The Economics*..., 2007). It contains several important conclusions, such as:

- "there is still time to avoid the worst impacts of climate change, if we take strong action now,
- climate change could have very serious impacts on growth and development,
- the costs of stabilising the climate are significant but manageable; delay would be dangerous and much more costly,
- action on climate change is required across all countries, and it need not cap the aspirations for growth of rich or poor countries,
- a range of options exists to cut emissions; strong, deliberate policy action is required to motivate their take-up, and
- climate change demands an international response, based on a shared understanding of long-term goals and agreement on frameworks for action." (*The Economics*..., 2007).

However, their verification and implementation requires the construction of a global loss and cost accounting system for natural disasters.

Some researchers adopt a different perspective, treating disasters as a factor stimulating the economy. This allows to justify the Keynesian argument of economic stimulation and socio-economic development. In this case, the existence of a unified system for recording losses and costs of natural disasters and catastrophes is also essential.

However, in the literature that we are aware of, there is no call for building a globally unified system for recording losses and costs of natural disasters and catastrophes. The lack of adequate conditions to undertake such work does not exempt us from reporting such a need. This challenge is much more important than building more models for such phenomena with limited cognitive and implementation values.

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Methodological remarks regarding the desired calculation of costs on a global scale

Before we propose the elements of a methodology for studying the costs of contemporary environmental barriers and developmental threats, it may be appropriate to look at the concepts of threat and crisis. The idea of threat includes foremost the possibility of occurrence with a certain level of probability (risk) of a given negative, usually fairly homogeneous phenomenon. A threat is "a situation signalling something that may occur, usually something bad, undesirable, or dangerous" (Markowski, 2004). The potentiality of realisation (occurrence, coming into existence), as well as one-dimensionality of effect, are characteristics of threats. A crisis is a co-mingling of many threats that transform potential into an actual situation. It signifies the occurrence of different negative phenomena with all of their consequences. Therefore, while the costs of threats are potential quantities, which means methodologically they have to be weighed as risk levels, or probabilities of their occurrence, then under crisis circumstances, these costs become real quantities. If they are costs, then their assessment (evaluation) was performed using accepted and approved evaluation or accountancy techniques (Roubini & Mihm, 2011).

The present paper draws attention to the different kinds of costs which occur in a process-based (cybernetic) approach to crises and threats. Here we can propose the following chronological schema of costs of the occurrence and development of crises (threats) for contemporary civilisation (Figure 1). It encompasses the entire process of emergence and liquidation of consequences linked to a given crisis (threat), including:

- the initial stage of the crisis (threat) emerges as a consequence of human actions, which are its primary causes,
- it transitions into the stage of development of crisis phenomena, following different paths of development of changes, from the proportional and linear, easy to model, through the linearised (able to be presented as linear), to the non-linear, most often encountered in reality, all of which at some level allow for assessing the negative consequences,
- next, it transitions to the stage of preparation and realization of anti-crisis policy, which may be limited to containing the negative consequences to an acceptable level or may lead to their complete liquidation and prevention of the future occurrences of this type of crisis.

Each stage is the source of particular costs which are borne by persons, social groups or entities subject to the negative consequences of a given crisis (or threat). Although costs are the subject of the present analysis, we must remember that the co-mingling of phenomena related to a given crisis may

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include benefits intercepted by some entities, not necessarily internalized by their appropriate recipients. Some entities bear costs, others block benefits to which they are not entitled. In the macroeconomic or mega economic (global) calculus, the internalisation of costs and benefits is a secondary consideration. Much more important is the issue of the positive or negative sign and the quantity outcome of the economic calculus (benefits minus costs). This is what determines whether we are talking about a crisis (when the sign is negative), and what are its proportions (size of the outcome of the calculus). Internalisation is mostly an issue of intrageneration and intergeneration justice and ethical integrity (Mączyńska, 2017).

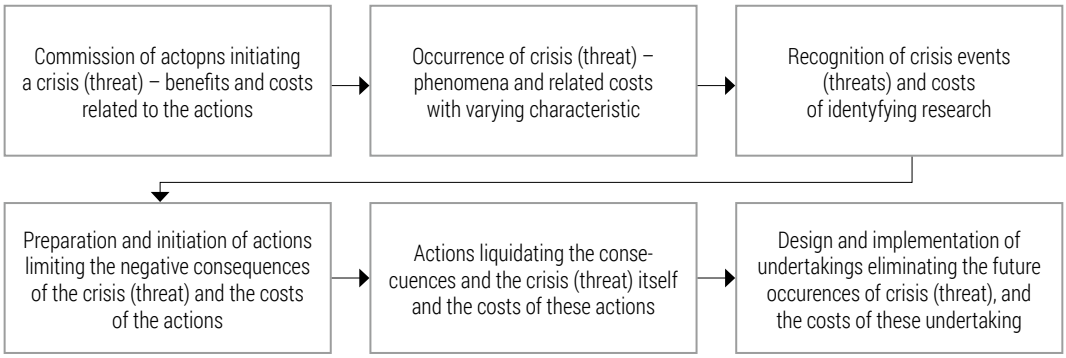

Figure 1. Chronology of the occurrence and development of crises (threats) of contemporary global civilisation and related costs

Source: author's work.

Taking into account the wide range of the presented issues and the limited scope of the present paper, the authors focused on several remarks regarding the methodology of research and the identification of the dimensions of contemporary global crises of human civilisation. To avoid oversimplification, even a short review of the literature was omitted, as it would have to include the very rich literature on cost calculation, as well as the even more voluminous sources of information regarding the contemporary crises of human civilisation. The authors hope that this paper will become an impulse or encouragement for scientific discussion and future research. However, such research is a task for large teams and large research projects. The authors, as economists, are cognizant of another challenge, which they do not take up in the present paper, namely: are contemporary economic sciences up to the tasks (challenges) posed by civilisation in the XXI century. This is a question for other studies (Kirman, 2018).

As mentioned, the purpose of the present paper is an attempt to identify the characteristics and varieties of costs which appear at each stage of the

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recognition of a crisis (threat) of a given kind. The following questions, therefore, become important:

1) how important are costs in the economic calculation, versus benefits, versus the outcome of their comparison (profit or loss, economically speaking);
2) what are the characteristics of the varieties of costs, or how potential versus how real are the costs; in the first case, the probability of their occurrence becomes an important issue, in the second case, the way of evaluation becomes an issue;
3) if they are the costs of fighting the undesirable effects of a crisis (threat), which are reactive, or if they are costs of fighting barriers, which are preventative;
4) what are the quantities of the kinds of the studied costs, that is, what are the relations between the size of the crisis (threat) and the size of the costs;
5) what kinds of costs occur in each stage of the emergence and development of crises (threats) of contemporary civilisation;
6) what are the concrete forms of costs related to the specific main crises (threats) of contemporary civilization.

The answer to the first challenge is extremely important not only from a cognitive, but also from an accountancy point of view. From a cognitive perspective, studying costs shows that practically any event, as a rule, generates costs and benefits, which means that even such situations as crises have two dimensions related to their positive and negative consequences. If that is indeed so, then while studying their widely understood consequences, we must consider the outcome of comparison between evaluated costs and benefits. Additionally, if a given phenomenon displays higher benefits than costs, it cannot be called a crisis or threat.

The second challenge presents two important and difficult cognitive and accounting problems. The first is related to the potentiality of costs, which then take on the attributes of risk. In particular, we must know the probabilities of their occurrence, which may be expressed as weights of expected value, according to the Pascal or Bernoulli theorems. The more precise the weight is, which depends on the assessment of the probability distributions of risk, the more precise the calculation of costs will be. The second problem is related in particular to consequences that do not have a market price (value), which is highly valued in economic accountant circles. However, we must remember that many adverse effects of crises are not reflected in the market, which forces the development of appropriate methods of evaluating them (Becla, Czaja, & Zielińska, 2012). This may be considered one of the more critical challenges of contemporary economics, especially the economic theory of value, accountancy, or cost calculus.

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The third challenge mentioned is mostly related to decision-making and management and is partly associated with the strategy and policy of reacting to barriers to development. If such strategy and related policy concentrate on reacting to the negative consequences of a crisis (threat), then the scope and varieties of incurred costs will be different than in the case of a preventative approach meant to anticipate potential threats. There are ongoing disagreements among economists studying the calculation of costs, as to which approach incurs higher costs in economic resources. The most probable position is that neither of these views is unequivocally dominant, meaning that in particular circumstances, one approach is more costly, while in other circumstances, the other is more costly. The preventative approach perhaps requires more knowledge and skill. However, the reactive approach may cause the occurrence of consequences that are irreversible or very hard to reverse. Then the costs of their liquidation rapidly grow even to infinity, and economic calculation loses its purpose and utility.

The fourth challenge is very interesting from the accounting point of view, as it is connected to the quantitative relations between the size of the crisis (threat) and the size of the costs related to it. In cost calculations, it is most often assumed, and this assumption seems justified, that most relations are directly proportional (linear) or linearised – the bigger or deeper the phenomenon, the bigger are the costs related to it, in appropriate proportions. There are situations, however, where the relations become non-linear. This may be as a result of synergy, which means additional influences (scale effects or critical mass effects) that are difficult or impossible to predict, or a result of many-directional influences on the size of the costs of different factors. The recognition of these relations forms the basis of introducing and utilising the appropriate accounting formulae in the calculation of costs.

The fifth challenge is a very curious issue. What are the kinds of costs that we encounter when evaluating the various forms of crises (threats), and what are the kinds proposed to us in this area by the theory of economic costs? Numerous studies related to social and economic costs show a wide variety of their kinds, as well as still existing shortcomings (Becla, 2019). The following costs, among others, were distinguished in that paper: (1) accounting costs, (2) transactional and quasi-transactional costs, (3) alternative costs of lost possibilities, (4) external costs to other entities, (5) various non-internalized social costs, (6) costs of purchasing data and information and/or data collection services, (7) costs of violating the law by the entity collecting data and information, (8) social costs of the diffusion system that cannot be internalised. It is most often postulated to consider the following four groups of kinds of costs in complex situations of crisis (threat): (1) accounting costs, *explicite*, (2) alternative costs, which together with the first group are the economic costs, as well as (3) transactional costs, and (4)

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widely understood social costs, together with external costs. Detailed analyses of given socioeconomic situations often point to additional challenges, when particular costs generate kinds of costs that are difficult to define.

The last, sixth challenge stated is related to issues of identifying, quantifying and evaluating, which come in real and potential form, as well as *ex post*, *in tempora*, or ex-ante, with every given crisis (threat) of contemporary civilization on a global scale. Examples of such combination of threats are the following: (1) environmental-climate crisis, demographic crisis, economic-financial crisis, virtual computer network and information network crisis, crisis of democracy and political institutions, and (2) economic threats, health threats, ignorance threats.

The desired calculus of costs proposed by the authors poses many cognitive, methodological and accounting challenges in four significant dimensions:

- spatial, spanning from the local to global scale,
- temporal, including research on the past, present, and future,
- variety of costs, related to the diversity of considered costs,
- variety of problems, related to the wide scope of considered forms of crises (threats).

Keeping in mind the complexity of the mentioned area, a few remarks are made about the chosen dimensions of contemporary global crises of human civilisation. The authors have chosen the examples. The choice includes elements considered most important by the authors, posing the largest threat to the future development of human civilisation on a global scale. Because the authors are adherents to the Sagan-Building idea of "spaceship Earth", the global perspective is the only appropriate one in their view. Although global phenomena are analysed, one must keep in mind that many threats are generated as microeconomic processes by the proper formation of attitudes and behaviour of micro-entities, often singular actions or micro trends. (Penn, Kinney, & Zalesne, 2009) Next, as they become widespread (occur more often) and deepened, they become global problems (Czaja & Becla, 2007).

Basic groups of costs generated by the global climate crisis ("black swan")

It is good to take a brief look at the main groups of costs generated by the global crises (threats) of the human civilisation distinguished above.

Global climate change and other environmental problems on this scale affect the entire globe. Apart from climate change, such global problems include: (1) degradation of the ozone layer, (2) deforestation of the Earth's surface, (3) desertification of the planet, (4) pollution of seas and oceans,

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(5) degradation of drinking water reserves, (6) degradation of biodiversity, (7) degradation of natural landscapes, ecosystems, and non-economic utilities of the natural environment, as well as (8) acid rain, and (9) outer space pollution (Czaja & Becla, 2007).

Therefore their scale and complexity generates the most groups of costs. Practical research of this type would be extremely difficult to conduct on a global scale. Case studies of local ecosystems or particular types of effects seem to be a better solution in terms of practical realization. These types of approaches may minimise estimation and calculation errors.

Several extraordinarily complex methodological and accounting problems emerge about all estimations on a global scale; these include:

- extremely hard to identify negative (mostly cost-generating) and positive (mostly benefit-generating) outcomes of the given crisis (threat);
- the fact that most outcomes are nonmarket-related, which calls for the development of appropriate but uniform methods for their evaluation;
- the need to determine the entities that are the primary agents and the recipients of certain costs, which are often external.

Taking into account the current level of recognition of problems, the current climate environmental crisis generates and will continue to generate (Kośmicki, 2009):

- direct costs of the degradation of the natural environment on vast areas of the planet, identified in numerous detailed empirical studies;
- ongoing costs of current actions limiting the most dangerous negative environmental consequences;
- the costs of increased disease prevalence and mortality due to environmental reasons;
- the benefits and environmental services lost due to deforestation;
- the costs of loss of soils suitable for agriculture and animal breeding due to desertification;
- economic losses (e.g. to fishing or tourism) due to pollution of the sea and oceanic waters;
- economic and non-economic consequences of diminished availability of drinking water;
- loss of benefits due to the degradation of biodiversity, natural landscapes or environmental services or utilities; these lost utilities may include: (1) loss of undiscovered species (loss of biological knowledge), (2) loss of production and nutritional value of unused animal and plant species, (3) losses due to danger to crops and livestock from new diseases and parasites, (4) loss of new drugs and substances for the pharmaceutical industry, (5) loss of new substances and materials usable by industry, (6) depreciation of human ethical and moral systems, (7) loss of aesthetic value, (8) loss of potential information about various environmental pro-

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cesses, (9) threat to life on Earth, and (10) threat to the existence of human civilisation, especially to future generations (Czaja & Becla, 2007);
- the costs of maintenance of material infrastructure and historical monuments, as well as soils and surface waters as a consequence of acid rain;
- the costs of threats to devices placed in outer space (telecommunication satellites, telescopes and research equipment) and danger to human life (astronauts).

These are several chosen kinds of costs related to the climate-environmental crisis (Klein, 2016; Popkiewicz, Kardaś, & Malinowski, 2018; Czaja, 1998). Each of the above groups of costs may be analysed into particular costs: accounting, alternative, transactional, and external, including social, each referring to a form of unfavourable influence on the natural environment. Each of the above groups of costs requires the following procedure for recording: (1) detailed identification of particular components, (2) quantification of their size in natural units and (3) monetary valuation that allow for comparison and aggregation of these costs.

Identification requires appropriate knowledge of the effects of environmental threats and crises, understood as their costs. It also requires a detailed specification of their kinds if they are meant to be an accounting/recording macrosystem element. Quantification should be based on sufficiently (acceptably) precise size measurements in natural units of their occurrence. Monetary valuation generates two groups of challenges: (1) finding market (meaning priced) counterparts for adverse outcomes of threats/crises or (2), if such images do not exist, developing acceptable methods of evaluating negative consequences.

The remaining forms of global environmental problems such as (1) destruction of the ozone layer, (2) deforestation of the surface of the Earth, (3) desertification of the surface of the planet, (4) pollution of seas and oceans, (5) degradation of drinking water reserves, (6) degradation of biodiversity, and (7) degradation of natural landscapes, ecosystems, and non-economic utilities of the natural environment, as well as (8) acid rain, and (9) outer space pollution, generate similar groups of costs, which require identification, quantification, and valuation. A similar approach may be applied more widely, to other kinds of threats to contemporary human civilization, for example: (1) the demographic crisis, which means global overpopulation, especially in the countries of the impoverished South, and global migration movements; (2) the economic and financial crisis, which is related to uncontrolled actions of Veblen's "business world" on a global scale, widespread debt on all levels, from households to states, as well as poverty in many forms, and property and income polarization, (3) economic threats in the form of excessive consumerism and aggressive marketing, with various consequences, (4) health threats, which not only result in lowered lifespans,

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changed death rates (with prevalent deaths related to cancer, respiratory system diseases, circulatory system diseases, and obesity), disease-to-pharpacological-treatment chains, and new threats, and more frequent epidemics (malaria, AIDS), or even pandemics (coronavirus), (5) ignorance and irrationality, a peculiar phenomenon in a world with dynamic science growth, (6) a crisis of information and computer networks, of the Internet and virtualization, with all its negative consequences with short-term and long-term consequences, (7) crisis of democracy and democratic and political structures, leading to totalitarian states, and populist attitudes and actions, as well as (8) civilization, cultural and religious conflicts related to a lack of tolerance in particular axiological systems.

Raising the topic of the sources of the costs of the crises of human civilisation on a global scale, the authors were cognizant of their cognitive, methodological and accounting complexity. They were not entirely convinced that this type of problem could be solved on this kind of scale. Global accounting would be possible under two essential conditions: (1) everyone should want the realisation of this kind of idea, and (2) a global system of recording such costs should be developed, modelled after the *System of National Accounts* (SNA). These conditions are not easily fulfilled, which is confirmed by the following: the increasing ignorance and irrationality and the difficulties with global socioeconomic statistics, despite the seventy years it has existed for. In many (indeed most) states, an SNA system does not exist. All attempts at introducing new measures and indicators, such as HDI, sustainable growth indicators, or KAM for an information society, do not find an appropriate reference and are based more on external estimations than on precise record-keeping, which weakens their significance.

The question of the viability of the development of a calculation of the global costs of the crises of human civilisation is related to a different one – what is the purpose of making such calculations? An affirmative answer is connected to several points:

- for cognitive reasons, which do not need to be justified, and which positively affect the development of science, including economics and economics of waste,
- due to the desire to realise joint ventures (global policies),
- for consciousness reasons, in order to convince the necessary part of humanity to initiate preventative measures,
- to strengthen international cooperation and development of global governance,
- to limit waste in all forms of human activity due to the growing scarcity of resources and anthropopression on a global scale.

This is an opportune place to raise two other reasons for which global accounting makes sense:

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- the s-logistic or non-linear characteristic of the development (evolution) of many phenomena and processes,
- the problem of information overload, or the overabundance of information about the human brain's capacity for absorption.

Regarding the non-linear trajectory of the evolution of phenomena (processes), the problem of the difficulty of their prediction is generated and the issue of reacting to their negative consequences. Contemporary economics has few methods helpful in this domain. Their development is one of the modern economic theory's most challenging and critical cognitive challenges. The overabundance of information poses a different danger related to the fact that it is necessary to utilise algorithms or, indeed, to subordinate humans to algorithms and computer programs.

Does the development of economic sciences and systems of accounting and compilation of data (information) allow for an effective solution for the above challenges? The answer to this question is affirmative. If it was possible to develop and introduce a global system of accounting for the costs of crises (threats), there would be a chance for: (1) limiting their scope and range through better prediction and more effective reaction, (2) strengthening international cooperation, and thus in its scope a more just internalisation of such negative effects, (3) taking more effective (efficient) preventative measures. It bears remembering that the mentioned and other global forms of threats and crises will only intensify and not desist. Perhaps such a global system of accounting the costs of problems (threats) is one of the significant fail-safes necessary for the survival of human civilisation in the coming decades.

Conclusions

The growing number, variety, and depth of threats and crises of contemporary human civilisation prompts the following conclusion: it is necessary to develop macrosystems for accounting for the negative effects of such phenomena, understood in categories of cost calculus. This demands fulfilling a few preconditions, most importantly: (1) deepening the development of research on threats, crises, or civilisational barriers, (2) developing the methodological accounting basis for such macrosystems, modelled after SNA or LINK, and also (3) the presence of political will for the development of such global system of accounting the costs of negative phenomena. The existing legacy of international agendas, government institutions, NGOs, research institutes, academic centres, insurance companies, or national and international systems for socioeconomic statistics may be utilised. The need for the existence of such a system is beyond discussion in light of humanity's experiences.

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The contribution of the authors

The article was written in collaboration by all authors.

References

Ayres, R. (1998). *Turning Point. The End of the Growth Paradigm*, London: Earthscan.

Becla, A. (2019). *Kształtowanie się kosztów pozyskania informacji ze źródeł zewnętrznych w świetle dorobku ekonomii dobrobytu*, Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu.

Becla, A., Czaja, S., & Graczyk, A. (2020). *Bariery gospodarowania we współczesnej ekonomii i gospodarce*, Warszawa: PWN.

Becla, A., Czaja, S., & Zielińska, A. (2012). *Analiza kosztów-korzyści w wycenie środowiska przyrodniczego*, Warszawa: Difin.

Czaja, S. (1998). *Globalne zmiany klimatyczne*, Białystok: Wydawnictwo Ekonomia i Środowisko.

Czaja, S., & Becla, A. (2007). *Ekologiczne podstawy procesów gospodarowania,* Wrocław: Wydawnictwo Akademii Ekonomicznej im. Oskara Langego we Wrocławiu.

Ficoń, K. (2019). *Inżynieria zarządzania kryzysowego*. *Podejście systemowe*, Warszawa: BEL Studio Sp. z o.o.

Galiński, P. (2018). Finansowanie i organizacja zarządzania kryzysowego i usuwania skutków klęsk żywiołowych w gminie. Zarządzanie i Finanse Journal of Management and Finance, 16, No. 4/1/2018, 77-88.

Indicators of Disaster Risk and Risk Management. (March 2008). Washington D.C.: Inter-American Development Bank.

Investment in Disaster Risk Management in Europe Makes Economic Sense, (2021). World Bank Report, Washington D.C.: World Bank.

Jakimowicz, A. (2017). *Nowa ekonomia. Systemy złożone i homo compositus*, Warszawa: PWN.

Kanisty, K. (2003). *Klęska żywiołowa czy katastrofa społeczna. Psychologiczne konsekwencje polskiej powodzi 1997*, Gdańsk: Wydawnictwo Psychologiczne.

Kirman, A. (2018). *Ekonomia złożoności*. In *Przemyśleć ekonomię od nowa*, Poznań: Heterodox.

Klein, N. (2016). *To zmienia wszystko. Kapitalizm kontra klimat*, Warszawa: Warszawskie Wydawnictwo Literackie MUZA SA.

Kośmicki, E. (2009). *Główne zagadnienia ekologizacji społeczeństwa i gospodarki*, Białystok: Wydawnictwo EkoPress.

Kuźmiński, Ł. (2018). *Modele probabilistycznego pomiaru i oceny ryzyka powodziowego (na przykładzie dorzecza środkowej Odry)*, Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu.

Markowski, A. (Ed.). (2004). *Wielki słownik poprawnej polszczyzny*. Warszawa: PWN.

Mączyńska, E. (2017). *Etyka i ekonomia. W stronę nowego paradygmatu*, Warszawa: PTE.

Penn, M., Kinney Zalesne, E. (2007). *Microtrends: the small forces behind tomorrow's big changes*, New York: Twelve.

DOI: 10.34659/eis.2022.80.1.429

Popkiewicz, M., Kardaś, A., & Malinowski, Sz. (2018). *Nauka o klimacie*, Warszawa: PostFactum.

Roubini, N., Mihm, N. (2011). *Crisis economics: A crash course in the future of finance*, New York: Penguin Press.

Stern, N. (2006). *The Economics of Climate Change*, Cambridge U.K.: Cambridge University Press.

Stern, N., Stiglitz, J. (February 2022). The Economics of Immense Risk, Urgent Action and Radical Change: Toward New Approaches to the Economic of Climate Change. Journal of Economic Methodology. https://doi.org/10.1080/1350178X.2022.2040740

Stern, N. (2010). *Global Deal* (*Globalny ład*). Warszawa: Krytyka Polityczna.

Taleb, N. (2007). *The Black Swan. The Impact of Highly Improbable*, New York: Random House.

Taleb, N. (2012). *Antifragile. Things That Gain from Disorder*, New York: Random House.

The Economics of Climate Change: The Stern Review, (January 2007). Cambridge: Cambridge University Press. https://www.lse.ac.uk/granthaminstitute/publication/the-economics-of-climate-change-the-stern-review/

UNESCO. (2020). *Zarządzanie ryzykiem katastrof w światowym dziedzictwie*, Warszawa. https://whc.unesco.org/document/185306

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ENVIRONMENTAL POLICY AND MANAGEMENT

Grażyna **BORYS**

ROUGH ASSESSMENT OF THE CONSIDERATION OF SPATIAL PLANNING TOOLS IN THE MUNICIPAL PLANS FOR ADAPTATION TO CLIMATE CHANGE. AN EXAMPLE OF SELECTED POLISH CITIES

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ABSTRACT: The subject of the study whose results are presented in this paper is an attempt at assessing the consideration of spatial planning tools in the municipal plans for adaptation to climate change, performed on the sample of fifteen Polish cities with populations of over 100,000. The assessment was performed using a three-step descriptive analysis. The first stage consisted of identifying the thematic areas of such adaptation for which spatial planning tools had been used. The second stage, done against the background of a general review of spatial planning tools, involved identifying the tools that could be assigned to the already identified thematic areas of urban adaptation to climate change. The number of tools used was totalled at the third and final stage, and synthetic analysis of the tools used was performed using a set of selected criteria.
The study is the first, basic attempt to empirically verify the hypothesis that spatial planning and spatial policy play a critical role in adapting cities to climate change, as stated in the subject literature.

KEYWORDS: climate, adaptation, spatial planning

Introduction

The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2007) concluded that climate change would constitute the most significant challenge during the coming decades due to the growing population and the massive use of fossil fuels to provide energy for socio-economic development. In the face of these facts, the common ways of responding to climate change have been identified as follows: 1) mitigating current and future climate change by reducing GHGs emissions and/or increasing their absorption, and 2) adaptation to the effects of climate change. Initially, this reduction of GHG emissions and/or favouring their absorbers received much more attention in the political and scientific communities. During political debates and scientific discussions, less attention was paid to adaptation to climate change. This changed in the aftermath of the Paris Agreement (2015), which called not only on states and regions but also on cities to take action in the face of climate change impact and cooperate with other public and private actors (Lesnikowski et al., 2017). This tendency can be explained by the dynamically increasing number of climate-related disasters compared to the long-term results of climate change mitigation policies (Simonet & Fatorić, 2016). Moreover, during this century, the climate system will undergo significant changes, regardless of any and all efforts to reduce GHGs emissions, mainly due to the thermal inertia of oceans and the long cycle of carbon dioxide and other greenhouse gases (Matthews & Caldeira, 2008). The Sixth IPPC Report (2021) claims that many of these changes will be irreversible.

It is clear that climate change is a global phenomenon, but the effects are felt locally (Bowen & Friel, 2012). This has shifted attention to finding strategies to reduce the susceptibility of territories and populations to the impact of climate change, especially in cities with their growing number of inhabitants and population density, their accumulation of technical infrastructure, as well as their significant social, economic and demographic differentiation (Legutko-Kobus, 2017; Gendźwill, 2017). The Charter of European Planning (2013) clarifies that the local political and substantive leaders must proactively alleviate the impact of climate change instead of passively waiting for the initiatives of their national governments. It is the local action plans that should be the main tool for initiating the adaptation processes.

In the sphere of political activities, a direct result of the interest in adaptation to climate change at the municipal level were numerous initiatives undertaken at various latitudes, including Poland, which involved the development of municipal plans/policies of adaptation, while in the sphere of academic activity it was research on the efficacy and credibility of such plans/

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policies. These studies frequently hypothesise on the key role of spatial planning in adaptation processes. This is rooted in the well–established conviction significant the major advantage of spatial planning is its ability to coordinate matters of common interest or common good in the situation of sustainable development and to function at various levels of space, time and governance at the same time (Aylett, 2015; Czarnecki 2015; Pangsy-Kania 2015; Radziejewski, 2015). This would mean that the success of adaptation to climate change depends primarily on whether the planning activities (the planning tools utilised) as specified in the municipal adaptation plans will result in relevant corrections to the local plans for spatial development or will get accounted for in the newly created plans of this type. The study aimed to empirically verify this hypothesis through a rough assessment of the use of spatial planning tools in the plans for adaptation to climate change as developed by selected Polish cities.

An overview of the literature

Two main research trends have developed within the literature focused on municipal plans for adaptation to climate change. Within the first one, the subject of scientific considerations is the consistency of such plans for adaptation to climate change and their compliance with other municipal plans and programs (for economic development, environmental protection, spatial planning, revitalisation etc.) as well as the compliance of these plans with sectoral plans/programs of higher-level public administration, since the adaptation is horizontal in nature – it goes beyond the traditionally sectoral and vertical divisions in administration. This trend is represented, among others, by Johnson & Breil (2012), who conducted comparative studies of seven municipal plans for adaptation to climate change – those of New York City, Metropolitan District of Quito, Greater London, Tunis, eThekwini Municipality (Durban), Ho Chi Minh City and Bangkok. The study identified the various administrative levels of adaptation planning, the tools and information used in developing adaptation policies, and the role of governance and financing in adapting cities to climate change. Chrobak and Kryczka (2020), on the other hand, carried out a comparative analysis of five key instruments of municipal policies of the city of Wrocław (The Strategy of Wrocław 2030; Adaptation Plan to Climate Change 2030, The Environment Conservation Program for the City of Wrocław for 2016-2020, The Low-carbon Economy). Plan for Integrated Territorial Investments of Wrocław Functional Zone, The Downfall Management Program of Wrocław), verifying the degree of their correlation with the main climate threats identified within the city. Meanwhile, Hurlimanna et al. (2020) examined the occurrence of issues related to the adaptation of cities to climate change in the Australian instruments (pol-

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icies, strategies, legislation) of urban planning at the levels of both the nation and the state of Victoria and in terms of their consistency and compliance. In his research, Wilson (2007) analysed the regulations relating to flood hazards, urban environment, wildlife habitats and water resources as included in 14 local development plans adopted in 2000-2005 in Great Britain. The analysis focused on their consistency with actions covered by local adaptation plans.

Within the other trend, the subject of consideration is the credibility of municipal adaptation policies. Researchers assess the efficiency of actions covered by the plans for adaptation to climate change in the context of the need to raise financial resources for their implementation from private and/or public sources. This trend was initiated by Averchenkov and Bassi (2016) and further developed by Olazabal et al. (2019). Olazabal and her team have developed a conceptual framework for assessing the credibility of municipal plans for adaptation to climate change, including an assessment of political and economic credibility, technical and scientific credibility, and the credibility (legitimacy) of local authorities. Available resources, reliability, and public and private institutional support were identified as key political and economic credibility components. The components of technical and scientific credibility include helpful knowledge, monitoring, evaluation and reporting of achievements, as well as adaptation management. The assessment of the credibility of local authorities took into account its transparency and dialogue with the stakeholders of adaptation. The conceptual framework for assessing the credibility of municipal plans for adaptation to climate change was tested on a sample of four cities from four continents: Copenhagen, Durban, Quito and Vancouver.

Research methods

General information on case studies – selected Polish cities

At the Ministry of the Environment initiative, between January 2017 and January 2019, forty-four Polish cities of, as a rule, over 100,000 inhabitants carried out a project to develop municipal plans for adaptation to climate change. The main goal of the project was to "prepare city authorities and inhabitants to consciously and responsibly respond to possible climate change and its effects". For the purposes of this study, 15 cities were selected for detailed analysis, namely: Białystok, Bydgoszcz, Gdańsk, Katowice, Kielce, Kraków, Lublin, Łódź, Olsztyn, Opole, Poznań, Rzeszów, Szczecin, Wrocław, and Zielona Góra. Three central institutes for research coordinated the project. The project was based on a uniform methodology, as described in „Podręcznik adaptacji dla miast" (Ministry of Environment, 2017), which

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contains detailed guidelines for subsequent stages of adaptation plans development, i.e., the stage initiating the process, assessing the city's climatic susceptibility, climate risk analysis, studies on adaptation options, assessment and selection of adaptation options, and finally the preparation of a planning document.

Purpose, subject and stages of research

As already mentioned, the aim of the research presented in the article is rough verification of the hypothesis about the special role of spatial planning in adapting cities to climate change. The verification attempt was based on a descriptive analysis, which made it possible to evaluate the scope of the use of spatial planning tools in the adaptation plans of selected cities. The study was a three-stage one. At the initial stage, I identified the areas of planned local public intervention to reduce the susceptibility of cities to the predicted negative effects of climate change. Like any other form of public planning in a market economy, spatial planning is a form of public sector intervention in the market mechanism allocating factors of production, goods and, indirectly, also socio-economic activity of man in space (Markowski, 2013; Drzazga, 2018). In the case of spatial planning, the nature of this intervention is inherently non-physical (non-material). Still, it has effects primarily in the material dimension – it leads to a specific spatial development. At the second stage of the analysis, spatial planning tools were reviewed without considering any specific techniques. At the third stage, I conducted a comparative analysis of the use of spatial planning tools for individual areas of local public intervention as specified in planning documents and identified their relevant features to assess their role in the adaptation planning activities.

Results of the research

An analysis of the content of plans for adaptation to climate change demonstrated that the cities selected had planned their public intervention in the six most important areas:

- ensuring the thermal and humidity comfort of the population in public spaces,
- securing ventilation and airing of the city,
- ensuring natural water retention of the ground,
- limiting the urbanisation pressure on floodplains and lands with high landslide risk,
- protection against strong winds, local hurricanes and whirlwinds,
- protection of biodiversity and environmental components,

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- up-to-date visualisation of the distribution of exposure to climate risk throughout different areas of the city.

Public intervention in the sphere of ensuring the thermal and humidity comfort of the population in public spaces is dictated by an increased frequency of extreme thermal phenomena, i.e. heat or cold waves, and the occurrence of urban heat islands (UHIs). An "urban heat island" means an increase in air temperature in the ground layer of the atmosphere within an urban area in relation to the air temperature outside the city. Urban heat islands result from a local increase in air temperature due to the rise in the share of heat–absorbing surfaces of roads and buildings, a reduction in green areas and the number of trees, and hydrological changes.

The aim of public intervention in the sphere of ventilation and airing of the city is to counteract air stagnation within the urban area due to limited horizontal and vertical exchange of air masses and to the lack of appropriate climate supply zones – large areas of open space located by the prevailing wind direction (Rawski, 2017).

Public intervention in the sphere of natural water retention in cities, especially in large cities, has become a necessity in the situation where the natural mechanisms maintaining the water balance have been eliminated from the built environment by the disappearance of natural (permeable) surfaces and in particular the disappearance of natural water circulation systems. The urban planning of the 20th century had water significance reduced to its utility functions, and consequently, water management became a purely engineering domain. The classical engineering approach to urban water management deals solely with a water supply and wastewater disposal.

Public intervention in the urbanisation process of floodplains (i.e. areas that are not usually covered by water, but there is a risk of such coverage whenever water rises in natural watercourses, reservoirs, canals or at a seashore) is a key element of a flood risk management system. Flooding is one of the most dangerous hydrological phenomena that humans can face. Intervention in areas at risk of landslides relates primarily to mountain and foothill areas.

A public intervention consisting of protection against strong winds, local hurricanes, and whirlwinds translates to the protection of residents' life, health, and property in the event of a threat from falling trees, branches, or damaged elements of building structures.

In the context of adaptation to climate change, the public intervention of cities includes up-to-date visualisation of the distribution of exposure to climate risk throughout different city areas.

It should be noted that among the above-mentioned thematic areas earmarked by the cities in question for public intervention, no consideration was given to the positive effects of climate change, which means a visible

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narrowing of the concept of adaptation to climate change. The IPCC (2013) defines adaptation as adapting natural or human systems in response to the actual or likely climatic stimuli or mitigating damage or taking advantage of beneficial opportunities. However, the cities have not demonstrated any awareness of the opportunities related to climate change, and consequently of the possibilities of using them, which seems to suggest that adaptation to climate change is perceived solely as a forced response that requires a lot of investment, sacrifices and resulting restrictions (Simonet & Fatoric, 2016). This may reduce the social commitment to such adaptation.

Local public authorities can and should use the entire range of spatial planning activities/tools in the process of adapting cities to climate change. These include inventories, analyses, developing urban and architectural concepts, studies of pre-conditions, environmental impact assessments, eco physiography studies, zoning (urban planning) standards, visualisations, reviews, monitoring and evaluation of plans[1]. Among these tools, a significant role is played by urban planning standards, i.e., patterns of spatial development, which include principles, guidelines, recommendations and urbanisation indicators. The standards may be "soft", i.e., they may function as land development and development methods recommended for use in a given area or mandatory when the necessity to apply them results from local, regional or national law provisions. The latter may be national or regional guidelines for the development of local plans for spatial development or may be applicable outside the plan as a spatial management regulation of a national, regional or local reach, specifying the management methods for specific types of areas (e.g. floodplains, protected natural areas, single-family housing estates, landscaped or natural green areas).

In the sphere of ensuring thermal and humidity comfort in public spaces, four tools were used: a spatial analysis of the scope and distribution of UHIs, the concept of building green and blue infrastructure, the architectural and landscaping concept of urban green areas, urban planning standard (technical and architectural recommendations for shaping public spaces, taking into account the green and blue infrastructure), review of planning documents (pre-conditions studies and local plans for spatial development) in terms of up-to-date temperature forecasts for the city. The scope of using these tools in plans for adaptation to climate change is shown in Table 1.

1 The list of these tools is obviously much shorter than the general list of spatial policies' tools, which also includes, inter alia, stimulating and incentivising measures (e.g. tax preferences, targeted subsidies), compulsory measures (e.g. expropriations, pre-emptive rights), urban marketing, regulations (e.g. laws and administrative decisions), as well as participatory spatial planning processes (social consultations and mediation).

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Table 1. Spatial planning tools identified in the sphere of ensuring thermal and humidity comfort in public spaces

City	Analysis of the scope and distribution of UHIs	Architectural and landscaping concept of urban green areas	The idea of building green and blue infrastructure	Urban planning standard	Review of planning documents
Białystok	–	–	–	+	+
Bydgoszcz	–	–	–	–	+
Gdańsk	+	–	–	+	+
Katowice	+	–	–	–	+
Kielce	–	–	+	+	+
Kraków	–	–	+	–	+
Lublin	–	–	+	+	+
Łódź	–	–	–	–	+
Olsztyn	–	–	–	+	+
Opole	–	+	–	–	–
Poznań	–	–	+	–	–
Rzeszów	–	–	–	–	–
Szczecin	–	–	–	+	+
Wrocław	+	–	–	–	–
Zielona Góra	–	+	–	–	–
Total	3	2	4	6	10

Source: author's work based on the adaptation plans studied.

As can be seen from the information in Table 1, in the sphere of ensuring thermal and humidity comfort in public space, the spatial planning tools most often used were a review of planning documents and urban planning standards in the cities' adaptation plans.

However, it should be noted that the activity consisting of conducting a review of planning documents was formulated in a very general manner – as a review in terms of up-to-date temperature forecasts – and did not explicitly require these documents to be modified.

In the sphere of securing ventilation and airing of the city, three spatial planning tools were used in municipal plans for adaptation to climate change: analysis of the pre-conditions / potentials for ventilation and airing of the city (i.e. classification of areas by their air exchange function and identification of barriers to city ventilation), the urban planning standard related to passive and active protection of ecological corridors and city ventilation,

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as well as verification of the existing planning documents in such terms. The scope of using these tools in plans for adaptation to climate change is shown in Table 2.

Table 2. Spatial planning tools identified in the sphere of ensuring ventilation and airing of the city

City	Analysis of pre-conditions/potentials	Urban planning standard	Verification of planning documents
Białystok	–	+	+
Bydgoszcz	–	+	+
Gdańsk	–	+	–
Katowice	–	+	+
Kielce	+	+	+
Kraków	–	–	+
Lublin	+	+	+
Łódź	–	+	+
Olsztyn	–	+	+
Opole	+	+	+
Poznań	–	–	–
Rzeszów	–	–	–
Szczecin	+	+	+
Wrocław	+	+	+
Zielona Góra	–	+	+
Suma	5	12	12

Source: author's work based on the adaptation plans studied.

The information shown in Table 2 indicates that in the sphere of ventilation and airing of the city, the studied entities envisage using such spatial planning tools as the urban planning standard and verification of the existing planning documents. The urban planning standard aims to passive protection of city airing (building development restrictions) and active protection of ecological corridors (protection and enlargement of green areas with an appropriate species composition and multi-storey structure).

In the sphere of ensuring natural water retention, four tools were used: land surveys of the components of rainwater management system/retention potential of water reservoirs and green areas, urban planning standards, studies of hydrological, lithological and natural preconditions for the crea-

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tion of retention, and verification of planning documents. The scope of using these tools in municipal plans for adaptation to climate change is shown in Table 3.

Table 3. Spatial planning tools identified in the sphere of ensuring natural water retention

City	Land survey	Pre-conditions study	Concept of building green and blue infrastructure	Urban planning standard	Verification of planning documents
Białystok	–	–	–	+	+
Bydgoszcz	–	–	–	–	–
Gdańsk	–	–	+	+	+
Katowice	–	–	+	+	+
Kielce	+	–	–	+	+
Kraków	+	–	–	–	–
Lublin	–	–	–	+	+
Łódź	–	–	–	–	+
Olsztyn	–	–	–	+	+
Opole	+	–	–	+	–
Poznań	–	–	–	–	–
Rzeszów	–	–	–	–	–
Szczecin	–	–	–	+	+
Wrocław	–	–	–	+	+
Zielona Góra	–	+	–	+	+
Total	3	1	2	10	10

Source: author's work based on the adaptation plans studied.

In the municipal plans for adaptation to climate change covered by the study, the most significant importance is attached to the following spatial planning tools in the area of natural water retention: verification of planning documents and the urban planning standard of protecting unsealed (permeable) areas against the pressure from investors.

In the sphere of limiting the urban pressure on floodplains and areas threatened with landslides, five spatial planning tools were used: the concept of blue and green infrastructure in natural floodplains, assessment of landslide threat, urban planning standard to limit investment/building in river floodplains and areas actually flooded in the past, the adaptation of provisions of the planning documents to the currently forecasted threats, and removal/function change of infrastructure facilities located in flood risk

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zones. The scope of using these tools in municipal plans for adaptation to climate change is shown in Table 4.

Table 4. Spatial planning tools identified in the sphere of limiting urban pressure on both floodplains and areas at risk of landslides

City	Concept of blue-green infrastructure	Assessment of landslide risk	Urban planning standard	Verification of planning documents	Removal/function change of objects in high-risk zones
Białystok	–	+	+	–	–
Bydgoszcz	–	–	–	–	–
Gdańsk	–	–	–	–	+
Katowice	+	–	–	–	–
Kielce	–	–	+	–	–
Kraków	–	–	–	+	–
Lublin	–	–	+	–	–
Łódź	–	–	–	+	–
Olsztyn	–	–	–	–	–
Opole	–	–	–	–	–
Poznań	–	–	–	–	–
Rzeszów	–	–	–	–	–
Szczecin	+	–	+	–	+
Wrocław	–	–	–	–	–
Zielona Góra	–	–	–	–	–
Total	2	1	3	2	2

Source: author's work based on the adaptation plans studied.

The spatial planning tool most widely used in the municipal plans for adaptation to climate change in the sphere of reducing pressure on floodplains was the urban planning standard, followed by the concept of blue-green infrastructure and adaptation of planning documents to the forecasted flood risk.

One tool was used in the sphere of protection against strong winds, local hurricanes, and whirlwinds – a land survey of urban green areas and facilities in urban areas in terms of their vulnerability in extreme weather conditions. Its use has been declared by four cities: Bydgoszcz, Lublin, Szczecin and Wrocław.

The following eight cities reported the protection of biodiversity and components of the natural environment through accounting for the results of

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the dendrological survey and assessing the value of trees in municipal adaptation plans: Białystok, Bydgoszcz, Kielce, Lublin, Olsztyn, Opole, Poznań and Wrocław.

Six cities declared ongoing updating of visualisations of the distribution of exposure to climate risk in various areas of the city in their plans for adaptation to climate change: Białystok, Gdańsk, Katowice, Olsztyn, Rzeszów and Wrocław.

The scope of using spatial planning tools in all the spheres discussed is presented in Table 5.

Table 5. Spatial planning tools identified in various spheres of adaptation to climate change

City	Sphere / maximum number of tools used							
	Thermal comfort / Max. 5	Ventilation and airing of the city/ Max. 3	Water retention / Max.5	Pressure on floodplains and areas with a high risk of landslides/ Max.5	Protection against solid winds / Max.1	Environment protection Max.1	Visualization of risk exposure/ Max.1	Total
Białystok	2	2	2	0	0	1	1	8
Bydgoszcz	1	2	0	0	1	1	0	5
Gdańsk	3	1	3	0	0	0	2	9
Katowice	2	2	3	1	0	0	3	11
Kielce	3	3	3	2	0	1	0	12
Kraków	2	1	1	0	0	0	0	4
Lublin	3	3	2	2	1	1	0	12
Łódź	1	2	1	0	0	0	0	4
Olsztyn	2	2	2	0	0	1	1	8
Opole	1	3	2	0	0	1	0	7
Poznań	1	0	0	0	0	1	0	2
Rzeszów	0	0	0	0	0	0	1	1
Szczecin	2	3	2	3	1	0	0	11
Wrocław	1	3	2	0	1	1	1	9
Zielona Góra	1	2	3	0	0	0	0	6

Source: author's work.

The information presented demonstrates that in the municipal plans for adaptation to climate change of the cities studied, the richest range of spatial planning tools/planning activities was identified in the sphere of ensuring

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thermal and humidity comfort of the population in public spaces as well as ensuring natural water retention (5), in the sphere of reducing pressure on floodplains and on areas with a high risk of landslides (4) and then in the sphere of ventilation and airing of the city (3). One tool was identified in the remaining spheres of public intervention where spatial planning tools are used. Lublin and Kielce are the leaders of the declared use of spatial planning tools in planning for adaptation to climate change, followed by Katowice and Szczecin. Those most significantly lagging behind include Rzeszów, followed by Poznań, Kraków and Łódź.

A vast majority of identified spatial planning tools are used at the pre-planning stage and are informative and diagnostic in nature (e.g. surveys of the retention potential of water reservoirs and green areas; surveys of greenery and objects located in urbanised areas in terms of their vulnerability to extreme weather conditions; analysis of the scope and distribution of UHIs; assessment of landslide risk) or conceptual (e.g. the concept of building blue-green infrastructure). In the planning phase, an important role is played by urban planning standards, the creation of which is declared in the plans for adaptation to climate change. However, the plans don't make it clear whether adherence to these standards will be mandatory or optional (recommendations only). The most directive is the planning activity intended to be used by Gdańsk and Szczecin and consists of the removal/function change of objects located in high-risk flood zones. Nearly half of the cities surveyed have declared that they would use one of the tools – ongoing spatial visualisations of the distribution of exposure to climate risk – apart from the planning activities.

The above analysis of the use of spatial planning tools in municipal plans for adaptation to climate change in the cities studied should be supplemented by observation of using these tools against the background of other types of tools. Tools/activities have been divided into educational and informational or organisational and technical (investment) activities to develop municipal plans for adaptation to climate change. Spatial planning activities/tools have been placed in the organisational tools/activities group. In general, technical tasks dominate in the analysed plans for adaptation to climate change and are followed by information and education tasks. It should be noted that estimated expenditure amounts were assigned to the individual investment, information and education tasks. On the one hand, it is understandable as, as DuPuis & McFarland (2016) emphasise, the use of tools generating cities' own revenues are limited not only by the local economic and political realities, but – significantly – are inevitably affected by the policies incorporated in the multi-level governance framework that covers not only various levels of the national government, but also non-governmental entities such as international organisations and supranational networks. As cities become

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key players in the process of adaptation to climate change, the question must be about not only what climate tools and strategies to adopt but also how to finance them (Gore & Robinson, 2009; Peterson, 2018). On the other hand, the dominance of investment tasks in municipal plans for adaptation to climate change may mean that their authors consider adaptation to be limited to the technical adaptation of cities to biophysical changes, i.e., incremental adaptation to reduce the cities' susceptibility to climate change. Meanwhile, the latest literature on adaptation to climate change contradicts the efficacy and legitimacy of such perception of adaptation, as it limits the potential of adaptation space (Morchain, 2018; Eriksen et al., 2015; Corry & Jorgensen, 2015). It is suggested to move from incremental adaptation, consisting of further infrastructure investments, to transformational adaptation, i.e., one which aims to eliminate ways of creating susceptibility to climate change. This would mean the need to expand the thematic scope of adaptation processes, and this would require a broader discussion, far beyond the scope of this article.

Conclusions

The conducted assessment of the use of spatial planning tools is the first preliminary attempt to empirically verify the hypothesis about the key role of spatial planning in adaptation processes. Another attempt should be made when the plans are already at their monitoring and review phase and a subsequent one – after their full implementation.

It should be noted that the current assessment faced major problems related, firstly, to the fact that the lists of strategic goals as included in the plans in question had been formulated based on various criteria, and secondly to the fact that in some cases, the responsibility for using a specific tool / performing a particular action was not clearly assigned to organisational units of the local authorities. More often than not, the lists of strategic goals had been devised using the criterion of climate stressor type (e.g. temperature, extreme precipitation) and/or the criterion of the type of action/tool to achieve the goals set (e.g. technical, information and/or educational activities). In this context, the city which stands out is Białystok, as it had identified a detailed strategic goal of adaptation – accounting for climate change in spatial planning – and had just one action assigned to this goal, namely the development and adoption of planning and urbanisation guidelines in view of climate change, those to be accounted for both in a study on pre–conditions and directions of the city's spatial development and the resulting local plans for spatial development. Only five municipal climate change adaptation plans specify which organisational units will be in charge of implementing individual adaptation measures.

DOI: 10.34659/eis.2022.80.1.427

References

Averchenkova, A., & Bassi, S. (2016). *Beyond the targets: assessing the political credibility of pledges for the Paris Agreement*, London: Centre for Climate Economics and Policy and Grantham Research Institute on Climate Change and the Environment. https://eprints.lse.ac.uk/65670/

Aylett, A. (2015). Institutionalising the urban governance of climate change adaptation: Results of an international survey. Urban Climate, 14, 4-16.

Bowen, K. J., & Friel, S. (2012). Climate change adaptation: Where does health fit in agenda? Globalization and Health, 8(10), 1-7.

Carter, J. G., Cavan, G., Connelly, A., Guy, S., Handley, J., & Kazmierczak, A. (2015). Climate change and the city: Building capacity for urban adaptation. Progress in Planning 95, 1-66.

Chrobak, K., & Kryczka, P. (2020). The Comparison of urban policy documents in the context of adaptation to climate change – case study of Wrocław, Space & Form, 42, 147-160.

Corry, O., & Jorgensen, D. (2015). Beyond 'dennies' and 'believers': Towards a map of the polities of climate change. Global Environmental Change, 32, 165-174.

Czarnecki, A. (2015). O spójności w planowaniu strategicznym dla rozwoju obszarów wiejskich. Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu, XVII (6), 44-49.

Drzazga, D. (2018). *Systemowe uwarunkowania planowania przestrzennego jako instrument osiągania sustensywnego rozwoju (Systemic Preconditions of Spatial Planning as a Tool for Sustainable Development)*, Łódź: Publishing House of the University of Łódź.

DuPuis, N., & McFarland, C. K. (2016). *Paying for local infrastructure in a new era of federalism: A state-by-state analysis*. Washington: National League of Cities. http://www.nlc.org/resource/local-infrastructure-funding-report

Eriksen, S., Nightingale, A., & Eakin, H. (2015). Reframing adaptation: The political nature of climate change adaptation. Global Environmental Change, 35, 523-533.

Gendźwiłł, A. (2017). Zdecentralizowana adaptacja? Opinie władz lokalnych o zmianach klimatu i lokalnej polityce adaptacji do zmian klimatycznych. Studia Regionalne i Lokalne, 2(68), 31-38.

Gore, C. D., & Robinson, P. (2009). *Local government response to climate change: Our last, best hope?* In H. Selin, I S.D. VanDeveer (Eds.). *Change climate in North American politics. Institutions, policymaking, and multilevel governance*. (pp. 137-158). Cambridge, MA: MIT Press.

Hurlimann, A., Moosavi, S., & Browne, G.R. (2021). Urban planning policy must do more to integrate climate change adaptation and mitigation actions, Land Use Policy, 101, 1-9.

IPPC 2007: *The Physical Science Basis. Report*. (2021, September 22). https://www.ipcc.ch/report/ar4/wg1/

IPPC 2013: *The Physical Science Basis. Report*. (2021, September 22). https://www.ipcc.ch/report/ar5/wg1/

IPPC 2021: *The Physical Science Basis. Report*. (2021, September 22). https://www.ipcc.ch/report/ar6/wg1/

Johnson, K., & Breil, M. (2012). Conceptualizing urban adaptation to climate change. Findings from an applied adaptation assessment framework, CMCC Research Paper No. 131. https://dx.doi.org/10.2139/ssrn.2077476

DOI: 10.34659/eis.2022.80.1.427

Legutko-Kobus, P. (2017). Adaptacja do zmian klimatu jako wyzwanie polityki rozwoju miast w kontekście krajowym i europejskim (Adaptation to climate change as a challenge for urban development policies in the national and European context). Biuletyn Komitetu Przestrzennego Zagospodarowania Kraju Polskiej Akademii Nauk, 268, 83-97.

Lesnikowski, A., Ford, J., Biesbroek, R., Berrang-Ford, L., Maillet, M., Araos, M., & Austin, S. E. (2017). What does the Paris agreement mean for adaptation? Climate Policy, 17, 825-831.

Markowski, T. (2013). Teoria sprawiedliwości i interes publiczny jako podstawa budowania regulacyjnego systemu planowania przestrzennego: konceptualizacja problemu (Theory of justice and public interest as the foundation for building a regulatory system for spatial planning: conceptualization of the problem). In F. Kuźnik (Ed.). *Badania miejskie i regionalne. Doświadczenia i perspektywy*. (pp. 12-23). Studia Komitetu Przestrzennego Zagospodarowania Kraju PAN, vol. CLIII.

Matthews, H. D., & Caldeira, K. (2008). Stabilizing climate requires near-zero emissions. Geophysical Research Letters, 35(4), 1-5.

Ministry of Environment. (2017). *Podręcznik adaptacji dla miast. Wytyczne do przygotowania miejskiego planu adaptacji do zmian klimatu (Adaptation Manual for Cities. Guidelines for the Preparation of a Municipal Plan for Adaptation to Climate Change)*. http://projektymiejskie.pl/wp-content/uploads/2021/09/podrecznik_adaptacji_dla_miast_20191126.pdf

Morchain, D. (2018). Rethinking the framing of climate change adaptation. Knowledge, power, and politics. In S. Klepp & L. Chavez-Rodriguez (Eds.). *A critical approach to climate change adaptation*. *Discourses, politicies, and practices.* (pp. 55-73). New York, Oxon: Routledge.

Olazabal, M., Galarraga, I., Ford, J., Sainz De Murieta, E. & Lesnikowski, A. (2019). Are local climate adaptation policies credible? A conceptual and operational assessment framework. International Journal of Urban Sustainable Development, 11(3), 277-296.

Pangsy-Kania, S. (2015). System zarządzania rozwojem w Polsce i rola w nim dokumentów strategicznych (Development management system in Poland and the role of strategic documents therein). Studia z Polityki Publicznej, 3(7), 121-137.

Peterson, J. (2018). Multilevel governance and innovations in the financing of urban climate change strategies. In S. Hughes, E. K. Chu & S. G. Mason (Eds.). *Climate change in cities. Innovations in multi-level governance.* (pp. 281-298). https://doi.org/10./007/978-3-319-65003-6_14

Radziejowski, J. (2015). Planowanie przestrzenne jako sposób adaptacji do zmian klimatu i przeciwdziałania zjawisku rozlewania się miast (Spatial planning as a means of adapting to climate change and counteracting urban sprawl) In A. Kalinowska (Ed.). *Miasto idealne – miasto zrównoważone. Planowanie przestrzenne terenów zurbanizowanych i jego wpływ na ograniczenie skutków zmian klimatu* (pp. 45-52). Warsaw: Center for Research on Natural Environment and Sustainable Development of Warsaw University.

Rawski, K. (2017). Analiza przewietrzania i wentylacji miasta Białegostoku (An analysis of ventilation and airing of the city of Białystok). Budownictwo i Inżynieria Środowiska, 3, 75-78.

Rosenzweig, C., Solecki, W. D., Hammer, S. A., & S. Mehrotra S. (2011). *Climate Change and Cities: First Assessment Report of the Urban Climate Change Research Network*, Cambridge University Press, New York: Cambridge.

DOI: 10.34659/eis.2022.80.1.427

Simonet, G., & Fatorić, S. (2016). Does "adaptation to climate change" mean resignation or opportunity? Regional Environmental Change, 16, 789-799.

The Charter of European Planning, Barcelona 2013. (2021, October). *The Vision for Cities Regions – Territoires of Europe in the 21st Century. ECTP – CEU*. https://inu.it/wp-content/uploads/ECTP-CEU_Charter_of_European_Planning-_Illustrated_Executive_Summary.pdf

The Paris Agreement 2015. (2021, September). https://www.un.org/en/climatechange/paris-agreement

Wilson, E. (2006). Adapting to Climate Change at the Local Level: The Spatial Planning Response, Local Environment: The International Journal of Justice and Sustainability, 11(6), 609-625.

DOI: 10.34659/eis.2022.80.1.427

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EVALUATION OF THE USE OF COGENERATION BONUS AS A SUPPORT MECHANISM FOR THE TRANSFORMATION OF THE HEATING SYSTEM IN POLAND IN 2019-2020

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ABSTRACT: The development of cogeneration is an element of the transformation of the heating sector in Poland. Consequently, the state applies various subsidy mechanisms. One of them is the cogeneration bonus, designed to stimulate investment in high-efficiency cogeneration. It subsidies the generated electricity to entities that won the cogeneration bonus auction and then made investments in new cogeneration engines. This paper aims to evaluate the use of the cogeneration bonus. The thesis assumes that the cogeneration bonus, despite its supportive nature, is not used by investors. This is evidenced by the low level of contracting of subsidies available in individual auctions. To achieve the study's objective, the ratio of contracted subsidies in the cogeneration bonus auctions to the volume available for contracting in individual auctions was analysed. The author has studied the auction results for cogeneration bonuses, sector reports, CO_2 emission price, types of fuel, and aggregated financial data of heat plants in Poland. The research has an implication character, confirming the lack of adequacy of cogeneration bonuses to the financial situation of potential investors.

KEYWORDS: CHP, cogeneration bonus, RSE, support mechanisms

Introduction

Pollution of the environment and deteriorating air quality have caused regulators to look more and more closely at environmental issues, including ways of generating electricity, especially from renewable sources. One of the solutions in this area is cogeneration, i.e. production of heat and electricity in one technological process. The transition from conventional heat generation to cogeneration poses a significant challenge to the economy due to the substantial investment needed to modernize heating plants; hence Polish legislation applies several incentives and support mechanisms to develop this energy sector. One of them is cogeneration bonus auctions organized by the Energy Regulatory Office.

The essence of the research is to assess the level of utilisation of funds from the cogeneration bonus auctions in 2019-2020 and, as a further search for the causes of the existing situation, macroeconomic analysis of the heating sector in Poland. In this publication, the author has focused on the main factors affecting the condition of the heating market in Poland, i.e.:

- types of fuels used in heat plants in Poland,
- changes in the prices of CO_2 emission rights over the 2017-2020 period,
- changes in prices of coal used in the heating sector in 2017-2020.

Numerous reports of the heating sector and data aggregated by the Energy Regulatory Office in Poland give researchers the opportunity and tools to evaluate the effectiveness of support mechanisms. This article will determine the level of use of the support mechanism, which is the cogeneration bonus.

Basic research categories – An overview of the literature

For ease of understanding by the reader of the text, selected definitions have been adopted that will apply to the terms used later in the paper. Table 1 summarises the basic terms used further in the article and their adopted definitions.

The problem of cogeneration bonuses in Poland is a novel issue, as the first auction of the cogeneration bonus auction was organised by the Energy Regulatory Office only in 2019. Hence, there are not many studies on this detailed issue. The auction organiser for the cogeneration bonus is the Energy Regulatory Office. The auction is open to heat plants, which intend to produce not only heat but also electricity in the so-called cogeneration, i.e. in one technological process (Kiciński & Lampart, 2005). Entities that win the auctions must modernise and start production under high-efficiency cogeneration within five years. As a result of winning the auction, the company (heat

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plant) receives a surcharge on the kWh produced, declared in the auction price, once the heating plant starts producing electricity. The auction is won by entities that meet the formal requirements and declare the lowest auction price until the volume of funds allocated to the cogeneration bonus for a given auction is exhausted (URE, 2021).

Table 1. Definitions of basic categories

Category	Definition
Cogeneration	Generation of heat and electricity in a single process
High-efficiency cogeneration	According to the Energy Law, this is the fuel savings achieved, in a cogeneration system relative to a separate system with reference values, greater than 10%
Cogeneration bonus	Subsidies for electricity generated in auctions held by the Energy Regulatory Office dedicated to medium-sized cogeneration units with electric power between 1 and 50 MW

Source: Kiciński & Lampard 2009; Energy Regulatory Office, 2019; Energy Law, Art. 1. Pt. 38.

Also, the issue of the situation of the heating sector and, in particular, the analysis of support mechanisms in the context of the transformation of the heating sector in Poland is not the subject of many studies in both domestic and foreign literature. The topic of cogeneration itself and its positive impact on the process of heat and electricity generation is addressed by, among others, Jan Kiciński, Piotr Lampart (Kiciński & Lampart, 2009), Janusz Flasza (Flasza, Popenda, & Jąderko, 2013) or Marek Urbanik (Urbanik & Tchórzewska-Cieślak, 2014).

Despite the occurrence of scientific studies and articles in the literature, there is a research gap concerning support mechanisms, their sense-making and effectiveness of action. Within the framework of this article, the author attempts to partially fill this gap by assessing the use of the cogeneration bonus in Poland.

The production of heat and electricity is part of a closed-loop economy. A closed-loop economy is an increasingly prevalent issue in environmental economics. More and more publications appear in this area, and numerous authors, including Walter R. Stahel (Stahel, 2016), Piero Morseletto (Morseletto, 2020), and Joseph Sarkis (Geng, Sakris, & Bleischwitz, 2019), conduct research on the sensibility and the way to implement a closed-loop economy. Within the Polish authors, it is worth noting the studies of Jerzy Śleszyński (Śleszyński, 2018) or Elżbieta and Agnieszka Lorek (Lorek & Lorek, 2018). The main assumption of a closed-loop economy is its self-sufficiency and closed circulation of materials, recycling of waste and reuse in the same processes (Pichlak, 2018, p. 335-339). Non-carbon generation of heat and electricity is necessary within the various processes. Figure 1 shows the pro-

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cesses in a closed-loop economy, along with a listing of energy and heat-intensive processes.

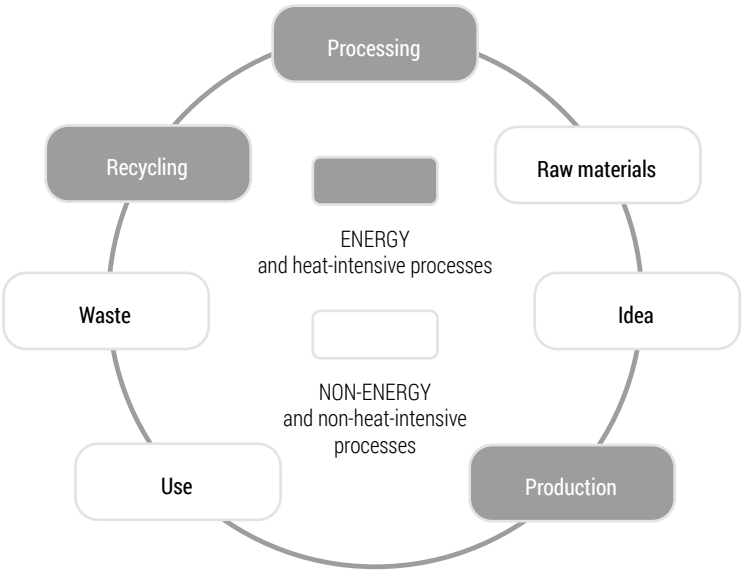

Figure 1. Energy and heat generation in a closed-loop economy

Source: author's work based on Andersen, 2007, 133-140.

Some operations such as recycling, manufacturing or processing often involve the consumption of both electricity and heat. An important aspect is a self-sufficiency and emission-free production of heat and power itself. The production of energy and heat from renewable sources and the efficiency of the production process itself are key factors in developing a closed-loop economy.

Hence, as part of the ongoing energy transition, great importance is attached to renewable energy sources and the generation process itself, including cogeneration. It is worth noting that both the European Union and Poland impose plans for energy transformation. Legal acts regulating climate targets as well as support models for cogeneration include:

- Act of 14 December 2018 on the promotion of electricity from high-efficiency cogeneration (Journal of Laws of 2019, item 42),
- National Energy and Climate Plan 2021-2030,
- Energy Policy of Poland until 2040 (PEP2040),
- Energy Law (Journal of Laws of 2021, item 716).

The main goals for Poland in the context of the energy transformation until 2030 are (KPEiK):

- 7% reduction in greenhouse gas emissions compared to 2005 baseline,

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- 21-23% share of RES in gross final energy consumption,
- reducing the share of coal in electricity production to 56-60%.

The mentioned legal acts also set targets for Poland in the field of heating and cogeneration, i.e. increase of the share of renewable energy sources in heating by 1.1% per year and increase of new cogeneration capacity by 5 GW by 2030.

Legal acts and programs implemented by state institutions result in several support mechanisms aimed at stimulating changes in the heating industry in Poland. These mechanisms can be divided into those focused on supporting capital expenditures and those aimed at stimulation through subsidies to the energy generated in the cogeneration process.

Figure 2 shows Poland's existing and planned support mechanisms for cogeneration until 2030.

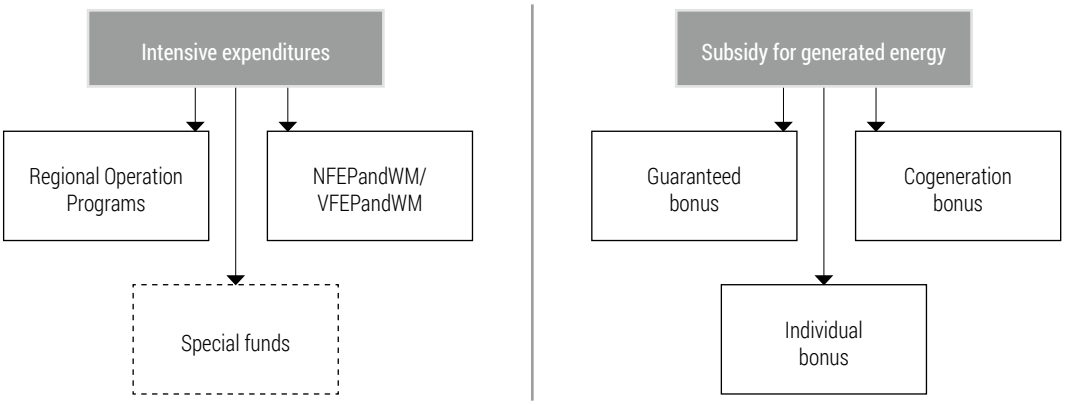

Figure 2. Support mechanisms for cogeneration

Source: author's work based on Urząd Regulacji Energetyki, 2021a.

Regional Operational Programs and resources from the National Fund for Environmental Protection and Water Management are among the most important mechanisms designed to support investment expenditures. These are support programs financed mainly from EU funds. Additionally, national resources' special funds for cogeneration development are planned until 2030. In contrast to the mechanisms focusing on capital expenditures, there are mechanisms based on subsidies for energy generated in high-efficiency cogeneration. These programs stem from the Act on Promoting High-Efficiency Cogeneration (2019, item 42) and are run by the Energy Regulatory Office.

This article focuses on the cogeneration bonus because the distribution of funds under this mechanism (unlike the others) operates on an auction basis, using market mechanisms (i.e. equating supply and demand).

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Research objectives and methods

As the literature review shows, there are many measures and support mechanisms in place for both renewable energy sources and high-efficiency cogeneration itself. It is worth investigating whether these mechanisms are effective and whether they are being used appropriately and as intended. The utilization rate of the cogeneration bonus is measured in this study as the ratio of the contracted funds in a given auction to the volume of funds allocated to that auction (contractable volume).

It was defined by the formula:

$$DCB = \frac{A}{P}, \tag{1}$$

where:
DCB – the degree of use of the cogeneration bonus in a given auction,
A – actual contracted volume (PLN),
P – volume possible to contract (maximum amount of subsidies specified in the auction announcement in PLN).

The author's thesis is that the cogeneration bonus is not adequately used. Within the framework of the study, the author's task is to assess the utilisation level and the reasons for the success or failure of the cogeneration bonus auction. As it is commonly known, each research method should be correlated with the set research objective (Apanowicz, 2000, p. 86) and fulfil the research provisions in a coordinated way. According to the classification of research methods of J. Apanowicz (Apanowicz, 2002, p. 61-77), the method of the research of secondary sources was chosen. Numerous sources were analysed, ranging from market reports, results of the auction for the cogeneration bonus, to coal price indices and aggregate financial results of the heating sector in Poland.

The research process was divided into the following stages:

- Analysis of the results of the Energy Regulatory Office's cogeneration bonus auction in 2019-2020.
- Summary of fuel types used in the heating sector in Poland.
- Analysis of prices of coal used in heating (PSCMI2 index).
- Analysis of CO_2 emission allowance prices (CFI2Z1 index).
- Aggregation of results of heating companies on the Polish market.
- Conclusions from the research.

The research process was designed to fill a research gap, which is the evaluation of the level of utilisation of the cogeneration bonus.

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Course and results of the study

The first part of the research concerns the cogeneration bonus and the degree of its utilisation in 2019-2020. The transformation of heating in Poland is complex and is influenced by many factors. It is determined by normative regulations economic and sectoral situation on the national and EU level. In the further part of this study, the analysis of factors that influence changes in the heating sector is presented. Firstly, the structure of fuels used in the heating sector in Poland was analysed. On this basis, exogenous factors were selected, and two factors were chosen that have a significant influence on the cost and profitability of these enterprises:

a) heating coal prices over recent years,
b) CO_2 emission prices affecting environmental charges.

The study concludes with aggregate financial data for heat plants in Poland.

Cogeneration bonus as a support mechanism for the Polish heating sector

The cogeneration bonus is one of the support mechanisms to promote investment in cogeneration. It stems from the Act on Promoting (2019). Energy Regulatory Office is in charge of conducting auctions for cogeneration bonuses. The cogeneration bonus consists of subsidies for the generated electricity by the companies selected under the auction system.

The main assumptions for the cogeneration bonus auction:

- units with generation capacity between 1 and 50 MW can participate,
- the auctions concern only new or significantly modernised units,
- the surcharge for each kWh applies to the energy produced within 15 years from the first day after the date of the auction, generation, introduction to the grid and sale of electricity,
- the investment implementation period is 60 months,
- the subsidy applies only to each kWh of electricity generated as part of high-efficiency cogeneration,
- no less than 70% of usable heat from the cogeneration unit must be introduced into the public heating network.

The provision concerning usable heat to be fed into the public network limits the support mechanism to enterprises controlled by local governments or companies controlled by the State Treasury. This makes it very difficult to use alternative forms of financing, such as Public-Private Partnership (PPP) or heat plants reaching for private investors or investment funds.

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Results of the 2019-2020 cogeneration bonus auction

The research analysed the effectiveness of the cogeneration bonus auction. Figure 3 shows the support funds available for contracting and their actual use. The study covers the period from the first auction held in 2019 to the end of 2020.

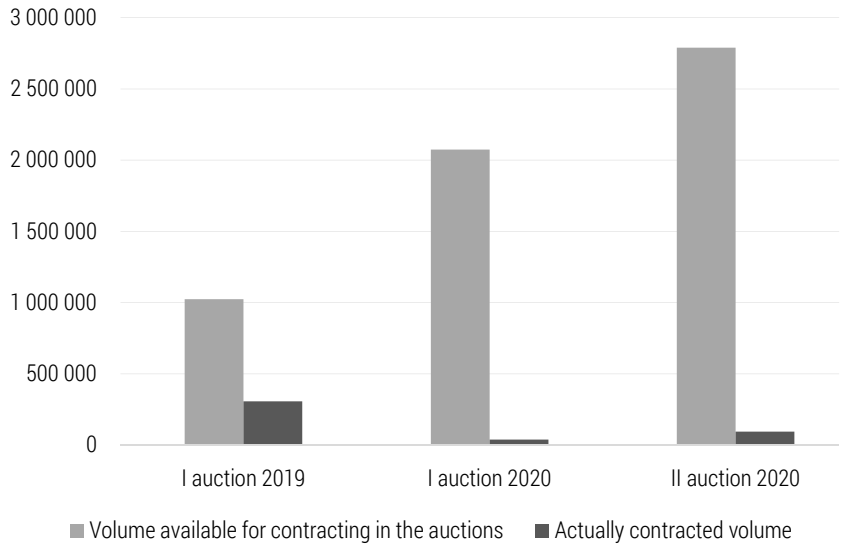

Figure 3. Cogeneration bonus auctions in 2019-2020 in thousand PLN

Source: author's work based on the Energy Regulatory Office data, (15-12-2021).

As shown in the chart, the first three auctions for the cogeneration bonus did not use even a fraction of the possible volume. The efficiency of the first auction measured by the percentage share of available funds was 30.09%, while the efficiency of the two subsequent auctions was 1.89% for the first auction in 2020 and 3.4% for the second auction in 2020. The second auction in 2020 contracted only PLN 94.77 mill. out of the PLN 2 788.93 mill. that could be contracted.

Types of fuel used in heating plants in Poland

The type of technology and raw material for heat generation is one of the key issues in the context of the profitability of heat generation. The most common raw materials used in the heating industry in Poland include hard coal, natural gas and biomass. Based on data from the Energy Regulatory Office, the percentage share of raw materials used in the total heat production in Poland is presented below (Figure 4).

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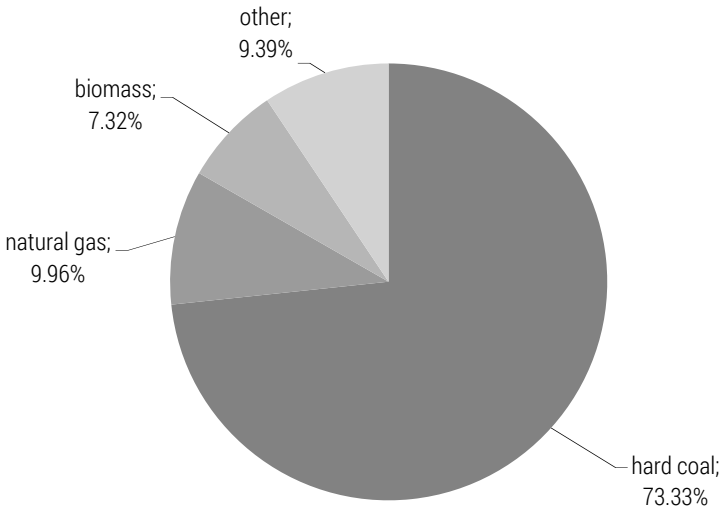

Figure 4. Types of raw materials used for heat generation in Poland in 2019

Source: author's work based on Urząd Regulacji Energetyki, 2021.

Most of the heat in Poland is generated by burning hard coal. In the total volume of raw materials consumed, almost three quarters are coal, 10% is natural gas, and 7% is biomass. Considering that most of the heat is generated from hard coal, it is worth analysing changes in its prices in recent years.

The impact of hard coal price changes from 2017 to 2020

Prices of coal, the primary raw material for heat generation, are reflected in the PSCMI2 index, calculated in PLN/ton. The index is traded on the Polish Power Exchange. Its calculation methodology was developed by the Institute of Mineral Raw Materials and Energy Management of the Polish Academy of Sciences in Krakow. The index represents prices of coal dust used in heating, having the following quality parameters:

- energy value between 23 and 27 MJ/kg,
- sulphur content is less than 0.8%.

Presented prices (Figure 5) are ex-mine (net price excluding excise tax, determined at the point of loading, not including insurance costs).

The price of coal in 2017 was at 240 PLN per one ton. In 2020, heat generators already had to pay more than 315 PLN per one ton. This gives a price increase of more than 30% within three years. The raw material price is the highest cost in every heating company. Price increases in recent years have had a negative impact on the heating market in Poland and have reduced the profitability of most companies in this sector in Poland.

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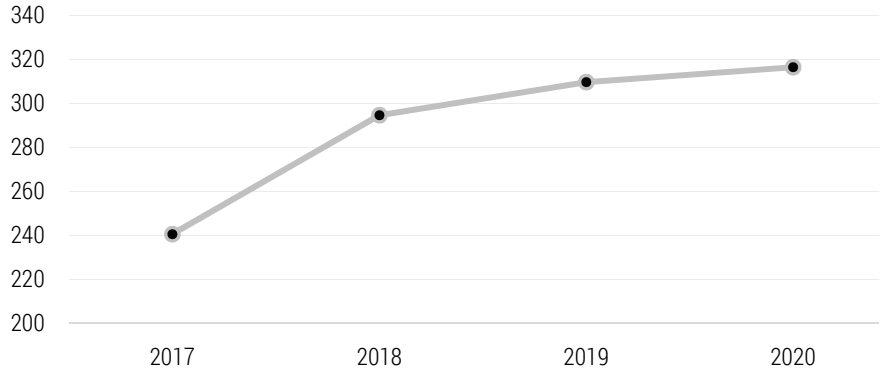

Figure 5. PSCMI2 Index 2017-2020 (PLN/Mg)

Source: author's work based on data from the TGE.

Prices of CO_2 emission allowances

Another factor that burdens heat generation costs is the prices of CO_2 emission allowances (related to the use of hard coal as a fuel). Depending on the level of CO_2 emissions of a given heating plant, it has to reckon with the costs of purchasing emission allowances. The prices of CO_2 emission allowances are reflected in the CFI2Z1 index, which is maintained on the London Stock Exchange. This index presents the costs of forwarding contracts to purchase CO_2 emission permits.

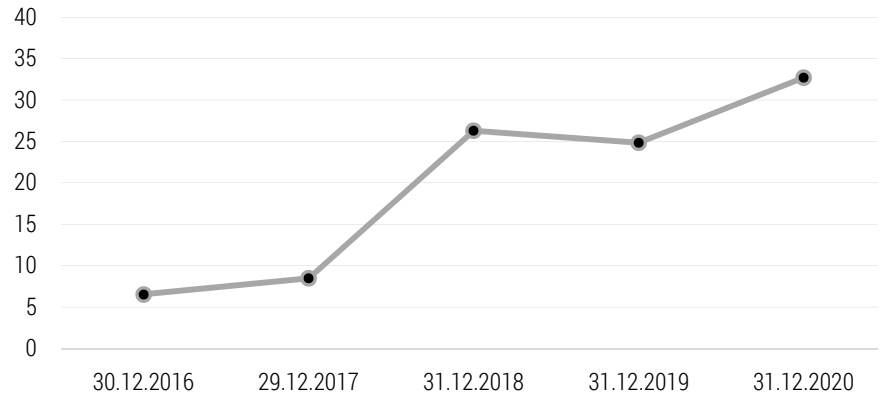

Figure 6. CFI2Z1 Index (EUR) 2016-2020

Source: author's work based on Investing.com, 2021, (15-12-2021).

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The prices of CO_2 emission allowances have increased significantly. While at the end of 2016, the price was at EUR 6.54, by the end of 2020, the price was almost five times higher at EUR 32.72 (Figure 6). This directly affected the performance of heating companies in Poland (shown in Table 2), which use fuels that cause significant emissions (including, to a large extent, Polish heating plants based on coal fuel).

The situation of the heating sector in Poland from 2017 to 2019

The study aggregates the data of the heating sector in Poland and shows the most important total data of the heating industry in Poland from 2017 to 2019. The impact of rising prices of fossil fuels (including hard coal) and CO_2 emission allowances caused a significant deterioration of the heating market in Poland.

Aggregate financial results of heating plants in Poland are presented in Table 2.

Table 2. The financial situation of Polish heating plants in 2017-2019

Selected total results of heating companies in Poland			
Specification	2017	2018	2019
	[in thousand PLN]		
Revenues from heating business	18 942 094,9	18 368 410,7	18 590 936,8
Costs of heating business	17 671 154,7	18 023 295,9	19 134 003,9
including the cost of process fuel	4 083 316,8	4 589 625,6	4 807 128,8
percentage share of fuel costs	23,11	25,46	25,12
incl. environmental charges	188 542,4	235 762,7	324 307,2
Gross profit on heating business	1 270 940,2	345 114,8	-543 067,1
Return on sales	6,71%	1,88%	-2,92%

Source: author's work based on Urząd Regulacji Energetyki, 2021.

In the three years under review, the financial situation of the heating market in Poland deteriorated significantly. While in 2017, heating companies in Poland generated more than PLN 1 billion profit from the heating business, in 2019, they already showed a loss of more than PLN 500 mill. Fuel costs (mainly hard coal) increased by more than PLN 700 mill. in this period, and emission prices almost doubled. The deterioration of the cost positions of the heating companies adversely affected their financial condition, as well as their ability to incur financial liabilities and limited their potential to carry out modernisation and investments in new technologies.

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Conclusions

The development of the market for heating services and support mechanisms designed for renewable energy sources and the assessment of their effectiveness is undoubtedly an important research gap in environmental economics, as well as public finance itself. The author focused on the cogeneration bonus within the study's framework, as it is a new mechanism, existing only since 2019 (the date of the first auction for the cogeneration bonus). The presented study illustrates how important a factor is the excellent selection of support mechanisms to the economic situation of the sector and its current financial condition.

The main findings of the study are:

- as a support mechanism in its current form, the cogeneration bonus is not effective and does not fill the intended and available volumes;
- the main reasons for the insignificant interest in the cogeneration bonus by companies in Poland are:
- the deteriorating financial situation of heat plants causes a lack of funds and credit capacity to carry out the investment (need to incur outlays before the payment of support resulting from winning the auction for the cogeneration bonus),
- limitation of the support mechanism to companies with access to public heat transmission networks (restriction to public heating plants);

Poland needs to introduce new, more tailored support mechanisms for the coal-fueled heating sector to achieve the objectives arising from the National Energy and Climate Plan for 2021-2030 (2021) and the Energy Policy of Poland until 2040 (2021).

This article does not cover the entire spectrum of evaluating support mechanisms for renewables or even cogeneration itself. There are several possible directions for further research in this area. As part of further work, the author intends to focus on the issue of changing the assumptions of the support mechanism, which is the cogeneration bonus, and the analysis of possible measures to support the use of the cogeneration bonus, including:

- facilitation of PPP in the framework of investments in cogeneration,
- creation of additional financial products for Polish municipalities not constituting state aid (in the context of the required own contributions).

The data presented in the paper and their interpretation show that the correct initial assumptions of the support mechanisms do not produce the expected effects in stimulating the development of the heat market and its profitability due to the unused volume of support and external costs, including the increase in fuel prices and the increase in the costs of CO_2 emission allowances.

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References

Act on Promoting of High-Efficiency Cogeneration of 14 December 2018. Journal of Laws 2019 item 42 (2021). https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20190000042/U/D20190042Lj.pdf

Andersen, M. S. (2007). An introductory note on the environmental economics of the circular economy. Sustainability Science, 2(1), 133-1*40.*

Apanowicz, J. (2000). Metodologiczne elementy procesu poznania naukowego w teorii organizacji i zarządzania. Wyższa Szkoła Administracji i Biznesu.

Apanowicz, J. (2002). Metodologia ogólna (General methodology). Gdynia: Wydawnictwo Bernardinum.

Energy Law, Act of April 10, 1997. Journal of Laws 1997 No. 54, item 348 (2021). https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU19970540348/U/D19*970348Lj.pdf*

Energy Policy of Poland until 2040. (2021). Ministry of Climate and Environment. https://www.dziennikustaw.gov.pl/M2021000026401.pdf

Energy Regulatory Office (URE). (2019). Cogeneration Premium Auction Rules. https://www.ure.gov.pl/download/9/10541/REGULAMINAUKCJIlistopad2019.pdf

Energy Regulatory Office. (2021, December 15). Nowe systemy wsparcia dla jednostek w ustawie o promowaniu energii elektrycznej z wysokosprawnej kogeneracji, 2019.

Flasza, J., Popenda, A., & Jąderko, A. (2013). Kogeneracja CHP, szansa rozwoju elektrowni prosumenckich. Maszyny Elektryczne: Zeszyty Problemowe, 2(99), 293-297.

Geng, Y., Sarkis, J., & Bleischwitz, R. (2019). How to globalize the circular economy, Nature 565, 153-155. https://doi.org/10.1038/d41586-019-00017-z

Investing.com. (2021, December 15). Ceny kontraktów terminowych na emisję CO_2. https://pl.investing.com/commodities/carbon-emissions

Izba Gospodarcza Ciepłownictwo Polskie. (2021, December 15). *Raport o ciepłownictwie*. 2020. https://www.igcp.pl/wp-content/uploads/2020/03/Raport-o-ciep%C5%82ownictwie-systemowym-2020.pdf

Kiciński, J., & Lampart, P. (2009). Kogeneracja w dużej i małej skali. Acta Energetica, 2, 21-28. https://bwmeta1.element.baztech-article-BPB7-0022-0010

Lorek, E., & Lorek, A. (2018). Circular economy in sustainable water management – theory and practice. Ekonomia i Środowisko – Economics and Environment, 67(4), 10. https://www.ekonomiaisrodowisko.pl/journal/article/view/116

Morseletto, P. (2020). Targets for a circular economy. Resources, Conservation and Recycling, 153, 104553. https://doi.org/10.1016/j.resconrec.2019.104553

National Energy and Climate Plan 2021-2030. (2021). Ministry of State Assets. https://www.gov.pl/web/aktywa-panstwowe/krajowy-plan-na-rzecz-energii-i-klimatu-na-lata-2021-2030-przekazany-do-ke

Pichlak, M. (2018). Gospodarka o obiegu zamkniętym model koncepcyjny. Ekonomista, 3, 335-346.

Polskie Towarzystwo Elektrociepłowni Zawodowych. (2021, December 15). *Raport o kogeneracji w ciepłownictwie, 2019.* https://www.gov.pl/attachment/1b0d1dfe-9ad4-4e78-a895-21f8413b85d0

Stahel, W. R. (2016). The circular economy. Nature News, 531(7595), 435.

DOI: 10.34659/eis.2022.80.1.439

TGE (Towarowa Giełda Energii). (2021, December 15). http://gpi.tge.pl/

Urbanik, M., & Tchórzewska-Cieślak, B. (2014). Kogeneracja w wytwarzaniu energii cieplnej. Czasopismo Inżynierii Lądowej, Środowiska i Architektury, 61(4), 293-301.

Urząd Regulacji Energetyki. (2021, December 15). Energetyka cieplna w liczbach – 2019, 2020. https://www.ure.gov.pl/download/9/11342/Energetykacieplna-wliczbach2019.pdf

Urząd Regulacji Energetyki. (2021a, December 15). www.ure.gov.pl/pl/urzad/informacje-ogolne/aktualnosci/8021,Nowe-systemy-wsparcia-dla-jednostek-w-ustawie-o-promowaniu-energii-elektrycznej-.html

Śleszyński, J. (2018). Circular economy in the natural and anthropocentric approach. Ekonomia i Środowisko – Economics and Environment, 67(4), 13. https://ekonomiaisrodowisko.pl/journal/article/view/114

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FINANCIAL ECONOMY OF COMMUNES WITH A LARGE FOREST AREA – EXAMPLE OF RURAL COMMUNES OF THE PODLASKIE VOIVODESHIP

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ABSTRACT: The financial situation of rural municipalities in the Podlaskie voivodeship, which has large forest areas, was discussed. The problem that was undertaken was addressed based on mass statistical data from the Central Statistical Office (GUS), and analysis covers the years 2016-2019. The financial economy was assessed based on budget, per capita and debt liability indicators. Correlation analysis was conducted to determine relationships between indicators. Both incomes and expenses per capita are lower than the average for Polish rural communes. Significant differences in the values of other indicators are present between groups, which arises from, among other things, the policy conducted by local authorities—income from forestry tax supplements other income from natural persons' property taxation. The share of income from forestry tax is similar to the percentage of income from agricultural tax and even higher in certain municipalities.

KEYWORDS: budget indicators, forest tax, local budget, rural commune

Introduction

Under conditions of dynamic changes in the external environment, the local authority has special responsibility for the financial situation of a local government unit. Assessment of the financial economy, using the tools appropriate for such assessment, provides information on the current situation and allows for identifying developmental capabilities. The condition of a municipality's financial economy depends, above all, on its internal resources, which determine its income. Municipalities vary in the natural resources they hold and in commercial activity, which ultimately affects generating income. Income from taxes and fees are an essential source of a municipality's income. They are determined by legislation but are at the complete disposal of territorial self-government. This group of taxes includes the property tax. The relevant legislative acts regulate taxation on property components (real estate). The most important among them are: Act on agricultural tax (1984), Act on forestry tax (2002) and Act on local taxes and fees (1991).

Qualifying land as agricultural or forestry land in the land and buildings registry is the basis for taxation, and this tax revenue is an essential source of rural municipalities' income. The number of municipalities in Poland is currently 2477, and of these, 1523 are rural municipalities. They vary in terms of the forest area. Cities of the Lubuskie voivodeship are characterised by the most significant forest coverage (51.7%), and the national average of the forested surface area is 30.9% (CSO, 2020).

The topic of forestry tax is present in the subject literature (Potocki, 2016; Milewska, 2017; Dziuba & Życzkowska, 2021); however, not much attention is dedicated to the financial situation of municipalities disposing of this tax. It seems that the topic is significant, particularly in cities with rich forestry resources. In such a case, the economic potential of commercial activity in municipalities is largely determined by natural conditions. Assessment of the financial economy of rural cities in the Podlaskie voivodeship, where 31.8% of the area is forested, with differentiation from 15% to 88% depending on the municipality (Statistical Office in Bialystok, 2020), was adopted as the goal of research. There are four national parks on the grounds of the voivodeship, including the oldest in Poland, Białowieża National Park, which figures on the UNESCO Global Heritage List.

Forest tax in the commune finance

A municipality's financial autonomy is strictly associated with its right to receive its income and expend it freely. These rights constitute a necessary condition, although insufficient by itself, about autonomy in financial man-

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agement. Municipalities have limited tax authority. They can shape some aspects of taxes within the statutory scope afforded them. The factor deciding the degree of autonomy is an adaptation of the municipality's income to the expenses arising from the performance of its statutory tasks. The realisation of these tasks has a significant impact on the financial economy due to the nature of public services. The research results indicate no significant difference in the tax policy of rural municipalities in terms of the structure of taxes and instruments applied compared to the policies of other types of cities (Dziuba, 2019). Local authorities' activity in using tax policy stimulates the municipality's economic growth, which in consequence increases tax revenue, thereby enhancing the self-government's financial autonomy (Dziuba, 2016). Tax revenue is the most significant revenue stream in the municipality's income structure.

The forestry tax is a typical local tax. Forestry tax applies to the forests specified in the relevant act, except forests occupied for the performance of the non-forestry commercial activity. Since the introduction of the forestry tax (independently of changes in the law), it has been associated with a responsibility for the ownership or management of forests (Pater, 2018). Forestry tax is also employed in forest management policy. Many forest management instruments in the USA are associated with reducing the tax burden in exchange for caretaking and maintaining the forest in its natural condition (Schram et al., 2021).

The tax instrument of forest management for protecting habitat biodiversity is also applied in Japan. A forest-environmental tax has been introduced in many municipalities to protect forests and their environmental functions (Okada et al., 2007; Nakauyama et al., 2019). Research by Wakiyama et al. (2021) is a foundation for the formulation of financing schemes encompassing taxes and other donations by taxpayers to support sustainable services of the forest ecosystem. The environmental aspect of the forestry tax and other forest taxes is also raised in studies by other authors (Daigheault et al., 2020). All US states offer preferential taxation of forest real estate to support ecosystem services (Frey et al., 2019).

Forestry tax is the subject of discussion in a municipality's finances. On the one hand, it emphasises the need to link forestry tax to the rational use of forestry resources. On the other, the impact of tax policy concerning forests on local budgets (Lazhentsev et al., 2020). By applying the appropriate financial instruments, the administrator can influence the self-governing unit's financial situation (Filipiak, 2009). In general, tax policy has a minor influence on the significance of forestry tax in a municipality's structure of finances (Dziuba & Życzkowska, 2021). The results of other studies indicate that local tax policy is not always an effective tool for generating economic

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growth (Korolewska, 2014). The share of forestry tax in a municipality's total income is small, but it is of greater significance in the structure of its income.

Methodology

The undertaken problem was addressed based on mass statistical data from the Local Data Bank (Statistics Poland, 2021). The study covered 78 rural municipalities of the Podlaskie voivodeship. The research process covered two stages. In the first stage, the share of forestry tax in the income structure was calculated for all municipalities. Next (based on quartiles), four groups of municipalities with a varied share of forestry tax in municipality income were identified:

- group I – up to 0.421% (19 municipalities),
- group II – from 0.421% to 0.643% (19 municipalities),
- group III – from 0.643% to 1.343% (21 municipalities)
- and group IV – above 1.343% share of forestry tax in total income (19 municipalities).

In the second research stage, only municipalities with the highest percentage of forestry tax in the budget were considered (group IV). Next, these municipalities were divided into two subgroups, A and B. The division into two subgroups seems justified, as the share of forestry tax in income varies between municipalities (V = 59.02). Until now, research concerning the financial situation of municipalities included municipalities in which income from the forestry tax made up at least 4% of total income (accepted arbitrarily) (Milewska, 2017). Subgroups were distinguished based on the median value (2.57) in this research. 10 of the following municipalities were classified into subgroup A: Janów, Grodzisk, Zambrów, Dziadkowice, Narew, Zbójna, Nurzec-Stacja, Mielnik, Milejczyce, Sztabin.The share of forestry tax in the income of these municipalities ranged from 1.37% to 2.57%. municipalities were classified into subgroup B, where the share of forestry tax in total income ranged from 3.78 to 7.77%, and they are: Szudziałowo, Hajnówka, Nowinka, Dubicze Cerkiewne, Gródek, Narewka, Białowieża, Giby, Płaska. An assessment of the financial economy was conducted for both subgroups. Financial management is comprehensive, so the analysis was limited to selected aspects of economic evaluation, including budget indicators, per capita indicators and debt liability indicators. Evaluation of the financial economy was conducted concerning the years 2016-2019.

Results were compared to rural municipalities in the Podlaskie voivodeship or nationwide, depending on data availability.

Assessments were conducted based on the following indicators:

- budget indicators: share of current revenues in total income (%), the share of own income in total income (%), the share of operational surplus

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in total income (%), the share of capital expenditure in total expenses (%), self-financing indicator (operational surplus + capital gains/ total costs expressed as a %;
- per capita indicators: transfers per capita (PLN), operating surplus per capita (PLN);
- debt liability indicators: share of total liabilities in total income (%), encumbrance of total revenue with debt service expenses (%), the share of mature liabilities in total liabilities (%).

Correlation analysis was conducted to determine relationships between indicators. The matrix of correlation coefficients is given in Tables 3 and 4. Analysis of the financial situation of territorial self-government units differs from an enterprise's analysis, mainly due to the nature of the tasks with which self-government is entrusted. Territorial self-government units are appointed to satisfy the needs of the local community hence they are not profit-oriented. Differences also arise from different sources of financing and different approaches to the principles of financial management (Dylewski et al., 2004).

Results

A municipality's financial autonomy is strictly associated with its right to receive its income and expend it freely. The data given in Tables 1 and 2 indicates the high variation of the studied municipalities regarding their financial situation. The share of own income in total income (WB_2) speaks to financial autonomy. In group A, the average percentage of own income amounted to 34.91% with a range of variation from 20.2% to 75.9%, and in group B, this was 41.03%, with a range of variation from 24.5% to 65.7%. Indicator WB_2 was 33.67% on average during this period for rural municipalities of the Podlaskie voivodeship (Statistical Office in Bialystok, 2000). This indicates that the financial autonomy determined by this indicator is similar to the voivodeship's cities in the case of municipalities from group A. For group B, it is higher (by approx. 7.3%). Significant differences in the values of other indicators are present between groups.

Higher-income and a higher share of it in total income demonstrate greater autonomy of the self-government unit and independence from transfers from the state budget. Own income decides the number of funds allocated to local development. In the studied municipalities, the share of own income in total income (WB_2) was positively correlated with the operational surplus to total income (WB_3) and per capita ratios (WL_2), as well as with the capital expenditures to total expenses ratio (WB_4). A positive correlation was found between the mentioned indicators in group A: r = 0.4332, r = 0.3865, r = 0.6453 (Table 3) and group B: r = 0.5911, r = 0.5408, r = 6375 (Table 4).

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It is also worth paying attention to current income (WB_1), which makes up, on average, over 90%, where the range of variability is very high (0.7-100%).

Table 1. Descriptive statistics of budget indicators for debt liabilities and per capita – group A

Indicator*	Average	Median	Minimun	Maximum	Lower quartile	Upper quartile	Coefficient of variation V
WB1	91.97	95.10	0.70	100.00	90.65	99.05	17.08
WB2	34.91	29.80	20.20	75.90	26.60	41.20	37.64
WB3	9.70	8.55	1.40	25.30	6.00	12.40	55.53
WB4	15.07	12.25	2.10	43.50	9.20	20.50	61.19
WB7	128.81	109.20	28.60	474.40	82.80	149.10	62.84
WZ1	23.19	24.95	0.00	50.50	11.40	32.40	59.27
WZ3	4.68	3.40	0.00	36.90	2.25	4.75	122.92
WZ5	16.13	9.45	0.00	133.80	6.40	17.10	139.05
WL1	2818.97	2735.34	1687.19	4127.92	2458.86	3213.55	20.76
WL2	475.51	394.12	73.81	1357.92	258.74	541.12	66.73

*WB1-share of current income in total income (%); WB2 – share of own income in total income (%); WB3 – share of the operating surplus in total income (%); WB4 – share of property expenditure in total expenditure (%); WB7 – self-financing ratio (operating surplus + property income / total cost) (%); WZ1 – share of total liabilities in total income (%); WZ3 – burdening total revenues with debt servicing expenses (%); WZ5 – burdening own gains with debt servicing expenses (%); WL1 – current transfers per capita (PLN); WL2 – operating surplus per capita (PLN)

Source: author's work based on (Ministerstwo Finansów, 2020).

Table 2. Descriptive statistics of budget indicators for debt liabilities and per capita – group B

Indicator*	Average	Median	Minimun	Maximum	Lower quartile	Upper quartile	Coefficient of variation V
WB1	90.92	95.70	8.70	100.00	88.00	99.25	17.38
WB2	41.03	38.65	24.50	65.70	32.85	47.65	29.17
WB3	7.71	7.35	-2.60	21.60	4.10	9.95	68.70
WB4	13.24	12.10	2.20	31.70	6.70	16.55	59.74
WB7	125.61	96.45	-0.90	394.50	69.85	159.50	70.71
WZ1	34.79	33.20	8.30	76.00	25.85	41.60	42.79
WZ3	4.14	4.15	0.00	8.50	3.40	4.95	42.45
WZ5	11.01	9.00	0.00	24.40	7.15	15.50	53.33
WL1	2456.21	2503.94	1819.54	3046.82	2177.92	2702.22	13.08
WL2	356.84	315.92	-121.85	1247.00	191.67	411.38	72.94

* as in table 1

Source: author's work based on (Ministerstwo Finansów, 2020).

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According to the act on public finance, current income should cover current expenses. In the studied municipalities, this principle was fulfilled, as shown by the positive result between these two values, called the operational surplus. Only in Szudziałowo municipality did a current deficit (WB_3 = -2.6) occur in 2019. Operating surplus reflects the degree of a given unit's financial autonomy and investment capacities. Operating surplus is frequently referred to as the most synthetic indicator of a municipality's financial situation. It informs how many funds remain available after expenses related to current operations are covered. The presence of an operational surplus increases capabilities when it comes to implementing investment projects serving the municipality's development. In assessing a self-government unit's financial situation, the share of operating surplus in total income is significant. This indicator reflects the degree of a given unit's financial autonomy and investment capacities. The average value of the WB_3 index in the analysed communes was 7.71%, which was less than in other rural communes of the Podlaskie Voivodeship (9.97%).

Capabilities of executing investments would have to be analysed through the lens of another indicator, namely the self-financing indicator (WB_7), as the construction of this indicator accounts for capital gains in addition to the operational surplus (Ministerstwo Finansów, 2020). A significant positive dependency was determined between the self-financing indicator and operational overload per capita (r = 0.6056 and r = 0.3882). A negative correlation was found between the self-financing hand and the share of capital expenditures in total expenses (r = -0.5346 and r = -0.4599). The data presented shows that the calculated indicators have an informational (theoretical) value, and self-governments decide on the actual purpose of funds – many factors condition investment.

Only a few municipalities possess capabilities of financing development with their equity, and in most cases, development projects require external funding. The share of capital expenditures in total expenses (WB_4) indicates that municipalities mainly finance tasks related to current operations and leave few resources for the execution of investments. This indicator was lower than in other rural communes of the Podlaskie voivodship (18.52%) in the analysed communes. On the national scale, the share of investment expenditures from 2016-2019 amounted to 15% in rural municipalities (Ministerstwo Finansów, 2020). This indicator was higher in only 8 of the studied municipalities during this time. In municipalities of group B, a negative correlation also occurred between capital expenditures and the encumbrance of own income with debt service (r = -0.3968). The average share of total liabilities amounted to 34.79% (group A – 23.19%) with a range of variation of 8.30-76%. Municipalities with the highest income and highest share of capital expenditures in total expenses were the most indebted. One could

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suppose that, in this case, investment processes were more advanced than in other municipalities where indebtedness was substantially lower.

Table 3. Matrix of correlation coefficients between the studied indicators – group A

Indicator	WB1	WB2	WB3	WB4	WB7	WZ1	WZ3	WZ5	WL1	WL2
WB1	1.0000									
WB2	-0.0940	1.0000								
WB3	0.0352	0.4332**	1.0000							
WB4	-0.0740	0.3865*	0.5093**	1.0000						
WB7	0.0847	-0.2123	0.0387	-0.5346**	1.0000					
WZ1	0.1119	0.0029	0.1474	0.2321	-0.0872	1.0000				
WZ3	-0.6575	-0.1687	0.06493	0.0884	0.1152	0.2265	1.0000			
WZ5	-0.0501	-0.3334*	-0.0305	0.0308	0.1525	0.2359	0.9761***	1.0000		
WL1	-0.0334	-0.4575**	-0.2352	-0.1724	0.3571*	0.2170	0.2873	0.3719*	1.000	
WL2	-0.0117	0.6453**	0.8896***	0.6056**	0.0304	0.2405	0.1048	-0.0139	-0.2379	1.000

correlation coefficients are significant p<0,05; * low dependence, ** moderate dependence, *** high dependence
Source: author's work based on (Ministerstwo Finansów, 2020).

Table 4. Matrix of correlation coefficients between the studied indicators – group B

Indicator	WB1	WB2	WB3	WB4	WB7	WZ1	WZ3	WZ5	WL1	WL2
WB1	1.0000									
WB2	0.0067	1.0000								
WB3	0.1718	0.5911**	1.0000							
WB4	-0.3001	0.5408**	0.3078*	1.0000						
WB7	0.1290	0.1202	0.2206	-04599**	1.0000					
WZ1	0.2059	-0.2107	0.2451	-0.1773	0.6998	1.0000				
WZ3	-0.0419	-0.0138	0.0027	-0.1590	0.1405	-0.0279	1.0000			
WZ5	-0.0487	-0.5566**	-0.2961	-0.3968*	0.0386	0.0403	0.8244***	1.0000		
WL1	0.0363	-0.3045	-0.5145**	-0.1454	0.0515	0.3169	-0.2658	-0.1291	1.0000	
WL2	0.1051	0.6375**	0.8996***	0.3882*	0.2656	0.0285	0.0228	-0.2956	-0.5198**	1.0000

correlation coefficients are significant p<0,05; * low dependence, ** moderate dependence, *** high dependence
Source: author's work based on (Ministerstwo Finansów, 2020).

Analysing the financial situation of the studied municipalities, it is worth noting their position on the background of rural municipalities in the country. Indicators informing of municipalities' financial autonomy are exciting.

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From this point of view, it should be noted that indicator WB_2 was at a similar level in group A. In contrast, in group B, it was 10% higher, while the self-financing indicator (WB_7) in both groups was half that of rural municipalities nationwide (Ministerstwo Finansów, 2020).

Relating to the issue of forestry tax, it is worth noting the role of this tax in own income. While the share of forestry tax in a municipality's total income is small, it is of greater significance in the structure of its income (Zaborek & Czarnecki, 2018). The share of forestry tax in the total income of the studied municipalities ranged from 1.37% to 7.77%, and the percentage in own income was 2.53-19.79%. Of course, this all depends on the level of income from other sources, and relative values do not fully explain the role of this tax in income. Nevertheless, it is worthy of attention that, in the case of many municipalities, the share of income from forestry tax is similar to the percentage of income from agricultural tax and even higher in certain municipalities (tab. 5). In municipalities with an agricultural-forestry profile, both types of taxes are a substantial source of own income. On the national scale, the share of the forestry tax in the structure of municipalities' income (excluding cities under powiat rights) amounted to 0.58% during the years 2016-2019, and in the case of municipalities in the Podlaskie voivodeship, 1.64% (Statistics Poland, 2020). This value was much higher in the studied municipalities.

Table 5. Share of forestry tax and agricultural tax in the income of the studied communes

Commune	The share of forest tax in total income (%)	The share of forest tax in own income (%)	The share of agricultural tax in own income (%)
Group A			
Dziadkowice	1.46	5.33	18.73
Grodzisk	1.41	4,89	25.28
Janów	1.37	4.67	12.60
Mielnik	1.96	2.53	0.51
Milejczyce	2.45	7.90	10.35
Narew	1.57	3.10	5.65
Nurzec-Stacja	1.90	7.17	6.45
Sztabin	2.57	10.19	8.84
Zambrów	1.43	2.75	5.75
Zbójna	1.58	7.35	0.93
Group B			
Białowieża	5.17	7.89	4.38
Dubicze Cerkiewne	3.82	7.27	6.08

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Commune	The share of forest tax in total income (%)	The share of forest tax in own income (%)	The share of agricultural tax in own income (%)
Giby	6.63	15.30	2.98
Gródek	4.06	9.03	3.02
Hajnówka	3.78	7.32	9.25
Narewka	4.48	6.63	1.66
Nowinka	3.79	10.82	4,97
Płaska	7.77	19.79	0.59
Szudziałowo	3.78	6.94	10.98

Source: author's work based on (Poland, 2020).

Conclusions

The financial situation of the studied municipalities indicates their varied economic potential. It is the result of natural, economic and social conditions. Both incomes and expenses per capita are lower than the average for Polish rural municipalities. There are also significant differences between the values of other indicators, which arises from, among other things, the policy conducted by local authorities. Income from forestry tax supplements other income from natural persons' property (agricultural tax, real estate tax). The value of forestry tax and its share in the structure of total income is determined by a municipality's forestation level. The municipality council has a voice on this issue, as it has tax authority and may apply reduced tax rates.

In most municipalities, forestry tax is of no greater significance in local budgets however there are municipalities for which this is a non-trivial source of income. Therefore, it is worth paying attention to this source of own income, particularly in highly forested municipalities.

This article is meant to stimulate discussion about forests not only through the lens of their economic and environmental functions but also in the context of local budgets. The perception of forests as a common good is changing, e.g. a forestry-environmental tax has been introduced in Japan to protect the forest environment. Society has started to consider the forest as common property and recognises its responsibility for its use, with full awareness of the need to incur costs. In the opinion of Bush and Mukherjee (2018), forests and the costs associated with them should be treated as an investment in future income to the budget. And forests should be viewed from this perspective.

In this context, one could ask whether similar solutions could be implemented in Poland? A broad social discussion should precede the answer to

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this question. Above all, one should take a look at current divisions of competencies. Forest tax is a municipality's income intended for allocation for the performance of public tasks assigned to the municipality by law. However, the institution called "State Forests" is responsible for managing forests and the forest economy, including the preservation of natural and cultural assets. It does not seem that anything is likely to change in this regard. Perhaps the starting point in this situation should be a discussion about public participation in financing the most valuable natural resources, which forests undoubtedly are, and how this would affect the budgets of municipalities.

References

Act of 12 January 1991 on local taxes and fees (Polish Journal of Laws of 1991, No. 9, item 31, with later amendments).

Act of 15 November 1984 on agricultural tax (Polish Journal of Laws of 1984, No. 52, item 268, with later amendments).

Act of 30 October 2002 on forestry tax (Polish Journal of Laws of 2002, No. 200, item 1682, with later amendments).

Bush, J., & A.; Mukherjee. (2018). Encour*aging State Governments to Protect and Restore Forests Using Ecological Fisc*al Transfers: India's Tax Revenue Distribution Reform. Conservation Letters, 11(2). https://doi.org/10.1111/conl.12416

CSO. Central Statistical Office. (2020). Statistical Yearbook of the Regions-Poland.

Daigneault, A. J., Sohngen, B. L,. & Sedjo, R. (2020). Carbon and market effects of U.S. forest taxation policy, Ecological Economics, Elsevier, vol. 178(C). https://doi.org/10.1016/j.ecolecon.2020.106803

Dylewski, M., Filipiak, B., & Gorzałczyńska-Koczkodaj, M. (2004). Analiza finansowa jednostek samorząd*u terytorialnego. Warszawa: Wydawnictwo Municipium.*

Dziuba, J. (2016). Zróżnicowanie fiskalnych skutków polityki podatkowej jednostej samorządu terytorialnego. Annales Universitatis Mariae Curie-Sklodowska Lublin, Sectio H, Oeconomia, 50, 351-360.

Dziuba, J., & Życzkowska, E. (2021). The importance of municipal tax policy in shaping forest tax revenues in Poland. Ekonomia i Prawo. Economics and Law, 20(1), 91-105. https://doi.org/10.12775/EiP.2021.006

Dziuba J. (2019). Polityka podatkowa gmin wiejskich w Polsce w latach 2006-2017. Zeszyty Naukowe SGGW, Ekonomika i Organizacja Gospodarki Żywnościowej, 125, 33-43.

Filipiak, B. (Ed.). (2009). Metodyka kompleksowej oceny gospodar*ki finansowej jednostek samorządu terytorialnego. Warszawa: Wydawnictwo Difin.*

Frey, G. E., Meier, J. T., Kilgore, M. A., Snyder, S. A., & Blinn, C. R. (2019). Factors associated with family forest landowner enrollment in state preferential forest property tax programs in the United States. Land Use Policy, 89, 104240. https://doi.org/10.1016/j.landusepol.2019.104240

Korelewska, M. (2014). Polityka podatkowa gmin i miast na prawach powiatu w zakresie podatku od nieruchomości a wspieranie przedsiębiorczości przez samorząd terytorialny. Studia BAS, 1(37), 85-108.

DOI: 10.34659/eis.2022.80.1.438

Lazhentsev, V. N., Chuzhmarova, S. I., & Chuzhmarov, A. I. (2020). Tax Administration in the Forest Management System and its Influence on the Budgets of Northern Territories. Economic and social changes – FactsTrendsTorecast, 13(1), 125-143. https://doi.org/10.15838/esc.2020.1.67.7

Milewska, A. (2017). Przestrzenne zróżnicowanie wpływów z tytułu podatku leśnego w gminach wiejskich w Polsce. Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu, XIX(6), 170-175. https://doi.org/10.5604/01.3001.0010.7924

Ministerstwo Finansów. (2020). Wskaźniki do oceny sytuacji jednostek samorządu terytorialnego w latach 2017-2019.

Nakayama, K., Shirai, M., & Yamada, M. (2019). Effects of Environmental Taxes on Forest Conservation: Case of Water Resources Conservation Fund in Toyota City. Theoretical and Empirical Analysis in Environmental Economics, 34, 49-67.

Okada, K., Okada, S., & Yui, M. (2007). Process of policymaking in forest environment tax: A study on the forest tax Advisory Committee of the State Prefecture. Tohoku Journal of Forest Science, 12(1), 1-11.

Pat^{er}, B. (2013). The Structure of Forest tax in Poland. Proceeding Paper of the 12th Conference of Business and Non-Profit Organization Facing Increased Competition and Growing Customers Demands, Czorsztyn, June 17-18, 2013, 323-334. http://konferencja.jemi.edu.pl/files/monografie/monografia_vol12.pdf

Potocki, A. (2016). Opodatkowanie lasów a źródła finansowania gmin. Rocznik Samorządowy, 5, 201-215.

Schram, B., Potter-Witter, K., Huff, E., & Poudel, J. (2021). Family Forest Owner Management Decisions for Participants Enrolled in a Forest Property Taxation Program in Michigan. Forests, 12(1), art. 3*5. https://doi.org/10.3390/f12010035*

*Stati*stical Office in Bialystok. (2000). Budżety *jednostek samorządu terytorialnego w wojew*ództwie podlaskim w 2019 r.

Statistical Office in Białystok. (2020). Statistical Yearbook of Podlaskie Voivodship.

Statistics Poland, Local Data Bank. (2021, November 30). https://bdl.stat.gov.pl/BDL/start

Wakiyama, T., Lenzen, M., Kadoya, T., Takeuchi, Y., & Nonsai, K. (2021). Forest tax payment responsibility from the forest service footprint perspective. Environmental Sci*ence &Technology, 55(5), 3165-3174, https://pubs.acs.org/doi/10.1021/acs.est.0c043*27

Zaborek, D., & Czarnecki, K. (2018). Podatki lokalne jako źródło dochodów samorządu gminnego. Analiza podatku od nieruchomości, podatku rolnego i leśnego w gminie Lidzbark w latach 2010-2015. Prawo Budżetowe Państwa i Samorządu, 6(2), 47-71. https://doi.org/10.12775/PBPS.2018.010

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THE ACADEMIC INTEREST FOR BIOPLASTICS – A BIBLIOMETRIC ANALYSIS

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ABSTRACT: Plastic materials are shaping modern society and making our lives easier. However, due to improper handling of plastic waste, plastics are no longer ubiquitous only in our homes, villages and cities but also in the natural environment. In line with the concept of bioeconomy, bioplastics are presented as a sustainable option that could help the economy overcome its dependence on fossil fuels and contribute to the reduction of overall plastic pollution. The study aims to identify the areas of academic interest in bioplastics. The study's methodological approach is based on a bibliometric (scientometric) analysis. It was found that in academia, biology, chemistry, and biotechnology are the main areas dealing with bioplastics, focusing on the whole process of product development. At the same time, there is a significant lack of research in areas such as social sciences, including economics. These findings should contribute to the global scientific discourse.

KEYWORDS: bioplastics, plastics, bioeconomy, bibliometric analysis, circular economy

Introduction

Since the early beginnings of their production in 1869, plastics have permeated the global market due to their relative ease of processing into lightweight, cost-effective, and durable products of high quality and wide use that are omnipresent (Špajcar et al., 2012; Avio et al., 2017). Society has benefited from their versatility and manufacturability at low cost, but the environment pays the price and dependence on fossil fuels (Ashok et al., 2018). Global plastic consumption is estimated to increase from the current volume of around 350 million metric tons per year to 1 billion metric tons per year in 2050, increasing the amount of mismanaged waste entering the environment (Valderrama et al., 2019; Lebreton & Andrady, 2019). Plastics durability combined with poor waste management has led to plastics being ubiquitous and accumulating in landfills, nature and ecosystems in the form of large plastics, as well as degraded pieces such as microplastics or nano plastics (Heller et al., 2020; Shen et al., 2020). Bioplastics, some of which are biodegradable, are touted as an environmentally friendly alternative to petrochemical plastics because they are considered ecologically safe, energy-efficient, have a smaller carbon footprint, allow independence from fossil sources, and reduce biomass waste (Shamsuddin et al., 2017).

The bioeconomy, based on the substitution of fossil resources with biological resources for production, seems to be a promising economic concept to address various challenges. However, bioplastics can be seen as a possible solution and a potential threat (Jander, 2022). The bioeconomy, often presented as a concept leading to sustainable development, can also be controversial and raise doubts in some aspects. The academic debate on its sustainability is evident. Although the bioeconomy should be approached more interdisciplinary or transdisciplinary, most scientific publications focus on processing and technology, resources, environmental impacts, and social aspects. Economic issues seem to receive less attention (Pfau et al., 2014). The importance of the bioeconomy is not balanced across research disciplines. We suppose that a similar situation will occur with bioplastics. As bioeconomy and bioplastics production are relatively novel fields of research, their development in the future can be expected. With emerging topics, some problems need to be solved for the successful market launch of the products while minimising the adverse effects of the alternatives that promise to be more sustainable. We want to point out the challenges that could be labelled as problems connected with plastics and bioplastics. This paper aims to identify the areas of academic interest in bioplastics when it comes to topics researched more often and to identify the scientific fields that contribute the most to bioplastics research.

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Problems associated with plastics

Animal species often suffer from entanglement or ingestion of plastic debris, leading to gastrointestinal blockages, malnutrition or perforation, and even death. Evidence shows that 80 marine species, including megafauna species such as cetaceans, have died due to plastic ingestion, although microplastics rarely cause death. Nevertheless, high amounts of microplastic ingestions by fishes and seabirds were reported (Thiel et al., 2018; Roman et al., 2020). Moreover, microplastics adsorb toxic chemicals, transmit pathogenic microorganisms, contaminate freshwater and marine environments, enter the food chain, and accumulate at higher trophic levels (Liu et al., 2021; Boni et al., 2021; Athey et al., 2020; Mercogliano et al., 2020; Lots et al., 2017; Ivleva et al., 2016). Increasing consumption, depletion of fossil resources, and awareness of the problems associated with plastics such as lack of degradability, increasing soil and water pollution, the planned closure of landfills and pressure on waste management capacities are behind the push to develop alternative materials and to introduce biodegradable plastics (Shah et al., 2008). Given the general assumption of plastic production growth, more sustainable production and waste management methods are being considered. Improved collection, recycling and reuse of plastics when they become waste is a part of the solution.

Moreover, this requirement is in line with the philosophy of the circular economy (Rhodes, 2018). Nevertheless, recycling is not without problems due to the different properties and composition of plastics, some of which are not recyclable at all, and the composition of waste, which also includes unwanted and unidentifiable materials (Egun & Evbayiro, 2020; Roosen et al., 2020; Lahtela et al., 2019). Some non-recyclable materials can be subjected to downcycling, while others, such as films or bags, can clog recycling machines (Egun & Evbayiro, 2020; Sharuddin et al., 2017; Hou et al., 2018). Waste management problems worsened when China, which has extensive recycling infrastructure and capacity, played an important role in plastic recycling and the global circular economy, imposed an import ban on foreign waste. Since 1992, China has imported 45% of the world's plastic waste (Brooks et al., 2018). While developed countries lack recycling capacities due to their reliance on exports in the past, developing countries lack environmental regulations and proper treatment technologies. Yet, they may become new endpoints for waste from both developed and developing countries (Qu et al., 2019). After the Chinese ban, Asian countries saw a rapid increase in plastic waste imports, so many began to limit them (Liang et al., 2021). In addition, the disposal of plastics is still a challenge in many places. In India, landfilling, incineration or littering are the common methods to get rid of

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plastics (Nkwachukwu et al., 2013). In South Asian countries, burning waste in fires is still common, increasing the amount of harmful emissions that threaten human health and ecosystems (Saikawa et al., 2020). The burning of plastics releases not only CO_2 emissions but also various toxic substances into the air (Verma et al., 2016). Many countries and cities worldwide have introduced bans on single-use plastic or at least plastic bags that African countries have also adopted (Herberz et al., 2020; Turpie et al., 2019). However, the whole situation has been significantly affected by the COVID-19 pandemic, which has increased our dependence on plastics, mainly for safety and hygiene reasons. It has also exacerbated problems related to waste management and to lift bans on single-use plastics (Vanapalli et al., 2021; Prata et al., 2020).

Bioplastics as a potential solution or threat

Bioplastics are those plastics produced from renewable biological sources or are biodegradable or both (Imre & Pukánszky, 2013). Biodegradable plastics are considered the main alternatives to conventional plastics (Song et al., 2009). Switching plastic production from fossil to renewable resources is necessary to achieve the goals of the Paris Agreement (Valderrama et al., 2019). Global demand for bioplastics has increased in recent decades. Their popularity continues to grow, thanks to a fundamental shift in consumer behaviour that encourages the development of more environmentally friendly plastics and also influences the willingness to pay a higher price for them (Al-Battashi et al., 2019; Cinar et al., 2020; Jaconis et al., 2019; Klein et al., 2019). Unfortunately, bioplastics are still not competitive with conventional plastics, not only because of their higher cost but also because of their poorer mechanical properties (Jiménez-Rosado et al., 2020; Coppola et al., 2021). One way to reduce the cost is to utilise waste from agriculture, food industry, forestry and other by-products as feedstock (Saharan et al., 2012; Jõgi & Bhat, 2020). The current challenge is to develop such bioplastics that provide a sustainable and cost-effective alternative while achieving comparable mechanical properties to conventional plastics but are biodegradable and safe for the environment (Krishnamurthy & Amritkumar, 2019). However, about half of current bioplastics are not biodegradable, and waste disposal becomes increasingly problematic as production volumes increase.

Bioplastics, therefore, pose new challenges for waste management and policymakers (Rahman & Bhoi, 2021). Moreover, there is a risk of contamination of the recycling process if bioplastics are not separated from conventional plastics (Arikan & Ozsoy, 2015). Low consumer awareness of and information about bioplastics and their disposal when they become waste, including various disposal guidelines, seems to be a barrier to their adoption.

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Bioplastics are disposed of illegally by consumers and thrown into nature, buried in the ground or burned. The lack of an efficient and intuitive recycling system for bioplastics leads to consumer frustration (R×3, 2011; Selvamurugan & Sivakumar, 2019). Biodegradability should lead to a reduction in plastic waste, especially in agriculture, where this property is crucial. The decomposition of plastics releases various substances into the soil that may affect plant growth and development, such as germination, root development, expansion of above-ground parts, and increase in stress. In the case of mulch materials, it is necessary to monitor biodegradability itself and ecotoxicity, environmental safety, and effects on the soil environment (Serrano-Ruíz et al., 2018). One of the under-studied areas is the potential impact of microplastics from bioplastics, which should be prioritised to understand their decomposition, degradation, even potential toxicity and impact on organisms and whole ecosystems.

Similarly, methods of disposal and collection of bioplastics need to be identified and facilitated to ensure a proper and vital recycling process (Shruti & Kutralam-Muniasamy, 2019). To solve the problems related to bioplastics and their use, important questions must be answered. In particular, we need to focus on cost-effectiveness and competitiveness of bioplastics, non-biodegradable bioplastics, microplastics and nanoplastics, environmental safety, safe disposal of waste bioplastics, their recycling and separation from conventional plastics, and how to improve their properties. We suppose these and similar questions to be reflected by researchers, and if so, this shall be evidenced by the scientometric analysis. The issues are related to various research fields, including technology, chemistry, biology, environmental sciences, and social sciences and economics as production and prices should reflect costs and demand.

Research methods

To identify the prevailing academic concern, when it comes to most emphasised topics and scientific fields researching bioplastics, a bibliometric (scientometric) analysis was performed using VOSviewer software (version 1.6.15) and Web of Science. "Analyze results" tool. Bibliometric analysis is a pretty recent approach for research documents analysis providing an extensive review of the literature (Paltaki et al., 2021). It enables a method to identify and map the development of publications, in this case, scientific literature, based on statistical indicators regarding the outputs of scientists, and enables to map new fields of science, networks, and the development within (Konstantinis et al., 2018). VOSviewer was used for bibliometric analysis and mapping by, e.g. van Eck and Waltman (2010; 2017), Jeong and Koo (2016), Shah and Lei (2020). Within the bioeconomy, this software was used,

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for example, to define bioeconomy (Konstantinis et al., 2018), an overview of factors influencing the bioeconomy (Muizniece et al., 2019), an overview of bioeconomy and livestock production (Paltaki et al., 2021), an overview of forest bioeconomy (Biancolillo et al., 2020), or biorefineries in the context of circular bioeconomy (Ubando et al., 2020). For this paper, all records indexed in the Web of Science database related to the bioplastic topic available up to 21st January 2021 were selected. The dataset consisted of 2,257 publications, and the search for keywords in the abstract, title and keywords sections was conducted. This made a total of 8,250 keywords, of which 715 keywords are analysed as they occurred at least in five different articles. The results are displayed using network visualisation and density visualisation. Network visualisation reveals the importance of individual keywords within a given dataset by their occurrence and also linkings of the use of these keywords. At the same time, the second method visualises only the use of keywords by their density. This analysis serves to identify the topics that are most emphasised by academia regarding bioplastics. To determine the research areas dealing with bioplastics and to support our results, we used a bibliometric tool, "Analyze results", provided by the Web of Science which enabled analysing the search results. This tool was used for a bibliometric analysis by e.g. Carmona-Serrano et al. (2020), Marín-Marín et al. (2021), López-Belmonte et al. (2020). Within the bioeconomy, this tool seems to be not used often. Still, it was used, for example, to review publications on energy resources by Grubert and Zacarias (2022) or to review the utilisation of orange peel waste by Jiménez-Castro et al. (2020). This analysis was conducted on 11th March 2022. Although we used the advanced search to set a date range back up to 21st January 2021, it provided more results than the analysis made earlier up to this date, with a total of 2521 publications. It may be a result of some publications and journals indexed later. However, as for the results, we had decided to use the TOP 20 research areas and the TOP 20 Web of Science categories as we perceived a threshold laying there and kept the results well arranged. Furthermore, we examine year-wise publications distribution in the given period. The only exception is the year 2021, as we try to keep the consistency of the paper.

Results of the research

Depending on how many times each keyword appears, the most important topics in current scientific discourse in bioplastics are listed. Besides the terms bioplastic and bioplastics, the most frequently mentioned topics are polylactic acid, polyhydroxyalkanoates, mechanical properties, films, which appear in more than 200 cases. This is followed by polyhydroxybutyrate, biodegradation, degradation, biosynthesis, composites, acid starch, poly-3-

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hydroxybutyrate, glycerol and blends, which occur in more than 100 cases. At least 80 studies mentioned polymers, behaviour, water, biomass, poly-beta-hydroxybutyrate, cellulose, protein, fermentation, morphology, biopolymers and plastics. *Escherichia coli* appears in 79 cases. However, other important topics include nanocomposites, *Ralstonia-eutropha*, and growth, covered in at least 60 articles. Optimisation, wheat gluten, waste, bacteria, extrusion, barrier properties, biopolymer, thermal properties, temperature, polyester, accumulation, chitosan and crystallisation are topics covered in more than 50 studies. Thermoplastic starch, sustainability, performance, *Alcaligenes-eutrophus*, metabolism, biodegradability, lignin, edible films, proteins, poly(3-hydroxybutyrate-co-3-hydroxy-valerate), expression, cross-linking, fibres, as key terms occur in at least 40 cases. Biorefineries, physical properties, recombinant *Escherichia coli*, renewable resources, life cycle assessment, food, plasticisers, extraction, fed-batch culture, functional properties, rheological properties, biodegradable plastics, nanoparticles, wastewater, conversion, kinetics, energy, culture, identification, cyanobacteria, circular economy, impact and oil occur as keywords in more than 30 scientific articles. Genes and purification appear in 29 cases, food waste, PHA production, green composites, P3HB production, polyethylene and plasticisers in 28 cases, genes in 27 cases, microalgae, soy protein, metabolic engineering, molecular-weight, poly(l-lactic acid) and chemicals in 26 cases. The density of keywords is shown in Figure 1.

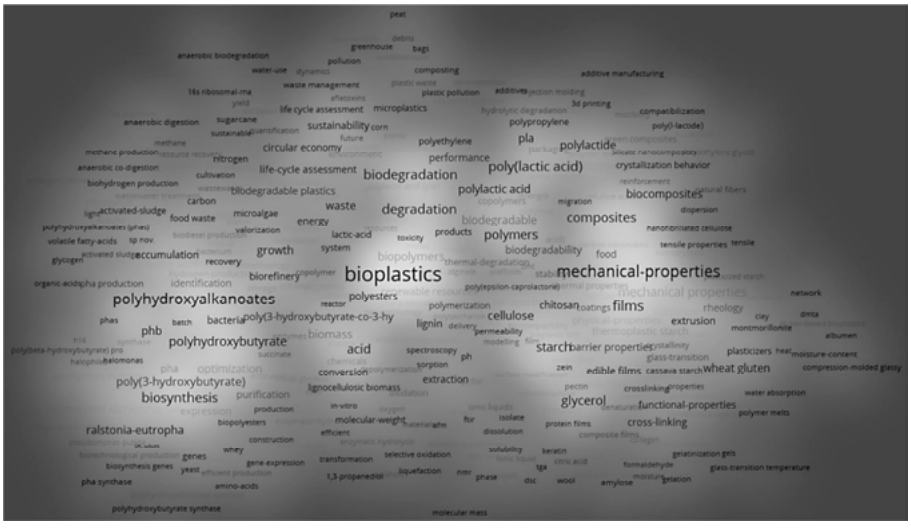

Figure 1. Density of keywords

Source: author's work based on VOSviewer.

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Obviously, the main academic focus is on the properties, composition, processes, synthesis and degradation of bioplastics or their types. The analysis of the literature shows that mostly chemistry, biochemistry, biology and biotechnology as scientific fields are dealing with the topic of bioplastics, while socio-economic and interdisciplinary research is missing. The economic context of the production of these plastics seems on the periphery of interest, even though it is one of the crucial tasks of their production. Nevertheless, the terms like sustainability, bioeconomy, circular economy, innovation, management appear as well. Although the terms efficiency, growth and optimization also appear in the results, it can be stated that in these are rather aspects of biotechnological processes than the economy. Using the analysis based on the minimum occurrence of the keyword in at least two articles, the economic aspects can be extended by low-cost production, efficient production, cost, purchasing, branding, consumption, waste management, industry and few keywords regarding bioplastic products, bioproducts or by-products.

The network analysis presented in Figure 2 shows that mechanical properties are related with morphology, i. e. physical, thermal, functional, barrier and rheological properties, also water vapour permeability, rheology, biodegradability, degradation, or, vice versa, to stability, and also to behaviour including crystallization behaviour.

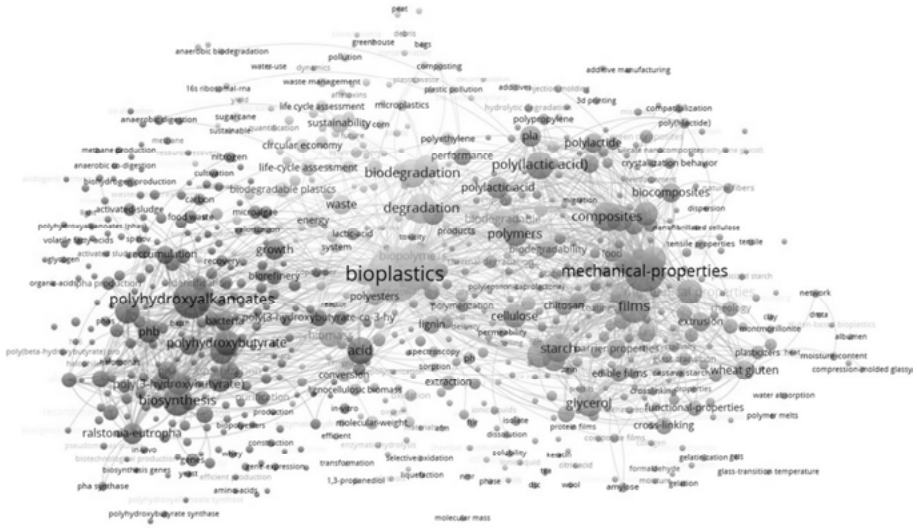

Figure 2. The network analysis

Source: author's work based on VOSviewer.

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In addition to mechanical properties, the processes and processing of bioplastics are often studied, including the issues related to plasticization, plasticizers, crosslinking, extrusion, crystallization, plastic injection, polymer blends, composites, green and biocomposites, silicate nanocomposites, composite films, edible films and films in general. There are also links to individual types of various thermoplastics, bioplastics, biopolymers, biodegradable polymers, PE, PP, and feedstocks to produce bioplastics, which include proteins, thermoplastic starch, cassava starch, wheat gluten, glycerol, gelatin, lignin, cellulose, soy proteins, acids, especially polylactic acid, or fibres and natural fibres, or renewable resources in general, and waste. The issue of coatings also appears. Some of the keywords already mentioned in connection with mechanical properties also associate with polyhydroxyalkanoates. These include mainly biodegradable polymers and polymers, biodegradation, biodegradability, blends, acids, and again polylactic acid. Polyhydroxyalkanoates are also associated with copolymers, polyesters, oil and biomass. In the context of these bioplastics, the terms connected to synthetic biology and microbiology, synthetic and microbial processes, metabolic engineering or starting materials and related organisms, are used extensively. This is evident from the use of terms such as metabolism, microorganism, bacterium, bacteria, bacillus, microbial degradation, culture, growth, fermentation, purification, biorefinery, regeneration, accumulation, optimization, biosynthesis, synthase, batch, batch culture, *Escherichia coli*, and also recombinant *Escherichia coli*, then *Pseudomonas*, *Cupriavidus necator*, *Alcaligenes eutrophus*, *Ralstonia eutropha* or activated sludge and wastewater. The individual types of bioplastics and their constituents such as polyhydroxyalkanoates as well as the preparation of PHA, beta-hydroxybutyric acid, polyhydroxybutyrate, and similarly the preparation of PHB, poly-3-hydroxybutyrate, the preparation of poly-3-hydroxybutyrate, including also poly(3-hydroxybutyrate-co-3 hydroxyvalerate) are mentioned. However, terms like molecular weight, carbon, and storage also occur.

As for the research areas that deal with bioplastics, the dominance of engineering, polymer science, chemistry, biotechnology, microbiology, technology, as well as materials science is inevitable. Similarly, environmental sciences, biochemistry, microbiology, agriculture play a crucial role. However, the results differ depending on the measure, as indicated by Figure 3, which shows research areas, and Figure 4, which presents Web of Science categories. What is also clearly visible from both figures is the lack of social sciences addressing bioplastics; the only exception is education and educational research. There are just a few publications from fields like business economics, social sciences, anthropology, urban studies, and surprisingly even art.

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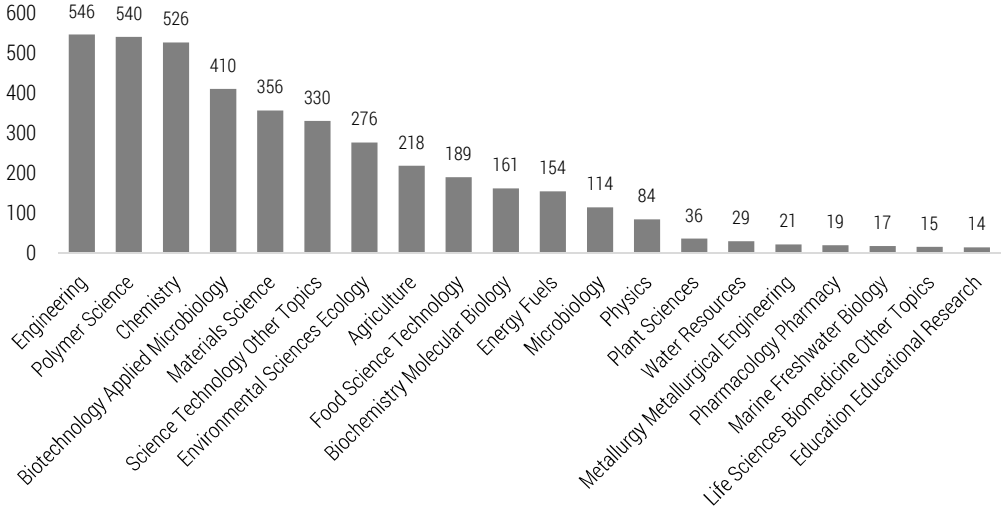

Figure 3. Research areas

Source: author's work based on Web of Science.

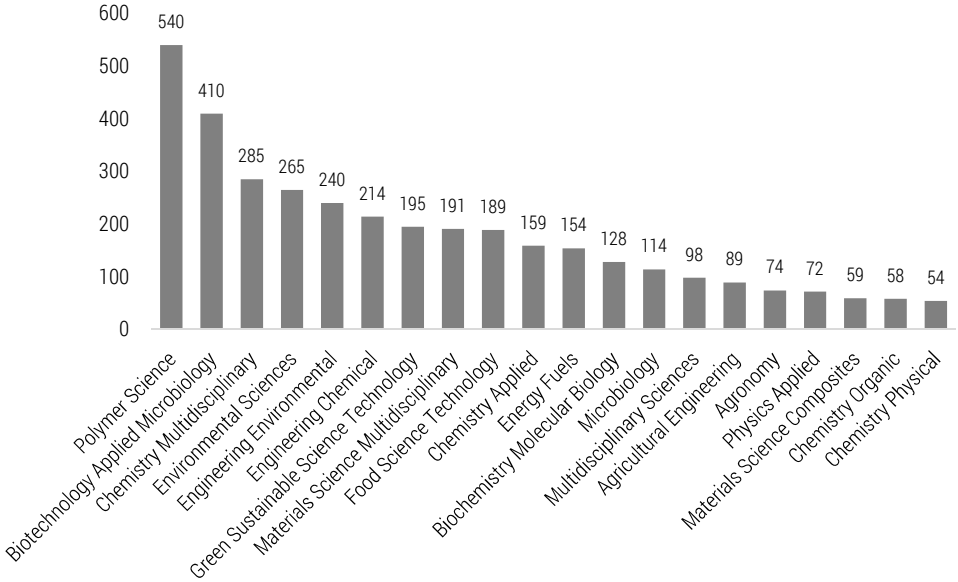

Figure 4. Web of Science categories

Source: author's work based on Web of Science.

The year-wise distribution of publications in the given period is shown in Figure 5. Some years are missing as there were no records of publication activity in Web of Science. Although the data for the year 2021 present just

the first 21 days of the first month, the amount of the publications reach nearly the same level as the year-wise publications for the year 2011. This reflects the growing popularity and interest in bioplastics in the scientific community. The increasing publication activity is permanently evident since the year 2005. In 2020, the number of publications was more than 22 times higher than in 2005.

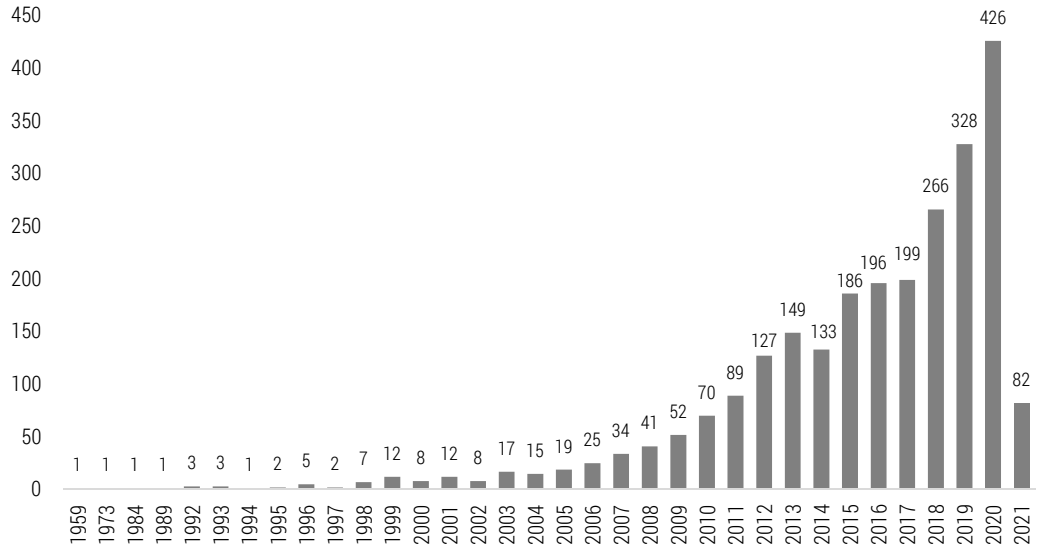

Figure 5. Annual publication

Source: author's work based on Web of Science.

Discussion

The methods employed in this paper can be conducted relatively quickly and may provide results that could not be attained manually. The topics related to bioplastics are gaining more attention and are increasingly more addressed by scientists. The recent science also increasingly reflects the bioeconomy and circular economy (Paltaki et al., 2021). However, most scientific publications in bioplastics focus on polymers processing, technology, resources, and other following issues, with a lack of attention on treating economic issues of the production similarly as in the case of the bioeconomy pointed out by Pfau et al. (2014). The current research reflects some problems that need to be addressed, mainly the materials and their properties, waste utilisation, biodegradability, and degradability of bioplastics. There are also publications targeting life-cycle-assessment, sustainability, bioeconomy, and circular economy.

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Nevertheless, the issues of the economy of production, cost optimisation, or some broader aspects related to the society and economy, which both shall treat the materials when they become waste, seem to be understudied, similarly like the issue of microplastics and nanoplastics, possible ecotoxicity and the impact on the organisms that degrade these materials. These findings are in line with the results of Serrano-Ruíz et al. (2018), who focused on the decomposition of plastics, especially in the case of mulch plastics degrading in soil or Shruti and Kutralam-Muniasamy (2019), who concerned about the possible impact on organisms and ecosystems. The growing interest in waste biomass utilisation that could help the environment and the cost of bioenergy and chemicals production was pointed out by Usmani et al. (2021). Similarly, a business plan covering the use of organic municipal solid waste was thought out by Moscato et al. (2020), who also expect an increase in bioplastics use and, therefore, waste in Italy and some other countries. We perceive waste utilisation as a good and sustainable resource for the bioeconomy in general. Paltaki et al. (2021) emphasise waste management, manure, biorefineries, fermentation, and circular economy as the future directions for sustainable growth and bioeconomy.

Conclusions

The number of studies dealing with bioplastics has increased significantly in recent years, and this trend will continue as bioeconomy strategies are launched worldwide. Bioplastics are frequently mentioned in these strategies. Currently, mainly biologists, technologists, and chemists are researching bioplastics. Scientists' main issues relate to primary resources, production processes, biotechnologies, end products, and their properties, including degradation and biodegradation. Thus, mainly technical, technological, biotechnological, chemical, biochemical, microbiological and other biological issues are under consideration and receive great attraction by academia. But the market introduction of these materials, which has already taken place, means contact and interaction with society and its construct – the economy, so the lack of interest of the social sciences, particularly economics, and the related issues are shocking, to say the least. The absence of economic topics and aspects, such as the standard topics like cost-benefit analysis of production processes, financial instruments to support this production (subsidies, tax relief...) and topics with a broader overlap with the circular economy, the bioeconomy, reflects a certain lack of interest among experts, but probably also in society and politics. As we supposed, academia mainly reflects processing technology and resources as in the case of bioeconomy, while the social and economic issues tend to receive low attention. We also expected more articles considering and assessing the sustainability of bioplastics as

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such or their recycling as important issues that scientists would reflect. Nevertheless, circular economy, which should consider recycling and closing the loops, partly occurs as a topic of interest related to sustainable development.

The contribution of the authors

Nikola Sagapova: conception – 90 %, literature review – 90 %, acquisition of data – 100 %, data analysis and interpretation – 90 %, manuscript – 90 %.

Eva Cudlínová: conception – 10 %, literature review – 10 %, data analysis and interpretation – 10 %, manuscript – 10 %.

References

Al-Battashi, H., Annamalai, N., Al-Kindi, S., Nair, A. S., Al-Bahry, S., Verma, J. P., & Sivakumar, N. (2019). Bioplastic production (poly-3-hydroxybutyrate) using waste paper as a feedstock: Optimization of enzymatic hydrolysis and fermentation employing Burkholderia sacchari, Journal of Cleaner Production, 214, 236-247. https://doi.org/10.1016/j.jclepro.2018.12.239

Arıkan, E. B., & Bilgen, H. D. (2019). Production of bioplastic from potato peel waste and investigation of its biodegradability, International Advanced Researches and Engineering Journal, 3(2), 93-97. https://doi.org/10.35860/iarej.420633

Ashok, A., Abhijith, R., & Rejeesh, C. R. (2018). Material characterisation of starch derived biodegradable plastics and its mechanical property estimation, Materials Today: Proceedings, 5(1), 2163-2170. https://doi.org/10.1016/j.matpr.2017.09.214

Athey, S. N., Albotra, S. D., Gordon, C. A., Monteleone, B., Seaton, P., Andrady, A. L., Taylor, A. R., & Brander, S. M. (2020). Trophic transfer of microplastics in an estuarine food chain and the effects of a sorbed legacy pollutant, Limnology and Oceanography, 5(1), 154-162. https://doi.org/10.1002/lol2.10130

Avio, C. G., Gorbi, S., & Regoli, F. (2017). Plastics and microplastics in the oceans: From emerging pollutants to emerged threat. Marine Environmental Research, 128, 2-11. https://doi.org/10.1016/j.marenvres.2016.05.012

Biancolillo, I., Paletto, A., Jacques, B., Keller, M., & Romagnoli, M. (2020). A literature review on forest bioeconomy with a bibliometric network analysis, Journal of Forest Science, 66(7), 265-279. https://doi.org/10.17221/75/2020-JFS

Boni, W., Parrish, K., Patil, S., & Fahrenfeld, N. L. (2021). Total coliform and Escherichia coli in microplastic biofilms grown in wastewater and inactivation by peracetic acid, Water Environment Research, 93(3), 334-342. https://doi.org/10.1002/wer.1434

Brooks, A. L., Wang, S., & Jambeck, J. R. (2018). The Chinese import ban and its impact on global plastic waste trade, Science Advances, 4(6), https://doi.org/10.1126/sciadv.aat0131

Carmona-Serrano, N., López-Belmonte, J., Cuesta-Gómez, J.-L., & Moreno-Guerrero, A.-J. (2020). Documentary Analysis of the Scientigic Literature on Autism and Technology in Web of Science, Brain Sciences, 10(12), 985. https://doi.org/10.3390/brainsci10120985

Cinar, S. P., Chong, Z. K., Kucuker, M. A., Wieczorek, N., Cengiz, U., & Kuchta, K. (2020). Bioplastic Production from Microalgae: A Review, International Journal of Environmental Research and Public Health, 17, 3842. https://doi.org/10.3390/ijerph17113842

Coppola, G., Gaudio, M. T., Lopresto, C. G., Calabro, V., Curcio, S., & Chakraborty, S. (2021). Bioplastic from Renewable Biomass: A Facile Solution for a Greener Environment, Earth Systems and Environment, 5, 231-251. https://doi.org/10.1007/s41748-021-00208-7

Egun, N. K., & Evbayiro, O. J. (2020). Beat the plastic: an approach to polyethylene terephthalate (PET) bottle waste management in Nigeria, Waste Disposal & Sustainable Energy, 2, 313-320. https://doi.org/10.1007/s42768-020-00052-x

Grubert, E., & Zacarias, M. (2022). Paradigm shifts for environmental assessment of decarbonizing energy systems: Emerging dominance of embodied impacts and design-oriented decision support needs, Renewable and Sustainable Energy Reviews, 159, 112208. https://doi.org/10.1016/j.rser.2022.112208

Heller, M. C., Mazor, M. H., & Keoleian, G. A. (2020). Plastics in the US: toward a material flow characterization of production, markets and end of life, Environmental Research Letters, 15(9), 094034. https://doi.org/10.1088/1748-9326/ab9e1e

Herberz, T., Barlow, C. Y., & Finkbeiner, M. (2020). Sustainability Assessment of a Single-Use Plastics Ban, Sustainability, 12(9), 3746. https://doi.org/10.3390/su12093746

Hou, P., Xu, Y., Taiebat, M., Lastoskie, C., Miller, S. A., & Xu, M. (2018). Life cycle assessment of end-of-life treatments for plastic film waste, Journal of Cleaner Production, 201, 1052-1060. https://doi.org/10.1016/j.jclepro.2018.07.278

Imre, B., & Pukánszky, B. (2013). Compatibilization in bio-based and biodegradable polymer blends, European Polymer Journal, 49, 1215-1233. https://doi.org/10.1016/j.eurpolymj.2013.01.019

Ivleva, N. P., Wiesheu, A. C., & Niessner, R. (2016). Microplastic in aquatic ecosystems, Angewandte Chemie International Edition, 56(7), 1720-1739. https://doi.org/10.1002/anie.201606957

Jaconis, S. B., Morita, A. T., Coutinho, P. L. A., & Borschiver, S. (2019). Systematically Monitoring, Relational Database and Technology Roadmapping for Trends and Innovation Opportunities in Biopolymers, Journal of Renewable Materials, 7(11), 1221-1230. https://doi.org/10.32604/jrm.2019.00025

Jander, W. (2022). Advancing bioeconomy monitorings: A case for considering bioplastics. Sustainable Productii and Consumption, 30, 255-268. https://doi.org/10.1016/j.spc.2021.11.033

Jeong, D.-H., & Koo, Y. (2016). Analysis of Trend and Convergence for Science and Technology using the VOSviewer, International Journal of Contents, 12(3), 54-58. https://doi.org/10.5392/IJoC.2016.12.3.054

Jiménez-Castro, M. P., Buller, L. S., Sganzerla, W. G. & Forster-Carneiro, T. (2020). Bioenergy production from orange industrial waste: a case study, Biofuels, Bioproducts & Biorefining, 14(6), 1239-1253. https://doi.org/10.1002/bbb.2128

Jiménez-Rosado, M., Bouroudian, E., Perez-Puyana, V., Guerrero, A., & Romero, A. (2020). Evaluation of different strengthening methods in the mechanical and functional properties of soy protein-based bioplastics, Journal of Cleaner Production, 262, 121517. https://doi.org/10.1016/j.jclepro.2020.121517

Jõgi , K., Bhat, R. (2020). Valorization of food processing wastes and by-products for bioplastic production, Sustainable Chemistry and Pharmacy, 18: 100326. https://doi.org/10.1016/j.scp.2020.100326

Klein, F., Emberger-Klein, A., Menrad, K., Möhring, W., & Blesin, J.-M. (2019). Influencing factors for the purchase intention of consumers choosing bioplastic products in Germany, Sustainable Production and Consumption, 19, 33-43. https://doi.org/10.1016/j.spc.2019.01.004

Konstantinis, A., Rozakis, S., Maria, E.-A., & Shu, K. (2018). A Definition of Bioeconomy through the Bibliometric Networks of the Scientific Literature, AgBioForum, 21(2), 64-85.

Krishnamurthy, A., Amritkumar, P. (2019). Synthesis and characterization of eco-friendly bioplastic from low-cost plant resources, SN Applied Sciences, 1, 1432. https://doi.org/10.1007/s42452-019-1460-x

Lahtela, V., Hyvärinen, M., & Kärki, T. (2019). Composition of Plastic Fractions in Waste Streams: Toward More Efficient Recycling and Utilization, Polymers, 11(1), 69. https://doi.org/10.3390/polym11010069

Lebreton, L., Andrady, A. (2019). Future scenarios of global plastic waste generation and disposal, Palgrave Communications, 5, 6. https://doi.org/10.1057/s41599-018-0212-7

Liang, Y., Tan, Q., Song, Q., & Li, J. (2021). An analysis of the plastic waste trade and management in Asia, Waste Management, 119, 242-253. https://doi.org/10.1016/j.wasman.2020.09.049

Liu S., Fang, S., Xiang, Z., Chen, X., Song, Y., Chen, C., Ouyang, G. (2021). Combined effect of microplastics and DDT on microbial growth: A bacteriological and metabolomics investigation in Escherichia coli, Journal of Hazardous Materials, 407, 124849. https://doi.org/10.1016/j.jhazmat.2020.124849

Lots, F. A. E., Behrens, P., Vijver, M. G., Horton, A. A., & Bosker, T. (2017). A large-scale investigation of microplastic contamination: Abundance and characteristics of microplastics in European beach sediment, Marine Pollution Bulletin, 123(1-2), 219-226. https://doi.org/10.1016/j.marpolbul.2017.08.057

López-Belmonte, J., Parra-González, M. E., Segura-Robles, A., & Pozo-Sánchez, S. (2020). Scientific Mapping of Gamification in Web of Science, European Journal of Investigation in Health, Psychology and Education, 10(3), 832-847. https://doi.org/10.3390/ejihpe10030060

Marín-Marín, J.-A., Moreno-Guerrero, A.-J., Dúo-Terrón, P., & López-Belmonte, J. (2021). STEAM in education: a bibliometric analysis of performance and co-words in Web of Science, International Journal of STEM Education, 8, 41. https://doi.org/10.1186/s40594-021-00296-x

Mercogliano R., Avio, C. G., Regoli, F., Anastasio, A., Colavita, G., & Santonicola, S. (2020). Occurrence of Microplastics in Commercial Seafood under the Perspective of the Human Food Chain. A Review, Journal of Agricultural and Food Chemistry, 68(19), 5296-5301. https://doi.org/10.1021/acs.jafc.0c01209

Moscato, I., Munoz, D. C., & González, S. D. (2020). How to deal with organic municipal solid waste over-sieve fraction, Environmental Engineering and Management Journal, 19(10), 1807-1811.

Muizniece I., Zihare, I., & Blumberga, D. (2019). Obtaining the Factors Affecting Bioeconomy, Environmental and Climate Technologies, 23(1), 277-191. https://doi.org/10.2478/rtuect-2019-0018

Nkwachukwu, O. I., Chima, C. H., Ikenna, A. O., & Albert, L. (2013). Focus on potential environmental issues on plastic world towards a sustainable plastic recycling in developing countries, International Journal of Industrial Chemistry, 4, 34. https://doi.org/10.1186/2228-5547-4-34

DOI: 10.34659/eis.2022.80.1.436

Paltaki, A., Michailidis, A., Chatzitheodoridis, F., Zaralis, K., & Loizou, E. (2021). Bioeconomy and Livestock Production Nexus: A Bibliometric Network Analysis, Sustainability, 13(22), 12350. https://doi.org/10.3390/su132212350

Pfau, S. F., Hagens, J. E., Dankbaar, B., & Smits, A. J. M. (2014). Visions of Sustainability in Bioeconomy Research, 6, 1222-1249. https://doi.org/0.3390/su6031222

Prata, J. C., Silva, A. L. P., Walker, T. R., Duarte, A. C., & Rocha-Santos, T. (2020). COVID-19 Pandemic Repercussions on the Use and Management of Plastics, Environmental Science & Technology, 54(13), 7760-7765. https://doi.org/10.1021/acs.est.0c02178

Qu, S., Guo, Y., Ma, Z., Chen, W.-Q., Liu, J., Liu, G., Wang, Y., & Xu, M. (2019). Implications of China's foreign waste ban on the global circular economy, Resources, Conservation and Recycling, 144, 252-255. https://doi.org/10.1016/j.resconrec.2019.01.004

Rahman, M. D., Bhoi, P. R. (2021). An overview of non-biodegradable bioplastics, Journal of Cleaner Production, 294, 126218. https://doi.org/10.1016/j.jclepro.2021.126218

Rhodes, C. J. (2018). Plastic Pollution and Potential Solutions, Science Progress, 101(3), 207-260. https://doi.org/10.3184/003685018X15294876706211

Roman, L., Schuyler, Q., Wilcox, C., & Hardesty, B. D. (2021). Plastic pollution is killing marine megafauna, but how do we prioritize policies to reduce mortality? Conservation Letters, 14(2), e12781. https://doi.org/10.1111/conl.12781

Roosen, M., Mys, N., Kusenberg, M., Billen, P., Dumoulin, A., Dewulf, J., Van Geem, K. M., Ragaert, K., & De Meester, S. (2020). Detailed Analysis of the Composition of Selected Plastic Packaging Waste Products and Its Implications for Mechanical and Thermochemical Recycling, Environmental Science & Technology, 54(20), 13282-13293. https://doi.org/10.1021/acs.est.0c03371

Rx3, 2011. *The Irish Recycled Plastic Waste Arisings Study.* Dublin: Rx3.

Saharan, B. S., Ankita, & Sharma, D. (2012). Bioplastics – for sustainable development: a review, International Journal of Microbial Resource Technology, 1(1), 11-23.

Saikawa , E., Wu, Q., Zhong, M., Avramov, A., Ram, K., Stone, E. A., Stockwell, C. E., Jayarathne, T., Panday, A. K., & Yokelson, R. J. (2020). Garbage Burning in South Asia: How Important Is It to Regional Air Quality?, Environmental Science and Technology, 54(16), 9928-9938. https://doi.org/10.1021/acs.est.0c02830

Selvamurugan, M., Sivakumar, P. (2019). Bioplastics – An Eco-Friendly Alternative to Petrochemical Plastics, Current World Environment, 14(1), 49-59. https://doi.org/10.12944/CWE.14.1.07

Serrano-Ruíz, H., Martín-Closas, L., & Pelacho, A. M. (2018). Application of an in vitro plant ecotoxicity test to unused biodegradable mulches, Polymer Degradation and Stability, 158, 102-110. https://doi.org/10.1016/j.polymdegradstab.2018.10.016

Shah, A. A., Hasan, F., Hameed, A., & Ahmed, S. (2008). Biological degradation of plastics: A comprehensive review, Biotechnology Advances, 26, 246-265. https://doi.org/10.1016/j.biotechadv.2007.12.005

Shah, S. H. H., Lei, S. (2020). Prosumption: bibliometric analysis using HistCite and VOSviewer, Kybernetes, 49(3), 1020-1045. https://doi.org/10.1108/K-12-2018-0696

Shamsuddin, I. M., Jafar, J. A., Shawai, A. S. A., Yusuf, S., Lateefah, M., & Aminu, I. (2017). Bioplastics as Better Alternative to Petroplastics and Their Role in National Sus-

tainability: A Review. Advances in Bioscience and Bioengineering, 5(4), 63-70. https://doi.org/10.11648/j.abb.20170504.1

Sharuddin, S. D. A., Abnisa, F., Daud, W. M. A. W., & Aroua, M. K. (2017). Energy recovery from pyrolysis of plastic waste: Study on non-recycled plastics (NRP) data as the real measure of plastic waste, Energy Conversion and Management, 148, 925-934. https://doi.org/10.1016/j.enconman.2017.06.046

Shen, M., Song, B., Zeng, G., Zhang, Y., Huang, W., Wen, X., & Tang, W. (2020). Are biodegradable plastics a promising solution to solve the global plastic pollution? Environmental Pollution, 263, 114469. https://doi.org/10.1016/j.envpol.2020.114469

Shruti, V. C., Kutralam-Muniasamy, G. (2019). Bioplastics: Missing link in the era of Microplastics, Science of The Total Environment, 697, 134139. https://doi.org/10.1016/j.scitotenv.2019.134139

Song, J. H., Murphy, R. J., Narayan, R., & Davies, G. B. H. (2009). Biodegradable and compostable alternatives to conventional plastics, Philosophical Transactions of the Royal Society B, 364(1526), 2127-2139. https://doi.org/10.1098/rstb.2008.0289

Špajcar, M., Horvat, P., & Kržan, A. (2012). *Biopolymers and Bioplastics: Plastics aligned with nature*. Ljubljana: National Institute of Chemistry.

Thiel, M., Luna-Jorquera, G., Álvarez-Varas, R., Gallardo, C., Hinojosa, I. A., Luna, N., Miranda-Urbina, D., Morales, N., Ory, N., Pacheco, A. S., Porflitt-Toro, M., & Zavalaga, C. (2018). Impacts of Marine Plastic Pollution From Continental Coasts to Subtropical Gyres – Fish, Seabirds, and Other Vertebrates in the SE Pacific, Frontiers in Marine Science, 5, 238. https://doi.org/10.3389/fmars.2018.00238

Turpie , J., Letley, G., Ng'oma, Y., & Moore, K. (2019). *The case for banning single-use plastics in Malawi: Report prepared for UNDP on behalf of the Government of Malawi by Anchor Environmental Consultants in collaboration with Lilongwe Wildlife Trust*. Report No. AEC/1836/1. Anchor Environmental Consultants.

Ubando, A. T., Felix, Ch., B., Chen, & W.-H. (2020). Biorefineries in circular bioeconomy: A comprehensive review, Bioresource Technology, 299, 122585. https://doi.org/10.1016/j.biortech.2019.122585

Usmani, Z., Sharma, M., Awasthi, A. K., Sivaumar, N., Lukk, T., Pecoraro, L., Thakur, V. K., Roberts, D., Newbold, J., & Gupta, V. K. (2021). Bioprocessing of waste biomass for sustainable product development and minimizing environmental impact, Bioresource Technology, 322, 124548. https://doi.org/10.1016/j.biortech.2020.124548

Valderrama, M. A. M., Van Putten, R.-J., & Gruter, G.-J. M. (2019). The potential of oxalic – and glycolic acid based polyesters (review). Towards CO2 as a feedstock (Carbon Capture and Utilization – CCU), European Polymer Journal, 119, 445-468. https://doi.org/10.1016/j.eurpolymj.2019.07.036

Van Eck, N. J., Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping, Scientometrics, 84, 523-538. https://doi.org/10.1007/s11192-009-0146-3

Van Eck, N. J., Waltman, L. (2017). Citation-based clustering of publications using CitNetExplorer and VOSviewer, Scientometrics, 111, 1053-1070. https://doi.org/10.1007/s11192-017-2300-7

Vanapalli, K. R., Sharma, H. B., Ranjan, V. P., Samal, B., Bhattacharya, J., Dubey, B. K., & Goel. S. (2021). Challenges and strategies for effective plastic waste management during and post COVID-19 pandemic, Science of The Total Environment, 750, 141514. https://doi.org/10.1016/j.scitotenv.2020.141514

DOI: 10.34659/eis.2022.80.1.436

Verma, R., Vinoda, K. S., Papireddy, M., & Gowda, A. N. S. (2016). Toxic Pollutants from Plastic Waste – A Review, Procedia Environmental Science, 35, 701-708. https://doi.org/10.1016/j.proenv.2016.07.069

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STUDIES AND MATERIALS

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THE IMPACT OF CRISES SITUATIONS ON THE DEVELOPMENT OF BUSINESS CONTINUITY MANAGEMENT DURING THE COVID-19 PANDEMIC IN JORDANIAN HOSPITALS

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ABSTRACT: In this paper, the researchers have investigated the effect of various crises on the development of the Business Continuity Management (BCM) process in Jordanian hospitals. They used the quantitative research design technique to fulfil all the study's objectives. After that, they also tested whether their hypothesised model could be used for developing the BCM. After distributing questionnaires amongst the supervisors working in 7 private hospitals in Amman, Jordan, they collected all the data. Then, they carried analysed and sorted all the data using the SPSS software. The study results showed that the hospitals in Jordan were eager to maintain security and stability in the case of a crisis. Additional statistical tests presented evidence regarding the positive effect of different factors (such as external/ internal crises, natural disasters, operational and strategic risks, and the probability of recurrence of a crisis) on the BCM development in Jordanian hospitals. Here, the researchers have attempted to offer insights and knowledge to help practitioners, academicians and policymakers.

KEYWORDS: crises, Jordanian hospitals, business continuity management, probability of crisis recurrence

Introduction

BCM refers to the process where the management makes plans in the case of a crisis. The organisations usually develop these plans after identifying the probable threats and studying their effect on the daily operations (Kato & Charoenrat, 2018). The BCM process ensures that the organisation can still offer good services despite a disaster or crisis, thereby allowing them to preserve its reputation and maintain the inflow of revenue (Azadegan et al., 2020). Historically, the BCM process was developed in the 1970s as a response to the operational and technical risks that often delayed the firm's recovery from some interruptions or crises (Coombs, 2014).

The recent COVID-19 pandemic has significantly affected the operations of governments across the globe since all the officials are operating under uncertainty and facing many complicated trade-offs and social, economic and health challenges arising due to the pandemic. In 2020, this pandemic affected >50 million people living in different countries worldwide. By mid-2020, a majority of the countries had to impose strict lockdowns with extreme containment measures to prevent the spread of the virus. In addition to the human and health tragedy, the pandemic also triggered one of the most severe economic crises since World War II. Economists across the globe have stated that a majority of the economies would not be able to achieve their 2019 output levels till at least 2022 (OECD, 2020).

It was noted that many natural disasters and crises could disrupt the organisation's operations, which could delay their development (Bakar et al., 2019). Some of these crises can significantly affect the organisations' business operations, workforce, and property, whereas others could even threaten the organisation's existence and lead to its bankruptcy (Abo-Murad et al., 2019).

As mentioned above, any crisis or disaster disturb an organisation's existing and future business performance. A few statistics have stated that 75% of the organisations that do not have a continuity plan would fail within 3 years after the occurrence of a disaster or crisis (Fabeil et al., 2020).

A majority of the surveyed Jordanian organisations reported challenges, such as low demand and supply, decreased cash flow and a disruption in their value, owing to the containment measures that were implemented due to the COVID-19 pandemic (Kebede, 2021).

The main aim of the BCM was to build and improve the organisational ability to offer services and carry out primary tasks owed to the society during and after the occurrence of any crisis, disaster or emergency which interrupts its operations for some time (Gallagher, 2003). However, the problem of managing unexpected disasters (crises) is regarded as a major challenge

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that affects institutions and business organisations. The COVID-19 pandemic is a prime example of an unexpected crisis that could affect all organisations without any exemption (Fabeil et al., 2020).

Hence, it is important to understand the risks and the types of crises that could disrupt or force organisations to stop their operations. This type of study could help reduce or eliminate the recurrence or negative effects of the crises, both on the firms and parties interested in the organisation's operations (Lindstorm, 2012). Development of the BCM could benefit the organisations since it could allow the firms to become more resilient, protect their reputation, fulfil all regulatory requirements and boost the morale of their employees (Herbane et al., 2004).

It was noted that disasters, emergencies, and similar other crises could threaten the capability of a healthcare organisation to provide treatment, care, operate and serve the community. Out of all other organisations, the healthcare sectors need to develop an effective and concise Business Continuity Plan (BCP) for protecting their employees and patients. The healthcare Business Continuity needs to constantly offer its services to society during a crisis or disaster (Geelen-Baass & Johnstone, 2008). Hence, the development of a BCM process is regarded as an important variable. In their study, Wong (2009) highlighted the important role played by BCM in strategic management. He highlighted the significant role played by BCM in preserving future organisational competitiveness and organisational success.

As mentioned above, the researchers have attempted to identify the features and nature of the BCM in a crisis or emergency. For this purpose, they studied the hospitals in Jordan. They identified the effect of emergencies or crises faced by these hospitals that encouraged them to develop their BCM and offer better services to the people. The researchers selected the hospitals in their study as these organisations played a primary role in offering healthcare and medical services to the people at all times. Moreover, these organisations could successfully manage their operations and offer services without interruptions even during a crisis or disaster.

Literature review

Currently, business organisations are operating in a turbulent and unstable environment, facing recurrent crises (Kindleberger & Aliber, 2005). The COVID-19 pandemic has even affected the local public organisations. Some of these firms faced a slowdown or complete cessation of their activities, especially those related to tourism, leisure, entertainment, transport, and culture. A threat to equity, capitalisation and business failures have affected the company's shareholders (FEPL, 2020).

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A majority of the organisations have to face some common threats like product contamination, labour strike, terrorist attacks, technological breakdowns, pandemics and natural disasters (Cheval, 2012; Bharagva, 2012; Gupta et al., 2010). These crises can significantly affect any organisation's workforce, property, and business activities (Pearson & Clair, 1998). Moreover, a few major threats can even threaten the organisation's existence and lead to its bankruptcy and disappearance (Coombs, 2014; Wang et al., 2015; Abo-Murad & Al-Kharabsheh, 2019). Therefore, there is a need to implement proactive measures which can help the organisations prevent crises and recover.

The crises are unavoidable, and it becomes difficult for the organisations to remain immune to their negative effect (Wang et al., 2015) and continue their work operations, which has led to the development of the BCM concept (Swalha, 2013). BCM is an important process that ensures that the firms can maintain their normal business activities during a crisis without any disruption (Gallagher, 2003). In their study, Al-Kharabsheh et al. (2022) highlighted the importance of human resource management from the crisis management perspective.

Business continuity management

In 2011, north-eastern Japan was hit by a powerful earthquake after a devastating tsunami severely affected its national economy. These natural disasters also showed a global effect as the Japanese auto parts supply chains that supplied components to auto assembly plants in the world were disrupted (Ando & Kimura, 2012).

Similarly, in 2011, the Chao Phraya River in Thailand flooded, threatening the regional, national and global economy. As a result, Thailand's commercial and industrial sectors were affected and disrupted supply chains (Komori et al., 2012).

Many global platforms are determining the resulting economic damages and understanding the significant role of the private sector in their management as a result of global crises and disruption of important economic sectors as a result of natural disasters. The 4th session of Global Platform for Disaster Risk Reduction, supported by the United Nations, was held in 2013. All the participants highlighted the need to improve resilience and develop new opportunities that established public-private partnerships for improving risk management. They stated that more efforts need to be made that use an administrative approach for decreasing the consequences and effects of the disasters on the functioning and development of the companies (Baba et al., 2014).

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Furthermore, due to the joint efforts of the private and public sectors, regional and international researchers and consultative institutes have developed a system that can enable organisations to maintain their operations despite crises. Hence, a British Covenant initiative for specifications and standards established the British Standard, i.e., BS 25999, which developed a process that enabled the corporate management to plan and implement business continuity even in the case of a crisis. This standard called the Business Continuity Management System (BCMS) or the Business Continuity Plan (BCP) also offered solutions for overcoming a crisis as quickly and efficiently as possible. After this mechanism proved to be successful, an interactive management tool that helped the organisations before and during a crisis and also allowed their recovery was included. The International Organisation for Standardisation ISO (2012) issued a standard that stated that this tool could help protect the institution from disasters and crises like fires, floods, environmental inheritance, thefts, terrorist attacks, technical breakdowns, and diseases that could affect the workforce. This system also determined all the probable threats and their effect on the workforce. After that, it developed appropriate plans for addressing these issues before their occurrence or reducing their impact after their occurrence (BSI, 2012).

The above results indicated that mainly the coping or response strategies were used for managing the crises. It was also noted that the changing path strategy was the most popular strategy implemented by the organisations during a crisis. In this study, the researchers have presented a few novel insights regarding crisis management in Jordanian hospitals since they could contribute to this field of research in developing countries (Abo Murad et al., 2021).

Crisis management

Crisis management has been practised for several decades. It refers to the interactions and decisions made by people in the case of a crisis or emergency. However, it was defined using different terms like leadership prowess, management diplomatic skills in the past. Despite the different names, this practice determines the actual test of a person's ability to face any crisis or emergency using their creative capability (Harwati, 2013; AL-Kharabsheh et al., 2014).

The increasing number of crises and a change in their characteristics (wherein the crises have become more dynamic, abnormal, and complicated) have garnered much academic interest. The researchers are placing a lot of importance on proactive crisis management (Roux-Dufort, 2000). Many researchers have started focusing on proactive crisis management studies

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(Jaques, 2010; Lagadec & Topper, 2012). Hence, several academicians are encouraging people to build their organisational skills and abilities that could allow them to confront dynamic, abnormal and complicated crises, instead of focusing on a rigid set of processes (Abo Murad et al., 2021).

Crisis management in the health sector and hospitals

The recent technological and scientific developments in the health sector have made it very dynamic (Geelen-Baass & Johnstone, 2008). Because of the growing population, there has been an increase in the number of unrecognised and new health threats, further highlighting the need to establish a regulatory framework for the health sector to manage the health crises (Liu et al., 2018). Regarding the management of health crises, an effective and coordinated operational action plan needs to be developed by the experts and then supervised by administrative staff. This can be implemented in the case of a health threat affecting the population, irrespective of the crisis length and duration (Efstathiou, 2008).

Many occurring crises and disastrous situations hamper the smooth operation of businesses across the globe. However, health-related disasters are one of the most severe types of crises as they directly affect the well-being and life of individuals. Hence, health crisis management systems play a vital role in overcoming health-related disasters, after adopting some plans that allow the smooth operation and continuation of all activities even in the presence of a crisis. These systems also help in controlling the spread and negative effects of the health crisis. For instance, the coronavirus pandemic that arose in 2019 led to many health crises that highlighted the underlying issues existing in the healthcare system across the globe (Blumenthal et al., 2020). This pandemic led to reforms for improving the ability of the healthcare administrations and governments to cope with similar future health disasters and crises.

Hospitals play a vital role in coping with healthcare crises and disaster management processes. Everyone expects the hospital staff to offer care, compassion and extensive support to the injured or uninjured disaster survivors. In the case of disasters like a terrorist attack or pandemic, the hospital communicators need to effectively communicate with their internal staff, external bodies and other organisations (Liu et al., 2018).

Disaster planning in a majority of the hospitals is very primitive and can only fulfil the minimum standards established by the governments. For instance, though there is an increase in the number of terrorist attacks, the hospitals are not equipped to face and tackle this form of crisis. Furthermore, there is a large gap between the administrative and planning processes, with

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regards to the willingness of the hospitals to handle and respond to the biological and chemical crises, nuclear or radioactive crises and even pandemics (Kaji & Lewis, 2006; Born et al., 2007).

Business continuity management in hospitals

Often the health care facilities are seen lacking during a crisis, which can be attributed to a shortage of human or material resources related to this sector. This gives rise to the need to determine the factors that can help improve hospitals' performance in crises by implementing some plans or managing the business continuity during crises.

Jafar and Taneja (2017) noted that many healthcare facilities and hospitals in India faced the risk of disruption owing to disasters. They also stated that healthcare facilities must always be accessible, particularly during a crisis. Furthermore, they presented some factors that affected the application of BCM in the hospitals during a crisis, which included a lack of skills, no awareness regarding the risks and disaster management, low finances, lack of an effective emergency contingency plan, no awareness about the international protocols and agreements or even government plans and directions.

For implementing the proper management of business continuity plans in the hospitals during a crisis, the administrative team must possess a set of following qualifications and skills (Hendrickx et al., 2016):

- Ability to communicate effectively.
- They must be able to work with the high-tech and technology administrators.
- Should think clearly during the crisis.
- Must be able to analyse effectively.
- They need to influence and manage effectively.
- They should be able to maintain the smooth operation of the hospital during a crisis and handle the subsequent stress.
- They need to objectively analyse the cost and benefits and also make a few unbiased recommendations.
- They also must benefit from the earlier experiences regarding the BCM process.
- They must be able to learn and understand the existing and new management practices.

Furthermore, another factor that challenges the healthcare and hospital sectors that requires the adoption of the BCM process is related to medical data. It is noted that the healthcare sector relies significantly on the data that gets circulated between the insurance companies, hospitals, nursing stations, doctors, pharmacies, etc. Though the health centres maintain high confiden-

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tiality and secure the medical data, it can still be subjected to a tragic situation, either man-made or natural. For instance, the medical data possessed by Anthem insurance was breached, which affected more than 80 million patient records. Such incidents highlight the significance of maintaining business continuity and contingency plans. The health care sector often follows the earlier processes and arrangements that were established for the smooth and safe operation of the centre during or after a crisis. These are not only essential but also legally needed (Ripley, 2015).

Public and private Jordanian hospitals have faced many crises in the last few years (Al-Kharabsheh, 2018). After the arrival of several refugees into Jordan from the neighbouring countries that were affected due to revolutions, the Jordanian hospitals faced a lot of pressure due to a significant increase in the need for healthcare and medical facilities. Hence, business continuity is regarded as necessary since the healthcare sector cannot be idle for a single day as it could affect the lives of people and society.

Types of crises situations in modern business organisations

A. Natural disasters

A disaster can be defined as an event that occurs at a particular place or time, either caused due to human errors or nature, is unintentional or intentional, often results in a loss of property or lives and requires a lot of effort to overcome that can exceed the abilities of the whole country or several countries (Al-Sahli, 2011).

Natural disasters are categorised based on their reason for their origin, such as water-based disasters (i.e., floods), geological-based disasters (i.e., volcanoes, earthquakes, landslides, and cracks), climate or wind-based disasters (storms, hurricanes, etc.) or a disaster that is caused because of the aggravation of natural disasters like the spread of diseases, epidemics, pollution or starvation (Abu Zayed, 2015).

Many countries, even developed ones, have failed to control or manage the loss that occurred due to natural disasters. After reviewing all the probable reasons, it was noted that the organisations related to risk management of these disasters could not face larger disasters or prepare themselves using preventive or proactive strategies (Kapucu & Garayev, 2011). The developed countries have realised the importance of BCM and adopted BCM processes to tackle the risks arising from disasters. In other countries, the governments have started understanding the significance of BCM and encouraged the organisations to undertake BCM processes for protecting themselves against disastrous situations (Kim & Amran, 2018).

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B. Internal and external crises

Organisations worldwide are facing a higher number of dynamic, complex, and abnormal crises. These crises are caused by many factors existing within and outside their work environment (Abo-Murad et al., 2021). The Jordanian healthcare organisations face many different types of crises like floods, natural disasters, terrorist attacks, political instability, economic inflation, and government processes (Al-Kharabsheh, 2018). Recently, the Covid-19 pandemic has also significantly crippled the healthcare system in the country. Furthermore, many internal crises like a shortage of human, material and technological resources, ineffective communication channels between the organisations and other related institutes and weak leadership affected the health care sector (Al-Serafi, 2008).

Numerous business owners have presented their view regarding the type of support they needed for handling a crisis, such as direct financial support, pay subsidies, access to credit and certain policies for decreasing the business costs, work permits, licensing fees and implementation of solvency regulations and laws (Kebede, 2021).

C. Operational and strategic risks

The strategic and operational risks were related to an organisation and its activities. One important factor related to BCM that allows the organisations to face external crises is related to the type of insurance that can cover the undesirable effects of the crisis. The operational and strategic risks can lead to the destruction of a complete organisation. Furthermore, it was noted that the operational and strategic risks along with a natural disaster could completely "destroy" an organisation in the absence of a BCM model that can reduce the negative effects of the disaster (Filipović et al., 2018).

The risks mentioned above pose a real threat to the continuous business operation of the organisations in normal situations or crises. Hence, it must be prioritised by the management and administrators of any organisation. Some important strategic and operational risks affecting the smooth operations of the health care sector in Jordan are as follows (Jordan University of Science and Technology, 2018):

Health and Human Risks: There is a higher risk of spreading infection owing to infectious viruses or diseases, injuries, asphyxia, or trapping of people during fires. This factor also includes the risk that the organisations cannot control the spread of disasters owing to standard or systematic contexts.

Risks associated with the public safety measures: These includes the risks due to compressed gases, lack of knowledge regarding the procedure to be followed in the case of fire, fires resulting due to storage of flammable liquids, lack of fire-protection devices (like alarm systems, extinguishing

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devices, etc.), absence of indicative or warning signs for exits in the case of an emergency; lack of service rooms, risks faced by contractors during projects, operational and maintenance risks, risk of renovation within the buildings and risks associated with climatic conditions like dust hazards, storms, rain, torrential hazards, sunstroke, etc.

Technological/informational risks: These include risks such as computer virus attacks, hacking, unauthorised access to the technical and administrative departments, use of fake computer software, unauthorised modification of information or data, data compatibility or accuracy, malfunction of systems or hardware.

Financial risks: The financial risks include a lack of government support, risk of scarcity of existing material resources or the ability of the corporation, risk of managing financial resources or assets, administrative and financial operational risks, and also risks associated with the mismanagement of financial liquidity.

D. Probability of the recurrence of a crisis once the crisis has occurred and overcome, irrespective of the effectiveness of the response displayed by the organisations, it must be regarded as an experience that teaches the management a few lessons. The crisis management processes have to be assessed to understand the effective steps and the areas that need improvement. For this purpose, the management should set up a separate crisis assessment team/committee, in addition to the crisis management team, for evaluating their efforts for combating the crisis and recommending alternative processes for handling the crisis. This could help them decrease the probability of the recurrence of the crisis and resulting damage as they can incorporate the lessons derived from the organisation's crisis management system, thereby improving their techniques for preventing, preparing and responding to the crisis.

After that, the organisations have to identify and restore any damage occurring to the workflow during this crisis, especially the damage to their reputation. A majority of the organisations use communication strategies to explain their position during the crisis, which is sufficient; however, sometimes additional efforts need to be made to repair their reputation. For determining these steps, the organisational management must assess the different effects of the crisis after comparing the pre-crisis criteria to the public opinion and perceptions of their stakeholder perceptions regarding the organisational performance. Then, they need to review all the factors responsible for the earlier crisis and their resulting negative effects. Finally, the organisation releases a few updates related to the processes they have undertaken to prevent the recurrence of the crisis, describe the various corrective activities

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that they have implemented, and publish the potential results from their investigation of the crisis (Coombs, 2014).

Impact of the COVID-19 pandemic on the Jordanian organisations

The organisations investigated in this study reported some challenges like decreased demand and supply, reduced cash flow, and a disrupted supply chain, owing to the measures they used to respond to the COVID-19 pandemic. Only 7% of the organisations were able to operate without any issues, while 39% of the investigated organisations were operational with a reduced staff (7%) or lower working hours (16%) or both (16%). However, 51% of the investigated organisations had to be temporarily shut down (Kebede, 2021).

42% of the organisations stated that they would be able to pay their workers under the existing conditions only for one month. In comparison, 42% of the organisations could pay their workers only for three months. Furthermore, a few micro-businesses (55%) and small organisations (44%) stated that they did not possess the means to pay their workers' salaries. In contrast, the medium (33%) and large organisations (23%) could pay their worker wages for another month. Around 26% of the firms stated that during the time of this survey, they could not remain operational for even a month; whereas 30% of the organisations mentioned that they could operate for 1-3 months; 5% stated that they were operational for 4-6 months; while only 13% of the organisations would operate for ≥ 6 months. Furthermore, 27% of the surveyed organisations stated that they did not know how long they would remain operational if the pandemic situation prevailed in the future (Kebede, 2021).

A majority of the employees, who could not come to work due to lockdowns, were still receiving partial (20% of the employees) or complete (71%) salaries from their organisations. The results indicated that the employees working in larger organisations usually received their complete salaries compared to those working in smaller organisations. It was also noted that ≈40% of the investigated organisations had stopped their payments to social security due to the pandemic, thereby using the waiver introduced in Defence Order 1. This observation was more commonly noted amongst the smaller organisations than large firms. Furthermore, 45% of the micro industries had stopped their payment entirely compared to 34% of the SMEs (with ≥100 workers).

The results indicated that 52% of the surveyed respondents were confident that they could weather the pandemic and resume their businesses,

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whereas 20% of the organisations were not confident about their economic future. However, when they were asked questions about the financial condition before the pandemic, 25% of the respondents stated that they were in loss; while 46% stated they could only break even.

The researchers concluded that a majority of the companies on the verge of bankruptcy after the pandemic were already facing financial difficulties before implementing the lockdown measures. The home-based and micro industries were very apprehensive about their future. Furthermore, it was concluded that the capability of an organisation to survive the financial crisis depended on several factors, like how agile the firms were in adapting new business techniques and ensuring their business continuity. However, only 25% of the surveyed organisations possessed a business continuity plan. Regarding the measures executed for preventing the spread of the coronavirus at the workplace, >72% of the surveyed organisations possessed disseminated protective gear, such as gloves and masks, whereas 55% possessed better cleaning and sanitising facilities at the time of this survey.

However, 23% of the micro-organisations did not undertake any such measures. 67% of the surveyed organisations were unaware of any support packages offered by the government for helping them reduce the effect of the crisis even by April-end (Kebede, 2021).

53% of the firms considered direct financial support essential as it would allow them to cope with the crisis. However, 60% of the micro-enterprises and 43% of the SMEs (with ≥100 employees) stated that they needed this type of support. In addition, 42% of the surveyed organisations and 68% of the SMEs (with ≥100 employees) proposed wage subsidies for coping with the crisis, while 20% of the organisations requested access to credit (Kebede, 2021).

Hypothesised model and hypotheses

The researchers developed a hypothesised model based on the arguments mentioned above (Figure 1). This hypothesised framework was designed using the variables described above, as presented in Figure 1. The Independent Variables (IVs) included in the framework were crises (such as natural disasters, internal and external crisis issues, operational and strategic risks, and the probability of a crisis recurrence). In contrast, the Dependent Variable (DV) included the development of the BCM. This hypothesised model was used for investigating the direct effect of the crises on the development of the BCM in Jordanian hospitals.

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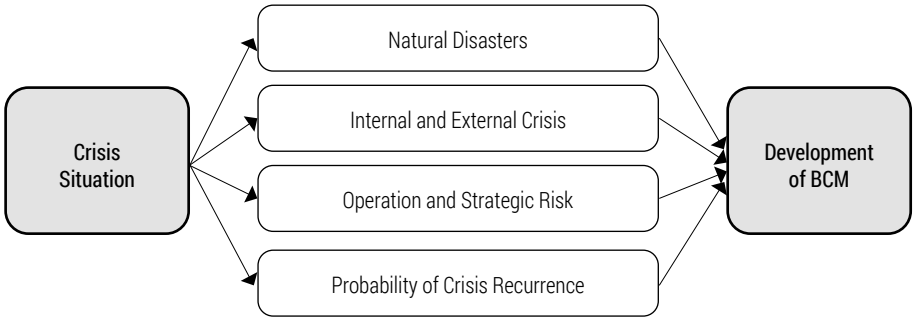

Figure 1. Hypothesised model

Source: author's work based on that described by Filipović et al., 2018.

The primary hypothesis investigated in this study was that "the Crises and Emergencies significantly and morally affected the development of the BCM process in the Jordanian hospitals." This objective was investigated in small parts as follows:

H1: The internal crises were associated with the development of the BCM in Jordanian hospitals.
H2: The external crises were associated with the development of the BCM in Jordanian hospitals.
H3: Natural disasters crises were associated with the development of the BCM in the Jordanian hospitals.
H4: Operational and strategic risks crises were associated with the development of the BCM in the Jordanian hospitals.
H5: The probability of the recurrence of a crisis also affected the development of the BCM in Jordanian hospitals.

In the past two decades, many phenomena threatened the societal progress and the stability and security of the countries, such as terrorist attacks, hacking, the spread of epidemics, and climate changes arising due to environmental damage. Such disasters affect every individual on the planet. Hence, it is necessary to adopt a qualitative administrative behaviour that can help in maintaining business continuity in difficult situations, especially in the essential sectors, such as hospitals, that offer basic services to the citizens. This can only be achieved by ensuring that these sectors' normal business and operations are carried out without any interruptions. This approach gets significantly affected during a crisis or disaster, which hinders the success of a BCM process. Hence, a lot of experience and strategic thinking is needed. The management can benefit from their past experiences and make future decisions for preventing the recurrence of a crisis or at least enabling recovery from these situations.

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Research methodology

In this study, the researchers implemented a quantitative technique for data collection. First, they used a descriptive-analytical process by deriving conclusions from the references and the published literature related to the topic under investigation. They developed a self-administrated questionnaire for investigating the different variables (Filipović et al., 2018). These questionnaires were distributed amongst the respondents through email or hand-delivered. The respondents included the directors of various administrative departments, their deputies, assistants, heads of departments and consultants in the Jordanian hospitals.

A total of 70 questionnaires were distributed amongst the different respondents, while 61 could be retrieved and used for data analysis, i.e., 87% of the distributed questionnaires. This questionnaire included 2 Sections. Section 1 aimed to collect demographic information about the respondents. Section 2 included items for describing the study variables. The researchers used a 5-point Likert scale ranging from 1 (i.e., least important) to 5 (most important) to determine the answers for every questionnaire item. All data were analysed using the SPSS software.

Results and discussion

Profile of the respondents

Table 1 presents the demographic information of the respondents.

Table 1. Demographic profile of respondents

Category	Description	No.	%
Gender	Male	45	73.8
	Female	16	26.2
	Total	61	100.0
Age	19-24 y	34	39.3
	25-30 y	16	26.2
	>30 y	1	1.6
	Total	61	100.0
Educational	University	48	78.7
	Diploma	13	21.3
	Secondary certificate	0	0
	Total	61	100.0

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Category	Description	No.	%
Occupational level	Top management	13	21.3
	Senior management	44	72.1
	Lower management	4	6.6
	Total	61	100.0
Years of experience at the hospital	<5 y	24	39.3
	5-10 y	20	32.8
	≥10 y	17	27.9
	Total	61	100.0

Source: author's work.

Part one: Items related to the Independent Variable (i.e., crises)

A. Cases and crises (internal and external) experienced by the hospitals

Table 2 presents the average values derived from the questionnaire for the hypothesis that "Cases and conditions of crises (internal and external) affected the development of BCM in Jordanian hospitals", which ranged between 4.08 and 4.56. The maximal value for the statement that "Hacking medical information and disrupting access presents a crisis to the employees" was 4.56. This indicated that the hospitals were concerned about their security system, especially in the case of a crisis occurrence. The second paragraph stated that the "Prevalence of any viral or bacterial infection in the hospital led to a crisis in the hospitals" showed an average value of 4.33, indicating that the hospitals were eager to implement their designed plans accurately.

The lowest mean value was noted for the 4th paragraph that stated that "Theft or any misuse of narcotic substances presented a crisis", i.e., 4.08. Thus, it could be concluded that the private hospitals tried to prevent the development of any crisis (either internal or external) by establishing smart objectives and designing detailed plans, which had to be implemented accurately and appropriately. Thereafter, the hospital management acquired valuable feedback so that they could make any changes in their plans.

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Table 2. Results for the Mean and Standard Deviation of the items related to the Crises variable in a descending order

No.	Statement	Mean	SD	Degree
1	Hacking of medical information and disabling access to it – a security effect at the time of the crisis	4.56	0.5	High
2	Prevalence of a bacterial/viral infection in the hospital	4.33	0.63	High
3	Insufficient numbers of workers due to the crowded hospital with patients and auditors	4.2	0.65	High
4	Fatal medical errors in diagnosis and dispensing of the drug	4.13	0.78	High
5	Medical errors resulting from the negligence of the nursing staff exacerbate the patient's condition and death	4.1	0.72	High
6	Theft or misuse of narcotic drugs	4.08	0.76	High
7	Part of the building collapses, or the building is cracked	4.2	0.63	High
8	A fire broke out in the hospital	4.18	0.59	High
9	Suspension of work by the medical staff as a matter of participation in sit-ins and occupational strikes	4.18	0.65	High
	Total rate	4.23	052	High

Source: author's work.

B. Natural disasters

Table 3 presented the mean values derived from the questionnaire for the hypothesis that "Natural Disasters affected the development of BCM in the Jordanian hospitals", ranging between 4.03 and 4.26. The maximal value was noted for the second statement that "Torrents that impeded the movement of ambulances and affected the transportation of the patients to the hospitals" showed a mean of 4.26 and a high degree. This was attributed to the nature of the hospitals and the fact that they need to monitor natural disasters constantly. Furthermore, the 3rd statement that "Heavy thunderstorms could cause a power outage that affected the important devices in the hospitals, causing several deaths" showed a mean of 4.21. This indicated that the hospitals were aware of the significance of training courses related to natural disaster management. Statement 1 stated "Snowstorms often prevent the workers from arriving at the hospitals since the roads were often blocked" and was ranked last with a mean of 4.3 and high degree. This indicated that the hospitals were aware of the significance of effective communication channels between the employees and top management if there was an occurrence of a natural disaster. All the statements showed a mean of 4.23. Thus, the above results showed that the hospitals need to make full use of their workers and managers by providing them more training, helping them

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develop their skills and experience since these factors could allow them to manage natural disasters and decrease their negative effects.

Table 3. Results for the Mean and Standard Deviation of the items related to the Natural Disaster variable in a descending order

No.	Statement	Mean	SD	Degree
1	Snowstorms that prevent workers from reaching the hospital due to the interruption of roads	4.3	0.72	High
2	Floods that hinder the movement of ambulances and transport patients on the roads to the hospital	4.26	0.79	High
3	Heavy thunderstorms that cause power outages for vital devices in the hospital, causing deaths among patients	4.21	0.78	High
	Total rate	4.23	0.49	High

Source: author's work.

C. Strategic and operational risks

Table 4 presented the mean values derived from the questionnaire for the "Performance Orientation" variable, ranging between 4.2 and 4.36.

Table 4. Results for the Mean and Standard Deviation of the items related to the Strategic Risk variable in a descending order

No.	Statement	Mean	SD	Degree
1	The state of confusion that affects employees' performance of their duties in times of crisis	4.36	0.61	High
2	Lack of a backup program for all information and data	4.31	0.72	High
3	Lack/shortage of electric generators (including fuel and cooling water) in hospital	4.2	0.81	High
4	The lack of medical staff and the failure to absorb the large numbers of patients and clients	4.2	0.68	High
5	Lack of budget allocated for the purchase of medical supplies and medicines	4.18	0.74	High
6	Dependence on specific sources of supply of medical supplies and medicines – monopoly	4.18	0.74	High
7	Vinegar and malfunctions alarms in intensive care rooms and operations	4.3	0.78	High
8	Lack of protective equipment, resources and capabilities needed to preserve the "staff life" in times of crisis	4.15	0.87	High
	Total rate	4.32	0.52	High

Source: author's work.

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Statement 1 stated that "A confusing situation affected the employee performance in a crisis", showed the highest average of 4.36. This highlighted that the hospitals were very interested in employing qualified and capable employees with suitable job characteristics to decrease the effect of disasters. The 4th statement, i.e., "A lack of medical staff and their failure to absorb the massive increase in the number of patients and auditors" showed a mean of 4.18. This score indicated that the hospitals were eager to review the actual operational performance of this strategy. All statements showed a mean value of 4.36.

D. The probability of crisis reoccurrence

Table 5 presents the average values for the "probability of crisis recurrence" variable ranging from 4.3 to 4.44. Statement 1, i.e., "repeated fires within the hospital premises irrespective of their cause" showed the highest mean of 4.44, thus indicating that the hospitals constantly monitored and reviewed the probability of crisis recurrence. Statement 5 stated, "The hospitals did not benefit from the primary crisis and corrected their operational and strategic course of action" and showed a mean of 4.3 with a high degree. This highlighted the hospitals' eagerness in monitoring and decreased the crisis recurrence, thereby reducing its negative effects. All the statements showed a mean of 4.24. This value indicated that the hospitals were aware of their role in making the workers aware of the severity of the crisis and aiding in the crisis-recovery process.

Table 5. Results for the Mean and Standard Deviation of the items related to the Crisis recurrence variable in a descending order

No.	Statement	Mean	SD	Degree
1	Frequent fires inside the hospital regardless of the cause of the fire every time	4.44	0.70	High
2	The long-term effect of weather – cold and rain for a long time	4.41	0.72	High
3	The constant change in health technology systems makes the process of monitoring and constantly updating a recurrent crisis	4.41	0.72	High
4	The return of occupational strikes in the country from time to time	4.38	0.71	High
5	Not benefit from the first crisis and correcting the path of action strategically and operationally	4.30	0.76	High
	Total rate	4.24	0.52	High

Source: author's work.

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Part two: Paragraphs related to the Dependent Variables (Development of BCM)

Table 6 presents the average values for the hypothesis that "the hospitals identify many areas requiring development and change for improving their business continuity", ranging between 4.11 and 4.59. Statement 1 stated that "fundamental changes were made for the business continuity plan" and showed the highest mean value of 4.59. This indicated that the private hospitals in Jordan aimed to positively affect their team and display their keenness regarding the continuity of their work. Statement 5, i.e., "hospitals used new computerised programs and updated their current BCM process", showed the lowest mean value of 4.11, with a high degree. This showed that the hospitals aimed to simplify the complex systems and their work processes. All the statements showed a mean of 4.32. The above results indicated that the hospitals presented an environment that allowed development and changes for improving their BCM and improved the employees' accountability.

Table 6. Results for the Mean and Standard Deviation of the items related to the BCM development in a descending order

No.	Statement	Mean	SD	Degree
1	Make drastic changes to the business continuity plan	4.59	0.56	High
2	Increased interest in testing the effectiveness of the plan developed through implementing the activities required in the plan	4.36	0.66	High
3	Implementing the new computerised software and updating the existing business continuity management	4.36	0.90	High
4	Pay close attention to cyber security and cyber risks	4.34	0.89	High
5	Application of modern technologies in information technology and cloud applications	4.11	0.73	High
6	Increased focus on crisis management	4.16	0.80	High
	Total rate	4.32	0.61	High

Source: author's work.

Part three: Hypotheses testing

H1: No statistically significant impact of the internal crisis was noted on the development of BCM in private hospitals.

H2: No statistically significant impact of the external crisis was noted on the development of BCM in private hospitals.

H3: No statistically significant impact of natural disasters was noted on the development of BCM in private hospitals.

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H4: No statistically significant impact of strategic and operational risks was noted on the development of BCM in private hospitals.
H5: No statistically significant impact of the recurrence of a crisis was noted on the development of BCM in private hospitals.

Table 7. Test Results of the study hypotheses

Hypothesis	T calculated	T-Tabulated	T-SIG	H0 conclusion	H1 conclusion
H1	18.88	1.9799	0.000	Rejected	Accepted
H2	4.88	1.9799	0.000	Rejected	Accepted
H3	4.1667	1.9799	0.000	Rejected	Accepted
H4	0.8312	2.0452	0.000	Rejected	Accepted
H5	4.349	2.0452	0.000	Rejected	Accepted

Source: author's work.

Table 8. Results of the Beta coefficient (β)

Factor	β coeff.	SE	B (standard coeff.)	T	SIG	Tolerance	VIF
Constant	0.894	0.235		3.804	0.000		
Cases and crises situation (internal and external)	0.020	0.069	0.027	0.281	0.779	0.478	2.093
Natural disasters	0.2853	0.074	0.308	3.407	0.001	0.523	1.913
Operational and strategic risks	0.162	0.058	0.228	2.785	0.007	0.641	1.560
Probability of crisis reoccurrence	0.306	0.093	0.314	3.302	0.001	0.306	0.093

Source: author's work.

The above results highlight the importance of the Beta coefficient in different areas that need development and changes for improving BCM in the Jordanian hospitals, thereby allowing the hospitals to decrease the negative effects of natural disasters.

In this study, the researchers have noted that the crises directly affect the development of the BCM in Jordanian hospitals. This highlighted the significance of the BCM in the success of the hospitals that wish to continue their operations in an emergency. A similar observation was made by Liu et al. (2018) and Fabeil et al. (2020). Furthermore, Blumenthal et al. (2020) stated that the health care institutes aimed to ensure that the medical services were prepared to offer medical treatment as a response to external man-made and natural disasters. Therefore, the hospital managers and decision-makers had to improve the BCM plans and processes and regularly update their pro-

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cesses, since other global disasters like the COVID-19 pandemic could drastically affect their operations.

The results also indicated that the hospitals were keen to improve their stability and security after the occurrence of a crisis, which could help them understand how to fulfil their goals easily. The researchers noted that the hospitals offered an environment that was conducive for the development and changes made for business continuity. Thus, it was easier to improve and account for the various employees. The results showed that the hospitals often analysed their operational processes and trends to understand their existing abilities and competencies and detect developmental opportunities for fulfilling their goals and facing crises.

Conclusion

This study was carried out for understanding the effect of the crisis on the development of the BCM in the Jordanian hospitals and to determine the processes that were implemented by the hospitals for handling the various crises and disasters. Furthermore, the researchers made a few recommendations. They stated that the hospitals need to be more interested in offering training courses to their workers for improving their knowledge and helping them handle any disaster without affecting the workflow. This would help them separate the BCM planning from the various operational and emergency plans outlined by the management. Furthermore, they also need to review the BCM processes after every crisis.

Theoretical and practical contributions

This study has contributed to the existing knowledge regarding BCM in many ways. Firstly, it has added to the knowledge regarding the understanding of all factors that affect BCM development. Secondly, it has contributed to the literature related to health care crisis management by highlighting the need for further work. It is noted that very few researchers are interested in studying crisis management strategies in the health care sector. The researchers have also contributed to the understanding that crisis management in developing countries is a new topic, as a majority of the crisis management studies have been conducted in developed and Western countries. Additionally, this research has presented some steps that would help determine the effect of a crisis on the development of the BCM process.

Practically, the health care institutes have many responsibilities during their normal operations, which increase many-folds during a crisis. Hence, this study has made a few practical contributions, as the researchers have drawn managerial attention to improving the BCM processes.

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Future research direction

This study was conducted in Jordan to determine the different techniques used by the Western and Asian healthcare systems to handle any crisis. In addition, the researchers have compared the operational processes implemented in Jordanian hospitals to those in developed countries. Thus, this study presents a quantitative research approach for determining the effect of a crisis on the development of BCM in Jordanian hospitals. In future, the researchers could implement different methodological processes that involve a large population sample and offer a better picture of the BCM process in the Jordanian hospitals. Here, the researchers primarily focused on the health care industry. However, in the future, the researchers could extend this methodology to other industries and countries for achieving more generalised results.

This study has shown that Jordan's crisis management and BCM development research is still developing. Hence, this study could be used by other researchers who wish to study this topic further in either the health care sector or other areas.

The contribution of the authors

The article was written in collaboration by all authors.

References

Abo Murad, M., Al-Kharabsheh, A., & Al-Kharabsheh, A. (2021). Crisis management strategies in Jordanian hotel industry. Journal of Environmental Management & Tourism, 12(2), 578-587.

Abo-Murad, M., & Abdullah, A. K. (2019). Turnover culture and crisis management: Insights from Malaysian hotel industry. Academy Of Strategic Management Journal, 18(2), 1-14.

Abo-Murad, M., Abdullah, A. K., & Jamil, R. (2019). Effect of the organisational culture on crisis management in hotel industry: A qualitative exploration. International Journal of Entrepreneurship, 23(2).

Abu Zayed, H. A. A. (2015). *Disaster management requirements and level of success in the Gaza strip: A case study of the ministry of interior's role in facing Alexa Flood in 2013 [Master of Business Administration Thesis]*. Gaza, Palestine: Islamic University.

Al-Kharabsheh, A., Ahmad, Z. A., & Kharabsheh, A. (2014). Characteristics of crisis and decision making styles: The mediating role of leadership styles. Procedia-Social and Behavioral Sciences, 129, 282-288.

Al-Khrabsheh, A. (2018). Impact of strategic planning on crisis management in the profit and non-profit sector in Jordan. Academy of Strategic Management Journal, 17(5).

Al-Khrabsheh, A. A., Al-Bazaiah, S. A. I., Al-Khrabsheh, A. A., & Alheet, A. F. (2022). The strategic role of human resources management in performing crisis manage-

DOI: 10.34659/eis.2022.80.1.422

ment: The mediating role of organizational culture and human capital during Covid-19 (An Applied Study on the Jordanian Ministry of Health). Journal of Management Information and Decision Sciences, 25(S1), 1-18.

Al-Sahli, F. F. G. (2011). *The requirements of strategic planning and its role in disaster damage reduction [Master thesis].* Riyadh, Saudi Arabia: Naif University for Security Sciences.

Al-Serafi, M. (2008). *Crisis Management*. Horus Foundation for Publishing and Distribution, Alexandria.

Ando, M., & Kimura F. (2012). How did the Japanese exports respond to two crises in the international production networks? The global financial crisis and the great east Japan earthquake. Asian Economic Journal, 26(3), 261-287.

Azadegan, A., Syed, T. A., Blome, C., & Tajeddini, K. (2020). Supply chain involvement in business continuity management: Effects on reputational and operational damage containment from supply chain disruptions. Supply Chain Management: An International Journal, 25(6). https://doi.org/10.1108/SCM-08-2019-0304

Bakar, Z. A., Yaacob, N. A., Udin, Z. M., Hanaysha, J. R., & Loon, L. K. (2019). Business continuity management implementation in the Malaysian public sector. International Journal of Business and Technology Management, 1(1), 18-27.

Bhragva, R. (2012). *15 marketing trends in 2013 and how your business can use them*. Washington: Likeonomics.

Blumenthal, D., Fowler, E. J., Abrams, M., & Collins, S. R. (2020). Covid-19 – Implications for the Health Care System. The New England Journal of Medicine, 383(15), 1483-1488. https://doi.org/10.1056/NEJMsb2021088

Born, C. T., Briggs, S. M., Ciraulo, D. L., Frykberg, E. R., Hammond, J. S., Hirshberg, A., Lhowe, D. W., & O'Neill, P. A. (2007). Disasters and mass casualties: I. General principles of response and management. The Journal of the American Academy of Orthopaedic Surgeons, 15(7), 388-396. https://doi.org/10.5435/00124635-200707000-00004

British Standard Institute (BSI). (2012). *Business Continuity Management Standard (BS 25999)*. UK.

Cheval, S. (2012). *Natural disasters*. South Carolina: Hazard Research Lab.

Coombs, W. T. (2014). *Ongoing crisis communication: Planning, managing, and responding.* Sage Publications.

Efstathiou, P. (2008). *Health crisis management and characteristics of the managers*. 5th Hellenic Conference on Quality of Healthcare Services, Athens, Greece.

Fabeil, N. F., Pazim, K. H., & Langgat, J. (2020). The impact of Covid-19 pandemic crisis on micro-enterprises: entrepreneurs' perspective on business continuity and recovery strategy. Journal of Economics and Business, 3(2).

FEPL. (2020). *Covid-19 – Synthèse Des Premières Estimations des Conséquences Économiques.* https://www.Lesepl.Fr/2020/04/Covid-19-Synthese-Des-Premieres-Estimations-Desconsequences-Economiques/

Filipović, D., Krišto M., & Podrug N. (2018). Impact of crisis situations on development of business continuity management in Croatia. Journal of Contemporary Management Issues, 23(1), 99-122.

Gallagher, M. (2003). *Business Continuity Management: How to protect your company from danger*. London: FT Prentice Hall.

Geelen-Baass, B. N., & Johnstone, J. M. (2008). Building resiliency: Ensuring business continuity is on the health care agenda. Australian Health Review, 32(1), 161-173.

DOI: 10.34659/eis.2022.80.1.422

Gupta, P., Prakash, S., & Jayaraman, U. (2010). *IT infrastructure and its management*. New Delhi: Tata McGraw Hill.

Harwati, L. N. (2013). Leadership style for effective outcomes. Asian J Manage Sci Edu, 2(2), 170-181.

Hendrickx, C., D'Hoker, S., Michiels, G., & Sabbe, M. B. (2016). Principles of hospital disaster management: An integrated and multidisciplinary approach. B-ENT, 12(26/2), 139-148.

Herbane, B., Elliott, D., & Swartz, E. M. (2004). Business Continuity Management: Time for a strategic role? Long Range Planning, 37(5), 435-457.

International Organization for Standardization. (2012). (ISO 22301:2012). http://www.Iso.Org/Iso/Catalogue_Detail?Csnumber=50038

Jafar, E., & Taneja, U. (2017). Determinants of Business Continuity Management in hospitals. Int. J. Critical Infrastructures, 13(1), 57-69.

Jaques, T. (2010). Reshaping crisis management: The challenge for organizational design. Organization Development Journal, 28(1), 9.

Jordan University of Science and Technology. (2018). *Risk Management Plan and Response Procedures*.

Kaji, A.H., & Lewis, R.J. (2006). Hospital Disaster Preparedness in Los Angeles County. Acad Emerg Med., 13(11), 11981203.

Kapucu, N., & Garayev, V. (2011). Collaborative Decision-Making in Emergency and Disaster Management. International Journal of Public Administration, 34(6), 366-375.

Kato, M., & Charoenrat, T. (2018). Business Continuity Management of Small and Medium-Sized Enterprises: Evidence from Thailand. International Journal of Disaster Risk Reduction, 27, 577-587.

Kim, L. L., & Amran, A. (2018). Factors Leading to The Adoption of Business Continuity Management (BCM) In Malaysia. Global Business and Management Research, 10(1), 179-196.

Kindleberger, C. P., & Aliber, R. Z. (2005). Najveće Svjetske Financijske Krize: Manije, Panike I Slomovi. Zagreb: Masmedia.

Komori, D., Nakamura, S., Kiguchi, M., Nishijima, A., Yamazaki, D., Suzuki, S., & Oki, T. (2012). Characteristics of The 2011 Chao Phraya River Flood in Central Thailand. Hydrological Research Letters, 6(0), 41-46.

Lagadec, P., & Topper, B. (2012). How Crises Model the Modern World. Journal Of Risk Analysis and Crisis Response, 2, 21-33.

Lindstrom, S. (2012). A Model to Explain a Business Contingency Process. Disaster Prevention and Management. 21(2), 269-281.

Liu, B. F., Fowler, B. M., Roberts, H. A., & Herovic, E. (2018). Keeping Hospitals Operating During Disasters Through Crisis Communication Preparedness. Public Relations Review, 44(4), 585-597.

OECD. (2020). *OECD Economic Outlook*. Interim Report September 2020, Paris: OECD Publishing. https://Dx.Doi.Org/10.1787/34ffc900-En

Pearson, C. M., & Clair, J. A. (1998). Reframing Crisis Management. Academy Of Management Review, 23(1), 59-76.

Ripley, H. (2015). The Importance of Business Continuity for The Healthcare Industry. Article Issued in East Tennessee Medical News. 6th June. http://Easttnmedicalnews.Com/Content/Importance-Business-Continuity-Healthcare-Industry

DOI: 10.34659/eis.2022.80.1.422

Roux-Dufort, C. (2000). Why Organisations Don't Learn from Crises: The Perverse Power of Normalisation. Review Of Business, 21(3/4), 25-30.

Sawalha, I. H. S. (2013). Organisational Performance and Business Continuity Management: A Theoretical Perspective and A Case Study. Journal Of Business Continuity & Emergency Planning, 6(4), 360-373.

Tewodros Aragie Kebede, S. E. (2021). *Impact Of The COVID-19 Pandemic on Enterprises in Jordan*. Jordan: Fafo, ILO, UNDP.

Wang, J., Ritchie, B. W., & Campiranon, K. (2015). The Influence of Organizational Culture on Crisis Planning: An Application of the Competing Values Framework (CVF) in Chinese Hotels. Tourism Crisis and Disaster Management in the Asia-Pacific, 44-61.

Wong, W. N. Z. (2009). The Strategic Skills of Business Continuity Managers: Putting Business Continuity Management into Corporate Long-Term Planning. Journal of Business Continuity & Emergency Planning, 4(1), 62-68.

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PHOTOVOLTAIC MICROGENERATION (RES) IN SELECTED MAJOR CITIES IN SILESIAN VOIVODESHIP

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ABSTRACT: The impact of climate change on the economy and environment humans live in has increased, leading to a relatively quick intensification of the effort to reduce the environmental footprint of the civilisation. The push to establish a sustainable energy economy has become one of the primary challenges today. A sustainable energy economy should ensure energy security, reduce energy poverty, and contribute to lower greenhouse gas emissions. Poland is facing considerable challenges relevant to the objectives of EU policy, particularly the Fit for 55 package, which cannot be achieved without renewable energy sources. The most popular renewable energy source in Poland is solar energy. Apart from its obvious advantages, the use of distributed photovoltaic generation (including microgeneration) entails the need for transmission grid upgrades. The paper's objective was to assess the RES potential of Poland through an analysis of the steps the state took and the progress of its targets. The empirical part focuses on the assessment of the use of the solar energy potential (in photovoltaic microgeneration) in cities with district rights in Silesian Voivodeship, Poland, from 2014 to 2020. The study employs selected cartographic representation, comparative analysis, in-depth case study, and spatial analysis methods. The calculations involved data from Tauron Dystrybucja SA on the number of microgeneration systems in the cities, Database of Topographic Objects, Local Data Bank of the Central Statistical Office of Poland and Eurostat.

KEYWORDS: renewable energy sources, global warming, sustainable development, photovoltaic microgeneration

Introduction

A competitive, safe, and sustainable energy economy that helps curb greenhouse gas (GHG) emissions is the primary climate and energy challenge for the European Union and Poland as its member state. Sustainable energy economy is the seventh of the Sustainable Development Goals listed by the United Nations (2022).

Intensified use of renewable energy sources (RES) is an important component of a sustainable energy economy and a method for controlling climate change. RES means not only reduced CO_2 emissions but also lower emissions of air pollutants and alleviation of low emission ramifications, although to a lesser extent.

In the past, Poland signed documents obliging it to reduce greenhouse gas emissions (such as the Kyoto Protocol or Paris Agreement). The country's agreement is currently bound by is the European Green Deal and the Fit for 55 package aiming at a 55% reduction in greenhouse gas emissions and European Union climate neutrality by 2050.

Among the different types of settlement units, urban areas account for the largest share of GHG emissions. (Seto et al., 2014) presents several estimates that indicate the significant contribution of cities to GHG emissions. Cities also have higher building density compared to rural areas hence solar energy, unlike wind or water energy, is one of the main renewable energy sources used in dense suburban spaces.

The paper's objective was to assess the RES potential of Poland through an analysis of the steps the state took and the progress of its targets. The empirical part focuses on the assessment of the use of the solar energy potential (in photovoltaic microgeneration) in cities with district rights in Silesian Voivodeship, Poland, from 2014 to 2020. The study employs selected cartographic representation, comparative analysis, in-depth case study, and spatial analysis methods. The calculations involved data from Tauron Dystrybucja SA on the number of microgeneration systems in the cities, Database of Topographic Objects, Local Data Bank of the Central Statistical Office of Poland and Eurostat.

The origins and conditions of RES use

Consequences of climate change were noted and addressed in the early 1990s in the United Nations Framework Convention on Climate Change (UNFCCC). The main objective of the Convention was a debate on climate change and proposals to limit anthropogenic greenhouse gas emissions. Since then, the international community started to pay more attention to the

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potential adverse consequences of climate change, leading to further international agreements and agendas.

The impact of energy on sustainable development has also been increasingly recognised. One of the goals of the 2030 Agenda for Sustainable Development is goal no. 7 – to ensure that everyone has access to stable, sustainable and modern energy at an affordable price (Graczyk, 2017, http://www.un.org.pl/cel7 2015). As you can read in the Agenda: *Overcoming challenges and taking advantage of the many opportunities in today's world is associated with access to energy. It is essential for work, ensuring security, combating climate change, producing food and increasing national incomes*. It also sets out in more detail the 2030 targets (included in the 2030 Agenda for Sustainable Development) under Objective 7 and is (Sustainable Development Goals, 2022) including:

- 7.1 Ensuring universal access to affordable, reliable and modern energy services.
- 7.2 Significantly increasing the share of renewables in the global energy mix.
- 7.3 Doubling the growth rate of global energy efficiency.

In 1998, Poland signed the Kyoto Protocol, setting more detailed goals under the Framework Convention. In 2004, Poland was obliged to comply with EU obligations as it joined the European Union. Still, more importantly, it started to co-create the climate and energy policy of the EU, which grew more ambitious over time. The most current obligations include the Paris Agreement signed by Poland in 2018 and the climate neutrality by 2050 agreement signed in 2020. These targets would be met through the reduction in emissions of 'European' greenhouse gases by 55%, which will require a number of interdisciplinary activities in virtually all sectors of the economy, such as (European Commision, 2021):

- investments in environmentally-friendly technologies,
- introduction of cleaner private transport means,
- reduction in the emissions from the energy sector,
- increased energy performance of buildings.

These ambitious goals were set for a long horizon of 2050. It is vitally important to draft programmes to place reduction targets for each year and monitor progress. By 2020, one of the key national documents directing the pursuit of consecutive obligations regarding the promotion of renewable energy sources for the period 2010-2020 was the National Action Plan for Renewable Energy Sources. It set the national target for 2020 and annual thresholds for renewable energy consumption in heating and refrigerating, electricity generation (Figure 1) transport, and final consumption (Figure 2) (Ministerstwo Gospodarki, 2021). Using publicly available statistical data, the target RES proportions were compared to the reached values (Eurostat)

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and energy consumption (Central Statistical Office, 2021). Regrettably, the targets were more or less achieved only until 2015. After 2015, the actual proportion of RES both in electricity generation and total generated energy grew slower and failed to reach the milestones. The planned RES proportion in energy generated is unlikely to be met. An even greater difference of 2.5% was found for targets of RES proportion in electricity generation (Figure 2).

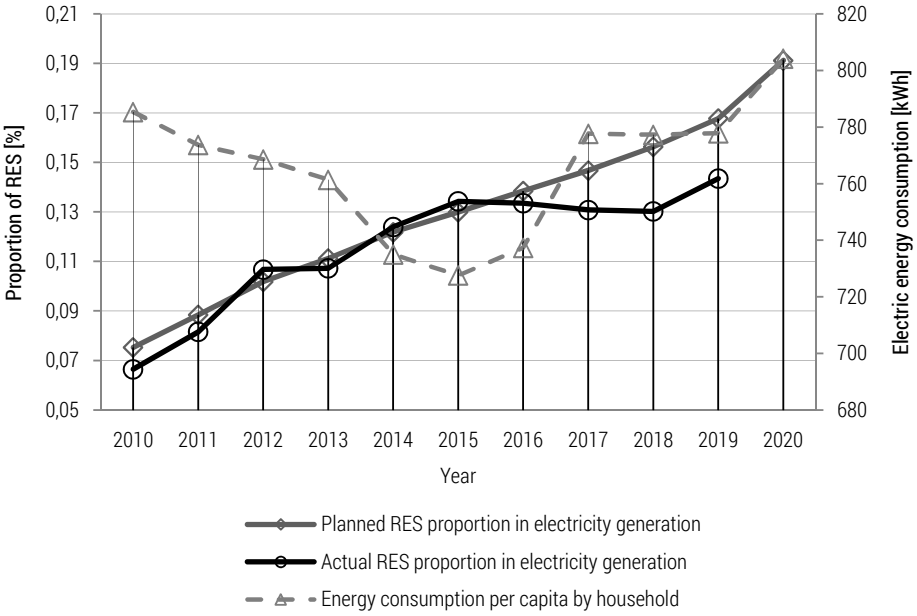

Figure 1. RES proportion in electricity generation

Source: Ministerstwo Gospodarki, 2021; Central Statistical Office, 2021; Eurostat.

Despite the actions taken and gradual reduction of CO_2 emissions, it was clear back in 2013 that the effort so far had been insufficient. Therefore, it was necessary to prepare for inevitable, adverse consequences of climate change in parallel to the reductions. Such adaptation plans for Poland were provided in the 2020 Strategic Adaptation Plan for Climate Change-Sensitive Sectors and Areas with 2030 Horizon (SPA) (Ministerstwo Środowiska, 2013).

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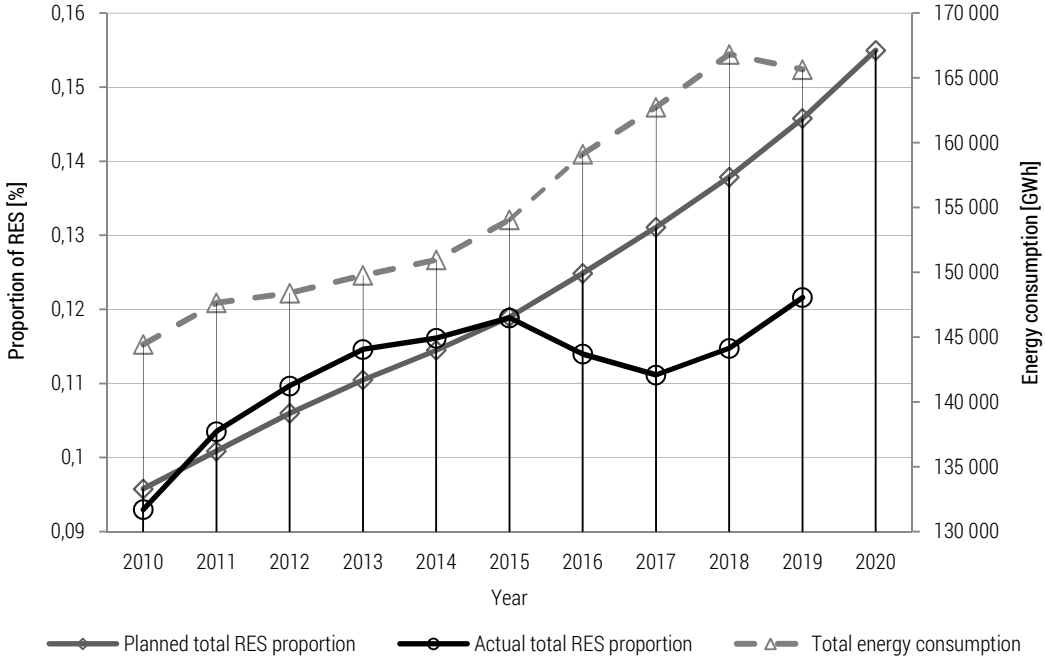

Figure 2. RES proportion in consumed energy

Source: Ministerstwo Gospodarki, 2021; Central Statistical Office, 2021; Eurostat.

The SPA presents threats and provides adaptive actions to ensure the effective functioning of the economy and society and sustainable development.

Regarding the energy sector, the authors noted (Ministerstwo Środowiska, 2013, p. 26):

- the susceptibility to damages of the overhead transmission grid, which is the dominant type in Poland,
- the potentially reduced performance of conventional power stations that need substantial amounts of water for cooling,
- the potential reduced biomass volume,
- the increased unpredictability and general worse wind conditions, which would mean increased failure or destruction risk for wind turbine generation,
- the potential improvement of photovoltaic generation conditions, which should be more effective with longer sunny weather spells and shorter winters.

The adaptive measures in the energy industry are summarised in Table 1.

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Table 1. Selected directions under activities 1.3 – the adaptation of the energy sector to climate changes

Item	Designation of adaptive activities as per the SAP	Selected development strategy areas with the adaptive activities
13.1	Development of alternative energy production potential at the local level, particularly for heating and air conditioning in low population density areas	1.3.5 Diversification of sources, effective use of energy, and natural threat responding 5.5. Increase in renewable energy sources use in rural areas 2.6. Increase in the importance of distributed renewable energy generation
1.3.5	Support for RES growth, in particular, microgeneration in agriculture	1.3.5 Diversification of sources, effective use of energy, and natural threat responding 2.7. Energy development of suburban areas

Source: Ministerstwo Środowiska, 2013, p. 38.

SPA was yet another document that emphasised the need for more significant RES employment. It further noted the potential improvement of photovoltaic (PV) generation use.

On RES and technical conditions

The problems of reaching the targets of RES proportion in generated energy as discussed earlier and the inevitability of adverse climate change consequences in a way leaves no choice but to use the available RES. In addition, fossil fuels, which are non-renewable resources, are gradually depleted.

Urban areas account for the largest share of GHG emissions. The IPPC report (Seto et al., 2014) presents several estimates of the percentage of cities in GHG emissions. According to IEA (2008), urban emissions accounted for 71% of total emissions in 2006. Final energy consumption in cities is estimated at 56-78% of global final energy consumption, which in terms of CO_2 emissions accounts for 53-87% of global emissions from final energy consumption (2005 data), (Grubler et al., 2012).

Combustion of fossil fuels, particularly low-class ones, in low, uncontrolled emission causes significant air pollution. It entails smog and several adverse health effects. Cities are responsible for high GHG emissions but are also seen as key areas where appropriate reduction measures can be implemented (Croci et al., 2021). The size of cities allows for a comprehensive, integrated policy covering the development of infrastructure, and mobility, as well as energy demand management (Brautigam & Knack, 2004; Rodrik et al., 2004).

Renewable resources/energy sources cannot be depleted. Still, 'large' RES systems (such as wind farms, PV farms, or large water reservoirs) can have multiple adverse effects on the environment and are frowned upon by environmentalist organisations. Microgeneration and small units generally

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do not have a negative environmental footprint. Note the issue of PV panel disposal. Humanity has fifteen years to resolve it. Wind turbine blade disposal poses problems as well.

The most popular type of energy used in microgeneration and small systems is solar energy. Hydropower generation requires a suitable location (on a river) and relatively significant upfront expenses, while the so-called 'wind turbine Act' (Ustawa, 2016) directly halted wind turbine investments in Poland in 2016.

Solar radiation offers a significantly large 'energy potential' value because it is on average 1000 kW/m^2, equivalent to 100 l of heating oil or 100 m^3 of natural gas (Szpryngiel, 2012, p. 81). Solar energy can be converted into:

- electricity with PV panels,
- heat with thermal panels to heat tap water or aid house heating (less popular).

The use of PV as RES comes at a price of economic and technical conditions. PV systems are relatively expensive (the unit cost decreases historically) but still much cheaper than heat pumps of similar power, and the payback period often exceeds ten years. PV microgeneration systems are installed chiefly on single-family houses due to legal and economic factors. One obligatory precondition is the so-called smart meter to measure consumed and generated energy. Installation of PV systems in multi-family buildings can entail significant infrastructural modifications. The impact of such systems on the transfer grid is not immaterial, either. According to the Polish Power Transmission and Distribution Association (PTPiREE, 2021), the following factors could contribute to an increase in the risk of problems:

- a large number and high output of microgeneration systems in an area with a single substation,
- systems located far from substations,
- small conductor sizes, uninsulated network,
- small energy consumption during the sunniest periods.

These problems can intensify in discontinuous urban fabric (urban sprawl) and for old, excessively elongated and underperforming power grids.

Formal, legal, and financial conditions for RES use

Today, PV microgeneration is supported through legal and financial means in Poland. Basic principles for shaping the energy policy and regulations and conditions for fuel and energy supply and use in Poland are provided in the Energy Law Act (Ustawa, 1997) aimed at providing energy security and rational energy and fuel use. The Act also contains regulations for energy transfer, connecting RES systems, and licensing requirements. In addition, detailed conditions and principles for generating electricity from

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RES, mechanisms and tools to support electricity generation from RES, biogas, and heat are regulated by the Renewable Energy Sources Act (Ustawa, 2015).

A microgeneration system is a RES system of a total installed electric power not exceeding 50 kW connected to an electric grid where the voltage does not exceed 110 kV (Ustawa, 2015., p. 7). RES system with a greater installed capacity between 50 and 500 kW are considered small systems (Ustawa, 2015, p. 7). Generating energy from microgeneration, small, or agricultural biogas systems does not require a licence or formal economic activity. Several more requirements apply (mainly technical ones, such as notifications or opinions) that will not be discussed here due to the length limitations. Small systems have to be registered with the Energy Regulatory Office (ERO) according to Article 17 (Ustawa, 2015).

PV panels can be installed virtually anywhere. The most significant challenge is installations in multi-family buildings as the approval of the housing community (and often technical opinion) is required in addition to a significant modification of the premises wiring. It often leads to prolonged duration and greater costs at the preparation stage, so such systems are rarely installed.

The most important financial instruments that support the growth of RES in Poland at the national level include:

- 'My Power' (*Mój Prąd*) scheme, which supports prosumer generation. Currently discontinued due to depleted funds. The subsidy in the previous year was PLN 5 thousand per system,
- 'thermal upgrade' tax deduction only for owners or co-owners of single-family residential buildings who improved building thermal performance or installed PV panels.

At the local levels, some Regional Operational Programmes offer subsidies. Therefore, there are several financial incentives to promote RES investments in Poland, both at the local, regional, and national levels.

RES performance and use, a case study

Study area

The selected group of objects was chosen purposefully. The cities are comparable (all of them are cities with district rights situated in Silesian Voivodeship), and their data are available. (Figure 3) presents the geographical location of the cities (19) within the limits of Silesian Voivodeship. Its central part has the greatest abundance of urban areas. It is the Upper Silesian conurbation of 14 cities with district rights. In 2017, nearly all cities in the conurbation (except Jaworzno) created the first metropolitan area in

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Poland. The Metropolitan Association of Upper Silesia and Dąbrowa Basin started in 2018. The area covers adjacent municipalities (41 municipalities in total) situated in historical Silesia and west Lesser Poland. Despite parts of the metropolitan area belonging to different regions, they are brought together by their industry-focused history cemented by local government initiatives and the local identity. A much smaller cluster of cities with district rights is located in the southwestern part of the voivodeship and covers Rybnik, Żory, and Jastrzębie-Zdrój.

Apart from the two conurbations, Silesian Voivodeship has two separate urban areas of broad impact zones and regional significance. Częstochowa in the northern part of the voivodeship has a colourful history and is essential for the local identity of the whole north part of the voivodeship, referred to as the Jurassic Upland. On the other hand, Bielsko-Biała is the most southern city with district rights in the voivodeship and the main urban area for the mountainous southern municipalities.

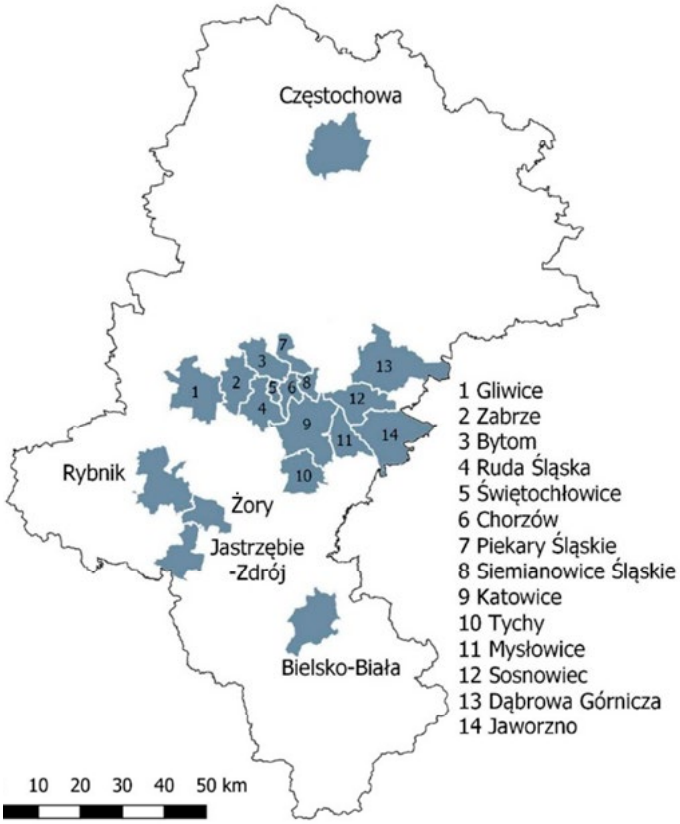

Figure 3. The investigated cities in Silesian Voivodeship

Source: author's work.

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Silesian Voivodeship has a significant RES potential, mainly from solar energy (PAN, 2005, 130-139). The analysis of the RES potential of the cities with district rights excluded biogas, which is used mainly in rural areas, and hydropower, which depends on hydrographical conditions. Solar energy was analysed as the most easily available RES in Silesian Voivodeship. The present paper investigates RES investments, the support measures used, and the growth potential of RES, particularly PV microgeneration. Therefore, the fundamental component of the profiles of the cities is the housing structure, focusing on single-family buildings (Figure 4).

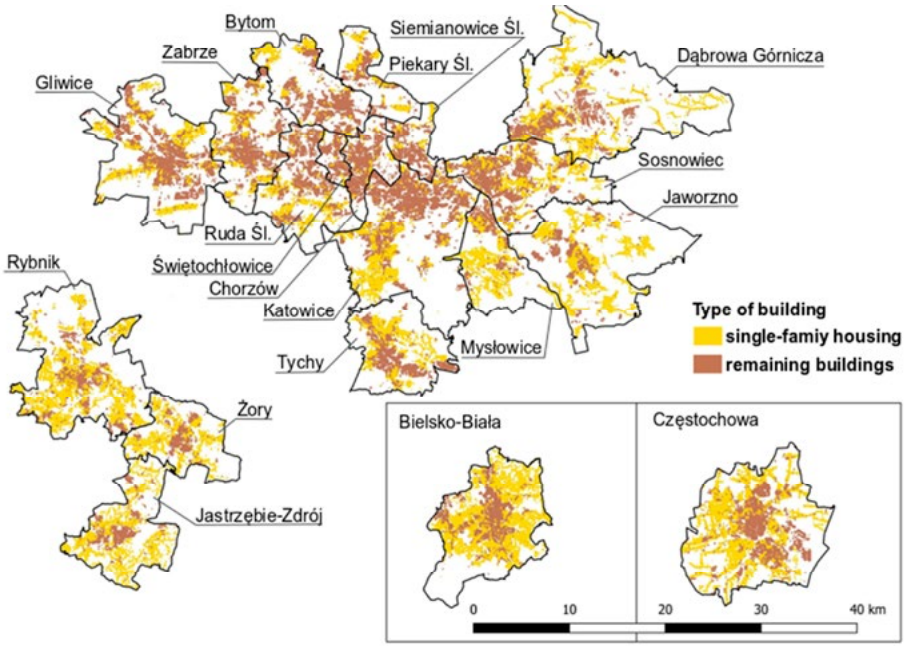

Figure 4. Types of buildings in the investigated cities

Source: author's work based on the database of topographic objects data (DTO).

Single-family housing dominates the conurbation of Rybnik, Żory, and Jastrzębie-Zdrój, covering almost entire areas of these cities up to their cores. In Bielsko-Biała and Częstochowa, the area of other buildings is greater, but single-family housing still dominates the city area. The Upper Silesian conurbation looks much different. Compact development stretches west to east and is the centre of gravity for single-family buildings that also sparsely dot other developments. Exceptions can be found in Tychy, where numerous multi-family blocks apparently stand out. Jaworzno and Dąbrowa Górnicza also feature individual clusters of compact developments. This image clearly depicts the agglomeration as a functional whole. Situated in its centre,

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Chorzów and Świętochłowice are dominated by close stories, while Jaworzno, Dąbrowa Górnicza, Mysłowice, and even southwestern part of Katowice are dominated by single-family housing.

The investigated cities vary significantly in terms of RES potential, area, population, population density, income, and development structure (Table 2).

Table 2. Profiles of the cities (as in 2020)

No.	City/district	Population density (people/1 km^2)	District income per capita (PLN)	Single-family housing vs. total district area (%)	Proportion of single-family housing*) in all buildings in district	Planning permissions for single-family houses
1	Bielsko-Biała	1364	8,151.40	**22.09**	89.60	236
2	Bytom	2350	6,345.64	5.63	46.06	107
3	Chorzów	3207	6,904.34	3.57	38.90	52
4	Częstochowa	1362	6,756.78	**16.06**	88.25	353
5	Dąbrowa Górnicza	**627**	7,788.75	6.85	91.44	**388**
6	Gliwice	1322	8,896.50	8.25	65.80	160
7	Jastrzębie-Zdrój	1032	6,655.52	13.46	**93.48**	139
8	Jaworzno	**593**	7,033.31	8.60	**92.53**	256
9	Katowice	1764	8,176.27	8.59	66.18	146
10	Mysłowice	1136	6,559.97	13.38	87.96	200
11	Piekary Śląskie	1372	6,118.58	9.15	82.49	73
12	Ruda Śląska	1757	6,501.52	8.12	73.08	309
13	Rybnik	925	7,302.49	**15.24**	**91.03**	300
14	Siemianowice Śląskie	2597	6,694.68	6.28	56.70	103
15	Sosnowiec	2167	6,324.86	10.24	79.78	194
16	Świętochłowice	3691	6,323.71	5.73	52.11	1
17	Tychy	1551	7,739.92	9.97	88.24	207
18	Zabrze	2125	6,295.62	7.58	59.36	121
19	Żory	972	6,696.16	12.55	**95.39**	**363**

*) Single-family and two-unit buildings (class BUBD01 and BUBD02) compared to class (BUBD) according to the DTO.

Source: author's work based on DTO and LDB data.

Some substantial differences can be found even in the Upper Silesian conurbation: the smallest and most densely populated city in the voivodeship is Świętochłowice (more than 3 thousand people per 1 km^2), while Jaworzno and Dąbrowa Górnicza have the smallest population densities (593 and 627

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people per 1 km^2, respectively). The largest income per capita is in Gliwice, Katowice, and Bielsko-Biała (over PLN 8 thousand), while the lowest, in Piekary Śląskie, Zabrze, Świętochłowice, Sosnowiec, and Bytom (less than PLN 6.5 thousand).

Compared to the other cities, Bielsko-Biała has the largest percentage of single-family housing (over 22%), while Chorzów has the smallest. Single-family houses dominate the majority of the urban areas compared to other buildings in terms of numbers. The largest value of the indicator was found in Żory, Jastrzębie-Zdrój, Jaworzno, Dąbrowa Górnicza, and Rybnik (over 90%), while the smallest, in Chorzów (less than 39%) and Bytom (about 46%). At the same time, the cities with the largest numbers of planning approvals for single-family houses were Dąbrowa Górnicza and Żory.

In light of the above, the cities with the largest solar energy use potential were Żory, Dąbrowa Górnicza, Jastrzębie-Zdrój, Rybnik, and also Częstochowa and Bielsko-Biała.

Use of RES from 2014 to 2020

The period from 2014 to 2020 can be divided into two stages. The subperiod of 2014–2018 was a time of microscopic interest and investments in PV microgeneration. Then, they grew massively in the other half of the period, from 2019 to 2020 (Figure 5).

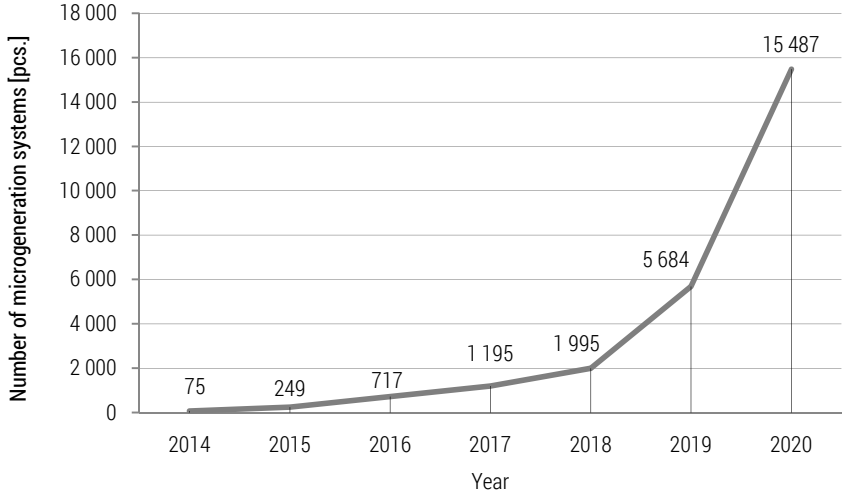

Figure 5. The total number of microgeneration systems in the cities from 2014 to 2020

Source: author's work based on data from Tauron Dystrybucja SA.

The conditions for RES investment changed substantially over the investigated period. New financial support instruments were offered. The My

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Power scheme was launched, and the 'thermal upgrade' tax deduction for RES projects was offered in late 2019. Some municipalities offered subsidies to RES (mostly PV systems and heat pumps) under the Regional Operational Programme of Silesian Voivodeship. The number of systems installed with local donations is shown in Table 3.

Table 3. The number of microgeneration systems and PV subsidies

No.	City/district	Number of microgeneration systems (2020)	Number of microgeneration systems vs. units in single-family buildings (%)	Microgeneration subsidies in 2021	Number of subsidised PV systems	Number of not subsidised microgeneration systems (2020)
1	Bielsko-Biała	1148	4.72	No	-	1148
2	Bytom	431	9.48	No	-	431
3	Chorzów	202	9.43	No	-	202
4	Częstochowa	**1613**	6.11	Yes	124	**1489**
5	Dąbrowa Górnicza	704	4.98	Yes	327	377
6	Gliwice	1028	8.10	No	-	1028
7	Jastrzębie-Zdrój	928	**11.12**	Yes	102	826
8	Jaworzno	1148	8.14	No	-	1148
9	Katowice	1243	7.58	No	-	1243
10	Mysłowice	676	7.64	No	-	676
11	Piekary Śląskie	352	6.66	Yes	69	283
12	Ruda Śląska	668	8.99	Yes	165	503
13	Rybnik	**1990**	8.76	Yes	154	**1836**
14	Siemianowice Śląskie	235	9.09	Yes	92	143
15	Sosnowiec	486	4.44	No	-	486
16	Świętochłowice	107	7.54	No	-	107
17	Tychy	793	**10.37**	Yes	647	146
18	Zabrze	889	**11.23**	No	-	889
19	Żory	846	**10.68**	Yes	91	755

*) Single-family and two-unit buildings (class BUBD01 and BUBD02) compared to class (BUBD) according to the DTO.

Source: author's work based on data from Tauron Dystrybucja SA and DTO.

The total number of systems in the cities is shown in (Figure 4). The undisputed leader in Rybnik with 1990 PV systems followed by Częstochowa (1613 systems). Note further that in Częstochowa, only 6.11% of units that

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could install PV systems did it, while in Rybnik, it was 8.76%. Cities that exceeded the 10% threshold of microgeneration system proportion in single-family buildings were Zabrze, Jastrzębie-Zdrój, Żory, and Tychy. This means that the leaders in microgeneration still have a significant capacity for such systems. Interestingly, both Rybnik and Częstochowa had PV subsidy schemes, but Zabrze achieved the best result (11.23%) without extra financial incentives.

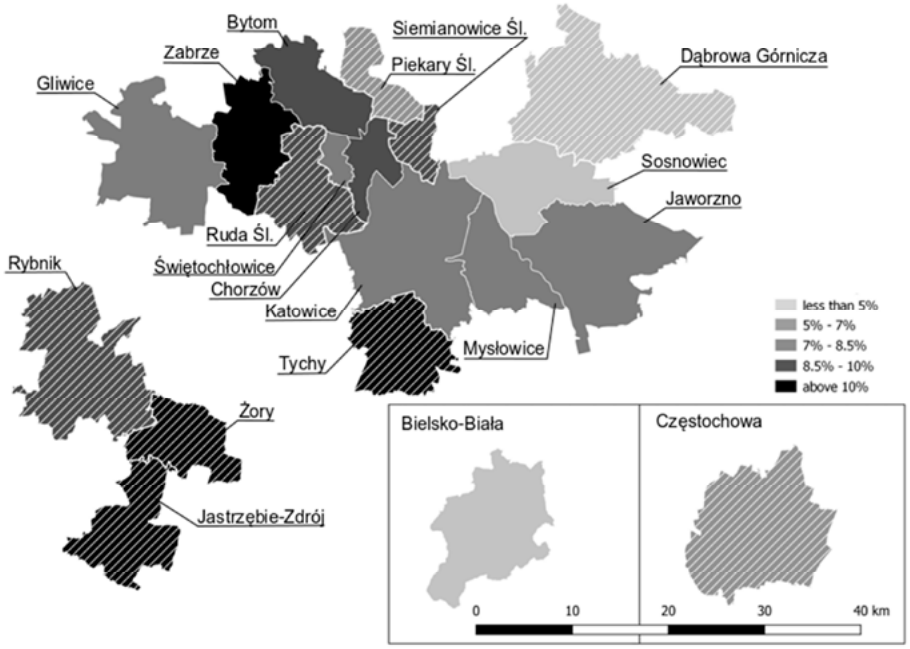

Figure 6. Microgeneration systems vs residential units in single- or two-family houses (%). Cities with PV subsidies are hatched

Source: author's work based on data from TAURON Dystrybucja SA and DTO.

Conclusions

The proportion of renewable energy failed to reach Poland's obligatory, planned level in 2019. The increase in PV microgeneration and small generation was one of the relatively more straightforward and faster methods for improving power generation statistics. Regrettably, there were virtually no investments in such systems from 2010 to 2016, which was undoubtedly due to unfavourable regulations (the wind farm Act) and lack of compelling financial incentives.

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The public grew more interested in PV generation in 2018 when the number of installed systems grew significantly, only to boom in 2019 and 2020. It was the period of the My Power scheme and subsidies in selected cities under the Regional Operational Programme of Silesian Voivodeship 2014-2020. Legal procedures for microgeneration connections were simplified significantly.

The subsidies fuelled public interest in PV systems. Still, they were not the decisive factor because subsidised projects usually vary from 10 to 20% of the total number of new systems. The only exception is Tychy. Other financial factors that could stimulate PV investments could have been low-interest rates and forecasts of high electricity prices.

The investigated cities have a significant, unfulfilled RES potential. The proportion of single-family houses with PV systems usually does not exceed 10% of the total number of single-family buildings. Of course, not all roofs are suitable for PV systems for various reasons (be it technical or situational). Still, the RES potential of large cities in Silesian Voivodeship remains largely untapped.

Financial incentives at various levels and seemingly attractive regulations for RES investments are not enough to drive a clear and dynamic increase in such investments. A high planning risk is not insignificant here. One-time subsidies provide support for the installation of a system, but what is needed is long-term legal and financial stability. Policies for calculating and purchasing energy from RES have been changing relatively frequently. First, it is vital to minimise the risk of investments in alternative energy sources.

References

Brautigam, D. A., & Knack, S. (2004). Foreign aid, institutions, and governance in sub-Saharan Africa. Econ. Dev. Cult. Chang. 52. https://doi.org/10.1086/380592

Central Statistical Office. (2021, December). http://www.stat.gov.pl

Croci, E., Lucchitta, B., & Molteni, T. (2021). Low carbon urban strategies: An investigation of 124 European cities, Urban Climate 40, 101022. https://doi.org/10.1016/j.uclim.2021.101022

European Commission. (2021, December, 15). *The Green Deal.* https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/

Graczyk, A. (2017). Wskaźniki zrównoważonego rozwoju energetyki. Optimum. Studia Ekonomiczne, 4(88). https://doi.org/10.15290/ose.2017.04.88.05

Grubler, A., Bai, X., Büttner, T., Dhakal, S., Fisk, D. J., Ichinose, T., Keirstead, J. E., Sammer, G., et al. (2012). Chapter 18: Urban energy systems. In Team, GEA Writing (Eds.). *Global Energy Assessment: Toward a Sustainable Future.* (pp. 1307-1400). Cambridge University Press and IIASA.

Marcotullio,P. J Sarzynski A., Albrecht J., Schulz N., & Garcia J. (2013). The geography of global urban greenhouse gas emissions: an exploratory analysis. Clim. Chang. 121, 621-634. https://doi.org/10.1007/s10584-013-0977-z

DOI: 10.34659/eis.2022.80.1.430

Ministerstwo Gospodarki. (2021, December). *Krajowy plan działania w zakresie energii ze źródeł odnawialnych (2010-2020).*

Ministerstwo Funduszy i Polityki Regionalnej. (2022, January 22). https://www.gov.pl/web/fundusze-regiony

Ministerstwo Klimatu i Środowiska. (2022, January 22). https://mojprad.gov.pl

Ministerstwo Środowiska. (2013). *Strategiczny plan adaptacji dla sektorów i obszarów wrażliwych na zmiany klimatu do roku 2020 z perspektywą do roku 2030*, Poland. https://bip.mos.gov.pl/strategie-plany-programy/strategiczny-plan-adaptacji-2020

PAN, Instytut Gospodarki Surowcami Mineralnymi i Energią. (2005). *Opracowanie metody programowania i modelowania systemów wykorzystania odnawialnych źródeł energii na terenach nieprzemysłowych województwa śląskiego, wraz z programem wykonawczym dla wybranych obszarów województwa, Część II: Program wykorzystania odnawialnych źródeł energii na terenach nieprzemysłowych województwa śląskiego (projekt).* https://bip.slaskie.pl/wojewodztwo/programy_plany_i_strategie_wojewodztwa/odnawialne-zrodla-energii-1.html

Polskie Towarzystwo Przesyłu i Rozdziału Energii Elektrycznej (PTPiREE). (2021, December 15). *Mikroinstalacje w Polsce*. http://www.ptpiree.pl/energetyka-w-polsce/energetyka-w-liczbach/mikroinstalacje-w-polsce

Rodrik, D., Subramanian, A., & Trebbi, F. (2004). Institutions rule the primacy of institutions over geography and integration in economic development. J. Econ. Growth, 9, 1573-7020.

Seto,K. C., Dhakal, S., Bigio, A., Blanco, H., Delgado, G. C., Dewar, D., Huang, L., Inaba, A., Kansal, A., Lwasa, S., McMahon, J. E., Müller, D. B., Murakami, J., Nagendra, H., Ramaswami, A. (2014). Human Settlements, Infrastructure and Spatial Planning. In O. Edenhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (Eds.). *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press. https://www.ipcc.ch/report /ar5/wg3/

Sustainable Development Goals. (2022, January 15). http://www.un.org.pl/cel7#

Szpryngiel, M. (2012). Promieniowanie słoneczne jako źródło energii. In B. Kołodziej, M. Mariusz (Eds.). *Odnawialne źródła energii. Rolnicze surowce energetyczne*. Poznań: Powszechne Wydawnictwo Rolnicze i Leśne Sp. zo o.o.

TAURON. (2021, December). Data obtained from TAURON Dystrybucja S.A.

United Nations (2022, January 22). *Goal 7.* https://sdgs.un.org/goals/goal7

Ustawa z 10 kwietnia 1997 r. Prawo energetyczne Dz.U. 1997 Nr 54 poz. 348. http://isap.sejm.gov.pl/

Ustawa z 20 lutego 2015 r. o odnawialnych źródłach energii (Dz. U. 2015, poz. 478, 2365). http://isap.sejm.gov.pl/

Ustawa z dnia 20 maja 2016 r. o inwestycjach w zakresie elektrowni wiatrowych (Dz. U. 2016 poz. 961). http://isap.sejm.gov.pl/

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ECOLOGICAL, TECHNICAL AND ECONOMIC ASPECTS OF USING FLINT WASTES AS AGGREGATE FOR SPECIAL CONCRETES

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ABSTRACT: This paper examines the ecological, technical, and economic aspects of using flint wastes extracted during the chalk extraction. The study presents the adverse effects of mining on the environment and draws attention to the mining waste generated. Flint wastes are proposed to be used in the crushed form as a substitute for high-quality aggregate for cement composites. Traditional concretes, which contained gravel and basalt aggregates in their volume, were used as control composites. Due to the satisfactory results of the technical tests, the described waste disposal method was also analysed in terms of possible economic benefits. Conclusions from the conducted tests proved that crushed flint waste is technically equal to high-quality special aggregates. At the same time, the costs of its acquisition and production in suitable deposition systems can be lower than the cheapest traditional gravel aggregates available on the market.

KEYWORDS: flint waste, green concrete, recycled concrete, aggressive environments, aggregate substitute

Introduction

Regardless of the industry for which the raw materials are extracted, any mining activity involves interference with the natural environment (Uberman et al., 2014). The extraction of minerals, including those that supply organic farms, often causes irreversible changes in the landscape, alters water relations and depletes raw material resources. Even though legal regulations in the mining law are becoming stricter (Lipinski, 2021) in favour of environmental protection and force entrepreneurs to minimise the impact of extraction, processing and use of mineral resources, this activity is still not indifferent to ecosystems. Currently, the mining lobby more and more often emphasises that the reclamation of areas occupied by mining and their use for purposes such as tourism creates new values of higher utility value (Nieć et al., 2008). However, irreversible depletion of mineral resources forces rational consumption, recycling, and use of substitutes, ultimately limiting the occupation of areas to exploit new deposits and reducing the impact on the natural environment (Kudełko & Nitek, 2011).

An often overlooked fact in terms of the environmental impact of mining is the changes to the landscape caused by mining or processing waste dumps. Even though low-waste technologies are increasingly being used, the amount of waste produced is still considerable. Around 50 million tonnes of waste are generated annually in the mining industry. Waste from mining processes accounts for 20% of the total, with the remainder coming from tailings. Only about 15% of the mining waste produced is used. Most of the waste is used for engineering works consisting of filling embankments and recultivation of the resulting excavations (Kasztelewicz, 2010). Such activities often do not use the potential of the extracted waste materials, which results in irretrievable loss of energy already consumed in their extraction.

One of the mineral resources used on a large scale in agriculture, carried out using the open-pit method, is chalk deposits. Chalk is a calcareous sedimentary rock characterised by a high content of calcium carbonate and a very fine-grained structure. It is used in many branches of industry: in the rubber, paper, chemical, pharmaceutical, cosmetic, ceramic and cement industries, in the production of paints and varnishes, plastics, building materials and in agriculture as fertiliser chalk for liming soils and animal husbandry as fodder chalk. In Poland, it occurs mainly in the Lublin region in formations of the Cretaceous period and in the north-eastern part of Poland, where Cretaceous formations occur in glacial till within Quaternary formations. Its comprehensive geological resources are estimated at 206 million tonnes. Chalk extraction in 2020 in Poland totalled 0.239 million tonnes (Szuflicki et al., 2021). In the process of opencast chalk mining, the mining waste that goes to the

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dumps is flint. Flint is a sedimentary, siliceous (SiO_2), cryptocrystalline rock that occurs in several forms: tubular, spherical, lenticular or loaf-shaped concretions around non-siliceous stones such as limestone, dolomite or marl. Flints usually form biaxially with the sediments that surround them. They consist of organic silica from the dissolution of skeletons derived from invertebrates, including siliceous sponge needles. They can also be formed secondarily, around much older rocks, by silica precipitation in solutions that circulate between fractures and cracks. Due to its high technical parameters such as high hardness (5.5-7 on the Mohs scale), high density of 2.58-2.91 kg/dm^3, flint has been used for centuries to manufacture tools or weapons. These characteristics are used to produce grinding balls in mills or friction materials (Ryka & Maliszewska, 1991). The features mentioned above of this waste material allowed the author of this article to hypothesise its possible use as an aggregate for cement composites. Such an action would be in line with the environmental policy (Bukowski, 2014), which assumes the use of as many recyclates as possible in the production of new products, thinking that products are obtained that are at least no worse than those made from natural raw materials.

Literature review

To implement the above policy and reduce the adverse effects of mining activities, multi-level scientific work is being carried out. The main direction of these activities is the search for new substitutes for natural raw materials among waste substances, whose technical parameters would be at least as good as those of traditional substrates. The use of waste as a substitute for raw materials taken from the environment, on the one hand, reduces the level of mineral extraction and, on the other, results in the rational neutralisation of waste. Examples of implementing such a system of activities include mining construction aggregates and producing the so-called "green concretes". At least 30% of waste materials of different origins are used to produce them. World literature proves that such actions are possible and not only beneficial from the ecological point of view. The use of local waste to produce composites is also beneficial from an economic point of view. Producers of waste have the chance to deposit it free of charge.

On the other hand, producers of composites can obtain raw materials for their production at no cost. An example of such a circulation of materials can be found in scientific studies of sanitary ceramic waste. They prove that these materials not only can act as substitutes for traditional aggregates but they can be used in unique composites such as ultra-high-strength composites (Zegardło et al., 2016), those resistant to chemically aggressive environments

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(Ogrodnik et al., 2017) accumulating heat, resistant to high temperatures (Zegardło et al., 2018a) or fillers for resin composites (Ogrodnik & Zegardło, 2018). The construction composites industry is so wide that other waste materials such as crushed bricks (Debieb et al., 2008), clinker (Khalloo & Ali, 1994), glass from used fluorescent lamps (Zegardło et al., 2018b), glass from used windshields or concrete rubble (Hansen & Narut, 2003), demolition materials (Rao et al., 2007), etc. can also find a place in it. To reduce the energy input of composite binder production, the use of waste substances is also proposed, e.g., as a partial replacement for cement. Here, dust with binding properties such as fly ash (Atis, 2005), waste materials from stack filters, e.g., micro-silica (Shikano, 1990) or glass dust, which improve the critical processes. All the waste materials described above, playing the role of substitutes for natural minerals, cause reduction of mineral extraction, and their use is considered their rational neutralisation.

The basis for carrying out the experimental work described in this article was the pilot study of waste flint to produce cement composites initiated by the author of this article published in (Bursztyka, 2019). During the experimental work, composites were made in which the aggregate for the concretes was waste flint with grain sizes of 0-4 mm and 4-8 mm. Three series of composites were then produced in which Series I – 100% was a composite containing only waste flint as filler, Series II – 70% in which 70% flint and 30% gravel aggregate was used as filler, and Series III – 0% as a control series containing only sand and gravel aggregate. However, the concrete composition was not designed at the time. Still, it was adopted as for composites traditionally produced on concrete plants with a very low W/C ratio, i.e. as for composites with the consistency of damp earth. This fact caused that grains of flint aggregate with a very peculiar structure of flat lamellae were not arranged uniformly in the slurry. With the increase in the amount of recyclate in the composite, the number of open pores between the aggregate grains increased. The results obtained for the basic technical parameters are presented in Table 1.

Table 1. Test results of the basic technical parameters of the composites

No.	Type of composite / parameter tested	Average intended specific density of the samples [kg/dm^3]	Average measured absorbability of the samples [%]	Average measured flexural strength [MPa]	Mean measured compressive strength of specimens [MPa]
1	I – 100%	0.99	6.09	8.62	35.54
2	II – 70%	1.17	5.35	8.68	39.26
3	III – 0%	1.27	5.72	8.72	44.39

Source: Bursztyka, 2019.

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The density and absorbability tests confirmed the presence of air voids within all the composites produced, including the control ones. The tests of strength parameters, even though they showed a certain decreasing tendency with the amount of waste aggregate used, were satisfactory. Such concretes had technical parameters qualifying them as structural concretes despite their then foreseen much less restrictive use as local road foundations in chalk mines. These experiments prompted the author of this paper to repeat the research with a new objective and two assumptions based on previous experience. The first assumption was to compose a structural concrete containing only precipitated silicate aggregates, with no air voids. The experiment assumed the production of a composite with a much more liquid slurry, i.e. a lower W/C ratio. All the spaces between the aggregate grains remained filled with slurry. The second assumption was to reduce the size of the silicate grains. This was dictated by an earlier observation of 4-8 mm grains, which were flaky in shape. Grains smaller than 4 mm were more oval, which was expected to align the grains better. The starting point in the research work presented in this paper was the rock of control – basalt composites resistant to chemically aggressive environments, which was introduced in (Zegardło et al., 2018c). The economic aspects of using waste flint as an aggregate for concrete composites were analysed concerning the data in (Tokarski & Zegardło, 2020).

Materials used in the study

Aggregates

The primary material used in the experiments was flint extracted as waste from the mining of fodder chalk. It originated from a spoil heap near a chalk mine located in eastern Poland. Waste lumps of bulbous form and 10-30 cm dimensions were collected from the heap and transported to the laboratory. Using the sieve method, the waste was crushed and then separated into grain sizes of 0-2 mm and 2-4 mm. Figure 1 shows the form's debris as received from the mine and after shredding.

The comparison aggregates were a traditional sand and gravel aggregate and a high-quality basalt aggregate. Before the experimental work related to the manufacture and testing of the composites, all the aggregates were subjected to the same tests as traditional aggregates for concrete. The first test carried out for all types of aggregates was the determination of the specific density, for which the standard method was used according to PN-EN1097-7:2008. The apparent density and absorbability of aggregates were tested using the traditional way according to PN-EN 1097-6:2013-11. A microscopic

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analysis of the aggregate grains was carried out for all types of aggregates. A scanning microscope was used for this purpose. Grain shape assessment analysis was carried out, and the type of grain texture was assessed; however, thanks to the use of the microscope, the work was carried out on representative grains from the group of grain sizes 2-4 mm, which were separated by the sieve method. The length, width and thickness of the representative grains which were most abundant in a given group were measured. The shape of the grains was assessed by comparing these sizes. The texture type of aggregate grains from waste materials and traditional materials was also evaluated based on (Jamroży, 2006).

a) b)

Figure 1. Flint waste from chalk extraction: a – received from the mine, b – after grinding

Source: author's work.

Table 2. Comparison of the characteristics of the aggregate obtained from recycled flint with traditional totals, which were supplemented with values taken from the literature

Type of aggregate / Properties	Unit	Flint	Sand, gravel	Basalt
Specific density	kg/m^3	2570	2650	2600-3200
Apparent density	kg/m^3	2490	1800-2000	2500-3100
Compressive strength	MPa	200-300	22-45	250-400
Modulus of elasticity	GPa	60-105	20-40	56-99
Absorptivity	%	0.15	0.6-2.8	0.1-0.4
Degree of crushing	%	5.4	8.0-16.0	3.8
Grain shape assessment	-	scaly, flat	spherical, oval	stocky, angular
Type of grain surface texture	-	glassy, smooth	rough, granular	glassy, smooth

Source: author's work based on Góralczyk & Kukielska, 2010.

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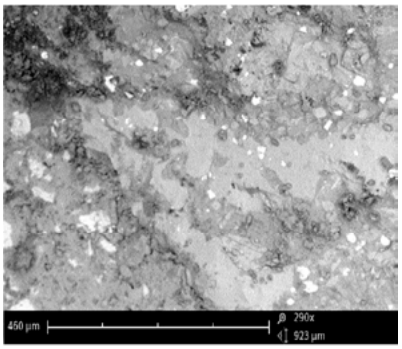
A comparison of the characteristics of the aggregate obtained from recycled flint with traditional totals, supplemented with values taken from the literature (Góralczyk & Kukielska, 2010), is presented in Table 2. Figure 2 shows representative grains of the analysed aggregates.

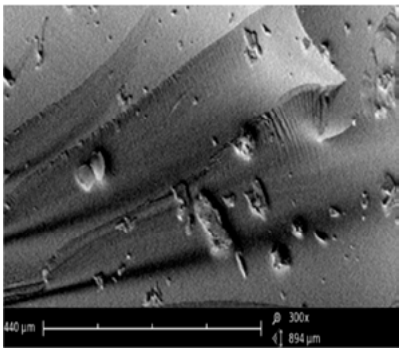
Figure 2.
Representative grains of analysed aggregates. From top: grains of basalt, gravel and flint

Source: author's work.

a)



b)



c)

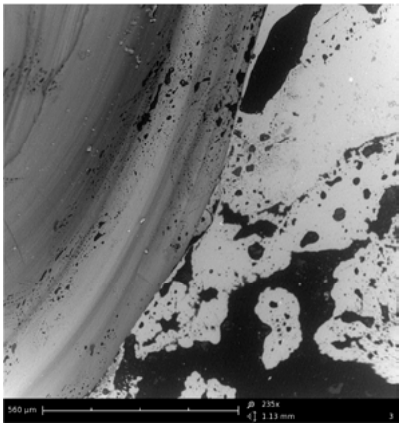


Figure 3.
SEM images: a) microscope image of a gravel grain at 450× magnification, b) basalt grain at 440× magnification, c) flint grain at 560× magnification

Source: author's work.

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A comparative analysis of the technical parameters of the aggregate made from flint waste with those recorded for traditional totals showed that they were most similar to those of high-quality basalt aggregates. The densities, water absorption and strength parameters taken from the literature were almost identical. Similarly, the surface images of the samples presented in Figure 3 were similar for both of these aggregates.

The grain surfaces of both these aggregates were smooth and vitreous in contrast to the gravel aggregates, whose surface was rough and granular. The technical parameters of the traditional sand and gravel aggregates were also significantly lower, indicating that the aggregate is more porous and less resistant than the waste aggregates. These characteristics and the proximity to basalt aggregates gave rise to the claim that aggregates obtained from waste flint could substitute for high-quality basalt aggregates.

The final test that was carried out for the aggregates was their resistance to an aggressive environment in the form of sulphuric acid. For this purpose, large aggregate grains with a size of 40-80 mm were used. Aggregate grains were weighed and immersed in an aggressive solution for 100 days. The chemical composition of the solution is presented in Table 3. The solution was gradually replenished so that the grains of aggregates remained immersed in it throughout the experiment.

Table 3. Chemical composition of the solution used to test the resistance of aggregates to aggressive environments. H_2SO_4

Solution	
Tap water	1 dm^3
Sulphuric acid H_2SO_4 (96%)	1 dm^3

Source: author's work.

The value evaluated during the test was the mass loss of grains of the tested aggregates. The test stand with selected aggregates during the experiment is presented in Figure 4.

This study proved that the flint waste aggregate has a very high resistance to the corrosive environment. The mass loss of waste aggregate grains was 3.8% and was related to the mass loss of white chalk efflorescence occurring on the waste flint. The mass loss of gravel aggregates was the greatest. The limestone grains present in the gravel were completely decomposed, and their residues in the solution formed a liquid mass. The assessed percentage mass loss here was 60.9%. The basalt aggregates were also corroded. Their outer surface was destroyed in the corrosive environment, and the assessed

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weight loss was 26.7%. The results of this study were the basis for hypothesising the potential use of the wastes mentioned above for composites resistant to chemically aggressive environments.

a) b)

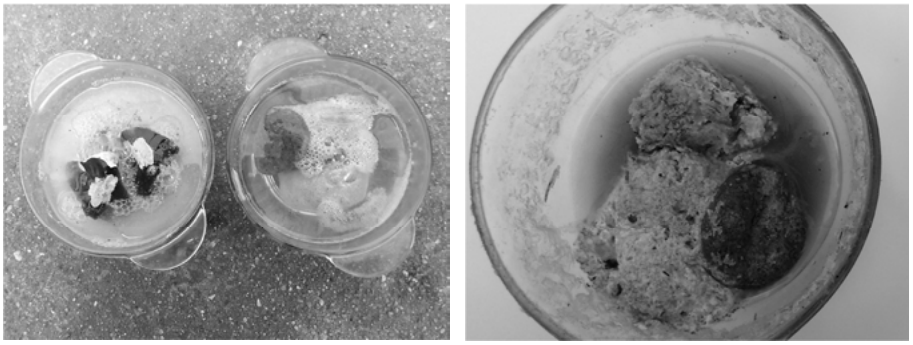

Figure 4. Test stand with selected aggregates: a) from the left: flint and gravel while testing the resistance of aggregates to chemically aggressive environment b) gravel grains which were destroyed

Source: author's work.

Further substrates used in the study were other composites components such as cement and admixtures and additives.

Cement, admixtures and additives

Portland cement CEM I 42.5N – SR 3/NA was used as cement for the composites prepared. According to the manufacturer's declaration, it has stable physicochemical parameters, adequate setting time, high early and final strength parameters, low alkali content and high resistance to aggressive chemical agents. These advantages make it popularly used in the commodity production of concrete mixes. Detailed values of the physical and chemical parameters of the cement-based on its technical sheet are summarised in Table 4.

The plasticising admixture ISOFLEX 7130 is produced with the latest hybrid polymer technology. Thanks to the knowledge of molecule synthesis, the admixture makes it possible to strongly reduce the amount of batch water, long-term maintenance of the concrete mix consistency, and homogeneity and cohesion of the concrete mix. Basic technical parameters of the admixture from its technological card are presented in Table 5.

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Table 4. Basic technical parameters of cement-based on manufacturer's technical card

Feature	Unit.	Average score	Requirements
Start of bond	min	233	> 60
End of bond	min	291	
Water efficiency	%	27.5	
Constant volume	mm	1.1	< 10
Specific surface area	cm^2/g	3688	
Compressive strengthafter 2 days	MPa	23.9	<10
Compressive strengthafter 28 days	MPa	55.9	> 42.5 < 62.5
Chemical analysis: SO_3	%	2.77	< 3.0
Chemical analysis: Cl	%	0.070	< 0.10
Chemical analysis: Na_2O eq.	%	0.53	<0.6

Source: manufacturer's technical card.

Table 5. Basic properties of the plasticising admixture based on its technical sheet

Feature	Description
Form	Homogeneous liquid
Colour	Brown
Density (20°C)	1.075 +/- 0.02 kg/dm^3
pH	5 +/- 1
Cl^- ion content	up to 0.1 %.
Alkali content calculated as Na_2O	up to 2.0 %

Source: manufacturer's technical card.

Micro-silica in the form of finely grained dust consisting mainly of spherical, vitrified grains was used as an additive in the concrete. According to the manufacturer's declaration, the micro silica used for the designed composites was obtained in gas cleaning of furnaces during the production of silicon-containing alloys. Its primary characteristics from the technical data sheet are presented in Table 6.

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Table 6. Basic properties of micro silica based on its technical sheet

Parameter	Unit	Value	Assessment method
Form	,-,	fine powder	visual
Colour	,-,	grey	visual
Fragrance	,-,	odourless	,-,
Density	g/cm^3	2.05	EN 1097-6
Bulk density	g/cm^3	1.1	EN 1097-3
Alkalinity	pH	less than 11.5	PN-EN-ISO 10523

Source: manufacturer's technical card.

Research methods

A working recipe for a concrete composite was used to produce the research composites, assuming its class to be C35/45. All the components used to create the composites were the same except for the aggregate. The quantity of the components was also the same each time and corresponded to the quantities presented in the paper. Three series of test composites were produced. The first series of CPF (Portland cement and flint) contained only aggregate from waste flint. The composition of this composite is presented in Table 7.

Table 7. Composition of the CPF master composite

Component	Unit	Amount
Cement CEM I 42.5N – SR 3/NA	kg	370
Aggregate: Flint 0/2 mm	kg	667
Aggregate: Flint 2/4 mm	kg	1296
Water	kg	139
Admixture ISOFLEX 7130	kg	5.6
Silica fume	kg	74

Source: author's work.

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The next series CPG (Portland cement and gravel) contained only sand and gravel aggregate. The last series CPB (Portland cement and basalt) had only basalt aggregate.

The components of the composites were mixed, placed in moulds and subjected to the process of vibration. The samples prepared in this way were maintained in high humidity conditions for seven days, after which the samples were removed from the moulds. After removing the moulds, the samples were cured in the same environment for 21 days. After the care period, the composite samples were subjected to the basic tests to which structural concretes used for the erection of buildings are subjected to.

The density of the composites according to EN 12390-7:2009 was tested on rectangular samples of dimensions 40×40×160 mm. The standard guidelines conducted the test, and the density was calculated as the ratio of the specimen mass to its volume.

The next test was a scalability test. It was tested on samples with dimensions of 40×40×160 mm in accordance with PN-EN 1097-6:2013. The samples were immersed in water and remained there until their weight was established. Wettability was calculated as the ratio of the amount of water the composite was able to absorb to the weight of the dry composite, expressed as a percentage.

The next test was the strength test. The three-point bending strength was tested according to the guidelines in PN-EN 12390-5:2009. Samples of the same dimensions of 40×40×160 mm were prepared for the test. After this test, the beam halves were used for the next test – the compressive strength test. The compression strength of the samples was performed according to PN-EN 12390-3:2011.

By the primary assumption of the experimental work, the composite containing waste flint was also evaluated in chemically aggressive environments. The industrial application of this waste was to be the use of flint as a substitute for high-quality aggregates, which industrial concrete batching plants use to produce concrete elements of sewerage networks. The operating environment of inspection wells, pumping stations, treatment plant tanks or sewage pipes is unfriendly to concrete composites. The destructive influences here are chemical, biological, thermal and mechanical influences. Exposure to harmful agents occurs both on the inner side, where the source of aggression is the sewage environment, and on the outer side, where there is contact with the ground and groundwater. The chemical composition of aggressive agents depends on their origin. Among the wastewater transported in concrete pipes, one can distinguish municipal wastewater, agricultural wastewater from farms, rainwater contaminated with salt and products of vehicle traffic and industrial wastewater of different compositions and origins. The experimental work presented in this paper focuses on the operation of con-

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crete elements in contact with wastewater transported through general sewage systems. In accordance with the literature (Gruner, 1983), aggressive hydronium ions H_3O^+ ions (pH), sulphate ions SO_4^{2-}, ammonium ions NH_4^+ and magnesium ions Mg^{2+}.

The corrosion mechanisms planned to be induced depending on the type of aggressive agents. The intended adverse effect of acid corrosion affected all concrete components, including aggregate (Czarnecki et al., 1995). It is caused by both strong mineral acids (e.g., H_2SO_4, HCl, HNO_3), weak acids (e.g., H_2S) and organic acids (e.g., acetic acid, lactic acid and humic acid). Degradation here involves the formation of readily soluble salts by reactions (1-3):

$$Ca(OH)_2 + 2H^+ \rightarrow Ca^{2+} + 2H_2O, \quad (1)$$

$$3CaO \cdot Al_2O_3 + 12H^+ \rightarrow 3Ca^{2+} + 2Al^{3+} + 6H_2O, \quad (2)$$

$$3CaO_2 \cdot SiO_2 + 6H^+ \rightarrow 3Ca^{2+} + H_2SiO_3 + 6H_2O. \quad (3)$$

Acid corrosion leads to an increase in the porosity of concrete and a decrease in its strength. To detect it, strength tests were planned for all composites after exposing the samples to an aggressive environment.

The mechanism of another possible type of corrosion, sulphate corrosion, is based on the reaction of sulphate ions with components of the hardened cement slurry. The corrosion products are insoluble compounds, which join water in crystallisation, causing a significant increase in volume. Initially, calcium hydroxide reacts, changing to hydrated calcium sulphate in reactions (4) and (5):

$$Ca(OH)_2 + SO_4^{2-} \rightarrow CaSO_4 + 2OH^-, \quad (4)$$

$$CaSO_4 + 2H_2O \rightarrow CaSO_4 \cdot 2H_2O. \quad (5)$$

In the next phase, monosulphated aluminate is formed in the form of platelets:

$$3CaO \cdot Al_2O_3 + CaSO_4 \cdot 2H_2O + 10H_2O \rightarrow 3CaO \cdot Al_2O_3 \cdot CaSO_4 \cdot 12H_2O, \quad (6)$$

or tricalcium sulphate alumina (*etryngite, Candlot salt)* in the form of clustered elongated needles in reaction (7):

$$3CaO \cdot Al_2O_3 + 3(CaSO_4 \cdot 2H_2O) + 26H_2O \rightarrow 3CaO \cdot Al_2O_3 \cdot 3CaSO_4 \cdot 32H_2O. \quad (7)$$

In the initial phase, sulphate corrosion has a beneficial effect on the concrete structure, as the reaction products fill the pores and capillaries, sealing

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and consequently increasing the strength parameters (Czarnecki et al., 2007). Further growth of the crystals induces high internal stresses, leading to cracks and fractures and eventually the material's destruction.

During magnesium corrosion by reaction with calcium hydroxide, magnesium ions replace calcium ions. The product of the response is poorly soluble magnesium hydroxide, which has no binding properties, and the concrete structure is weakened according to reaction (8):

$$Ca(OH)_2 + MgCl_2 \rightarrow CaCl_2 + Mg(OH)_2. \quad (8)$$

Analogous to magnesium corrosion, calcium ions are exchanged for ammonium cations. The product is volatile ammonia and easily soluble salts, which increases the porosity of the concrete formed in the reaction (9):

$$Ca(OH)_2 + 2NH_4Cl_2 \rightarrow CaCl_2 + 2NH_4OH. \quad (9)$$

To represent the chemically aggressive operating environment of concrete sewage network elements, concrete samples were placed in water solutions of corrosive substances. Because corrosion processes are very long-lasting processes, to accelerate the effects of the aggressive environment on the composites, the answers were prepared in concentrations much higher than those occurring in the natural environment. Apart from water, sulphuric acid was added to create the solution, and ammonium and magnesium ions were introduced in the form of ammonium sulphate and magnesium sulphate. The composition of the solution is shown in Table 8.

Table 8. Composition of the solution imitating the working environment of concrete composites in sewer elements

Solution	
Tap water	7 dm^3
Sulphuric acid H_2SO_4 (96%)	7 ml
Magnesium sulphate heptahydrate $MgSO_4 \cdot 7\ H_2O$	219.6 g
Ammonium sulphate $(NH_4)^2SO_4$	64.2 g

Source: author's work.

The test specimens were placed in plastic containers containing the solution. The samples are placed so that their upper surface is covered throughout the test cycle with a min layer 2 cm of solution. The samples were kept in solution for 40 days. The comparative composite samples were kept in tap water during the same period. After this period, the samples were subjected to compressive strength testing.

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The final stage of the research work carried out was an economic analysis of using waste flint by local concrete batching plants. This was done using the cost-benefit analysis method. Data were obtained from surveys conducted by producers and related to the values presented in the literature (Tokarski & Zegardło, 2020). Cost-benefit analysis is a comprehensive method of assessing the effectiveness of investments and projects, taking into account all expected benefits and costs, including qualitative and quantitative elements, and determining the degree of effectiveness of a given investment in the environment (Becla et al., 2012). In addition to the economic aspects of a project, the cost-benefit analysis also considers social, cultural and environmental areas, which are included in external costs (Boardman et al., 2006). Cost-benefit analysis is instrumental in evaluating many stakeholders projects and where profit maximisation is not the primary selection criterion. The theoretical basis for the above analysis is welfare economics (Szot-Gabryś, 2013). This paper estimates the costs and potential economic benefits of disposing of flint waste by using it to produce aggregates for speciality concrete. The proposed disposal system made them available free of charge by mining companies to local entrepreneurs producing concrete composites. It was assumed that concrete companies equipped with crushers would crush the waste and use it in concrete to replace traditional aggregates.

Results of the research

The composites' specific density and water absorption results are presented in Table 9.

Table 9. Results of testing the specific density and absorbability of the composites

Inclusion	CPT	CPG	CPB
Specific gravity [kg/dm^3]	2.552	2.382	2.546
Absorbability [%]	5.69	5.58	5.74

Source: author's work.

The tested specific density of the composite containing CPF flint waste was almost identical to that of the composite containing CPB basalt and was 2.552 kg/dm^3. The recorded difference in the density values of these two composites was less than 1%. The density value tested for the composite containing CPG gravel was slightly lower. However, this value was about 6% lower than the recorded highest value for basalt. This characteristic was likely influenced by the density of the aggregates themselves used in the study. There are grains of varied origin and structure among the gravel aggre-

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gate grains. There are grains with an open and porous structure, which affects the overall lower density of the aggregates themselves. Basalt grains and flint grains have a similar closed system, reflected in a similar tested density of both composites made of them.

The absorbability test showed a similar trend. The absorbability of the composite containing CPF flint waste was almost identical to that of the composite containing CPB basalt and was 5.69%. The recorded difference in the absorbency value of these two composites, similarly to the density, was less than 1%. The absorbency value tested for the composite containing CPG gravel was slightly lower. However, this value was about 2.8% lower than the highest recorded value for basalt. Here, as in the case of density, this characteristic was probably influenced by the composition of the aggregates themselves. The composition of the cement stone was the same in all cases, so it must have absorbed water with the same intensity. The gravel aggregate with the higher absorbability absorbed water with greater intensity than the basalt or flint. The results of this study again confirmed the similarity of the waste aggregate to basalt.

The results of the flexural strength test are presented in Figure 5.

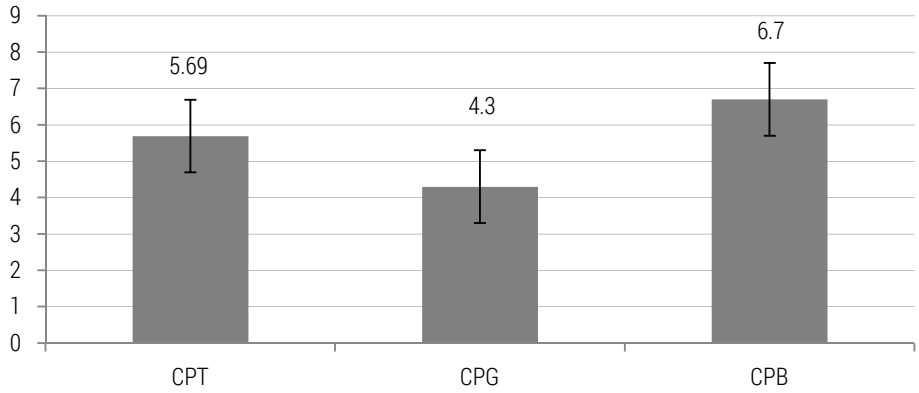

Figure 5. Test results for flexural strength of composites [MPa]

Source: author's work.

The flexural strength test results proved that the most favourable value of this parameter was recorded for the composite containing CPB basalt and was 6.7 MPa. The value tested for the other composites was lower. For the composite containing silicon CPF and gravel aggregate CPG, they were 5.69 MPa and 4.3 MPa, respectively. Therefore, the highest value recorded for the basalt was 15% higher than for the recycled concrete and 55% higher than for the gravel composite. Flexural strength is a property that is strongly influ-

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enced by the aggregate itself, while the adhesion of the total to the slurry is a factor that largely determines this parameter.

When bending, tensile stresses occur both in the aggregate itself, the cement stone and in the contact zone between the aggregate and the grout. Basalt aggregate is a high-quality aggregate with a glassy grain surface to which the cement slurry adheres compactly, forming a continuous, tight contact zone. The pores in the gravel grains mean that the zone does not adhere tightly, and contact is limited. The structure of grains of flint observed under the microscope was almost identical to grains of basalt aggregate. Therefore, it was predictable that the strength parameters were similar for both CPF and CPB composites. The slightly lower value recorded for the recycled aggregate may have been due to the presence of chalky inclusions in the flint grains. These were not clearly visible after grinding, but it is likely that the small grains contained fragments of these inclusions and therefore weakened the contact zone. However, the value observed for the recycled concrete was closer to the basalt composite.

The results of the compressive strength test are presented in Figure 6.

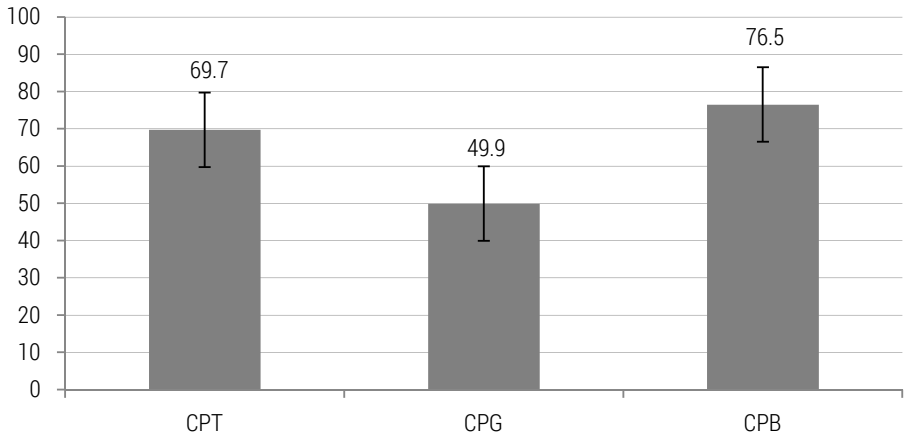

Figure 6. Compressive strength test results for composites [MPa]
Source: author's work.

The results of the composite compressive strength test again proved that the composite containing CPB basalt had the highest values. A value only 8.8% lower was recorded for the recycled aggregate containing flint and was 69.7 MPa. The value that was tested for the gravel aggregate was the lowest. It was 34% lower than the value recorded for the basalt aggregate and was 49.9 MPa. This study again confirmed the assumption that the waste aggregate was similar to the basalt aggregate. The slightly lower strength parameters observed for the recycled composite were again attributed to chalky

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inclusions present in the flint grains. Observation of the breakthrough of the samples after testing proved that the reduction of the composite grains and the increase in the liquidity of the mixture had a positive effect on the recycled composite. No air voids were observed in the volume of the samples and the contact zone between the flint grains and the cement was compact. The breakthrough of the recycled composite sample after compressive strength testing is presented in Figure 7.

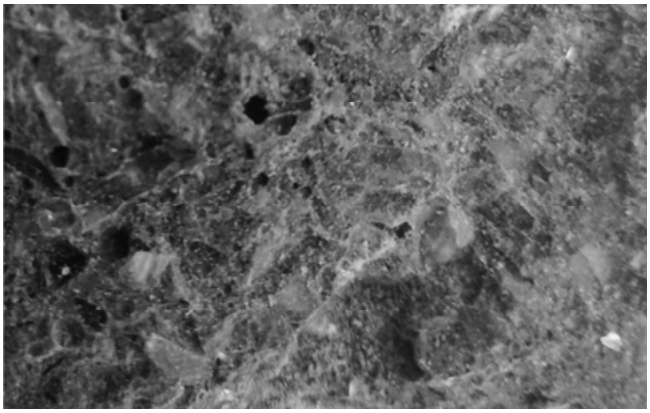

Figure 7. Breakthrough of a composite sample containing flint after compressive strength testing

Source: author's work.

The results of compressive strength testing of the composites after their exposure to a chemically aggressive environment are presented against the background of the tested strengths of the composites staying in tap water at the same time (Figure 8).

The results of testing the resistance of the composites to chemically aggressive environments showed a renewed similarity of the waste aggregates to basalt. The observed compressive strengths of recycled CPF and basalt CPB composites were very close and were 54.7 and 56.7 MPa, respectively. The difference between them was only 3.7%. The value tested for CPG gravel aggregates was 67% lower and amounted to only 18.7%. The relationship of these values to comparative values tested for composites in tap water also varied. Further decreases in compressive strength recorded for successive test series were: CPF – 26%, CPG – 63%, CPB – 27%. These values were, therefore, similarly similar for recycled and basalt composites. This study reflected the results of the resistance to aggressive environments of the aggregates themselves. The bold solution penetrated the composite structure and affected the total. Grains of gravel-carbonate aggregates underwent partial destruction in the aggressive environment. This process was the

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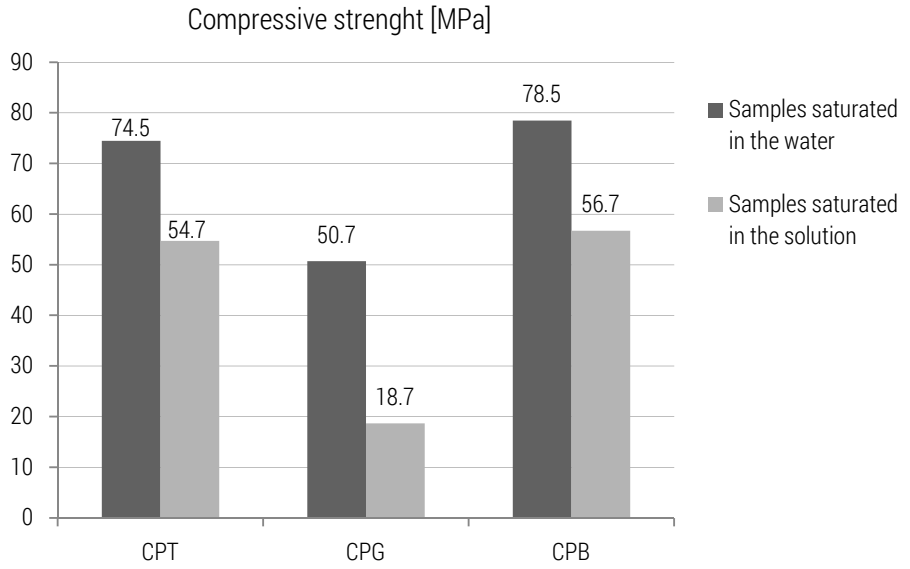

Figure 8. Results of testing the strength of composites after their exposure to a chemically aggressive environment against the tested strengths of composites residing in water [MPa]

Source: author's work.

result of the observed strength decrease. Basalt and recycled composites were characterised by a reduction of strength, which was probably influenced only by destructive processes occurring in the cement stone itself. A close-up of the breakthrough of the CPF recycled composite sample after compressive strength testing after removal from the aggressive solution is presented in Figure 9. The photograph shows that the aggressive environment penetrated the sample to a limited extent.

The depth of penetration was approximately 0.5 mm and resulted in exposure and contact with the aggressive environment of the aggregate itself. This fact confirmed the results of the strength tests and the described relationship of these results with the results of the chemical resistance tests of the aggregates themselves.

This experiment proved that both types of aggregates, flint and basalt, can fulfil the role of suitable aggregates for the composition of concretes resistant to aggressive environments.

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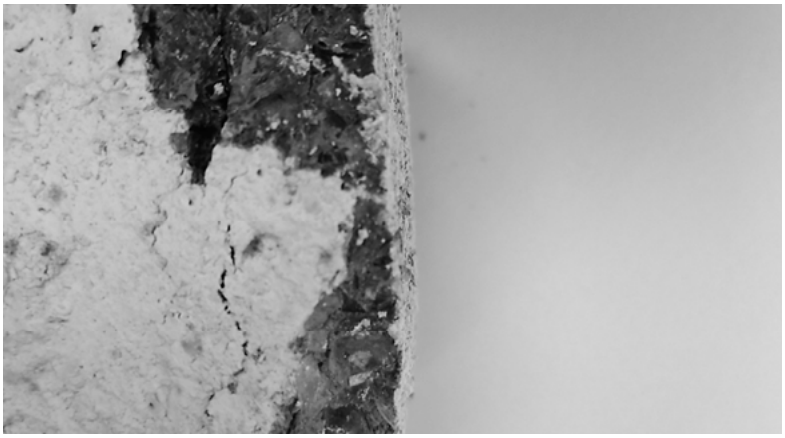

Figure 9. Close-up on the breakthrough of the CPF recycled composite sample after compressive strength testing after removal from the aggressive solution

Source: author's work.

The economic analyses were presented against the background of literature values for other traditional and recycled aggregates used in concrete batching plants (Tokarski & Zegardło, 2020). Table 10 shows the costs of transport, aggregate crushing, standardisation and other additional expenses that would have to be borne by entrepreneurs producing concrete based on the mentioned aggregates.

Analysing the data included in the table, it should be noted that the most economically justified is the use of aggregates produced based on flint. Even though this waste requires an adaptation process such as crushing, it can be a cheaper aggregate than the cheapest gravel aggregates available on the market when used in local concrete batching plants. They can be sourced as waste material at no cost, and their local use reduces transport and associated costs. As a non-absorbable aggregate, flint aggregate also does not require extraordinary expenditures for increasing the amount of cement, as is the case with concrete rubble. It is also worth noting the significant difference in the price levels of flint and basalt aggregates. Technical studies of the characteristics of these two aggregates have proved their considerable proximity. The price of an aggregate made of flint constitutes only 32% of the value of basalt aggregate price. However, according to the presented research results, both types of aggregates can be used for special purposes, such as producing composites with high resistance to chemically aggressive environments.

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Table 10. Economic analyses of the use of waste flint to produce concrete composites

Type of aggregate / Feature	Unit.	Traditional aggregate: sand, gravel	Concrete rubble of low-grade concretes	Destructive concrete for high performance concretes	Basalt grit	Waste of flint
Form in deposit	–	aggregate directly for use	large–scale elements	large–scale elements	manufactured aggregate directly for use	medium–sized elements
Deposit price (gross at retailer's)	PLN/tonne	36.9	18.45	30.75	61	0
Estimated transport distance from the deposit to the concrete producer	km	50	50	80	300	25
Transport price	PLN/tonne	12	12	19.2	72	6
Need to adapt to commodity production	yes/no	no	yes	yes	no	yes
Type of adjustment	–	–	cleaning and crushing	crushing	–	crushing
Estimated cost of compliance	PLN/tonne	–	21.07	14.76	–	37.15
Total cost in the concrete mixing plant	PLN/tonne	48.9	51.52	64.71	133	43.15
Special requirements in the production of concrete mixes	kind of	–	increasing the amount of cement	increasing the amount of cement	–	–
Input cost per 1t of aggregate	PLN/tonne	–	12.3	12.3	–	–
Total cost including additional expenditure	PLN/tonne	48.9	63.82	77.01	133	43.15

Source: author's work based on Tokarski & Zegardło, 2020.

Conclusions

Based on the conducted analyses, it may be stated that aggregate for concrete may be produced from waste flint, which is obtained as waste during chalk mining. The aggregate produced from the waste has a density, absorbability, surface structure and resistance to aggressive environments similar to those observed for high-quality basalt aggregates. These technical parameters are significantly better than those recorded for sand and gravel aggregates.

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Composites in which highly fragmented flint waste is used as the only aggregate have density, absorption, bending and compression strengths close to those of concrete composites containing basalt aggregate produced in industrial concrete plants. The high strength of waste composites classifies them as high-strength concretes and allows them to be used in structural elements. In addition, the composites produced in this way have a high resistance to chemically aggressive factors which occur in concrete elements of sewage systems. Aggressive hydronium ions H_3O^+ (pH reaction), sulphate ions SO_4^{2-}, ammonium ions NH_4^+ and magnesium ions Mg^{2+} with which the composite samples were in contact caused only a 26% decrease in the compression strength of the composite, while this parameter was almost the same as that of the comparative basalt composites.

Based on the analyses carried out, it may be stated that aggregates produced from waste flint may be a substitute for high-quality basalt aggregates with a particular recommendation for use in areas with increased chemical aggressiveness corresponding to the work of concrete elements in sewage systems.

Economic analyses show that a suitable system for the use of flint waste by local concrete batching plants producing concrete composites can be very beneficial. The costs of obtaining, transporting and crushing the waste can, in some cases, be less than the costs of obtaining traditional gravel aggregates.

According to the research results presented, the proposed system for the use of mining waste can be recommended for implementation in industrial operations. Chalk mining waste used in the above mentioned way can be a substitute for separate special aggregates. The described activities may have several levels of positive impact on the environment. The rational use of mining waste may contribute to a reduction in the extraction of natural basalt aggregates as well as the appropriate use of energy previously consumed in the extraction of the waste itself. Such activities may also have positive economic effects. Concrete batching plants operating locally next to chalk mines may have a chance to obtain a cost-free substitute for expensive special aggregates often transported from long distances.

References

Atiş, C. (2005). Strength properties of high-volume fly ash roller compacted and workable concrete, and influence of curing condition. Cement and Concrete Research, 35, 1112-1121. https://doi.org/10.1016/j.cemconres.2004.07.037

Becla, A., Czaja, S., & Zielińska, A. (2012). *Cost-benefit analysis in the valuation of the natural environment*. Warsaw: Difin.

Boardman, A. E., Greenberg, D., Vining, A., & Weimer, D. (2006). *Cost-Benefit Analysis: Concepts and Practice, 3rd edition. Upper Saddle River*. New Jersey: Pearson Prentice Hall.

DOI: 10.34659/eis.2022.80.1.441

Bukowski, Z. (2014). A plan for recycling. Recycling, 7-8, 16-17.

Bursztyka, P. (2019). *Design and analysis of basic properties of concrete composite containing silica waste in its composition.* [Thesis under the direction of Bartosz Zegardło]. Biała Podlaska: PSW.

Czarnecki, L., Broniewski, T., & Henning, O. (1995). *Chemistry in Building Industry*, Warsaw: Arkady.

Czarnecki, L., Łukowski, P., Garbacz, A., & Chmielewska, B. (2007). Ćwiczenia *laboratoryjne z chemii budowlanej*, Warsaw: OWPW.

Debieb, H., Farid, S., Kenai, L., & Said, A. (2008). The use of coarse and fine crushed bricks as aggregate in concrete, Construction and Building Materials, 25, 886-893.

Gruner, M. (1983). Corrosion and protection of concrete, Warsaw: Arkady.

Góralczyk, S., & Kukielska, D. (2010). Quality of domestic aggregates. Mining and Geoengineering, 34, 211-224.

Hansen, H., & Narud, H. (2003). Strength of recycled concrete made from crus*hed concrete coarse aggregate, Concr*ete International – Design and Construction, 5, 35-48.

Jamroży, Z. (2006). Beton i jego technologie (Concrete and its technologies). Warsaw: PWN.

Kasztelewicz, Z. (2010). Rekultywacja terenów pogórniczych *w polskich kopalniach odkrywkowych. Kraków: Fundacja Nauk*a i Tradycje Gór. AGH.

Khalloo, R., & A*li, R. (1994). Properties of concrete using crushed clinker brick as* coarse a*ggregate*. ACI Materials Journal, 4, 91-94.

Kudełko, J., & Nitek, D. (2011). Wykorzystanie odpadów z działalności górniczej jako substytutów surowców minernych. Cuprum, 3(60), 51-63.

Lipiński, A. (2021). Komentarz do ustawy: Prawo geologiczne i górnicze Dz. U. 2020, Prawne Problemy Górnictwa i Ochrony Środowiska, 1, 1-20.

Nieć, M., & Pietrzyk-Sokulska, E. (2008). Górnictwo wspomagające ochrony środowiska i jej kształtowanie – doświadczenia Kieleckich Kopalń Surowców Mineralnych. Gospodarowanie Surowcami Mieralnymi, 24(4), 251-258.

Ogrodnik, P., & Zegardło, B. (2018). Use of waste ceramic materials and polyester resins to produce synthetic composites with features of structural concretes used in construction, Chemical Industry, 97(1), 144-148.

Ogrodnik, P., Zegardło, B., & Szeląg, M. (2017). The use of heat-resistant concrete made with ceramic sanitary ware waste for a thermal energy storage, Applied Sciences, 7(12), 1-16. https://doi.org/10.3390/app7121303

Polish Committee for Standardization. (2008). Testing of mechanical and physical properties of aggregates - Part 7: Determination of density of filler – Pycnometric method. (PN-EN 1097-7:2008).

Polish Committee for Standardization. (2009). Testing hardened concrete. Flexural strength of test specimens. (PN-EN 12390-5:2009).

Polish Committee for Standardization. (2009). Testing hardened concrete – Part 7: Density of hardened concrete (EN 123907:2009).

Polish Committee for Standardization. (2011). Testing hardened concrete. Compressive strength of test specimens. (PN-EN 12390-3:2011).

Polish Committee for Standardization. (2013). Testing of mechanical and physical properties of aggregates - Part 6: Determination of density of grains and absorbability. (PN-EN 1097-6:2013-11).

DOI: 10.34659/eis.2022.80.1.441

Polish Committee for Standardization. (2013). Tests for mechanical and physical properties of aggregates. Determination of particle density and water absorption. (PN-EN 1097-6:2013).

Rao, K. N., Jha, S., & Misra, A. (2007). Use of aggregates from recycled construction and demolition waste in concrete, Res. Conserv. Recycl., 50, 71-81.

Ryka, W., & Maliszewska, A. (1991). *Słownik petrograficzny*, Warsaw: Wydawnictwa Geologiczne.

Shikano, H. et al. (1990). Role of silica flour in low cement castable, Taikabutsu Overseas, 1, 17-22.

Szot-Gabryś, T. (2013). *The concept of cost-benefit accounting in corporate social responsibility accounting*. Warsaw: Difin.

Szuflicki, M., Malon, A., & Tymiński, M. (2021). *Bilans zasobów złóż kopalin w Polsce,* Warsaw: Państwowy Instytut Geologiczny.

Tokarski, D., & Zegardło, B. (2020). Costs and economic benefits of recycling electrical insulators in special concretes production, Ekonomia i Środowisko, 4, 95-102. https://ekonomiaisrodowisko.pl/journal/article/view/15

Uberman, R., Pietrzyk-Sokulska, E., & Kulczycka, J. (2014). Environmental impact assessment of mining activities-trends of change. Future: World-Europe-Poland, 2(30), 87-119.

Zegardło, B., Brzyski, P., Rymuza, K., & Bombik, A. (2018c). Analysis of the effects of aggressive environments simulating municipal sewage on recycled concretes based on selected ceramic waste. Materials, 11(12), 25-65. https://doi.org/10.3390/ma11122565

Zegardło, B., Drymała, T., & Nitychoruk, J. (2018b). Composites based on unsaturated o-phthalic polyester resin filled with glass aggregate from depleted car side windows, Chemical Industry, 97(4), 595-600.

Zegardło, B., Szeląg, M., & Ogrodnik, P. (2016). Ultra-high strength concrete made with recycled aggregate from sanitary ceramic wastes – The method of production and the interfacial transition zone, Construction and Building Materials, 122, 736-742. https://doi.org/10.1016/j.conbuildmat.2016.06.112

Zegardło, B., Szeląg, M., & Ogrodnik, P. (2018a). Concrete resistant to spalling made with recycled aggregate from sanitary ceramic wastes – The effect of moisture and porosity on destructive processes occurring in fire conditions, Construction and Building Materials, 173, 58-68. https://doi.org/10.1016/j.conbuildmat.2018. 04.030

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GENERAL ENVIRONMENTAL AND SOCIAL PROBLEMS

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PERSPECTIVES OF MOBILITY DEVELOPMENT IN REMOTE AREAS ATTRACTIVE TO TOURISTS

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ABSTRACT: This paper addresses the problem of transport systems in remote areas, defined by a set of constraints deriving from a sparse population, infrequent transportation location means stops and cost-effectiveness of the system. Remote areas attractive to tourists additionally require transportation services designed with respect to changeable demand and the necessity to provide transportation solutions limiting detrimental influence on the environment. This paper aims to identify and assess the perspectives for developing innovative mobility solutions for residents and tourists in remote areas in line with sustainable development and evaluate factors supporting or hindering the development of the selected perspectives. The results of a Delphi study with 23 experts from seven EU Member States, Russia and Norway, enabled identification of factors shaping the future of mobility in peripheral areas, including IT-supported multimodal transport systems, demand-responsive transport and transport services tailored to the specific needs of different user groups.

KEYWORDS: innovative mobility solutions, sustainable mobility, transport policy, remote areas attractive to tourists, Delphi method

Introduction

Planning passenger transportation in areas with changeable demand for transportation services with peaks in tourist seasons and low demand periods during the remaining part of the year, where mainly inhabitants of the region use transport services, is a challenging task. The sparsely populated region with infrequently distributed stops of transport means enforces tailor-made solutions with transport on demand or at least based on through calculation of the demand to avoid the unnecessary cost of providing services for a few or no passengers. Such a problem mainly tackles depopulating areas where the concept of mobility as a service with community-driven platforms improves accessibility and livability of the area (Geurs et al., 2018).

Mobility planning in regions under special environmental protection, which is often the case in tourist destinations, requires innovative solutions reducing the detrimental impact on the environment, such as alternatively fueled vehicles (Tekil et al., 2022; Masmoudi et al., 2020), which is costly at the beginning of the implementation but provides returns from investment in a longer perspective.

Remote and sparsely populated areas require a special approach for their connectivity. Conventional public transportation means such as buses and trains efficiently transport a mass of travellers in busy traffic corridors. Small-sized vehicles can better serve low-density areas due to their flexibility (Yan et al., 2021). Mobility on demand systems synchronises various transit elements, such as the connection between rail and bus lines and between the line-based transit services and demand-response services (Yan et al., 2021; Errico et al., 2013; Wang et al., 2014). The system can also integrate autonomous vehicles to reduce the operation costs of transport (mainly driver cost) and facilitate communication and coordination among the vehicles (Buehler, 2018). Autonomous vehicles are also environmentally friendly.

Research interest in innovation, sustainable transport and sustainable mobility has been growing in recent years (Hoerler et al., 2019; Dziaduch, 2021; Paradowska, 2021; Fournier et al., 2018; Gil et al., 2011). However, most studies focus on urban areas, e.g. on intelligent transport systems in smart cities (Hajduk, 2021). Remote areas and rural areas receive much less attention (Soder & Peer, 2018; López-Iglesias et al., 2018; Szymańska et al., 2021; Flipo, 2021, Campisi et al., 2021; Bell & Sumper, 2015). In addition, there is little scientific contribution to transport and mobility issues in Baltic Sea Region (Berg, 2015; Nilsson, 2018; Kiryluk et al., 2021). Also, relatively little attention has been paid to the mobility of tourists at their destination (Dickinson & Robbins, 2008), while much more attention is paid to the means of transport used to travel from origin to destination (Gutiérrez & Miravet, 2016).

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In this paper, the results of the studies carried out in the course of the project MARA – Mobility and Accessibility in Rural Areas aiming to improve the accessibility and mobility in remote touristic areas of the Baltic Sea Region by increasing the capacity of transport actors are presented. The project was funded by the Interreg Baltic Sea Region Programme 2014–2020 and was performed between January 2019 and June 2021. The paper aims to present the outcomes of the research performed, particularly during the workshop "Future of mobility in remote areas", which took place on 16 April 2021 and was a part of the implementation of the MARA project. The workshop was attended by experts representing various project partners, comprising different stakeholders of mobility planning: regional planning agencies, local and regional governments, and universities from the Baltic Sea area. The regions represented in the project include Vidzeme (Latvia), Birštonas and Druskininkai (Lithuania), Zaonezhye, Karelia (Russia), Setesdal (Norway), Hajnowka district (Poland) and Ludwigslust-Parchim (Germany). These regions exemplify remote areas attractive to tourists (most of them have facilities listed on the UNESCO World Heritage Site) sharing several common challenges, such as population decline, seasonal fluctuation of the population (tourists), expensive public transport, car-dependent lifestyle and lack of using digital solutions (MARA, 2021).

This paper's objective was to identify and assess the perspectives for the development of mobility of residents and tourists in remote areas in line with sustainable development policy (using innovative solutions). Additional objective embraced evaluation of factors supporting or hindering the development of selected perspectives. This study addresses the problem of developing innovative transportation systems in remote areas, defined by a set of constraints deriving from the sparse population, infrequent location of transportation means stops, changeable demand deriving from tourist fluctuation and cost-effectiveness of the system.

In the paper, we present an overview of the literature relevant to mobility in remote areas. Issues regarding the specificity of such regions and their challenges were discussed, particularly low transport accessibility and consequently deprivation of access to certain facilities lowering the life standard, were underlined. Subsequently, we refer to innovative solutions for sustainable mobility possible to apply in such regions. Later we present the outcomes of the Delphi study, where experts evaluated the significance of the theses for the mobility of residents and tourists in remote areas as well as enabling factors and barriers to the theses realisation. The discussion of the results of the Delphi study referred to literature investigation allowed for indicating pillars shaping the future of mobility in remote areas.

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Literature overview

Problems in transportation in remote areas

In remote areas, individuals and communities are experiencing a number of limitations, which prove to be major impediments within the course of meeting livelihoods opportunities (Kapur, 2019). Sparsely populated areas face many challenges, including access to a limited range of education and career options, lower wages, high cost of living, lack of full-time employment opportunities, seasonality for some jobs, e.g. tourism and certain agricultural sectors (OECD, 2021). These socio-economic outcomes are often influenced by the accessibility of transport services manifested in how easily residents can access goods, services and activities (Litman, 2018). The main transportation problems of remote areas are connected with geographic isolation, lack of public transportation and poor infrastructure.

The issue of transport demand in remote areas is not specifically investigated. Transport policy seems to be tailored to urban, developed areas. Sustainable transport policy in urban areas promotes the transition to an environmentally more sustainable means of transport, such as non-motorized modes and public transport, as well as economic punishing of passenger cars, use (Jović et al., 2013).

However, remote, mainly rural areas are characterised by certain features that influence the specificity of transportation needs, which make them different from urban areas. Those specific features mainly include low population density, unfavourable demographic structure (young people are leaving because of the difficult access to educational centres and workplaces) (Pezzini, 2000; Rostami, 2005), distance from city centres, spatial scarcity of facilities and underdeveloped public transport network (or public transport does not exist).

One of the main challenges for remote areas development, especially attractive to tourists, is sustainable mobility. Sustainable mobility requires changes to the entire mobility management system. It should, in particular, aim to prevent the social exclusion of people living in remote areas and reduce the environmental damage caused by transport (Miller, 2020).

Geographically isolated regions are often dependent on air and maritime connections. However, those types of transport meet efficiency obstacles in sparsely populated areas. Airlines usually have little or no economic incentives to operate remote air services. Remote air routes often face shortages of qualified pilots and mechanics and difficulty attracting people of such professions (Tretheway et al., 2021). Similar to air transport, maritime passenger and freight transport in remote areas is affected by viability issues. That lack of sufficient demand in those types of transport in remote areas makes ser-

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vices unprofitable, providing private transport operators little incentive to maintain marginal routes.

At the same time, surface transport is limited by austerity policy in the aftermath of the 2008 economic crisis, which accelerated rationalisation and centralisation, affecting the distribution of basic services – including transport. Moreover, the disadvantage of surface transport in remote and sparsely populated areas is lower infrastructure network resilience and reliability (OECD, 2021). In some cases, this is due to high costs and a lack of funding for maintenance.

Other challenges relate to geographical barriers, the complexity of trips, climate change and seasonality of transportation links. As a result, residents of remote areas are transport-deprived and dependent on passenger cars (Pucher & Renne, 2005; Currie et al., 2009; Shergold & Parkhurst, 2010).

The low transport accessibility seems to be the main problem in remote areas. The term accessibility has several definitions. For example, in terms of economic and social opportunity, accessibility can be defined as proximity or facility for spatial interaction (Gutierrez, 2009). This also includes virtual access, which refers to the use of the Information and Communication Technologies (ICTs) as an alternative to physical mobility (e.g., e-work, e-services, e-business and e-commerce), (Kenyon et al., 2002, Kenyon et al., 2003). In the transport context, accessibility can be defined as a facility or opportunities with which basic services can be reached from a given location by using a certain transport system (Gutierrez, 2009).

Many remote areas have limited or no connection to public transport, and traditionally, as was mentioned, transport has been based on-road vehicles (Velaga et al., 2011) predominantly. The lack of transport accessibility and connectivity in remote areas strongly impacts those with limited access to private motorised transport such as children, older people, people with disabilities, and the mobility impaired (Velaga et al., 2011).

Low transport accessibility in remote areas by limitation of transport possibilities to road vehicles is caused by a low level of innovation which improves efficiency and service quality of transport systems.

Though innovative transport technologies have been widely deployed in urban and suburban areas in the developed world, their application in remote areas has been limited (Nalevanko & Henry, 2001). Potential exists for these technologies to contribute to alleviating accessibility and inclusion problems in such areas. Digital technologies are often used to make mainstream public services (such as education, health care and transport) more effective and efficient (Boulton, 2010; Ejdys & Gulc, 2020).

The ongoing process of increasing tax burdens by imposing a tax on car ownership, increasing registration fees as well as the rise of fuel prices further deprive residents of remote areas and lead them to even more signifi-

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cant transport deprivation and low transport accessibility (McNamara & Caufield 2011; Delbosc & Currie 2011). Transport deprivation may be one of the causes of the low mobility of both – residents of remote areas as well as tourists.

Most remote communities face higher costs of travel and more complex and often seasonal transportation links. Extreme weather in many remote regions, exacerbated by climate change impacts, make resilience an important issue (OECD, 2021).

Except for highly developed countries, transportation researches in remote areas have rarely been conducted (Jović et al., 2013). This is especially evident in underdeveloped countries and countries in transition. Therefore it is necessary to define a specific transport policy for remote areas to prevent social exclusion and to provide social equity of inhabitants as well as to attract tourists to those territories.

Developing policies for sustainable transport systems in remote areas is a major challenge for the future. The key issues to consider include a high level of uncertainty due to changes in, e.g., emission regulation and the development of alternative fuels and electric vehicles. Answering the challenges of climate change, regulation of CO_2 emissions, the urban environment are important drivers of sustainable transport development (Melander, 2018).

The European Commission and most European Union countries want Europe to become climate neutral by 2050 (European Commission, 2018; Dębkowska et al., 2022). Aiming to realise this aim, it is assumed in the European Green Deal to reduce greenhouse gas emissions from transport by 90% by 2050.

The key element of The European Green Deal as far as an EU transport policy is concerned is accelerating the shift to sustainable and smart mobility. It involves providing users with more affordable, accessible, healthier and cleaner alternatives to their current mobility solutions. (European Commission, 2019). In 2020 European Commission issued Sustainable and Smart Mobility Strategy – putting European transport on track for the future (European Commission, 2020). The strategy points among others to:

- greening of mobility based on an efficient and interconnected multimodal transport system, zero- and low-emission vehicles;
- digital transformation and mobility automation to improve the levels of safety, security, reliability, and comfort;
- improving accessibility of mobility for all, including the better connection between rural and remote areas;
- increase mobility's resilience to crises.

Better connected rural areas (between each other and with suburban and city areas) also be one of the pillars of the long-term vision for the EU's rural areas developed in 2021 – Towards stronger, connected, resilient and

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prosperous rural areas by 2040 (European Commision, 2021). This document also sets pressure on boosting sustainable and intermodal transport as well as digitalisation.

Innovative solutions for sustainable mobility

The concept of sustainable mobility was born out of a growing awareness of the negative impact of transport and current mobility patterns on the environment and focused on the users of the transport system (Bauchinger et al., 2021; Le Boennec et al., 2019). In recent years, the academic discussion on transport policy and transport management has increasingly replaced the term "transportation" with "mobility", which shows a shift in focus from vehicles to people (Miller, 2020).

Siefkes (2010) indicates four "e" cornerstones of sustainable mobility: energy (energy saving), efficiency, economy and ecology. According to Banister (2006), the sustainable mobility approach requires actions to reduce the need to travel (less trips), to encourage modal shift (e.g. switching from private cars to public transport or more environmentally-friendly vehicles such as electric vehicles bicycles), to reduce trip lengths and to encourage greater efficiency in the transport system. According to Thi Le (2014), sustainable mobility should not require a reduction in mobility. Still, it should be safe for all users and minimise negative effects on individuals, communities, the private sector, and the environment.

The essence and principles of the sustainable mobility paradigm are extensively described by Banister (2006), Scott, Hopkins and Stephenson (2014) and Miller (2020). Sustainable mobility in the context of rural areas was investigated, among others by Walkman et al. (2008), Shergold & Parkhurst (2010), López-Iglesias et al. (2018), Kühl (2021), and concerning tourism by Hopkins (2020).

Implementation and development of transportation services in remote areas requires innovative solutions, enabling a more sustainable and flexible approach to managing transport systems in regions. Among other things, it should consider the variability of demand for transport services, both from residents and tourists. Modern technologies will play an important role in this process. They take into account, among other things, the use of transport telematics that encompass a range of advanced computer, ICT, navigation and positioning systems and digital technologies in the field of transport (Giannopoulos, 2004; Sussman, 2005; Deeter, 2009). Examples include real-time bus arrival information at bus stops, intelligent public transport systems (such as electronic payment collection and automated vehicle scheduling), and shared flexible transport management (such as dial-a-ride share taxi services) (Politis et al., 2010). Technological innovations, especially in

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means of transport (e.g. electric vehicles, autonomous vehicles) and information and communication systems (e.g. wireless communication, geo-localisation), allow to increase transport effectiveness and efficiency (Pesch & Kuzmicz 2020), reduce its negative impact on the environment (e.g. by using alternative fuels and renewable energy sources) (Banister, 2006), and increase the competitiveness of the area as a place to live, work and relax.

Innovative transport solutions addressing the issues of sustainable mobility include, among others: vehicle sharing systems (carsharing, bikesharing) (Dalis & Amudha, 2015), ride-sharing (carpooling), multimodal transport (Keller et al., 2018), electric vehicles (Mann, 2014; Borén et al., 2017), autonomic vehicles (Akash & Kulkarni, 2021), micro-mobility and micro transit (Miller, 2020), which will facilitate a shift from private car use to (micro) public transport, thus reducing emissions, improving accessibility and preventing social exclusion (Bauchinger et al., 2021). Literature studies show that electric vehicles, autonomous vehicles and shared vehicles are among the most promising options for sustainable mobility (Subramanian & Dayakar, 2021; Mann, 2014; Webb, 2019; Anastasiadou, 2021; Schippl & Truffer, 2020).

Electricity-based mobility (EBM) refers to both Battery Electric Vehicles (BEV) and hydrogen (H_2) driven Fuel Cell Electric Vehicles (H_2-FCEV) or Synthetic Natural Gas Vehicles (SNG-V) (Rüdisüli et al., 2022). Although electric vehicles are more expensive than conventional cars, they are less harmful in terms of air and noise pollution than fossil fuel cars (Dalis & Amudha, 2015). Innovative forms of mobility concepts based on electric vehicles can not only contribute to the energy transition in a sustainable way but also better meet the needs of rural communities (Schuckmann et al., 2012). There is now a growing global political emphasis on developing innovative technologies and promoting incentives to support the use of alternative fuel vehicles (AFV) (Browne et al., 2012). However, there are many barriers to consumer adoption of alternative fuel vehicles (AFVs), including regulatory barriers, resources, infrastructure and vehicle features themselves (Byme, 2001). However, the main advantages of autonomous vehicles (AVs) include travel safety, travel time reduction, fuel efficiency, and parking benefits (Fagnant & Kockelman, 2015).

The demand for innovative technological mobility solutions has led to the development and rapid deployment of new mobility services. Public transport authorities in developed European countries have introduced the Mobility-as-a-Service (MaaS) products to assist citizens in piecing together individualised offerings that suit their travel needs (Hirschhorn et al., 2019; Smith, 2021). MaaS is here defined as a "type of service that through a joint digital channel enables users to plan, book, and pay for multiple types of mobility services" (Smith, 2020). MaaS is a novel brand of transport that

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promises to replace private cars with multimodal personalised mobility packages (Alyavina et al., 2020). The term emerged within the transport sector around 2014 (Heikkilä, 2014; Hietanen, 2014). Although the conversation initially focused mostly on urban transport problems, such as congestion, lack of parking, and excessive car use, rural MaaS has received increasing attention from both transport scholars and practitioners.

Lack of public transport service availability and efficiency can provide conditions that are highly suited to the development of more flexible, demand responsive transport services, which are often supported by transport telematics. Such services may develop more readily in social contexts notable for high levels of community involvement and support, e.g., concerns about traveller information in rural areas are leading to passengers sharing information about their journeys using the latest mobile and IT technologies through social networks, media sharing and blogging (Politis et al., 2010).

Another similar concept is integrated multimodal mobility (IMM) platforms, which idea is to provide one-stop-shop offering information, booking and payment options for multiple means of transport (Keller, Aguilar, & Hanss, 2018). A common feature of innovative mobility offers is their dependence on Intelligent Transport Systems, which users use via mobile applications on smartphones or tablets (Le Boennec et al., 2019). MaaS and IMM, as competitive alternatives to the private automobile, provide users with more flexible, convenient and integrated travel options (Goldman & Gorham, 2006). One of the key challenges for intelligent mobility in rural areas is standardised metrics for optimal routes' detection (Porru et al., 2020). New, innovative technologies and services can support sustainable mobility if they are successfully integrated into the given mobility system (Hoerler et al., 2019).

In peripheral regions, where public transport is rarely available, shared mobility should be promoted, particularly ride-sharing, including carpooling. Shared mobility is characterised by the sharing of a vehicle instead of ownership, as well as the utilisation of technology to connect users and suppliers (Santos, 2018). Carpooling is defined "as the sharing of short- or long-distance car rides between people who are not members of the same household, for a trip (or part of a trip) already scheduled by the driver, free of charge or expense sharing" (Aguiléra & Pigalle, 2021).

Private forms of carpooling can help to combine car trips and reduce emissions. However, research by Kühl (2021) shows that car sharing is considered a useful option only when trips are made with friends and is more feasible for leisure mobility (Kühl, 2021). In areas with low transport demand, the feasibility of implementing on-demand forms of transport would need to be assessed, particularly DRT (Demand Responsive Transport) (Campisi et al., 2021; Knierim & Schlüter, 2021). In small inaccessible towns, the likeli-

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hood of using, for example, on-demand buses increases with age, suggesting that DRT systems benefit a doubly constrained population, namely the older population in towns with few public services (Knierim & Schlüter, 2021; Broome et al., 2012). Automated demand responsive transport services are perceived as disruptive technologies in the transport markets (Grunicke et al., 2021).

Orienting remote areas towards sustainable mobility requires an appropriate transport policy and planning approach in the regions. In this process, it is important to create and model scenarios (Banister, 2006; Keseru et al., 2021) to draw attention to major challenges and organise different stakeholders' cooperation. Sustainable passenger transport policies are most often directed towards everyday travel and ignore the large and expanding amount of tourism travel (Holden & Linnerud, 2011).

Methodology and problem setting

The research presented in this article was based on one of the expert methods, the Delphi method. This method was developed at the RAND Corporation in the 1950s under the auspices of the U.S. Air Force as a technique to apply expert input in a systematic manner using a series of questionnaires with controlled opinion feedback (Linstone & Turoff, 2011). It can be defined as a structured group communication process to ensure the effectiveness of a community of independent people who, as a whole, tend to solve a complex problem (Linstone & Turoff, 2002). This method allows gathering data from a panel of selected experts as the information will be more credible than that of a single expert (Marchais-Roubelat & Roubelat, 2011; Curiel-Esparza et al., 2016).

The key features of Delphi include multi-stage procedure, anonymity, providing feedback, independence of experts' views (Kononiuk et al., 2021). Delphi method assumes at least a repeated survey of the same group of experts (Kowalewska & Głuszynski, 2009). This technique improves the efficiency of the dynamic process of the panel of experts (Curiel-Esparza et al., 2016).

In the case of research carried out for this article, the Delphi method was treated as an expert study in which intuitive expert opinions are treated as a legitimate contribution to formulating a vision (scenario) of the future on a research subject (Nazarko, 2013).

Currently, Delphi is widely used in various research fields, including but not limited to areas such as health, defence, business, education, information technology, transport and mobility (Skulmoski et al., 2007; Szpilko, 2014). However, the use of the Delphi method in transportation and mobility research is not very common. A systematic literature review conducted by

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Melander (2018) on the use of the Delphi in developing scenarios for the future of transportation identified about 20 papers published on the topic in WoS and Scopus. The topics covered in the literature review were divided into four broad themes related to transport: logistics, mobility, future developments of technologies and environmental issues. However, none of the articles dealt with transportation and mobility in remote areas attractive to tourists.

This article fills a research gap in using the Delphi method to identify directions of mobility improvement in remote areas attractive to tourists.

Development of the theses

In the classical approach, the Delphi study is preceded by the formulation of Delphi theses or projections and ancillary questions. The Delphi theses refer to the future description of dependencies between issues arising from the field of the study and a setting determined by the goal of the research carried out. Ancillary questions can include items such as, among other things: the level of expert knowledge, factors conducive to the realisation of the thesis, barriers to its implementation (Radziszewski et al., 2016). Since the development of Delphi theses highly influences outcomes validity and reliability, the authors follow strictly methodological rigour (Schuckmann et al., 2012).

The purpose of developing the theses was to describe foreseeable future directions of mobility improvement in remote areas attractive to tourists up to the year 2040. The process of development of the theses (Figure 1) began with a detailed review of the literature on transport and mobility in remote areas attractive to tourists. During the formulation of theses, the expertise gained through the participation of the authors in the MARA project was used. After developing a list of 25 theses, two internal online workshops were held, during which the list was limited to 7 theses through discussion and exchange of knowledge between authors. Then the list was provided for the MARA project leader with a request for possible corrections and suggestions for changes. After taking into account the comments of the MARA leader, the final list of 7 theses on directions of mobility improvement in remote areas attractive to tourists with a perspective beyond the year 2040 was prepared.

In general, the theses cover seven important trends prevailing in the literature review on the topic as well as in the outcomes of the MARA project (Figure 2).

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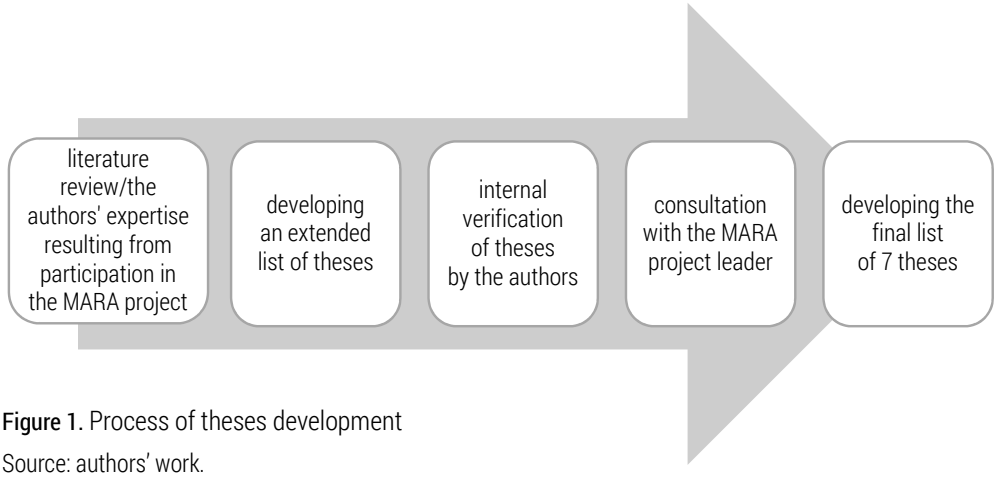

Figure 1. Process of theses development

Source: authors' work.

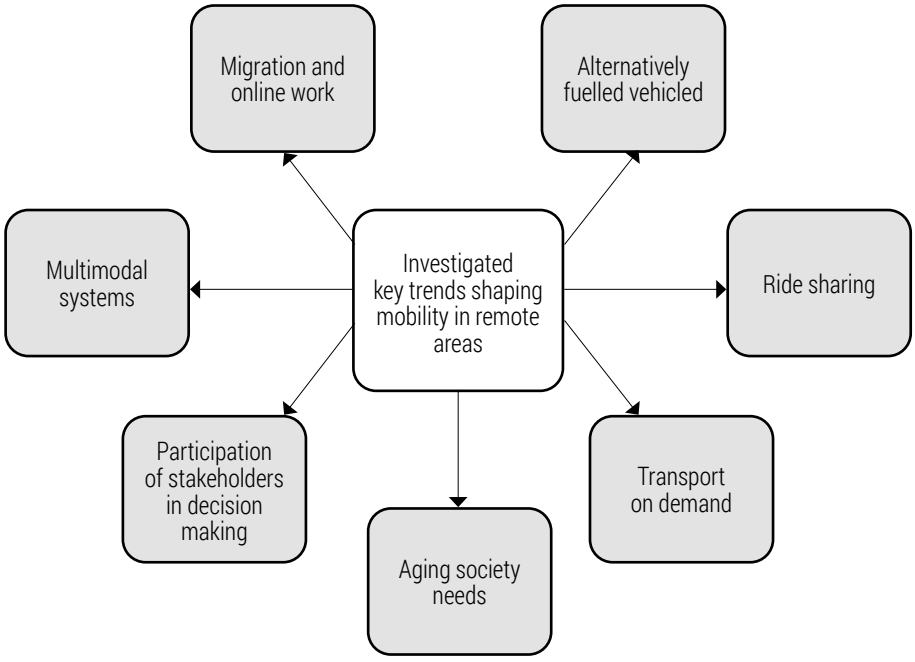

Figure 2. Investigated key trends shaping mobility in remote areas

Source: authors' work.

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The final list of the theses is presented in Table 1.

Table 1. Delphi theses

Symbol of thesis	The final formulation of the thesis
T1	The concept of ride-sharing will be less relevant in the future with the preference of individual transport (e.g. the influence of the pandemic Covid-19)
T2	Increased online work opportunities and migration of people to remote areas can change mobility patterns
T3	Demand-responsive transport (DRT) and tailor-made travel solutions will dominate in shaping the future of transport in sparsely populated, remote areas
T4	Dynamically aging society will increase demand for special transportation solutions for the needs of people with mobility constraints
T5	Deployment of electric and hydrogen vehicles will dominate transport in remote nature-valuable areas
T6	Multimodal transport systems (including public transport, bike and scooter rentals, ride-sharing, taxis and parking solutions) supported by integrated schedules and ticketing system as well as digitalisation (e.g. mobile applications, ride-sharing platforms) will improve mobility in remote areas
T7	Public policy intensifying cooperation of authorities at local, regional and national level in transport planning will improve transport infrastructure development

Source: author's work.

The explanation and justification of the theses are the following:

Thesis 1. *The concept of ride-sharing will be less relevant in the future with the preference of individual transport (e.g. the influence of the pandemic Covid-19)*

The concept of sharing economy was blooming before the Covid-19 pandemic. Still, the fight against virus spreading and the necessity of social distancing brought a turn in this trend and even a discussion whether it will restore after the pandemic (Wang et al., 2021). With the rising number of infections, some people became reluctant to share vehicles and turned to individual transport. It is not always possible due to economic reasons as it depends on the transport possibilities both individual and in terms of the local transport network. Weill et al. (2020) observed that social distancing responses to Covid-19 emergency declarations vary by income level of the region: wealthier areas decreased mobility significantly more than poorer areas. A similar hypothesis was investigated by Wee and Witlox (2021), assuming that the risk of the infection deters users from shared means of transportation. This thesis was aimed to investigate how much the pandemic can influence the trend of ride-sharing in the analysed areas.

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Thesis 2. *Increased online work opportunities and migration of people to remote areas can change mobility patterns*

The pandemic brought changes in the working system. Online work was recommended by the governments or enforced in lockdown periods. This became a temporary solution for some professions, but it turned out that it is a way to cut costs on offices and still bring expected results. At the same time is well perceived by the staff members because it offers them more flexibility.

European Parliament indicates that online working facilitates remote and distributed work, contributing to a more balanced spatial distribution of employment and population (Samek Lodovici et al., 2021). There is a wide recognition that the big scale of online work following the pandemic will contribute to a long-lasting impact on the spatial distribution of work, also in peripheral geographical locations, including areas across borders (ILO, 2016). They also underline the positive influence of online work on the environment and society, such as stress reduction, positive environmental impacts due to a decrease in traffic congestion and carbon emissions, and savings in terms of commuting time and costs.

The observed trend to leave the city and move to village areas to benefit from such a lifestyle while working online for the companies located in the cities became visible and also reflected in the change of prices of properties with a relative increase in village areas and decrease in the cities (Samek Lodovici et al., 2021; Delventhal et al., 2021; Gupta et al., 2021; OECD, 2020). Moving people to rural areas changed mobility patterns; new inhabitants have new needs, for example, increasing the number of children commuting to school. Therefore, this thesis has been investigated and how relevant this phenomenon can be for mobility solutions analysed.

Thesis 3. *Demand-responsive transport (DRT) and tailor-made travel solutions will dominate in shaping the future of transport in sparsely populated, remote areas*

The widely scattered population in remote areas does not generate sufficient demand to make local public transport economically viable, traditionally organised in fixed routes and served by big buses (Li & Quadrifoglio, 2010; Knierim & Schlüter, 2021). Knierim and Schlüter (2021) investigated the reasons and preferences of people in rural areas using demand responsive transport (DTR). They point out that people without car access are more likely to use DRT systems because they may see them as improving their individual mobility situation. They also indicate that mobility-related physical impairment of the transport service users favours the DTR. Changeable demand in tourist and non-tourist periods is a factor encouraging for DTR solutions, especially in the time of lower demand. Providing services for tourists requires tailor-made solutions reflecting tourists preferences and demands.

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Thesis 4. *Dynamically aging society will increase demand for special transportation solutions for the needs of people with mobility constraints*

Aging society is a problem under consideration worldwide. According to the United Nations Department of Economic and Social Affairs Population Division, older people comprise more than one-fifth of the population in 17 countries today, and they predict that in 2100 this will be the case for 155 countries, covering a majority (61%) of the world's population (United Nations, 2019). There were 703 million persons aged 65 years or over in the world in 2019. The number of older persons is projected to double to 1,5 billion in 2050. Globally, the share of the population aged 65 years or over increased from 6% in 1990 to 9% in 2019 and is projected to rise further to 16% by 2050. This means that one in six people in the world will be 65 years or older, which substantiates thinking about older adults' transportation needs very seriously.

In terms of transportation services, dial-a-ride solutions served by minibuses driving older adults to healthcare institutions, shopping, leisure activities etc. dominate. Dial-a-ride services may have different options of passenger transfers from one vehicle to another, considerations of assistance manpower requirements, multiple service providers cooperating in one area (Tekil et al., 2022; Masmoudi et al., 2020). Door-to-door service is required, and vehicles need to be equipped with entrance facilitating devices space for mobility aids for the elderly: wheelchairs, crutches, walkers. The organisation of on-demand minibuses for the elderly population proves to be especially effective in less developed regions (Liu et al., 2021). Since the problem of an aging society is rising (Jarocka & Wang, 2018), elderly people have become a substantial group for transport service providers. Therefore it was investigated how relevant it is to address this group's needs in transport planning in remote areas.

Thesis 5. *Deployment of electric and hydrogen vehicles will dominate transport in remote nature-valuable areas*

The rising awareness of the catastrophic influence of human activity on the environment and unavoidable climate change solutions for alternatively fueled vehicles raise a lot of attention. In order to accelerate the adoption of low-emission vehicles, governors and academics focus on financial incentives or technological advancements that might decrease purchase prices (Schlüter and Weyer, 2019; Egbue & Long, 2012), increase vehicle range (Greaves et al., 2014) or improve the charging infrastructure (Lieven, 2014). The preferences and attitudes of users are rarely considered, although Schlüter and Weyer (2019) point out that these might be decisive barriers to change and introducing sharing of electric cars may partially reduce the users' doubts. The financial barrier often remains the most influential in

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many regions. However, considering that the analysed areas are under the special protection of the surrounding nature, it seems that they are particularly suitable for the use of electric or hydrogen vehicles; hence the relevance of this thesis has been established for the experts' consideration. Borén et al. 2017 provide a sustainable vision for electric vehicle systems on the example of southeast Sweden with a view to 2030.

Thesis 6. *Multimodal transport systems (including public transport, bike and scooter rentals, ride-sharing, taxis and parking solutions) supported by integrated schedules and ticketing system as well as digitalisation (e.g. mobile applications, ride-sharing platforms) will improve mobility in remote areas*

Based on the literature review and the outcomes of the MARA project, it can be stated that multimodal transport systems integrating rural shared mobility services with public transport services seem very important. Mounce et al. (2020) indicate the main requirements for such an integrated system: the capability of the existent transport services to become integrated; necessary physical infrastructure to support interchanges; necessary digital infrastructure and connectivity to exchange the needed information, e.g. about service delays; the willingness of stakeholders to exchange information and to make compromises if necessary, e.g. in terms of altering timetables to facilitate speedy interchanges. Multimodal transport systems highly facilitate transport flow both in freight and passenger transportation reducing the time and resources needed to transfer from one means of transport to another (Kuźmicz & Pesch, 2017; Kuźmicz & Pesch, 2019). Passengers expect mobile applications integrating all transport means and one ticket for all transport possibilities, including additional services such as parking. Bike and scooter rentals because an important element of the first and last-mile transportation, especially providing transportation on remote stretches, so their integration into a multimodal system seems vital.

Thesis 7. *Public policy intensifying cooperation of authorities at local, regional and national level in transport planning will improve transport infrastructure development*

The development of transportation services in rural areas has a great value for its inhabitants, increasing the quality of their lives and giving them a chance to make up for some deficits. Some lack access to services offered in the cities. To a large extent, diminishing these differences has been funded by the European Union. However, these subsidies have decreased in recent years as part of a wider reduction by the central government on public spending (Mounce et al. 2020). The effective distribution of financial resources depends on the decision-makers. The more centralised is the system, the lower the level of inhabitants or tourists satisfaction. Therefore it is important to

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increase the level of engagement of local stakeholders. Providing this thesis considering intensifying cooperation of authorities at the local, regional and national level as a means of improvement of mobility has been an attempt to check whether the experts see this area as a chance for a real improvement.

Experts selection

Former research demonstrated that choosing appropriate experts for Delphi studies significantly influences the reliability of research results (Schuckmann et al., 2012). In selecting the panel for the Delphi study needs to be stressed, not only for finding a heterogeneous group willing to participate but also to consider their context, background, location and expertise (Melander, 2018). There are different approaches to select Delphi experts, one of them is to invite experts who took part in former studies and projects on the topic or by networking with professionals etc. (Piecyk & McKinnon, 2010).

Table 2. The structure of Delphi experts

Country	Name of the organisation	Category of stakeholders	Number of experts
Estonia	University of Tartu	university/academia	1
Finland	Finnish Environment Institute SYKE	university/academia	1
Germany	Ministry for Energy, Infrastructure and Digitalisation Mecklenburg-Vorpommern	local or regional government	2
Latvia	Vidzeme Planning Region	regional planning institution	3
Lithuania	Vilnius Gediminas Technical University	university/academia	2
Norway	Bygland Municipality	local or regional government	1
Norway	Agder Kollektivtrafikk AS	local or regional government	1
Poland	Bialystok University of Technology	university/academia	4
Poland	Transport consulting company	business	1
Poland	Hajnówka County	local or regional government	3
Russia	Petrozavodsk City Administration	local or regional government	1
Sweden	Dalarma Univeristy	university/academia	1
Sweden	Trafikverket	government agency	2

Source: author's work.

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In this case, 23 experts from the MARA project representing seven EU member states, Russia and Norway, took part in the study. Among them, representatives of different stakeholders groups were included, such as regional planning institutions (13%), regional and local governments (34%), universities/academia (39%), government agencies (9%) and businesses (4%) from the Baltic Sea Regions, including Estonia, Finland, Germany, Latvia, Lithuania, Norway, Poland, Russia, and Sweden (Table 2).

Firstly, the experts participating in the Delphi research were asked to evaluate their knowledge related to mobility in remote areas on a scale from 1 to 5, where 1 means the knowledge is „very low" and 5 means that the knowledge is „very high". 75% of experts declared that their level of knowledge is "high" or "very high", 25% of experts indicated their level of knowledge related to the issue of mobility in remote areas as „average" and none as „low" or „very low".

The procedure of conducting the Delphi study

The Delphi survey was conducted during the workshop "Future of mobility in remote areas", which took place online on the Zoom platform on 16 April 2021 and was part of the implementation of the MARA project.

The authors applied an Internet-based Delphi variant, which uses real-time logic and reduces the length of time required to conduct the survey (Schuckmann et al., 2012). The Internet-based Delphi method is particularly useful when experts are geographically dispersed and unable to meet as one group (Melander, 2018). Nowadays, Delphi studies use the Internet to distribute questionnaires (Szpilko, 2014).

The experts participating in the Delphi research, firstly, were asked to evaluate their knowledge relating to mobility in remote areas on a scale from 1 to 5, where 1 means the knowledge related to mobility in remote areas is „very low" and 5 means that the command is „very high".

Next, the experts were asked to assess seven future theses/projections (listed in Table 1). The experts evaluated the significance of the thesis for the mobility of residents and tourists in remote areas in two rounds. The assessment was made on a scale from 1 to 5, where 1 means the importance of the thesis is „very low" and 5 means „very high". The second round of assessing the significance of theses was preceded by an open discussion over the evaluation results of each thesis obtained in the first round.

In the next stage, experts assessed the impact of the contributing factors and the barriers on the feasibility of the thesis.

In the last part of the survey, experts gave the opinion about the estimated time of realisation of theses. The implementation time of theses was evaluated by selecting one of the three responses: "before 2030", "in years 2030-2040", and "after 2040".

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The significance (*Si*) of the theses for the mobility of residents and tourists in remote areas were assessed according to the formula (based on Kononiuk et al., 2021):

$$S_i = \frac{100*n_{VH}+75*n_H+50*n_A+25*n_L+0*n_{VL}}{n}, \quad (1)$$

where:

n_{VH} – the number of responses "very high",

n_H – the number of responses "high",

n_A – the number of responses "average",

n_L – the number of responses "low",

n_{VL} – the number of responses "very low",

n – the number of responses.

In the next stage, experts assessed the impact of the contributing factors and the barriers on the feasibility of the thesis. The contributing factors (*C*) indicators and the barriers (*B*) indicators were calculated according to formula (2) and formula (3), respectively (based on Kononiuk et al., 2021).

$$C = \frac{100*n_{VH}+75*n_H+50*n_A+25*n_L+0*n_{VL}}{n}, \quad (2)$$

$$B = \frac{100*n_{VH}+75*n_H+50*n_A+25*n_L+0*n_{VL}}{n}. \quad (3)$$

Outcomes

The research was divided into two stages. The experts evaluated the significance of the thesis for the mobility of residents and tourists in remote areas in two rounds. The results obtained from the first round of the Delphi method are presented in Figure 3.

The indicators of thesis significance were determined according to the formula (1) and ranged from 50.0 to 85.2 (Table 3).

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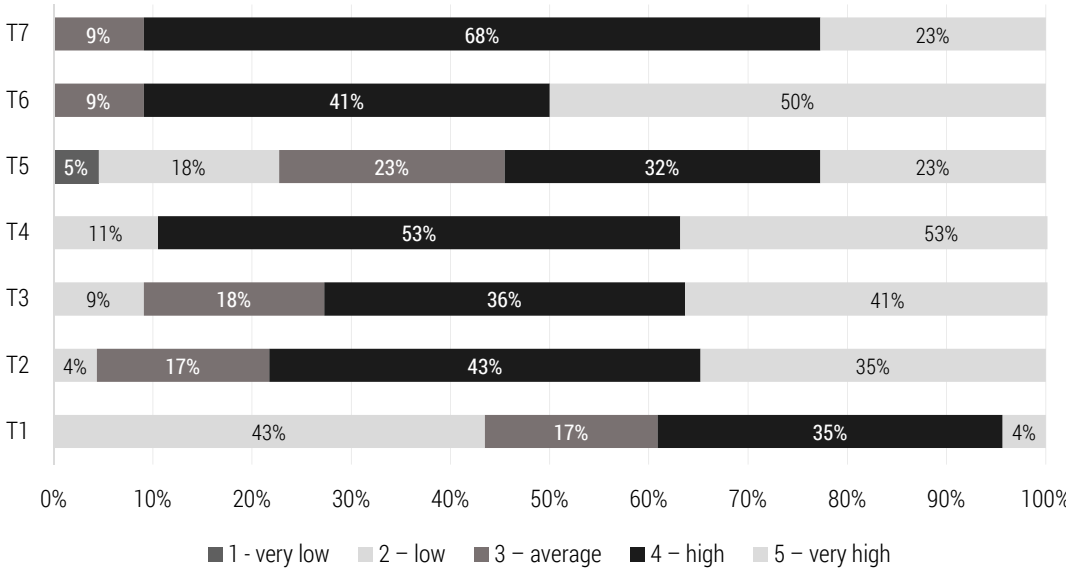

Figure 3. The significance of the theses for the mobility of residents and tourists in remote areas – experts' opinions (1st round)

Source: authors' work.

Table 3. Indicators of the significance of the theses for the mobility of residents and tourists in remote areas – 1st round results

Thesis	Indicators of the thesis significance (SI)
T1	50.0
T2	77.2
T3	76.1
T4	81.8
T5	62.5
T6	85.2
T7	78.4

Source: authors' work.

Analysing the results, it should be indicated that in experts' opinion, the theses that are the most significant for the mobility of residents and tourists in remote areas are thesis T6 – *Multimodal transport systems (including public transport, bike and scooter rentals, ride-sharing, taxis and parking solutions) supported by integrated schedules and ticketing system as well as digitalisation (e.g. mobile applications, ride-sharing platforms)* will improve mobility in remote areas, and thesis T4 – *Dynamically aging society will*

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increase demand for special transportation solutions for the needs of people with mobility constraints. The significance indicators of those theses exceeded the value of 80, and the importance of the thesis for the mobility in remote areas was assessed as "very high" by more than 50% of experts. The thesis of the lowest value of significance indicator is thesis T1 – *The concept of ride--sharing will be less relevant in the future with the preference of individual transport (e.g. the influence of the pandemic Covid-19)*. For 43% of respondents, the significance of that thesis is "low".

In the next stage, experts assessed the impact of the contributing factors and the barriers on the feasibility of the thesis. Among contributing factors were considered: (C1) Additional financial support; (C2) Fast development of technologies connected with sustainable transport solutions; (C3) Increased involvement of stakeholders in local transport policy; (C4) Raising of public environmental awareness and (C5) Increase of tourist interest in remote areas. The barriers examined are as follows: (B1) Limited funding; (B2) Legal restrictions on protected areas; (B3) Changeable demand for transport services (tourist seasonality); (B4) Lack of social acceptance; and (B5) Lack of digital competences. The values of contributing factors (C) and barriers (B) indicators were calculated according to the formula (2) and formula (3) (Table 4 and Table 5).

Table 4. Indicators of the impact of the contributing factors on the feasibility of the theses

Thesis	Additional financial support (C1)	Fast development of technologies connected with sustainable transport solutions (C2)	Increased involvement of stakeholders in local transport policy (C3)	Raising of public environmental awareness (C4)	Increase of tourist interest in remote areas (C5)
T1	51.3	62.5	56.6	48.8	58.8
T2	50.0	80.0	53.8	53.8	61.3
T3	71.3	80.0	73.8	60.0	63.2
T4	76.4	69.7	65.8	40.8	38.2
T5	76.3	88.2	50.0	68.4	61.8
T6	76.3	82.9	68.4	52.6	69.7
T7	64.5	56.6	82.9	55.3	63.2

Source: authors' work.

According to the experts' opinion, "additional financial support" is the factor contributing the most to the feasibility of the thesis T4 – *Dynamically aging society will increase demand for special transportation solutions for the needs of people with mobility constraints*, thesis T5 – *Deployment of electric*

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and hydrogen vehicles will dominate transport in remote nature-valuable areas, and thesis T6 – *Multimodal transport systems supported by integrated schedules and ticketing system as well as digitalisation will improve mobility in remote areas* – the value of contributing factors (C) indicators are 76.3-76.4. The next factor, "fast development of technologies connected with sustainable transport solutions", contribute the most to the feasibility of the thesis T5, formulated as *Deployment of electric and hydrogen vehicles will dominate transport in remote nature-valuable areas* (indicator value is 88.2). At the same time, it is the most important factor (with the highest indicator value in the study) among all the factors in the analysis. "Fast development of technologies connected with sustainable transport solutions" is highly evaluated also in the case of thesis T6 (indicator value – 88.2) and theses T2 and T3 (indicators value – 80.0). "Increased involvement of stakeholders in local transport policy" is of the greatest meaning in case of the thesis T7 (indicator value – 82.9) stated as *Public policy intensifying cooperation of authorities at local, regional and national level in transport planning will improve transport infrastructure development*. In turn, "Raising of public environmental awareness", according to the experts 'opinion, is the factor contributing the most to the feasibility of thesis T5 (indicator value – 68.4) while "Increase of tourist interest in remote areas" to the feasibility of thesis T6 (indicator value – 69.7).

A summary of respondents assessment of the barriers to the feasibility of the thesis is presented in Table 5. The values of indicators vary in the range from 30.3 to 77.6.

Table 5. Indicators of the impact of the barriers on the feasibility of the theses

Thesis	Limited funding (B1)	Legal restrictions on protected areas (B2)	Changeable demand for transport services (tourist seasonality) (B3)	Lack of social acceptance (B4)	Lack of digital competencies (B5)
T1	56.3	47.5	61.3	48.8	47.5
T2	41.3	40.0	55.0	51.3	58.8
T3	72.5	44.7	70.0	42.5	55.0
T4	76.3	30.3	51.3	44.7	61.1
T5	75.0	46.1	52.6	40.8	42.6
T6	77.6	43.4	59.2	50.0	63.2
T7	67.1	43.4	55.3	40.8	31.6

Source: authors' work.

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According to the experts, the first barrier, "Limited funding", seems the most significant affecting too much extent to the feasibility of all investigated thesis. The barrier is of the greatest importance for thesis T6, assuming that *Multimodal transport systems supported by integrated schedules and ticketing systems as well as digitalisation will improve mobility in remote areas* (indicator value – 77.6) and of the least importance for thesis T2 – *Increased online work opportunities and migration of people to remote areas will change mobility patterns* (indicator value – 41.3). Whereas the second barrier, "Legal restrictions on protected areas", is of the least importance, not impacting the feasibility of the theses remarkably – the barrier limits the most the implementation of the thesis T1 – *The concept of ride-sharing will be less relevant in the future with the preference of individual transport*. The indicator value, in that case, is 47.5. The barrier "Changeable demand for transport services (tourist seasonality)", in the experts' opinion, limits the most the realisation of the thesis T3 – *Demand-responsive transport (DRT) and tailor-made travel solutions will dominate in shaping the future of transport in sparsely populated, remote areas* with the indicator value 70.0. "Lack of social acceptance" is considered by experts as not strongly limiting the execution of all theses. The indicators values range from 40.8 in the case of thesis T5 and T7 to 51.3 in the case of thesis T2. The last barrier, "Lack of digital competencies", was evaluated as the most hindering the realisation of the thesis T6 and T4. The thesis T6 is formulated as *Multimodal transport systems (including public transport, bike and scooter rentals, ride-sharing, taxis and parking solutions) supported by integrated schedules and ticketing system as well as digitalisation (e.g. mobile applications, ride-sharing platforms) will improve mobility in remote areas,* and the thesis T4 as a *Dynamically aging society will increase demand for special transportation solutions for the needs of people with mobility constraints*. The indicators values are 63.2 and 61.1, respectively.

In the next part of the study (the second round of the Delhi method), the experts evaluated the significance of the thesis for the mobility of residents and tourists in remote areas for the second time. An open discussion on them preceded the assessment of the significance of theses. The results obtained from the second round of the Delphi method are presented in Figure 4 (experts opinion in scale from 1 to 5, where 1 means the importance of the thesis is „very low" and 5 means „very high") and Table 6 (the indicators of thesis significance determined according to the formula (1)).

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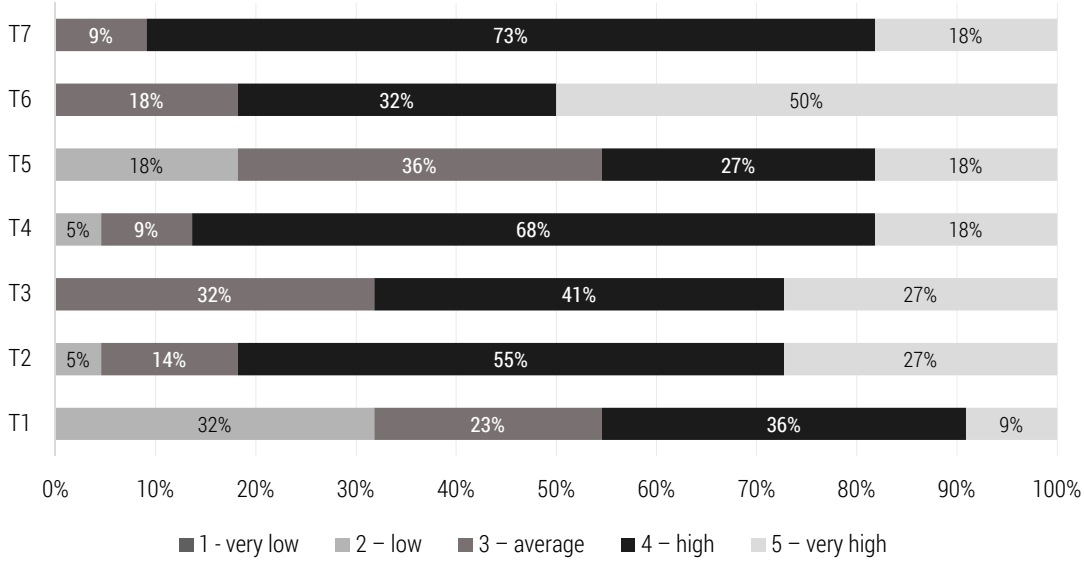

Figure 4. The significance of the theses for the mobility of residents and tourists in remote areas – experts' opinions (2nd round)

Source: authors' work.

Table 6. Indicators of the significance of the theses for the mobility of residents and tourists in remote areas – 2nd round results

Thesis	Indicators of the thesis significance (SII)	Change in comparison to 1st round
T1	55,7	5,7
T2	76,1	-1,0
T3	73,9	-2,2
T4	75,0	-6,8
T5	61,4	-1,1
T6	83,0	-2,3
T7	77,3	-1,1

Source: authors' work.

The second round Delphi research results show that the experts, first of all, changed the assessment of the significance of the thesis T4 – *Dynamically aging society will increase demand for special transportation solutions for the needs of people with mobility constraints* and thesis T1 – *The concept of ride-sharing will be less relevant in the future with the preference of individual transport*. However, worth stating is that, in the opinion of experts, the thesis T1 is still of the lowest value of significance for mobility in remote

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areas. The significance of the thesis, besides thesis T1, is lower than in 1st round. However, the changes in indicators values for thesis T2, T5 and T7 are not high. However, the thesis T6 formulated as *Multimodal transport systems (including public transport, bike and scooter rentals, ride-sharing, taxis and parking solutions) supported by integrated schedules and ticketing system as well as digitalisation (e.g. mobile applications, ride-sharing platforms)* is still the most significant for the mobility of residents and tourists in remote areas. The significance of the thesis was assessed as "very high" by 50% of respondents and "high" by 32% of experts. As theses of secondary importance for the mobility in remote areas (assessed by experts on a similar level – indicators value around 73.9-77.3), should be mentioned thesis T2, T3, T4 and T7.

In the last part of the survey, experts gave the opinion about the estimated time of realisation of theses. The implementation time of theses was evaluated by selecting one of the three responses: "before 2030", "in years 2030-2040", and "after 2040" (Figure 5).

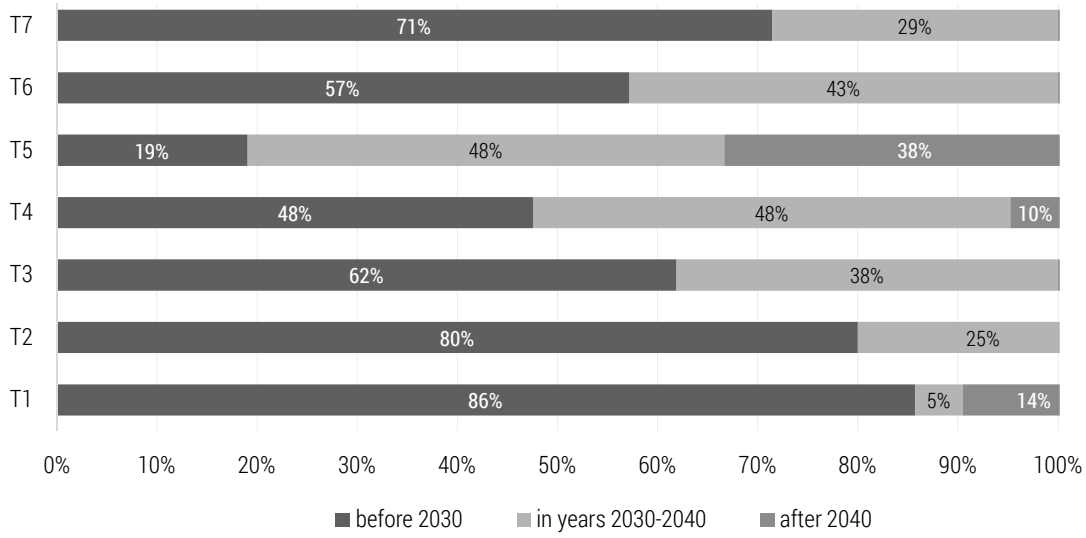

Figure 5. Estimated time of the theses realisation for the mobility of residents and tourists in remote areas

Source: authors' work.

The theses with the shortest realisation time are T1 and T2. According to experts' opinion, the chance of realising those theses before 2030 is around 80%. The dominant opinion about the estimated implementation time for theses T3, T6 and T7 is also before 2030. However, the respondent opinions are not so unified – more than 50% of experts believe that the theses will re before 2030, but another assume that in years 2030-2040 (around 30-40%

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of experts) or even later – after 2040 (in the opinion of 5% of respondents). The thesis T5 – *Deployment of electric and hydrogen vehicles will dominate transport in remote nature-valuable areas* is estimated by experts as the thesis that will be realised in the most distant perspective – in years 2030-2040 or even after 2040.

Discussion

The development and implementation of sustainable mobility solutions in remote areas attractive to tourists are challenging and require elaborating an innovative and flexible approach to managing the region's transport system. The research results indicate that the most significant in improving the mobility of residents and tourists in remote areas is a multimodal transport system supported by integrated schedules and ticketing system as well as digitalisation (Figure 6). Multimodal transport systems integrate different transport services, public and private, typical for densely populated as well as sparsely populated areas. The best solution should be supported by mobile applications and Internet platforms or even one ticket for all transport possibilities. Such a conclusion supports Mounce et al. (2020), who indicates integration as a pivotal requirement for the transport system.

According to our study, the estimated time for the possible introduction of multimodal transport systems in remote areas is before the year 2030 or 2030-2040. The most meaningful factor contributing to the feasibility of this thesis is the fast development of technologies connected with sustainable transport solutions and additional financial support.

Solutions of Demand Responsive Transport should reinforce the multimodal transport systems development supported by mobile applications and Internet platforms. The research shows that DRT and tailor-made travel solutions will be a significant transport element in sparsely populated remote areas in the near future (in experts' dominant opinion before the 2030 year). It is consistent with Li and Quadrifoglio (2010) research and Knierim and Schlüter (2021) explaining no economic rationale for traditionally organised, fixed public transport in remote areas. The DRT is also a good solution to ensure a connection with traditional transport systems (e.g. rail or busses), which is pointed out by Yan et al. (2021), Errico et al. (2013) or Wang et al. (2014). The most significant for DRT solutions is the fast development of technologies connected with sustainable transport solutions and increased involvement of stakeholders in local transport policy.

The necessity is the compliance of transport systems with solutions dedicated to the special needs of elderly people, people with mobility constraints and people who migrate from more densely populated to remote areas and work online. The dynamically aging society will increase demand for special

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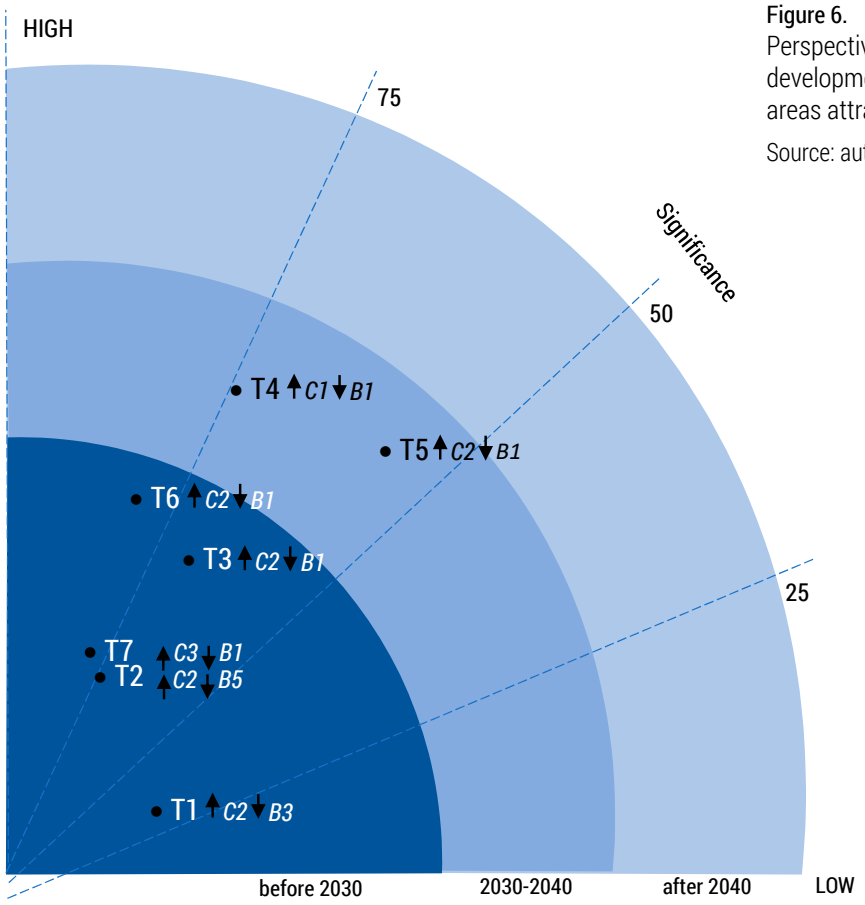

Figure 6.
Perspectives of mobility development in remote areas attractive to tourists

Source: authors' work.

Legend:
T1 – The concept of ride sharing will be less relevant in the future with the preference of individual transport
T2 – Increased online work opportunities and migration of people to remote areas can change mobility patterns
T3 – Demand-responsive transport and tailor-made travel solutions will dominate in shaping the future of transport in sparsely populated, remote areas
T4 – Dynamically aging society will increase demand for special transportation solutions for the needs of people with mobility constraints
T5 – Deployment of electric and hydrogen vehicles will dominate transport in remote nature-valuable areas
T6 – Multimodal transport systems supported by integrated schedules and ticketing system as well as digitalisation will improve mobility in remote areas
T7 – Public policy intensifying cooperation of authorities at local, regional and national level in transport planning will improve transport infrastructure development
↑ Main contributing factor
C1 – Additional financial support
C2 – Fast development of technologies connected with sustainable transport solutions
C3 – Increased involvement of stakeholders in local transport policy
↓ Main barrier
B1 – Limited funding
B3 – Changeable demand for transport services (tourist seasonality)
B5 – Lack of digital competences

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transportation solutions with a high probability before 2030 or in the years 2030-2040. The predictable barriers for developing solutions explicitly dedicated to the needs of elderly people are limited funding and a lack of digital competencies. Some possible answers for that trend are dial-a-ride services (served, for example, with minibuses). This conclusion is coherent with Liu et al. (2021), who demonstrated the effectiveness of such a solution in less developed regions, Yan et al. (2021), who underline flexibility of such solutions and Knierim and Schlüter (2021), who pointed out that the likelihood of using buses on-demand increases with people's age. Additionally, the movement of people from big cities to the village areas is observed. The observed trend was strengthened in times of the Covid-19 pandemic that brought increased emphasis on remote work and, what is important, allowed to discover the advantages and reduce the concerns arising from such a solution. The mobility solution in remote areas must take into account the need of such a group of society because, according to experts' opinion, the chance of realising this thesis before the year 2030 is more than 80%. The perceived factors contributing to the migration of people to remote areas and changes in mobility patterns are mainly the fast development of technologies connected with sustainable transport solutions and the greatest predictable limitation – the lack of sufficient funding for the development of dedicated mobility solutions.

The introduction of new mobility solutions in remote areas should entail integrated actions and a broad perspective in transport planning and supporting decisions regarding various transport initiatives. This perspective should assume authorities cooperation on a local, regional and national level. The increase of local stakeholders engagement and its impact on mobility solutions in their region will improve transport infrastructure development, answering the needs of local residents and tourists. The conducted research shows that if stakeholders involvement in local transport policy increases and financial support is to be assured, the estimated implementation time for the thesis will be before the year 2030.

Individual car transport is less important for mobility increase in remote areas attractive to tourists. Surprisingly despite social distancing due to the pandemic and many people reluctant to close contact with other people, the experts didn't see the trend of ride-sharing as less relevant in the future. The research also shows that the deployment of electric and hydrogen vehicles is of lower relevance for mobility than other analysed issues. It can be assumed that it is due to the fact that, like points, Velaga et al. (2011), the lack of transport accessibility and connectivity in remote areas has a strong impact on those with limited access to private motorised transport, so for such groups as children, older people, people with disabilities etc. other solutions are needed. Moreover, sustainable mobility should be not only environmentally and economically but also socially friendly.

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Limited funding and changeable demand for transport services related to peaks in times when there are many tourists in the region and low demand periods when the tourist mobility is very limited appeared to be the most significant barriers to the realisation of the analysed theses. Funding resources are indisputable obstacles to developing transportation systems, and in rural, sparsely populated places, it is probably even more evident, as funding often concentrates in big cities. In the areas investigated in the MARA project, the differences between a tourist and non-tourist seasons are significant, therefore the bigger challenge in transport services planning. This problem is clearly visible in forecasting income and cost of functioning of the transport system. It is vital for resource allocation planning; for example, in planning drivers employment, much higher demand in the tourist season and much lower at the other time. The same applies to planning the needed number of transport vehicles and their effective usage. The impact of a change in demand in the transport network correlates with the change in the cost of travel (e.g. fuel costs, fares). This barrier was considered especially significant for the realisation of the Thesis 3 Demand-responsive transport (DRT), and tailor-made travel solutions will dominate in shaping the future of transport in sparsely populated, remote areas that are, in fact, is, disputable. It is hard to say that variable demand is a barrier to DTR solutions; it should be rather understood that DRT is a solution helping to overcome this barrier as it involves adjusting service frequency to clients' needs. This barrier was assessed as relevant also for Thesis 1 – *The concept of ride-sharing will be less relevant in the future with the preference of individual transport (e.g. the influence of the pandemic Covid-19)* and Thesis 6 – *Multimodal transport systems (including public transport, bike and scooter rentals, ride-sharing, taxis and parking solutions) supported by integrated schedules and ticketing system as well as digitalisation (e.g. mobile applications, ride-sharing platforms) will improve mobility in remote areas)*. Both of the theses are significant components of transport system planning providing solutions or means of transport, and therefore changeable demand makes it more challenging.

Conclusions

This study embraces the identification of the perspectives for mobility development in remote areas in line with sustainable development policy. The conducted literature analysis showed that there is a great demand for studies supporting remote areas in the development of sustainable transport and mobility (Barfod, 2018).

Following the experts' opinion, the improvement of mobility in remote areas can be obtained by the popularisation of multimodal transport systems supported by integrated schedules and ticketing system as well as digitalisa-

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tion. In the opinion of experts, another important perspective for mobility development, which will dominate in shaping the future of transport in sparsely populated, remote areas, is demand-responsive transport and tailor-made travel solutions. The majority of experts also claimed that a dynamically aging society would increase the demand for special transportation solutions for the needs of people with mobility constraints. However, the above perspectives are strongly determined by the fast development of technologies connected with sustainable transport solutions and accessibility to the funding possibilities. Furthermore, a crucial perspective of transport infrastructure development in remote areas is intense public policy cooperation of authorities at a local, regional and national level. An important contributing factor for that perspective realisation is the increased involvement of stakeholders in local transport policy. The real improvement can be achieved through learning from best practices (Kuzmicz, 2015) and observation of the important trends both in transport and social aspect.

The contribution of this study is mainly filling the gap in the literature on mobility planning in remote, sparsely populated areas attractive to tourists. Planning a transport system answering to the challenges of such specific areas with sharp variability in demand in tourist and non-tourist periods, meeting the expectations of both residents and tourists, low density of stops of transport means and high level of significance of environmentally friendly solutions is troublesome. In this paper, perspectives of the development of mobility solutions in these regions are indicated together with contributing and hindering factors as well as time horizons.

The limitations of this study are related to the specificity of the method used. As the Delphi method strives to reach a consensus on a number of issues, it may lead to less innovative ideas than other methods (Melander, 2018). The Delphi method has its limitations, such as the use of non-randomized samples, subjectivism and bias imposed by the composition of the expert panel, and the lack of commonly accepted recommendations regarding the number of participants, rounds, the way of defining the consensus (Głuszek, 2021). Furthermore, as this method strives to reach a consensus on several issues, it may lead to less innovative ideas than other methods (Melander, 2018). Another limitation stems from the fact that only seven theses were included in the Delphi study. Indeed, additional theses relevant for the future of mobility development in remote areas attractive to tourists could be addressed. Nevertheless, the number of projections was narrowed to such a small number to increase data validity by ensuring low survey fatigue (Schuckmann et al., 2012).

It is worth noting that experts taking part in the study represent a broad array of expertise and experience in transport planning in remote areas of the regions attractive to tourists in the Baltic sea regions. Their practical and

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academic background allowed the identification of pillars shaping the future of mobility in remote areas. The next step for continuing research on the topic could be conducting the STEEPVL analysis and elaboration of scenarios of mobility solutions development specific to remote areas. The elaboration of scenarios would be preceded by an in-depth analysis of factors influencing mobility development in remote areas and an evaluation of their significance and uncertainty (Nazarko et al., 2017). Important direction is also the construction of optimisation models considering the above constraints. The issues of variable demand, meeting the needs of various groups of users young -expecting hi-tech solutions and elderly with their low digital competencies as well as integration of the different means of individual and group transport means supported by green technologies should gain special attention and comprises a rich research field to explore.

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The contribution of the authors

Katarzyna **Anna Kuźmicz**: conceptualisation, literature review, development of the Delphi tool, conducting Delphi study, discussion of the results, conclusions, writing – original draft, review and editing (25%)

Urszula **Ryciuk**: conceptualisation, development of the Delphi tool, data acquisition and analysis, discussion of the results, conclusions, writing original draft (24%)

Ewa **Glińska**: conceptualisation, development of the Delphi tool, methodology, conclusions, writing original draft (17%)

Halina **Kiryluk**: conceptualisation, literature review, development of the Delphi tool, conclusions, writing original draft (17%)

Ewa **Rollnik-Sadowska**: conceptualisation, literature review, development of Delphi tool, conducting Delphi study, conclusions, writing original draft (17%)

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References

Aguiléra, A., & Pigalle, E. (2021). The future and sustainability of carpooling practices. An identification of research challenges, Sustainability (Switzerland), 13(21). http://doi.org/10.3390/su132111824

Akash, & Kulkarni, P. (2021). Transformation of Mobility Industry by Advanced Digital Technologies, Journal of Physics: Conference Series, 1964(4), 042020. http://doi.org/10.1088/1742-6596/1964/4/042020

Alyavina, E., Nikitas, A., & Njoya, E. T. (2020). Mobility as a service and sustainable travel behaviour: A thematic analysis study, Transportation Research Part F: Traffic Psychology and Behaviour, 73, https://doi.org/10.1016/j.trf.2020.07.004

Anastasiadou, K. (2021). Sustainable Mobility Driven Prioritization of New Vehicle Technologies, Based on a New Decision-Aiding Methodology, Sustainability, 13(9), 4760. https://doi.org/10.3390/su13094760

Banister, D. (2008). The sustainable mobility paradigm, Transport Policy, 15(2), 73-80. https://doi.org/10.1016/j.tranpol.2007.10.005

Barfod, M. B. (2018). Supporting sustainable transport appraisals using stakeholder involvement and MCDA, Transport, 33(4), 1052-1066. https://doi.org/10.3846/transport.2018.6596

Bauchinger, L., Reichenberger, A., Goodwin-Hawkins, B. (...), Hrabar, M., & Oedl-Wieser, T. (2021). Developing sustainable and flexible rural-urban connectivity through complementary mobility services, Sustainability, 13(3), 1280, 1-23. https://doi.org/10.3390/su13031280

Bell, D., & Sumper, E. (2015). The public transport stop as an access point for equal mobility in rural areas [Die haltestelle als ausgangspunkt für gleichberechtigte mobilität im ländlichen raum], SWS – Rundschau, 55(3), 355-374.

Berg, P. G., Ignatieva, M., Granvik, M., Hedfors, P., & Bergquist, D. (2015). Resilient Citylands - Green-blue-built transport systems in Baltic Sea Region cities, History of the Future: 52nd World Congress of the International Federation of Landscape Architects, IFLA 2015 - Congress Proceedings, 2015, 406-413.

Borén, S., Nurhadi, L., Ny, H., Robèrt, K.-H., Broman, G., & Trygg, L. (2017). A strategic approach to sustainable transport system development – Part 2: the case of a vision for electric vehicle systems in southeast Sweden, Journal of Cleaner Production, Part 1 140, 62-71. https://doi.org/10.1016/j.jclepro.2016.02.055

Broome, K., Worrall, L., Fleming, J., & Boldy, D. (2012). Evaluation of flexible route bus transport for older people. Transport Policy, 21, 85–91.

Browne, D. J., O'Mahony, M., & Caulfield, B. (2012). How should barriers to alternative fuels and vehicles be classified and potential policies to promote innovative technologies be evaluated, Journal of Cleaner Production, 35, 140-151. https://doi.org/10.1016/j.jclepro.2012.05.019

Buehler, R. (2018). Can public transportation compete with automated and connected cars? Journal of Public Transportation, 21(1), 7-18.

Byme, M. R. (2001). Impediments to consumer adoption of sustainable transportation Alternative fuel vehicles, International Journal of Operations and Production Management,21(12),1521-1538.https://doi.org/10.1108/eum0000000006293

Campisi, T., Canale, A., Ticali, D., & Tesoriere, G. (2021). Innovative solutions for sustainable mobility in areas of weak demand. Some factors influencing the implementation of the DRT system in Enna (Italy), AIP Conference Proceedings, 2343, 090005. https://doi.org/10.1063/5.0047765

DOI: 10.34659/eis.2022.80.1.440

Curiel-Esparza, J.,Mazario-Diez, J. L., Canto-Perello, J., & Martin-Utrillas, M. (2016). Prioritization by consensus of enhancements for sustainable mobility in urban areas, Environmental Science & Policy, 55, 248-257.

Currie, G., Richardson, T., Smyth, P., Vella-Brodick, D., Hine, J., Lucas, K., Stanley, J., Kinnear, R., & Stanley, J. (2009). Investigating links between transport disadvantage, social exclusion and well-being in Melbourne – preliminary results. Transport Policy, 16, 97-105.

Dalis, R. N., & Amudha, S. (2015). Managing electric vehicle sharing using Green Move, ICIIECS 2015 – 2015 IEEE International Conference on Innovations in Information, Embedded and Communication Systems 2015, 7192890. https://doi.org/10.1109/ICIIECS.2015.7192890

Dalkmann, H., Hutfilter, S., Vogelpohl, K., & Schnabel, P. (2008). Sustainable mobility in rural China, Journal of Environmental Management, 87(2), 249-261. http://doi.org/10.1016/j.jenvman.2007.03.049

Dębkowska, K., Dymek, Ł., Kutwa, K., Perło, D., Perło, D., Rogala, W., Ryciuk, U., & Szewczuk-Stępień, M. (2022). The Analysis of Public Funds Utilization Efficiency for Climate Neutrality in the European Union Countries. Energies, 15(2), 581. https://doi.org/10.3390/en15020581

Delbosc, A., & Currie, G. (2011). The spatial context of transport disadvantage, social exclusion and well-being. Journal of Transport Geography, 19, 1130-1137.

Delventhal, M. J., & Parkhomenko, A. (2021). *Spatial Implications of Telecommuting*. http://www.andriiparkhom&enko.net/files/DelventhalParkhomenko_Telecommuting.pdf

Dickinson, J.E., & Robbins, D. (2008). Representations of tourism transport problems in a rural destination. Tourism Management, 29(6), 1110-1121.

Dziaduch, I. (2021). The degree of sustainable development principles implementation in transportation based on an economic analysis of rail buses' life cycle. Economics and Environment, 3(78), 8-29. https://doi.org/10.34659/2021/3/18

Egbue, O., & Long, S. (2012). Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perceptions. Energy Policy, 48, 717-729.

Ejdys, J., & Gulc, A. (2020). Trust in Courier Services and Its Antecedents as a Determinant of Perceived Service Quality and Future Intention to Use Courier Service. Sustainability, 12(21). https://doi.org10.3390/su12219088

European Commision. (2019). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *The European Green Deal*, COM(2019) 640 final, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN

European Commision. (2020). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *Sustainable and Smart Mobility Strategy – putting European transport on track for the future*, COM/2020/789 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0789

European Commision. (2021). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *A long-term vision for the EU's rural areas - Towards stronger, connected, resilient and prosperous rural areas by 2040*, COM(2021) 345 final. https://ec.europa.eu/info/strategy/priorities-2019-2024/new-push-european-democracy/long-term-vision-rural-areas_en

European Commission. (2018). *A Clean Planet for all A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy*. COM/2018/773 final, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX-:52018DC0773

Fagnant, D.J., & Kockelman, K. (2015). Preparing a nation for autonomous vehicles: Opportunities, barriers and policy recommendations, Transportation Research Part A: Policy and Practice, 77, 167-181. www.elsevier.com/inca/publications store/5/4/7/.10.1016/j.tra.2015.04.003

Flipo, A., Sallustio, M., Ortar, N., & Senil, N. (2021). Sustainable mobility and the institutional lock-in: The example of rural France, Sustainability, 13(4), 2189, 1-21. http://doi.org/10.3390/su13042189

Fourman, M., Boulton, G., Buneman, P., Clarke, P., McLaughlin, S., Milne, A. D., Ritchie, I., Schaffer, M., & Purvis, P. (2010). *Digital Scotland. Royal Society of Edinburgh*. http://www.royalsoced.org.uk/886_DigitalScotland.html

Fournier, G., Baumann, M., Gasde, J., & Kilian-Yasin, K. (2018). Innovative mobility in rural areas – The case of the Black Forest, International Journal of Automotive Technology and Management, 18(3), 247-269, http://doi.org/10.1504/IJATM.2018.093420

Geurs, K.T., Gkiotsalitis, K., Fioreze, T., Visser, G., & Veenstra M. (2018). The potential of a Mobility-as-a-Service platform in a depopulating area in The Netherlands: An exploration of small and big data. Advances in Transport Policy and Planning, 2, 57-79. https://doi.org/10.1016/bs.atpp.2018.09.001

Gil, A., Calado, H., & Bentz, J. (2011). Public participation in municipal transport planning processes – the case of the sustainable mobility plan of Ponta Delgada, Azores, Portugal. Journal of Transport Geography, 19(6), 1309-1319. doi: 10.1016/j.jtrangeo.2011.06.010.

Głuszek, E. (2021). Use of the e-Delphi Method to Validate the Corporate Reputation Management Maturity Model (CR3M). Sustainability, 13(21), 12019. https://doi.org/10.3390/su132112019.

Goldman, T., & Gorham, R. (2006). Sustainable urban transport: Four innovative directions. Technology in Society, 28(1-2), 261-273. https://doi.org/10.1016/j.techsoc.2005.10.007.

Greaves, S., Backman, H., & Ellison, A. B. (2014). An empirical assessment of the feasibility of battery electric vehicles for day-to-day driving. Transportation Research Part A, 66, 226-237. https://doi.org/10.1016/j.tra.2014.05.011

Grunicke, C., Schlüter, J., & Jokinen, J.-P. (2021). Evaluation methods and governance practices of new flexible passenger transport projects. Research in Transportation Business and Management, 38, 100575, https://doi.org/10.1016/j.rtbm.2020.100575

Gupta, A., Mittal, V., Peeters, J., & Van Nieuwerburgh, S. (2021). Flattening the curve: Pandemic-induced revaluation of urban real estate. Journal of Financial Economics, In Press. https://doi.org/10.1016/j.jfineco.2021.10.008

Gutiérrez, A., & Miravet, D. (2016). The Determinants of Tourist Use of Public Transport at the Destination. Sustainability, 8(9), 908. https://doi.org/10.3390/su8090908

Gutierrez, J. (2009). Transport and accessibility. In R. Kitchin & N. Thrift (Eds.). *International Encyclopedia of Human Geography.* (pp. 410-417). Oxford: Elsevier.

Hajduk, S. (2022). Multi-Criteria Analysis in the Decision-Making Approach for the Linear Ordering of Urban Transport Based on TOPSIS Technique. Energies, 15(1), 274. https://doi.org/10.3390/en15010274

DOI: 10.34659/eis.2022.80.1.440

Heikkilä, S. (2014). *Mobility as a Service: A Proposal for Action for the Public Administration, Case Helsinki* [Master Thesis]. Helsinki, Finland: Aalto University.

Hietanen, S. (2014, September 8). '*Mobility as a Service*' – *The new transport model? ITS & Transport Management Supplement*. Eurotransport, 12, 2-4. https://silo.tips/download/sampo-hietanen-ceo-its-finland

Hirschhorn, F., Paulsson, A., Sørensen, C. H., & Veeneman W. (2019). Public transport regimes and mobility as a service: Governance approaches in Amsterdam, Birmingham, and Helsinki. Transportation Research Part A: Policy and Practice, 130, 178-191. https://doi.org/10.1016/j.tra.2019.09.016

Hoerler, R., Haerri, F., & Hoppe, M. (2019). New solutions in sustainable commuting-the attitudes and experience of European stakeholders and experts in Switzerland. Social Sciences, 8(7), 220. https://doi.org/10.3390/socsci8070220

Holden, E., & Linnerud, K. (2011). Troublesome leisure travel: The contradictions of three sustainable transport policies. Urban Studies, 48(14), 3087-3106. https://doi.org/10.1177/0042098010396234

Hopkins, D. (2020). Sustainable mobility at the interface of transport and tourism: Introduction to the special issue on 'Innovative approaches to the study and practice of sustainable transport, mobility and tourism'. Journal of Sustainable Tourism, 28(2), 225-239. https://doi.org/10.1080/09669582.2019.1691800

International Labour Office. (2016, November 16). *Global Dialogue Forum on the Challenges and Opportunities of Teleworking for Workers and Employers in the ICTs and Financial Services Sectors*. https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/meetingdocument/wcms_547099.pdf

Jarocka, M., & Wang, H. (2018). Definition and classification criteria of logistics services for elderly. Engineering Management in Production and Services, 10(4), 65-75. https://doi.org/10.2478/emj-2018-0023

Jović, J., & Rankovic Plazinić, B. (2013). Transportation demand management in rural areas. Proceedings of the 4th International Conference "Towards a Humane City", Novi Sad, Serbia, (pp. 11-23).

Kapur R. (2019). *Problems and Challenges in Rural Areas*, https://www.researchgate.net/publication/332187494_Problems_and_Challenges_in_Rural_Areas

Keller, A., Aguilar, A., & Hanss, D. (2018). Car Sharers' interest in integrated multimodal mobility platforms: A diffusion of innovations perspective. Sustainability, 10(12), 4689. https://doi.org/10.3390/su10124689

Keseru, I., Coosemans, T., & Macharis, C. (2021), Stakeholders' preferences for the future of transport inEurope: Participatory evaluation of scenarios combining scenario planning and the multi-actor multi-criteria analysis. Futures, 127, 102690. https://doi.org/10.1016/j.futures.2020.102690

Kiryluk, H., Glińska, E., Ryciuk, U., Vierikko, K., & Rollnik-Sadowska E. (2021). Stakeholders engagement for solving mobility problems in touristic remote areas from the Baltic Sea Region. PLoS ONE, 16(6), 1-28. https://doi.org/10.1371/journal.pone.0253166

Knierim, L., & Schlüter J. Ch. (2021). The attitude of potentially less mobile people towards demand responsive transport in a rural area in central Germany. Journal of Transport Geography, 96, 103202. https://doi.org/10.1016/j.jtrangeo.2021.103202.

Kononiuk, A., Siderska, J., Gudanowska, A. E., & Dębkowska, K. (2021). The Problem of Labour Resources as a Development Barrier to the Polish Economy – the Application of the Delphi Method. WSEAS Transactions on Business and Economics, 18, 139-151. https://doi.org/10.37394/23207.2021.18.15

Kuzmicz, K. A., & Pesch, E. (2017). Prerequisites for the modelling of empty container supply chains. Engineering Management in Production and Services, 9, 28-36. http://doi.org/10.1515/emj-2017-0023

Kuzmicz, K.A., & Pesch, E. (2019). Approaches to empty container repositioning problems in the context of Eurasian intermodal transportation, Omega – the International Journal of Management Science, 85, 194-213. http://doi.org/10.1016/j.omega.2018.06.004

Kuźmicz, K. A. (2015). Benchmarking in university toolbox, Business, Management and Education, 13(1), 158-174.

Li, X., & Quadrifoglio, L. (2010). Feeder transit services: choosing between fixed and demand responsive policy. Transportation Research Part C: Emerging Technologies, 18(5), 770-780. https://doi.org/10.1016/j.trc.2009.05.015

Lieven, T. (2014). Policy measures to promote electric mobility – A global perspective. Transportation Research Part A, 82, 78-93. https://doi.org/10.1016/j.tra.2015.09.008

Linstone, H. A., & Turoff, M. (2011). Delphi: A brief look backward and forward, Technological Forecasting and Social Change, 78(9), 1712-1719. https://doi.org/1016/j.techfore.2010.09.011

Linstone, H.A., & Turoff, M. (2002). Introduction. In H.A. Linstone & M. Turoff (Eds.). *The Delphi Method. Techniques and Applications.* (pp. 3-5). Murray Turoff and Harold A. Linstone.

Litman, T. (2018). *Evaluating Accessibility for Transport Planning: Measuring People's Ability to Reach Desired Goods and Activities*. Victoria: Victoria Transport Policy Institute. http://www.vtpi.org/access.pdf.

Liu, S., Yamamoto, T., Yao, E., & Nakamura, T. (2021). Examining public transport usage by older adults with smart card data: a longitudinal study in Japan. Journal of Transport Geography, 93, 103046. https://doi.org/10.1016/j.jtrangeo.2021.103046

López-Iglesias, E., Peón, D., & Rodríguez-Álvarez, J. (2018). Mobility innovations for sustainability and cohesion of rural areas: a transport model and public investment analysis for Valdeorras (Galicia, Spain). Journal of Cleaner Production, 172, 3520-3534. https://doi.org/10.1016/j.jclepro.2017.05.149

Mann, A., Klopsch, K., Bieker, L., & Wölki, M. (2014). Do sparsely populated rural areas have the potential for the use of electric vehicles? WIT Transactions on the Built Environment, 138, 223-234. https://doi.org/10.2495/UT140191

MARA – Mobility and Accessibility in Rural Areas, cited on 05.11.2020, available at: https://www.mara-mobility.eu/

Marchais-Roubelat, A., & Roubelat, F. (2011). The Delphi method as a ritual: inquiring the Delphi oracle. Technological Forecasting & Social Change, 78(9), 1491-1499.

Masmoudi, M. A., Kuzmicz, K. A., Pesch, E., Demir, E., & Hosny, M. (2020). Container truck transportation routing as a Mixed Fleet Heterogeneous Dial-a-Ride Problem, MATEC Web of Conferences, 312, 02005. https://doi.org/10.1051/matecconf/202031202005

McNamara, D., & Caulfield, B. (2011). Determining the welfare effects of introducing a cap-and-share scheme on rural commuters. Transportation Research, 16, 547-553. https://doi.org/10.1016/j.techfore.2011.04.012

Melander, L. (2018), Scenario development in transport studies: Methodological considerations and reflections on delphi studies, Futures, 96, 68-78. https://doi.org/10.1016/j.futures.2017.11.007

DOI: 10.34659/eis.2022.80.1.440

Miller, H. J. (2020). Movement analytics for sustainable mobility, Journal of Spatial Information Science, 20, 115-123. https://doi.org/10.5311/JOSIS.2020.20.663

Mounce, R., Beecroft, M., & Nelson, J.D. (2020). On the role of frameworks and smart mobility in addressing the rural mobility problem, Research in Transportation Economics 83,100956. https://doi.org/10.1016/j.retrec.2020.100956

Nalevanko, A. M., & Henry, A. (2001). *Advanced Public Transportation Systems for Rural Areas: Where Do We Start? How Far Should We Go? TCRP Project B-17: Final Report*. https://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_webdoc_20.pdf

Nazarko, J. (2013). *Regionalny foresight gospodarczy. Metodologia i instrumentarium badawcze*, Warszawa: Związek Pracodawców Warszawy i Mazowsza.

Nazarko, J., Ejdys, J., Halicka, K., Nazarko, Ł, Kononiuk, A., & Olszewska A. (2017). Factor Analysis as a Tool Supporting STEEPVL Approach to the Identification of Driving Forces of Technological Innovation, Procedia Engineering, 182, 491-496. https://doi.org/10.1016/j.proeng.2017.03.142

Nilsson, J. H. (2018). Mobility and regionalisation: Changing patterns of air traffic in the baltic sea region in connection to European integration, Geographia Polonica, 91(1), 77-93, https://doi.org/10.7163/GPol.0092

OECD, International Transport Forum. *Connecting Remote Communities Summary and Conclusions*. (2021). https://www.itf-oecd.org/sites/default/files/docs/connecting-remote-communities.pdf

OECD, *Productivity gains from teleworking in the post COVID-19 era: How can public policies make it happen?* (2020). Policy Brief, 7, available at: https://read.oecd-ilibrary.org/view/?ref=135_135250-u15liwp4jd&title=Productivity-gains-from-teleworking-in-the-post-COVID-19-era

Paradowska, M. (2021). Remote study and deconsumption – sustainable mobility versus (un)necessary university commuting, Ekonomia i Środowisko, 3(78), 44-72. https://doi.org/10.34659/2021/3/20

Pesch, E., & Kuzmicz, K. A. (2020). Non-approximability of the single crane container transhipment problem, International Journal of Production Research, 58(13), 3965-3975.

Pezzini, M. (2000). Rural policy lessons from OECD countries, Economic Review, Federal Reserve Bank of Kansas City, 85 (Q III), 47-57. https://www.kansascityfed.org/documents/1140/2000-Rural%20Policy%20Lessons%20from%20OECD%20Countries.pdf

Piecyk, M., & McKinnon, A. C. (2010). Forecasting the carbon footprint of road freight transport in 2020, International Journal of Production Economics, 128(1), 31-42. https://doi.org/10.1016/j.ijpe.2009.08.027

Politis, I., Papaioannou, P., Basbas, S., & Dimitriadis, N. (2010). Evaluation of a bus passenger information system from the users' point of view in the city of Thessaloniki, Greece, Research in Transportation Economics, 7 , 1-7. https://doi.org/10.1016/j.retrec.2010.07.031

Porru, S., Misso, F. E., Pani, F. E., & Repetto, C. (2020). Smart mobility and public transport: Opportunities and challenges in rural and urban areas, Journal of Traffic and Transportation Engineering, 7(1), 88-97. https://doi.org/10.1016/j.jtte.2019.10.002

Pucher, J., & Renne, J. L. (2005). Rural mobility and mode choice: evidence from the 2001 National Household Travel Survey. Transportation, 32, 165-186. https://doi.org/10.1007/s11116-004-5508-3

Radziszewski, P., Nazarko, J., Vilutiene, T., Dębkowska, K., Ejdys, J., Gudanowska, A., Halicka, K., Kilon, J., Kononiuk, A, Kowalski, K. J., Król, J. B., Nazarko, Ł., & Sarnowski, M. (2016), Future trends in road pavement technologies development in the context of environmental protection, Baltic Journal of Road and Bridge Engineering, 11(2), 160-168. https://doi.org/10.3846/bjrbe.2016.19

Rostami, S. (2005). *Application of the transport needs concept to rural New South Wales: a GIS-based analysis*. [Doctoral dissertation]. Faculty of Built Environment, University of New South Wales.

Samek Lodovici, M. (Ed.). (2021). *The impact of teleworking and digital work on workers and society. Special focus on surveillance and monitoring, as well as on mental health of workers.* Policy Department for Economic, Scientific and Quality of Life Policies Directorate-General for Internal Policies. https://www.europarl.europa.eu/RegData/etudes/STUD/2021/662904/IPOL_STU(2021)662904_EN.pdf

Santos, G. (2018). Sustainability and shared mobility models, Sustainability, 10(9), 3194. https://doi.org/10.3390/su10093194

Schippl, J., & Truffer, B. (2020). Directionality of transitions in space: Diverging trajectories of electric mobility and autonomous driving in urban and rural settlement structures, Environmental Innovation and Societal Transitions, 37, 345-360, https://doi.org/10.1016/j.eist.2020.10.007

Schlüter, J., Bossert, A., Rössy, P., & Kersting, M. (2021). Impact assessment of autonomous demand responsive transport as a link between urban and rural areas. Research in Transportation Business and Management, 39, 100613. https://doi.org/10.1016/j.rtbm.2020.100613

Schlüter, J., & Weyer, J. (2019). Car sharing as a means to raise acceptance of electric vehicles: An empirical study on regime change in automobility, Transportation Research Part F 60, 185-201. https://doi.org/10.1016/j.trf.2018.09.005

Schuckmann, S. W., Gnatzy, T., Darkow, I. L., & von der Gracht, H. A. (2012). Analysis of factors influencing the development of transport infrastructure until the year 2030 – A Delphi based scenario study. Technological Forecasting & Social Change, 79(8), 1373-1387. https://doi.org/10.1016/j.techfore.2012.05.008

Scott, M., Hopkins, D., & Stephenson, J. (2014). Understanding sustainable mobility: The potential of electric vehicles. Proceedings – IEEE International Conference on Mobile Data Management, 2, 6916871, 27-30. https://doi.org/10.1109/MDM.2014.63

Shergold, I., & Parkhurst, G. (2010). Operationalising 'sustainable mobility': the case of transport policy for older citizens in rural areas. Journal of Transport Geography, 18(2), 336-339. https://doi.org/10.1016/j.jtrangeo.2009.08.002

Siefkes, T. (2010). ECO4 – Bombardier's modular portfolio of innovative solutions for sustainable mobility [ECO4 – Bombardiers modulares Portfolio innovativer Lösungen für nachhaltige Mobilität], ZEVrail, 134(9), 342-350. https://www.zevrail.de/files/uploads/zev_inhalt_2010_0.pdf

Skulmoski, G. J., Hartman, F. T., & Krahn J. (2007). The Delphi Method for Graduate Research. Journal of Information Technology Education, 6, 1-21. https://doi.org/10.28945/199

Smith, G. (2021). Mobility as a Service and Public Transport. In Mulley, C., Nelson, J., & Ison, S. (Eds.). *The Routledge Handbook of Public Transport*. (pp. 33-45). London: Routledge. https://www.routledgehandbooks.com/doi/10.4324/9780367816698-4

Smith, G. (2021). *Making Mobility-as-a-Service: Towards Governance Principles and Pathways*. Chalmers University of Technology. https://research.chalmers.se/publication/516812

Soder, M., & Peer, S. (2018). The potential role of employers in promoting sustainable mobility in rural areas: Evidence from Eastern Austria. International Journal of Sustainable Transportation, 12(7), 541-551. https://doi.org/10.1080/15568318.2017.1402974

Subramanian, V., & Dayakar, S. (2021). Self-Governing Commute for People with Disability in Autonomous/Shared Mobility by Universal Design Process. SAE International in United States, Technical Papers. https://doi.org/10.4271/2021-26-0122

Szpilko, D. (2014). The use of Delphi method in the process of building a tourism development strategy in the region. Economics and Management, 4, 330-346. https://doi.org/10.12846/j.em.2014.04.24

Szymańska, E., Panfiluk, E., & Kiryluk, H. (2021). Innovative Solutions for the Development of Sustainable Transport and Improvement of the Tourist Accessibility of Peripheral Areas: The Case of the Białowieża Forest Region. Sustainability, 13(4), 2381, 1-23. https://doi.org/10.3390/su13042381

Tekil-Ergün, S., Pesch, E., & Kuźmicz, K.A. (2022). Solving a Hybrid Mixed Fleet Heterogeneous Dial-a-Ride Problem in Delay-Sensitive Container Transportation. International Journal of Production Research, 60(1), 297-323. https://doi.org/10.1080/00207543.2021.2000658

Thi Le, D.-T. (2014). Tourist use of public transport at destinations – the case of Munich. [Doctoral dissertation]. Echnische Universität München, https://d-nb.info/10594 77246/34

Tretheway, M., Andriulaitis, R., & Kositsky, J. (2021). Northern and Arctic Air Connectivity in Canada, International Transport Forum Discussion Paper, 3. http://dx.doi.org/10.1787/76573c8d-en

United Nations (2021, September 8), *World Population Ageing 2019: Highlights* (ST/ESA/SER.A/430). Department of Economic and Social Affairs. https://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2019-Highlights.pdf

Wang, W., Miao, W., Liu, Y., Deng, Y., & Cao, Y. (2021). The Impact of COVID-19 on the Ride-Sharing Industry and Its Recovery: Causal Evidence from China, Transportation Research Part A, 155, 128-141. https://doi.org/10.1016/j.tra.2021.10.005

Webb, J. (2019). The future of transport: Literature review and overview. Economic Analysis and Policy, 61(C), 1-6. https://doi.org/10.1016/j.eap.2019.01.002

Wee B., & Witlox, F. (2021). COVID-19 and its long-term effects on activity participation and travel behaviour: A multiperspective view, Journal of Transport Geography, 95, 103144, https://doi.org/10.1016/j.jtrangeo.2021.103144

Yan, X, Zhao, X., Han Y., Van Hentenryck, P., & Dillahunt T. (2021). Mobility-on-demand versus fixed-route transit systems: An evaluation of traveler preferences in low-income communities. Transportation Research Part A, 148, 481-495. https://doi.org/10.1016/j.tra.2021.03.019

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SUSTAINABLE TOURISM AS A FACTOR IN THE DEVELOPMENT OF PROTECTED AREAS IN THE POMERANIA EUROREGION

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ABSTRACT: This study aimed to assess the opinion of the inhabitants of protected areas in the Polish-German borderland on the development of tourism using the concept of sustainable tourism. It was examined whether the type of protected area and the country of residence were determinants of sustainable tourism development. In 2019-2020, a questionnaire survey was conducted among residents near 14 protected areas in the Pomerania Euroregion. Multinomial and ordinal logit models were used in the data analysis. The main limitations of the survey were the inability to refer to similar surveys from previous years and for other protected areas in Poland and Germany. This prevented a complete spatial-temporal analysis. The study carried out on the acceptance by inhabitants of the neighbourhood of protected areas in the Pomerania Euroregion is unique. The Polish protected regions of the Pomerania Euroregion were shown to have more significant potential for sustainable tourism development than the German ones. The results also show some differences in the perception of tourism by the Poles and the Germans.

KEYWORDS: sustainable tourism, protected areas, peripheral areas, sustainable development, Pomerania Euroregion

Introduction

Peripheral areas are usually characterised by highly unfavourable socio-economic factors, as numerous studies show worldwide (Flynn, 1997; Malkowski et al., 2020; Havlíček, 2007). Border, borderland, and peripheral regions. This has led to increased efforts in the last decades to stimulate the socio-economic processes in border regions. Thanks to these dynamic and general functional changes of borders, especially in Europe, many border areas have developed high potential for rapid overall development. The economic potentials mainly include increased border traffic and growing tourism attractiveness (Stoffelen & Vanneste, 2017; Ianioglo & Rissanen, 2020). Cross-border tourism has become particularly attractive for border regions, as it comes in multiple mutually complementary forms, such as shopping tourism, ecotourism or medical tourism, etc. (Prokkola, 2010).

Discussions about developing tourism in border areas have increasingly involved calls for sustainable development principles with rising demands for developing competitive, sustainable tourism products (Bianchi, 2004; Zurick, 1992; Sharpley, 2000). Furthermore, sustainable tourism is considered an opportunity to increase the competitiveness of a region by leveraging its unique social, cultural, and natural potentials (Kauppila et al., 2009; Stoffelen & Vanneste, 2017). In particular, peripheral areas with high natural values are perceived as ideal for overall sustainable development.

The Polish-German borderland has long-standing and extensive experience in implementing cross-border cooperation. It has bolstered the area's development in terms of, e.g., ensuring closer contacts between people and the expansion of tourism, solving environmental problems, and improving the infrastructure. At the same time, however, this area is faced with several socio-economic challenges due to its peripheral characteristic. It is, therefore, crucial to seek new opportunities for supporting its further development. In particular, growing cross-border cooperation could contribute to a stronger social and economic integration of the overall area that is divided by the border. Euroregions are one of the European Union's initiatives to intensify cooperation between communities living in such border areas and overcoming barriers to border permeability (Kurowska-Pysz et al., 2018). One of the four Euroregions currently in operation on the Polish-German border is the Pomerania Euroregion, and whose protected areas are analysed in this paper.

This study aimed to evaluate the opinions of inhabitants living in protected areas in the Polish-German borderland areas regarding sustainable tourism development. The hypothesis was as follows:

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H: Polish and German inhabitants of protected areas in the Euroregion Pomerania, despite social, cultural and economic differences, highly appreciate the importance of protected areas as a factor in the development of sustainable tourism.

A survey among the local population in protected areas was conducted to verify the hypothesis. The results were analysed using multinomial and ordinal logit models.

Literature Review

Geopolitical changes in Europe have directly affected border areas – previously considered as underdeveloped and requiring incentives, but presently identified as areas with a potential for rapid economic growth. Therefore, the rationale of the recent years was to accelerate integration processes and foster development due to changing border functions.

The opening of the borders to free European border traffic and the revival of contacts between communities living on both sides of the border have created new opportunities for the development of the formerly divided region. Our review of the literature devoted to the issues of peripheral areas shows that contemporary research worldwide aims to determine the role of external (exogenous) and internal (endogenous) factors in the socio-economic development of border areas. In order to determine this role, regional policy-making also needs to be taken into account, apart from the strictly scientific interests of researchers. Regional political decisions mark a crucial factor in managing the development of these areas. Ongoing globalisation processes also influence these regions' socio-economic development, as they keep changing the weights assigned to the exo- and endogenous factors in the shaping of border region competitiveness. For many researchers, the endogenous factors and the decisions made locally have the most significant impact on the development of peripheral areas, with the external factors being less important. The significance of local research is therefore increasing. Such research is a precious source of information for local and regional authorities, which shape the development of these areas through their decisions.

The removal of borders and the opening-up of economies to contacts with foreign partners have enabled peripheral areas to be actively involved in social and economic globalisation processes. This has been made possible by taking advantage of the local circumstances to create global competitiveness. One such example is the U.S.-Mexico borderland and its success in fostering economic development, which was highly associated with the maquiladora project in its first phase of implementation (Bair, 2002; Waldkirch, 2010; Gruben & Kiser, 2001).

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Globalisation often leads to a polarised economic development and may become a factor in deepening the peripherality of border areas (Marada et al., 2006; Gezici & Hewings, 2004). This risk can be avoided through a responsible regional policy supporting those functions that will build the peripheral region's competitiveness both now and in the future (Pezzi & Urso, 2016; Dvoryadkina & Kaibicheva, 2017).

Over the last decade, every discussion concerning development on any scale has emphasised its sustainability. According to the Brundtland Report, sustainable development "meets the needs of today without compromising the ability of future generations to meet their own needs" (Pearce & Atkinson, 1998; Sneddon et al., 2006).

The concept of sustainable development emphasises the avoidance and reduction of adverse environmental impacts of business activities and the overall socio-economic consequences of environmental degradation. According to the principles of sustainable development, the most crucial objective is to create a balance of economic, social and ecological components of human activities to create thriving social-ecological systems. Discussions on the definition and scope of sustainable development have led to the development of several guidelines for its implementation. The following are considered as key elements (Van den Bergh & Nijkamp, 1991):

- comprehensive and long-term planning of socio-economic development accounting for the productive and non-productive functions of the environment,
- taking into account and anticipating the environmental impact of human economic activities,
- accounting for feedback in both ecology and economics, on the one hand, and at the interface between the two areas, on the other,
- accounting for and measuring the tangible and intangible assets and features of the environment,
- accounting for the qualitative changes taking place in the environment, including in particular irreversible changes,
- accounting for and implementing development models that will not conflict with the factors in such development, including environmental conditions, substitution between factors of production, and technical and technological progress.

These sustainable development guidelines clearly emphasise the need to strive for a fair distribution of benefits in terms of inter-and intragenerational responsibility and overall social justice. Moreover, as a model solution for the modern economy, it proposes a viable long-term shaping of the relationship between economic growth, protection of the (both natural and human-made) environment, and a high quality of life (Zurick, 1992; Kauppila et al., 2009).

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Understanding the aims of sustainable development calls for a definition of modern humans' needs in the context of existing planetary boundaries and the limited possibilities of exploiting the global ecological system (Bjorklund & Harnishfeger, 1990; Hunt, 1999). The claim of humans living within the ecological limits was already clearly pointed out by the "Limits to Growth" report by the Club of Rome (Meadows et al., 2013). The therein stated necessity to ensure the sustainable development of all fields of life and human activity has been reaffirmed by many other institutions and reports. A central critical aspect of conceptualising sustainable development in modern societies is mass economic consumption at the expense of the natural environment (Arrow et al., 2004; Daily et al., 2009). According to Adam Smith, overconsumption is the most potent enemy of stable economic growth (Smith, 1954; 1987). The volume-growth driven development of international tourism is one of the manifestations of modern consumerism in contemporary global lifestyles (Reddy & Wilkes, 2015).

Modern tourism is characterised by a high rate of growth, which for many destinations is an opportunity for creating new economic markets and gaining additional economic benefits (Du et al., 2016). A growing volume of tourism activities in areas with low tourism intensities results in an upturn in economic prosperity and improved living standards of its inhabitants. A continuously increasing number of tourists requires the expansion (modernisation or construction) of tourism infrastructure (hotels, boarding houses) and the accompanying local infrastructure that is also used by residents (roads, restaurants, shops, communication networks, etc.). In addition, the development of the tourism sector contributes to vocational options for the local population and increases the demand for labour.

In 2016, one in ten companies operating in the European non-financial corporate sector were in the tourism industry. It is estimated that these 2.4 million businesses employed approximately 13.6 million people. Companies in tourism-related industries employed 9.5% of all labour force in the non-financial corporate sector and 21.7 % of those employed in the services sector (Eurostat, 2021).

At the same time, tourism intensification might develop at the expense of environmental, health, and social cohesion, which also fuels conflicts between tourists and host communities (Getz & Timur, 2004; Zeppel, 2010). The primary motivation for travelling is to experience natural sceneries and thriving livelihoods, which causes direct consequences, mainly increased pressure on the environment, if visitor numbers grow continuously without being managed by local authorities. Negative environmental impacts include increased energy consumption, greenhouse gas emissions, land use and biodiversity loss caused by tourism infrastructures, higher levels of waste, water consumption and contamination, and noise pollution (Balas & Strasdas, 2019).

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Critical social impacts are mainly connected to unstable conditions of employment, low wages, poor social security, commercialisation, and a rise of artificial attractions. A high volume of visitors can also cause destabilisation and acculturation of the resident population. As the quality of the natural and social environment is a critical component of the tourism product, it can be claimed that the tourism sector is highly dependent on the conditions of the local environment. Tourism activities rely on the destination being fully functional, both ecologically and socially. In turn, this also implies a vulnerability to environmental damage, climate change, security, and regional authenticity. Literature on the subject highlights a clear correlation between the condition of the environment and the development of the regional tourism economy (Moscardo & Murphy, 2014; Strickland-Munro & Moore, 2013).

Krippendorf called this ambivalent relationship between tourism and its environment a "snake eating its own tail" (Krippendorf, 1987), with tourism growth becoming a threat to itself, apart from a sociocultural vividness of the regions, it requires ecosystems that are intact and environmentally valuable. This implies that wherever tourism destinations are constantly evolving, a responsible approach in preserving natural resources and social livelihoods must be adopted, with the interests of the local communities being at the core of any tourism development strategy.

This is the initial idea of sustainable tourism, developed and implemented in theoretical and practical terms in the 1980s and is still being widely discussed and defined (Bianchi, 2004; Kauppila et al., 2009). The United Nations World Tourism Organization (UNWTO) defines sustainable tourism as tourism that manages all needs in a manner that economic, social, and esthetic needs are met while respecting the cultural integrity, biological diversity, and life support systems, and without disturbing vital ecological processes (UNWTO/UNEP, 2005). The main objective of sustainable tourism is to carefully manage the economic and social benefits of growth in tourism while reducing or mitigating adverse environmental, historical, cultural, or social impacts. This is achieved by balancing the needs of both the tourists and the populations of tourism destinations.

Sustainable tourism is highly converged with the concept of sustainable development (Clarke, 1997). Moreover, the characteristic of tourism, as being a cross-sectoral industry with many indirect economic and social effects, provides the opportunity of connecting economic aims with overall regional development but maintaining an awareness of the need to respect the natural resources and the sociocultural authenticity of the community (Mathew & Sreejesh, 2017).

In recent years, international institutions such as the Global Sustainable Tourism Council (GSTC), the UNWTO, or the European Commission, have established several guidelines, standards, and recommendations for inte-

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grating sustainable tourism principles into economic practice and monitoring overall sustainability efforts (Bricker & Schultz, 2011; Tudorache et al., 2017; UNWTO, 2018). In addition, calls are growing louder for paying greater attention to the Agenda 2030 for sustainable development with its Sustainable Development Goals, as this has not yet been the case with sustainability schemes for tourism (Rasoolimanesh et al., 2020).

The diverse conceptual approaches, and the complexity of tourism activities, have led to significant criticism regarding the clarity and applicability of sustainability in tourism (Saarinen, 2014; McCool et al., 2013). As Wheeler states, sustainable tourism often remains declaratory. He compares it to the mythical "white elephant". He points out that sustainable tourism will remain a theoretical concept without a broad push against greed, hypocrisy, racism, and short-term economic gains (Wheeller, 2007). Sharpley argues that due to the industry-centric approach of sustainable tourism, it has become impossible to link it with the global concept of sustainable development (Sharpley, 2000). Other authors have similarly spoken about the need for further research regarding the implementation of sustainable tourism (Müller, 1994; Hall & Richards, 2003). Saarinen (2014) differs between three academic traditions with divergent views on sustainable tourism. He concludes that although a conceptual plurality and different research contexts are unavoidable, the need for reframing sustainability in tourism remains. This applies to the local-global nexus, meaning that the different spatial scales must be better interlinked. These demands consider an instead repositioned perspective of tourism on the local scale. The overall aim of sustainable development is at the centre of discussions and tourism, serving as a potential tool for achieving a good quality of life (Moscardo & Murphy, 2014).

Tourism as a tool for sustainable development also implies highly individualised approaches by tourism destinations. Consequently, the practical implementation of sustainable tourism planning will vary from one area to another, despite the universality of general sustainable tourism principles.

Peripheral areas particularly welcome a stronger evolvement of tourism linked to sustainability, as there are hopes for new decent jobs and, thus, increased employment rates within the host community. Furthermore, peripheral areas are often not urbanised because of their location, and their landscapes are still pristine with high natural values. Thus, they often serve as suitable locations for new protected areas (Pool, 2006), especially in the densely populated central European regions.

This goes hand in hand with global concerns of increasing environmental degradation worldwide. Economic leaders and researchers alike are pointing out hazards associated with extreme weather events, loss of biodiversity, and natural disasters. According to the World Economic Forum (WEC), four out of the five most significant global threats are related to the environment (The

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Global Risks Report World Economic Forum 2020, 2020). These concerns have also resulted in a new strategy by the UN Convention on Biological Diversity (CBD) to create further protected areas aiming to cover 30% of all land and sea areas, with at least 10% under strict protection (United Nations Convention in Biological Diversity, 2020). Protected areas aim to conserve biodiversity and preserve natural assets for future generations. In addition, such areas offer favourable conditions for tourism, education, and research. In recent years, there has already been a significant increase in the size and number of protected areas globally (Protected Planet Report 2018, 2018).

Since the need for further economic development is perceived as high in peripheral areas, researchers and local stakeholders call for planning decisions that are in line with sustainable tourism development, with a particular account of the risks which may be caused by overexploitation of natural sites.

Studies of the interrelations between tourism, the environment, and the local population are increasing research on sustainable tourism in protected areas (Ap, 1992; Holden et al., 2011; Liu et al., 1987). As Nepal (2000) pointed out, good park management and a sensible park concept are inevitable to harmonise residents' economic demands with natural protection aims. In addition, community participation is perceived as a critical element for successful overall tourism planning (Cole, 2006).

Nevertheless, due to contradictory aims regarding the economic development of protected areas in peripheral or transboundary regions, opposing perceptions of socio-economic growth amongst the local population often remain (Bramwell et al., 2017). This may lead to conflicts of interest at local and regional levels, particularly in areas with different forms of nature protection. This underlines the importance of reducing negative attitudes arising from the population's concerns about any economic intensification, such as a growth in tourism activities.

Sustainable tourism principles provide solutions for combining the interests of nature conservation with those of the economic development of a region (Walpole & Goodwin, 2001; Sekhar, 2003; Ormsby & Mannle, 2006; Carr et al., 2016). Protected areas that foster environmentally friendly tourism products and provide an umbrella for the attractiveness of a tourism destination serve as critical economic factors, whereby nature conservation efforts are being perceived as essential assets aimed at attracting tourists (Krippendorf, 1987; Puppim de Oliveira, 2005). Therefore, the development of tourism in such a setting can positively impact the local population's attitudes towards protected areas (Walpole & Goodwin, 2001; Sekhar, 2003; Scherl & Edwards, 2007). However, any positive response of the inhabitants towards protected areas depends on how they perceive the benefits and costs and on their knowledge about initiatives being carried out in pursuit of tourism and conservation goals. As Puntscher et al. (2017) state, positive

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overall economic development due to tourism activities might not directly affect the positive attitude of inhabitants regarding their support of protected areas if the induced benefits are not perceived as results from this development. On the contrary, a shortage of knowledge about activities of the park management might lead to negative attitudes such as beliefs that main benefits are flowing outwards. At the same time, locals need to cope with restrictions of nature protection, or it might even lead to the suspension of protected areas.

Ongoing discussions about tourism and the sustainable development of peripheral areas emphasise existing shortcomings in practical applications and research (Hall, 2011; Moscardo & Murphy, 2014). A question that remains unanswered is how to practically balance the interests of tourists, businesses, and the local population regarding sustainable tourism management. One frequent and significant weakness of the research is the necessity of including local needs and circumstances in the planning and implementation processes of tourism development (Walpole & Goodwin, 2001; Ormsby & Mannle, 2006).

As protected areas are mainly outlined based on ecological criteria, community participation often remains passive, rhetoric, and interpretative. This may lead to a low acceptance of protected areas among their inhabitants, leading to conflicts caused by the restrictions imposed in the protected areas (Mayer et al., 2019). Therefore, to ensure a balanced local economic development, it is crucial to first engage the local community in a discussion on the possible opportunities and risks associated with the existence of the protected area.

Materials and methods

In the present study, a survey on the local acceptance of protected areas was conducted to obtain an insight into the personal opinions of inhabitants living in the neighbourhood of protected sites. Since the management of protected areas aspires that socio-economic development needs to go hand in hand with nature conservation, the neighbourhood survey was carried out as part of much more comprehensive research into the socio-economic aspects of running protected areas within the REGE project (INT107). The neighbourhood survey was conducted in the Polish-German borderland, particularly the Pomerania Euroregion. Being able to carry out a neighbourhood survey in an area developing thanks to tourism primarily appeared to be an exciting task from a researcher's point of view. The neighbourhood survey was conducted in 2019 and the first half of 2020 by CATI method among 5547 inhabitants of the surroundings of the 14 protected areas of the Euroregion Pomerania. The survey covered 6 national parks: 3 Polish (Drawa

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Table 1. Structure of respondents in protected areas by gender and age groups

Name of the protected area	Number of respondents	Gender		Age					
		Women	Men	18-24	25-34	35-44	45-54	55-64	65 +
Drawieński Park Narodowy	400	51%	49%	9%	16%	20%	16%	18%	21%
Iński Park Krajobrazowy	400	60%	40%	4%	5%	9%	17%	23%	41%
Szczeciński Park Krajobrazowy "Puszcza Bukowa"	400	51%	49%	2%	15%	32%	21%	19%	11%
Biosphärenreservat Südost-Rügen	385	48%	52%	11%	18%	19%	15%	16%	21%
Nationalpark Jasmund	385	51%	49%	9%	18%	18%	15%	18%	22%
Nationalpark Vorpommersche Boddenlandschaft	370	50%	50%	10%	19%	18%	15%	19%	19%
Nationalpark Unteres Odertal	402	62%	38%	2%	4%	12%	15%	23%	44%
Cedyński Park Krajobrazowy	402	60%	40%	1%	2%	4%	8%	21%	64%
Park Krajobrazowy "Dolina Dolnej Odry"	403	55%	45%	3%	5%	10%	15%	28%	39%
Park Krajobrazowy "Ujście Warty"	400	50%	50%	3%	14%	23%	17%	18%	25%
Park Narodowy "Ujście Warty"	400	50%	50%	10%	18%	20%	16%	17%	19%
Woliński Park Narodowy	400	50%	50%	9%	19%	20%	16%	17%	19%
Barlinecko-Gorzowski Park Krajobrazowy	400	51%	49%	8%	16%	21%	14%	17%	24%
Drawski Park Krajobrazowy	400	51%	49%	8%	15%	19%	15%	19%	24%
Total	5547	53%	47%	6%	13%	19%	15%	19%	28%

Source: author's work.

National Park, National Park "Ujście Warty", Wolin National Park) and 3 German (Nationalpark Jasmund, Nationalpark Vorpommersche Boddenlandschaft, Nationalpark Unteres Odertal), 7 Polish landscape parks (Iński Landscape Park, Szczeciński Park Krajobrazowy "Puszcza Bukowa", Cedyński Park Krajobrazowy, Park Krajobrazowy "Dolina Dolnej Odry", Park Krajobrazowy "Ujście Warty", Barlinecko-Gorzowski Park Krajobrazowy, Drawski Park Krajobrazowy) and one German biosphere reserve (Biosphärenreservat Südost-Rügen). Due to the similar specificities in the further analysis, it was decided to combine landscape parks and biosphere reserves into one subgroup of areas – further discussed as landscape parks. There were between 370 and 403 respondents in each protected area, which guaranteed a significance level of 0.05 and a relative precision of the estimate of 5%. Table 1 shows the structure of respondents according to gender and age.

Logit models were used to analyse the respondents' responses (qualitative variable). The questions were multiple-choice ones and, therefore, the parameters of ordinal and multinomial logit models were estimated.

In the case of a dependent variable that is not dichotomous but nominal and takes values from a set of a multinomial logistic model can be used (Kleinbaum & Hedeker, 2010; Hosmer et al., 2000), which has the following form:

$$P(Y = 0|X) = \frac{1}{1+\sum_{j=1}^{g-1} exp(\alpha_{j0}+\sum_{i=1}^{m} \alpha_{ji}X_i)}, \quad (1)$$

$$P(Y = j|X) = \frac{exp(\alpha_{j0}+\sum_{i=1}^{m} \alpha_{ji}X_i)}{1+\sum_{j=1}^{g-1} exp(\alpha_{j0}+\sum_{i=1}^{m} \alpha_{ji}X_i)}, \quad (2)$$

where:
j – variant number of the explained variable; $j = 1, \dots, g-1$,
i – number of the independent variable; $i = 1, 2, \dots, m$,
α_{ji} – model coefficients; $j = 1, \dots, g-1$, $i = 0,1, 2, \dots, m$,
$Y \in \{0, 1, \dots, g-1\}$,
$X = [X_1, X_2, \dots, X_m]$.

In the case of a dependent variable that is ordinal and takes values from the set we can apply an ordinal logistic model (Kleinbaum & Klein, 2010; Hosmer et al., 2000). In contrast to polynomial regression, the ordering of the independent variable levels is considered in this model. It has the following form:

$$P(Y \geq j|X) = \frac{\exp(\alpha_{j0}+\sum_{i=1}^{m} \alpha_i X_i)}{1+\exp(\alpha_{j0}+\sum_{i=1}^{m} \alpha_i X_i)} \ , \quad (3)$$

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where:
j – variant number of the explained variable; $j = 1, \ldots, g - 1$,
i – number of the independent variable; $i = 1, 2, \ldots, m$,
α_{j0}, α_i – model coefficients; $j = 1, \ldots, g - 1$, $i = 1, 2, \ldots, m$,
$X = [X_1, X_2, \ldots, X_m]$.

Whereby $P(Y \geq 0|X) = 1$.

For both models, the odds ratio, or expression, is used to interpret the results:

$$\mathrm{OR} = \exp(\alpha_i). \tag{4}$$

The presented models will be used to determine the influence of the country of residence and the category of the neighbouring protected area on residents' responses regarding tourism. The independent variables (X_i) in this case are the country (Country) and the category of the protected area (Category). In the first stage of model estimation, the respondent's gender and age were additionally included as independent variables. It turned out that these variables were not statistically significant. Finally, two independent variables were used in the model: Country and Category. The explained variables (Y) are the residents' opinions on tourism. All models were estimated in the Statistica software. The author should indicate and describe the research methods applied to solve the research problem in the chapter.

Results of the research

There has been an increased interest in domestic and international tourism worldwide. Rising environmental awareness of societies due to increased ecological challenges leads to growing numbers of sustainable tourism enthusiasts. Because of their characteristics, border areas are beautiful for developing this type of tourism. Cross-border tourists can visit unknown destinations located just a short distance from their places of residence but have not yet discovered because they are located in another country. Sustainable tourism enables travellers to get to know the neighbouring country's culture, buy regional products, or take advantage of unique services. In addition, it helps evolve cross-border contacts between communities divided by borders.

Our analysis of the border traffic in Poland indicates that the potential for sustainable tourism has increased markedly in recent years. In 2019, the number of border crossings was 3.2% higher than in 2018. Compared to 2014, the traffic across the Polish border had increased by more than 20%.

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The motives for crossing the Polish-German border are interesting from the point of view of evaluating the potential for sustainable tourism development in the Polish-German borderland – Figure 1.

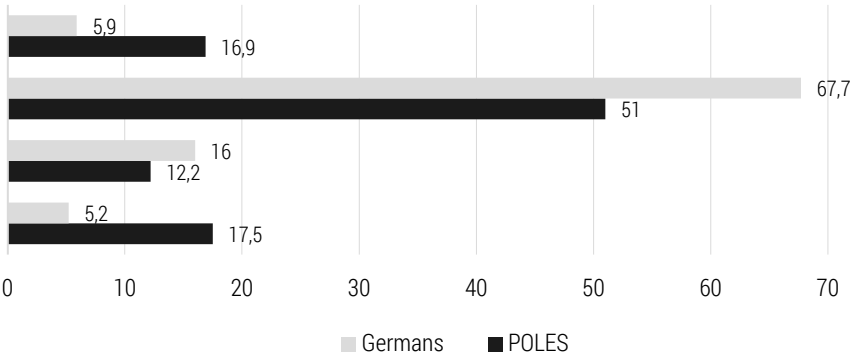

Figure 1. Motives of Poles leaving for Germany and Germans for Poland in 2019 [in %]
Source: author's work based on GUS data.

Those who crossed the Polish-German border most frequently claimed they did so for shopping purposes. This mainly applied to the Germans arriving in Poland (67.7% of the responses). Only 5.2 % of the Germans coming to Poland across the border came as tourists. As for the Poles, more than 17% of the respondents claimed they were coming for tourism purposes. Judging by the volume of border traffic in 2019, more than 3.8 million Germans visited Poland as tourists in that year. The value of German tourists' expenditure in Poland amounted to over PLN 900 million. More than 8 million Poles entered Germany as tourists in the same year, spending more than PLN 1,307 million. In addition, it should be noted that for 16% of the Germans, their arrivals in Poland were linked to their plans to visit family and friends. The exact purpose was declared by only 12.2% of the Poles crossing the border with Germany. These arrivals were often accompanied by visiting tourism destinations. It means that this area has a high potential for developing cross-border – including sustainable – tourism. This is reflected in the strategic assumptions of Zachodniopomorskie Voivodeship's tourism policy which, although still in a declaratory manner, indicate that the strategic long-term tourism-related activities of the local authority are aimed at ensuring the sustainable development of the tourism economy as a key element of local and sub-regional development in the border region. The objective is to create new jobs and a positive environment for new investments, as well as trans-regional and international links (Serwis Regionalnego Programu Operacyjnego Województwa Zachodniopomorskiego, 2021). The development of sustainable tourism is also called for in the Waterside Tourism Development Program for

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Szczecin (Biuletyn Informacji Publicznej. Urząd Miasta Szczecin, 2021). The area covered by this study also benefits from a project on sustainable tourism in the one-of-its-kind Dolina Dolnej Odry (Lower Odra Valley). The European Union supports it under the structural and investment policy from 3/11/2016 to 31/05/2021. The project partners are Park Narodowy Dolina Dolnej Odry, Poland, Zespół Parków Krajobrazowych Województwa Zachodniopomorskiego, Poland, and the city of Schwedt/Oder, Germany. Water sports association PCK Schwedt e.V., MomentUM – Tourismus und Citymanagement der Region Schwedt – Nationalpark Unteres Odertal are associated partners. The project envisages the establishment of tourism infrastructure in the form of special observation platforms and viewing towers, allowing for the non-invasive observation of wildlife in the cross-border area. In addition, the project will train local tourist guides to promote the idea of sustainable tourism.

This is because the development of this form of tourism requires special support from the local community. The community must recognise the potential that protected areas have, as it can support the local economy. Consequently, our survey of the local community's acceptance of the existence of protected areas included questions related to the development of tourism.

Among the questions asked to respondents, six were related to the issue of tourism. The answers: do not know and no answer was coded respectively: 96 and 99. Two characteristics were compared in the survey. The first was the respondent's country of residence. It was called "Country." The answers of the Poles were coded as one and the answers of the Germans as 0 (reference group). This allowed for a comparison of how respondents in Poland responded about respondents in Germany. 72% of respondents were Polish and 28% German. This feature was called "Category." In the case of respondents in landscape parks, they were coded as 1, and respondents in national parks as 0 (reference group). This made it possible to compare the answers given by respondents in landscape parks with those provided by respondents in national parks. 58% of respondents lived in the neighbourhood of landscape parks, and 42% were national parks. This resulted in ordinal and polynomial logit models with two dichotomous independent variables: Country and Region. The explained variables were the answers to the questions asked to the respondents. Answers that expressed an opinion were selected for modelling.

Responses to two questions (Q1 and Q2) were coded as a variable measured on a nominal scale. In this case, a multinomial logit model was used to analyse the responses. The structure of the respondents' answers to the questions is shown in Figure 4. The estimation results of both models are presented in Table 2. The presented measures of the models' fit prove their high quality.

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Q1 How would you rate the number of tourists in the protected area?

Respondents had a choice of three answers: code 0 marked the answer as "appropriate", 1 – "too much", 2 – "too little".

The respondents most often answered that the number of visitors to a conservation area was appropriate (Figure 2a). The number of answers with too many or too few visitors was similar and ranged from about 780 to about 800. A relatively large number of respondents, nearly 1,300, could not answer this question. Based on odds ratios, it can be concluded that the chance that the Poles indicate that the number of tourists is too low was more than twice as high (112%) as in the case of the Germans. On the other hand, the chance that Poles indicate that the number of tourists is too high was 87% lower than in the case of Germans. Inhabitants of the surroundings of landscape and national parks were equally likely to say that the number of tourists is too low (no significance of the parameter). The chance that residents of landscape parks indicated that the number of tourists is too high was 80% higher than in the case of residents of national parks.

Q2 Who do you think benefits most from the protected area?

Respondents could provide the following answers: "nature" this answer was coded 0 and was the reference answer providing a benchmark for the other answers. The next possible solutions were: "residents and tourists to the same extent" answer coded 1, "tourists" answer coded 2, "residents" answer coded 3, "no advantages" answer coded 4. The most frequent response was that residents and tourists benefit most from the advantages of a protected area to the same extent (Figure 2b). However, almost equally often, respondents answered that nature benefits most from the advantages of the protected area. Differences in opinions are evident when considering the country and category of protected areas (Table 1). The chance that Poles would indicate residents and tourists was 50% higher, tourists – more than twice as high (122% higher), residents – 365% higher, lack of advantages – 76% lower than in the case of Germans. The chance that residents of the surroundings of landscape parks would indicate residents and tourists was 18% lower, tourists – 50% lower, no advantages – 46% lower than residents of the surroundings of national parks. The parameter for the category residents was statistically insignificant, proving that residents of the surroundings of landscape parks and national parks evaluated the benefits for residents to the same extent.

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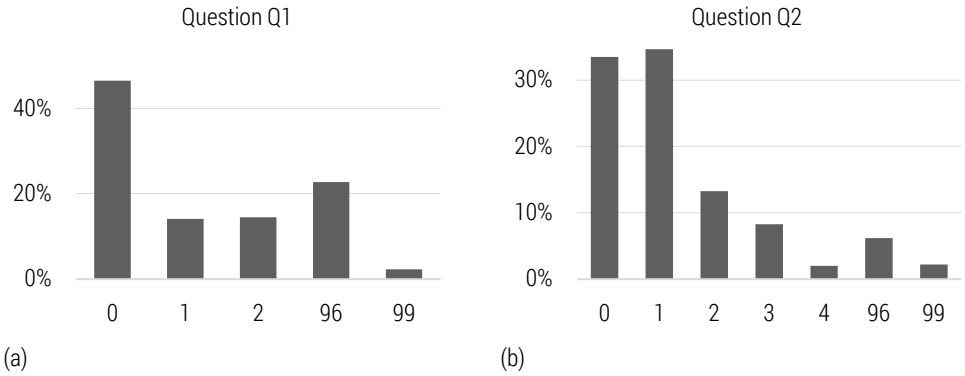

Figure 2. Structure of respondents' answers to questions Q1 and Q2

Source: author's work.

Table 2. Results of estimation of parameters of the multinomial logit model – questions Q1 and Q2

Variable	Coefficients	Standard error	Wald statistics	p-value	Odds ratio
Question Q1: $\chi 2$ = 8443.8755, AIC = 7135.56917					
Intercept 1	-0.4089	0.0650	39.5610	0.0000	0.66
Country	-2.0061	0.1039	372.8765	0.0000	0.13
Category	0.5877	0.1026	32.8017	0.0000	1.80
Intercept 2	-1.7880	0.1039	296.3756	0.0000	0.17
Country	0.7533	0.1201	39.3471	0.0000	2.12
Category	0.0250	0.0906	0.0763	0.7824	1.03
Question Q2: $\chi 2$ = 20483.984, AIC = 13114.6706					
Intercept 1	-0.1360	0.0632	4.6361	0.0313	0.87
Country	0.4040	0.0796	25.7613	0.0000	1.50
Category	-0.1970	0.0735	7.1876	0.0073	0.82
Intercept 2	-1.1303	0.0891	160.7841	0.0000	0.32
Country	0.7969	0.1101	52.3656	0.0000	2.22
Category	-0.6879	0.0961	51.2604	0.0000	0.50
Intercept 3	-2.6501	0.1613	269.9844	0.0000	0.07
Country	1.5379	0.1767	75.7284	0.0000	4.65
Category	0.0162	0.1201	0.0181	0.8928	1.02
Intercept 4	0.1259	222.8119	-2.1252	0.0000	0.15
Country	0.2429	35.0842	-1.9146	0.0000	0.24
Category	0.2387	6.5438	-1.0784	0.0105	0.54

Source: author's work.

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Responses to four further questions (Q3, Q4, Q5, Q6) were coded as a variable measured on an ordinal scale. In this case, an ordinal logit model was used to analyse the responses. The structure of the respondents' answers to the questions is shown in Figure 3, and the results of estimation of the models are presented in Table 3. The proposed measures of the models' fit prove their high quality.

Q3 How highly do you rate the importance of a protected area for tourism in your region?

Possible answers to this question were coded: 0 – 'very low', 1 – 'low', 2 – 'high', 3 – 'very high'.

The most frequent answer chosen by the respondents was that they highly appreciate the importance of the protection area for tourism (Figure 3a). Nearly 3,000 respondents answered in this way. However, the responses differed significantly whether Poles or Germans gave the answers and respondents gave them in landscape parks or national parks (Table 3). However, the positive assessment of Poles was 63% lower than that of Germans. This may result from the Germans much more often than Poles chose the answer that they highly evaluate the importance of the protected area for tourism in their region. On the other hand, the positive assessment level of landscape park residents was 35% lower than that of national park residents.

For the following questions: Q4, Q5 and Q6, the following answers were possible: code 0 – "I do not agree at all", 1 – "I rather disagree", 2 – "I am undecided", 3 – "I rather agree", 4 – "I completely agree".

Q4 Precious natural areas should be closed for recreation and leisure.

Based on the structure presented in Figure 3b, it can be concluded that the respondents most often chose the answers I agree with entirely, and I somewhat agree. However, significant differences could be observed between the responses of Poles and Germans (Table 3). Poles agreed with this statement much less (by 48%) than Germans. However, there were no significant differences in answers to this question between respondents in landscape parks and national parks (the model's parameter was not statistically significant).

Q5 The protected area has a positive impact on the region's image.

The structure of respondents' answers (Figure 3c) indicates that they most often ultimately agreed that parks positively impact the region's image. A relatively large number of solutions stated that the respondents somewhat agreed with this statement. Nearly 500 people did not answer this question. There were significant statistical differences between the responses of Polish

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and German respondents and respondents in landscape parks and national parks (Table 3). To a lesser extent (by 46%) than Germans, Poles considered that protected areas positively affect the region's image. Respondents in landscape parks also believed less (by 32%) than respondents in national parks that protected areas positively affect the idea of the region.

Q6 The quality of tourism in the region has increased due to the protected area

In the case of question Q6, the most frequently selected answer was that the respondents somewhat agree that the quality of tourism has increased due to the existence of a protected area (Figure 3d). There were also a relatively large number of answers saying that I completely agree that the quality of tourism in the region increased due to a protected area (over 1,200 cases) and that I partly agree (over 1,000 cases). That Poles agreed less (by 52%) than Germans that the quality of tourism in the region increased due to a protected area. Moreover, respondents in landscape parks also agreed less (by 21%) than respondents in national parks with this opinion, i.e., that the quality of tourism in the region increased due to the existence of a protected area.

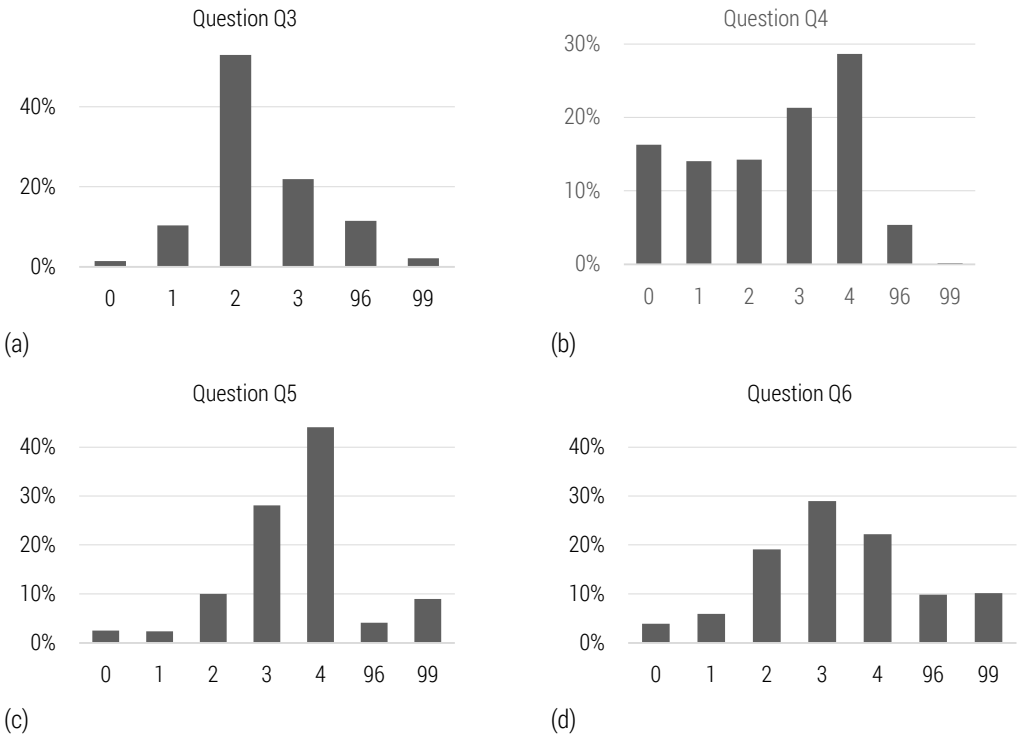

Figure 3. Structure of respondents' answers to questions Q3-Q6

Source: author's work.

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Table 3. Results of estimating the parameters of the ordinal logit model – questions Q3-Q6

Variable	Coefficients	Standard error	Wald statistics	p-value	Odds ratio
Question Q3: $\chi 2$ = 15506.6857, AIC = 8931.00208					
Intercept 1	-0.2217	0.0539	16.8910	0.0000	0.80
Intercept 2	2.9028	0.0714	1652.9710	0.0000	18.23
Intercept 3	5.1593	0.1279	1627.7680	0.0000	174.04
Country	-0.9854	0.0712	191.4910	0.0000	0.37
Category	-0.4301	0.0659	42.6200	0.0000	0.65
Question Q4: $\chi 2$ = 21018.4766, AIC = 16332.6424					
Intercept 1	-0.4169	0.0501	69.1380	0.0000	0.66
Intercept 2	0.5517	0.0504	119.8150	0.0000	1.74
Intercept 3	1.2003	0.0525	523.6260	0.0000	3.32
Intercept 4	2.0280	0.0575	1244.0490	0.0000	7.60
Country	-0.6480	0.0606	114.3040	0.0000	0.52
Category	0.0576	0.0548	1.1030	0.2935	1.06
Question Q5: $\chi 2$ = 20081.507, AIC = 10976.8384					
Intercept 1	0.7278	0.0639	129.6460	0.0000	2.07
Intercept 2	2.3314	0.0716	1059.3900	0.0000	10.29
Intercept 3	3.5931	0.0879	1669.4490	0.0000	36.34
Intercept 4	4.2745	0.1057	1633.9450	0.0000	71.85
Country	-0.6208	0.0854	52.8090	0.0000	0.54
Category	-0.3905	0.0675	33.4910	0.0000	0.68
Question Q6: $\chi 2$ = 18530.5874, AIC = 12286.9858					
Intercept 1	-0.2904	0.0585	24.6650	0.0000	0.75
Intercept 2	1.3011	0.0619	442.0730	0.0000	3.67
Intercept 3	2.7253	0.0722	1423.8120	0.0000	15.26
Intercept 4	3.7282	0.0897	1728.0100	0.0000	41.61
Country	-0.7393	0.0815	82.3640	0.0000	0.48
Category	-0.2351	0.0681	11.9000	0.0006	0.79

Source: author's work.

This study is unique, as it concerns a specific area – the Pomerania Euroregion. It is therefore difficult to refer the survey results to other research. They are, after all, dependent on the socio-economic situation of the resident population and the geographical and natural circumstances of the protected areas. Acceptance analyses are often made for sites that are to be converted into protected areas or where existing parks are planned to be

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expanded. However, it should be stressed that in most such studies, the populations have high opinions about the impact of tourism on the development of their regions and express their acceptance of such activities. Seridi and Djebar (2017) conducted a public acceptance study accompanying the creation of a marine protected area: Cap de Garde in Annaba, Algeria. 79.8% of the population consented to create the protected areas due to the planned expansion of sea-related commerce. 87% of the respondents believed it would positively impact tourism development in the region. However, there are concerns regarding the benefits derived from tourism in many other areas. Puntscher et al. (2017) studied the residents' views of Vietnam's Hoang Lien National Park.

The economic benefits derived from sustainable tourism were supposed to convince the local population that the restrictions and regulations on using the protected area were necessary and beneficial. However, although the locals did indeed note the economic advantages of sustainable tourism as a sector, they did not perceive themselves as the actual beneficiaries. They implicated that the greatest benefits generated by this industry would flow to external actors. Ayivor et al. (2020) arrived at similar conclusions in their study of the opinions held by local communities regarding the impact of protected areas on their lives. Their research covered selected protected areas within the main ecological zones of Ghana. Only 30% of the local population claimed they were benefiting from tourism. This means that people have positive attitudes toward expanding tourism in their protected areas in emerging economies. At the same time, however, they are aware that someone else will receive the better part of the benefits. Engen et al. (2019) questioned randomly selected residents of two mountainous regions of Norway to determine their preferences regarding how they lived in were used. Acceptance of the development of the industry and energy sectors and the popularity of private construction (summer houses) were lower in protected areas than elsewhere. However, the same level of acceptance was observed in developing tourist facilities. Brown et al. (2015) stress that the conservation policy for any protected areas must take account of the cultural context. Poles expressed greater attachment to the values and preferences focused on the environment and nature conservation than Norwegians, who emphasised resource exploitation. For Norway, biodiversity protection in protected areas consists of the sustainable use of such sites and not of strict nature conservation. The governance of such regions favours a model that involves local management control and active public participation. In Poland, any changes in how protected areas are managed to improve biodiversity conservation are less likely to happen due to the national values regarding the environment being often contrary to the values and preferences held locally.

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The main reason for this is the persistent lack of confidence in the government and the low level of civic participation. Our study also helped highlight some cultural differences. These resulted from the different levels of civil participation between Poland and Germany. However, as the research area covered a single common region (the Pomerania Euroregion), the border was so close to the people's domicile, and crossing the border was so easy, the overall opinion about the significance of tourism in the development of the region was high, without any significant differences between the nations. Andries et al. (2021) explored the local population's views on the development of tourism in the Natural Protected Area Jaltepeque Estuary (El Salvador, Central America) and the establishment of a Biosphere Reserve. This region. The respondents welcomed a concept for tourism development. The local fishers were the only opposing stakeholder group, as they feared the negative economic consequences of such development. They highlighted inequalities in the distribution of the benefits and increased living costs. Their judgment was informed by similar effects of tourism development observed in the nearby Costa del Sol Boulevard. Although tourism expansion is desirable for local communities, it may be necessary to discuss how this process should be approached from socio-economic transformation.

Conclusions and recommendations

The present survey among the inhabitants of 14 protected areas in the Pomerania Euroregion, including 10 Polish and 4 German ones, proved helpful in learning their opinions on tourism. Based on the study results, particularly the logit models used therein, conclusions can be drawn on tourism in these sites. Despite the social, cultural and economic differences between them, the Polish and German local communities of the Pomerania euro region's protected areas expressed mostly similar high opinions regarding the significance of a protected area for tourism (Q3). At the same time, the residents of both countries most often indicated that the number of visitors to their protected site was appropriate (Q1). In the context of the essence of sustainable tourism, it is encouraging that most respondents from both the countries claimed that the benefits of the given protected area were most often shared equally by both the residents and the tourists (Q2) and that the protected area had a positive impact on the region's image (Q5).

The present study also showed that the inhabitants of the protected areas were aware of the assets that these sites had and did not give preference to the tourism benefits derived by the local communities over the overall benefits of operating a protected area, since the respondents most often fully or instead fully agreed with the statement that the precious natural areas should be closed to leisure and recreation (Q4). The survey on the acceptance by

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inhabitants of protected regions of Euroregion Pomerania is unique. This results in some limitations. It is not possible to refer to similar surveys in earlier years. This would have made it possible to compare changes in residents' attitudes towards tourism over time. There is also a lack of large-scale studies for other protected areas in Poland and Germany. These two limitations make it impossible to complete spatial and temporal analysis. The authors plan to continue their research and extend it to other protected areas. They are interesting from a scientific point of view and are also crucial for managing protected areas. Conclusions from the conducted spatial and temporal analyses will help better assess sustainable tourism development in the Euroregion Pomerania.

The study results also show differences in how Poles and Germans living in the Pomerania euro region's protected areas perceive tourism. Although both the responding Poles and Germans mainly claimed that the number of visitors to their protected areas was appropriate, Poles were more than twice as likely to state that the number was too small. At the same time, the Poles were 87% less likely to state that the number of tourists was too large. Also, the Poles were 50% more likely to point to the inhabitants and tourists as the primary beneficiaries of the protected area, and 122% more likely to indicate the tourists alone. In the light of the study results, it can be concluded that the regions of the Polish protected areas in the Pomerania Euroregion have more significant potential for the development of sustainable tourism than the German regions, the development being defined as increased tourist traffic. The more excellent developmental opportunities offered by the Polish side of the Euroregion is also evidenced by the socio-economic circumstances observed in Poland, which favour Germans arriving in the country.

Along with the transformations taking place, including the changing border functions, the new directions for the evolution of the former development model for these areas should be accounted for. The model for the sustainable development of borderlands should become one of the key policy elements for Polish peripheral regions. The diversity of the region's natural potential and its cross-border location make it an ideal place for developing various forms of tourism and creating a diversified product offering targeted at specific market segments. However, increased tourism is accompanied by several adverse environmental effects. Therefore, to protect the environment and at the same time provide support to the local economy, alternative solutions to be incorporated into the regional policy must be sought. In this context, sustainable tourism appears to be one of the essential factors in ensuring the socio-economic development of the cross-border region. It enables the region's environmental, cultural, and human potential to be exploited. It also encourages the creation of new jobs and ensures the protection of particularly valuable areas. Tourism expansion requires, above all, a change

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in how the local communities perceive the protected areas. The various forms of environmental protection are seen as an opportunity for the region's economy to develop and not as a threat. This calls for extensive cooperation between the local communities, nature conservation institutions, and local and regional authorities. Looking at the current conditions for the development of sustainable tourism in the cross-border area in question, the recommendations for future actions are:

- To build a platform for cooperation between the protected areas, local authorities, NGOs, tourism industry actors, educational institutions, and local leaders ensure a joint effort in deploying sustainable tourism principles in the borderland. Appointment of a cross-border working team to create opportunities for broader cooperation in the field of sustainable socio-economic development of the Euroregion Pomerania area.
- To create a cross-border tourism product based on sustainable tourism and drawing from the environmental potential of the region.
- To establish a regional system for training staff in sustainable tourism practices.
- To implement a training system for the tourism industry (catering and accommodation service providers, tour guide and leader service providers) to raise the awareness of sustainable tourism and provide skills in creating new and improving existing tourism services in the region.
- To develop an integrated tourist information system with uniform labelling and a wide range of materials promoting sustainable tourism on both local and cross-border levels.
- To conduct a series of promotional activities using various tools to promote sustainable tourism in the cross-border region.
- To account for the needs of sustainable tourism stakeholders and the tourism sector and to support the development of tourism infrastructure in previously undeveloped areas of high natural value.
- Promoting good practices in the area of creating services and products related to sustainable tourism.

The contribution of the authors

Arkadiusz **Malkowski**: conception 33%, literature review 33%, data analysis 34%,

Beata **Bieszk-Stolorz**: data collection 33%, data analysis 33%, interpretation of results 34%,

Dawid **Dawidowicz**: data collection 34%, data analysis 33%, interpretation of results 33%,

Wojciech **Zbaraszewski**: conception 34%, literature review 33%, interpretation of results 33%,

Martin **Balas**: conception 33%, literature review 34%, data collection 33%.

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References

Andries, D. M., Arnaiz-Schmitz, C., Díaz-Rodríguez, P., Herrero-Jáuregui, C., & Schmitz, M. F. (2021). Sustainable Tourism and Natural Protected Areas: Exploring Local Population Perceptions in a Post-Conflict Scenario. Land, 10(3), 331. https://doi.org/10.3390/land10030331

Ap, J. (1992). Residents' perceptions on tourism impacts. Annals of Tourism Research, 19(4), 665-690. https://doi.org/10.1016/0160-7383(92)90060-3

Arrow, K., Dasgupta, P., Goulder, L., Daily, G., Ehrlich, P., Heal, G., Levin, S., Mäler, K.-G., Schneider, S., Starrett, D., & Walker, B. (2004). Are we consuming too much? Journal of Economic Perspectives, 18(3), 147-172. https://doi.org/10.1257/0895330042162377

Ayivor, J. S., Nyametso, J. K., & Ayivor, S. (2020). Protected Area Governance and Its Influence on Local Perceptions, Attitudes and Collaboration. Land, 9(9), 310. https://doi.org/10.3390/land9090310

Bair, J. (2002). Beyond the maquila model? NAFTA and the Mexican apparel industry. Industry and Innovation, 9(3), 203-225. https://doi.org/10.1080/13662710220000034462

Balas, M., & Strasdas, W. (2019). *Sustainability in tourism: developments, approaches and clarification of terms.* Dessau-Roßlau: German Environmental Agency. https://www.umweltbundesamt.de/publikationen/sustainability-in-tourism-developments-approaches

Bianchi, R. V. (2004). Tourism restructuring and the politics of sustainability: A critical view from the European periphery (The Canary Islands). Journal of Sustainable Tourism, 12(6), 495-529. https://doi.org/10.1080/09669580408667251

Biuletyn Informacji Publicznej. Urząd Miasta Szczecin (2021, May 15). http://bip.um.szczecin.pl/konsultacje/files/2721C4BE756E4D9BAAA7022F64896815/Program_Szczecin_FINAL4_.pdf

Bjorklund, D. F., & Harnishfeger, K. K. (1990). The resources construct in cognitive development: Diverse sources of evidence and a theory of inefficient inhibition. Developmental Review, 10(1), 48-71.

Bramwell, B., Higham, J., Lane, B., & Miller, G. (2017). Twenty-five years of sustainable tourism and the Journal of Sustainable Tourism: looking back and moving forward. Journal of Sustainable Tourism, 25(1), 1-9. https://doi.org/10.1080/09669582.2017.1251689

Bricker, K. S., & Schultz, J. (2011). Sustainable tourism in the USA: A comparative look at the Global Sustainable Tourism Criteria. Tourism Recreation Research, 36(3), 215-229. https://doi.org/10.1080/02508281.2011.11081668

Brown, G., Hausner, V. H., Grodzińska-Jurczak, M., Pietrzyk-Kaszyńska, A., Olszańska, A., Peek, B., Rechciński, M., & Laegreid, E. (2015). Cross-cultural values and manage-

ment preferences in protected areas of Norway and Poland. Journal for Nature Conservation, 28, 89-104. https://doi.org/10.1016/j.jnc.2015.09.006

Carr, A., Ruhanen, L., & Whitford, M. (2016). Indigenous peoples and tourism: the challenges and opportunities for sustainable tourism. Journal of Sustainable Tourism, 24(8-9), 1067-1079. https://doi.org/10.1080/09669582.2016.1206112

Clarke, J. A. (1997). A framework of approaches to sustainable tourism. Journal of Sustainable Tourism, 5(3), 224-233. https://doi.org/10.1080/0966958970866 7287

Cole, S. (2006). Information and empowerment: The keys to achieving sustainable tourism. Journal of sustainable tourism, 14(6), 629-644. https://doi.org/10.2167 /jost607.0

Daily, G. C., Polasky, S., Goldstein, J., Kareiva, P. M., Mooney, H. A., Pejchar, L., Ricketts, T. H., Salzman, J., & Shallenbergeri, R. (2009). Ecosystem services in decision making: time to deliver. Frontiers in Ecology and the Environment 7(1), 21-28. https://doi.org/10.1890/080025

Du, D., Lew, A. A., & Ng, P. T. (2016). Tourism and Economic Growth. Journal of Travel Research, 55(4), 454-464. https://doi.org/10.1177/0047287514563167

Dvoryadkina, E. B., & Kaibicheva, E. I. (2017). Trends of centre-periphery polarisation in Sverdlovsk region between 2008 and 2015. R-Economy, 3(2), 120-129. https: //doi.org/10.15826/recon.2017.3.2.014

Engen, S., Fauchald, P., & Hausner, V. (2019). Stakeholders' perceptions of protected area management following a nationwide community based conservation reform. PLoS ONE 14(4): e0215437. https://doi.org/10.1371/journal.pone.021 5437

Flynn, D. K. (1997). "We are the border": identity, exchange, and the state along the Bénin-Nigeria border. American Ethnologist, 24(2), 311-330. https://doi.org/10. 1525/ae.1997.24.2.311

Getz, D., & Timur, S. (2004). Stakeholder involvement in sustainable tourism: balancing the voices. In W. F. Theobald (Ed.). *Global tourism* (pp. 247-264). London: Routledge.

Gezici, F., & Hewings, G. J. (2004). *Regional convergence and the economic performance of peripheral areas in Turkey*. Review of Urban & Regional Development Studies, 16(2), 113-132. https://doi.org/10.1111/j.1467-940X.2004.00082.x

Gruben, W., & Kiser, S. L. (2001, June). NAFTA and Maquiladoras. Is the Growth Connected? Federal Reserve Bank of Dallas. https://www.dallasfed.org/-/media/ Documents/research/border/tbegruben.pdf?la=ens

Hall, C. M. (2011). Policy learning and policy failure in sustainable tourism governance: From first-and second-order to third-order change? Journal of Sustainable Tourism, 19(4-5), 649-671. https://doi.org/10.1080/09669582.2011.555555

Hall, D., & Richards G. (2003). *Tourism and sustainable community development*. London: Routledge.

Havlíček, T. (2007). Border, borderland and peripheral regions. Theoretical considerations in the framework of the process of transformation. In G. Jones, W. Leimgruber, & E. Nel (Eds.). *Issues in Geographical Marginality. Papers presented during the Commission Meetings 2001-2004.* (pp. 2-10). South Africa: Rhodes University.

Holden, A., Sonne, J., & Novelli, M. (2011). Tourism and poverty reduction: An interpretation by the poor of Elmina, Ghana. Tourism Planning & Development, 8(3), 317-334. https://doi.org/10.1080/21568316.2011.591160

Hosmer, D. W., Lemeshow S., & Sturdivant, R. X. (2013). *Applied logistic regression*. New York: Wiley.

Eurostat. (2021, December). https://ec.europa.eu/eurostat

Hunt, S. D. (1999). *A general theory of competition: Resources, competences, productivity, economic growth.* Thousand Oaks: Sage Publications.

Ianioglo, A., & Rissanen, M. (2020). Global trends and tourism development in peripheral areas. Scandinavian Journal of Hospitality and Tourism, 20(5), 520-539. https://doi.org/10.1080/15022250.2020.1848620

Kauppila, P., Saarinen, J., & Leinonen, R. (2009). Sustainable tourism planning and regional development in peripheries: A Nordic view. Scandinavian Journal of Hospitality and Tourism, 9(4), 424-435. https://doi.org/10.1080/15022250903175274

Kleinbaum, D. G., & Klein, M. (2010). *Logistic Regression A Self-Learning Text*. Third Edition. New York: Springer.

Krippendorf, J. (1987). *The Holiday Makers: Understanding the Impact of Leisure and Travel illustrate*. London: William Heinemann Ltd.

Kurowska-Pysz, J., Szczepańska-Woszczyna, K., Štverková, H., & Kašík, J. (2018). The catalysts of cross-border cooperation development in euroregions. Polish Journal of Management Studies, 18(1), 180-193. https://doi.org/10.17512/pjms.2018.18.1.14

Liu, J. C., Sheldon, P. J., & Var, T. (1987). Resident perception of the environmental impacts of tourism. Annals of Tourism Research, 14(1), 17-37. https://doi.org/10.1177/004728758702600151

Malkowski, A., Mickiewicz, B., & Malkowska, A. (2020). Shopping tourism as a factor in the development of peripheral areas: the case of the Polish-German borderland. European Research Studies Journal, 23(3), 238-248. https://doi.org/10.35808/ersj/1635

Marada, M., Chromỳ, P., Jančák, V., & Havlíček, T. (2006). Space polarization and peripheral regions in Czechia, Europa XXI, 15, 29-34.

Mathew, P. V., & Sreejesh, S. (2017). Impact of responsible tourism on destination sustainability and quality of life of the community in tourism destinations. Journal of Hospitality and Tourism Management, 31, 83-89. https://doi.org/10.1016/j.jhtm.2016.10.001

Mayer, M., Zbaraszewski, W., Pieńkowski, D., Gach, G., & Gernert, J. (2019). *Cross-Border Tourism in Protected Areas Potentials, Pitfalls and Perspectives*. Cham: Springer.

McCool, S., Butler, R., Buckley, R., Weaver, D., & Wheeller, B. (2013). Is the concept of sustainability utopian: Ideally perfect but impracticable? Tourism Recreation Research, 38(2), 213-242. https://doi.org/10.1080/02508281.2013.11081746

Meadows, D. H., Meadows, D. L., Randers, J. (2013). The limits to growth (1972). In R. Libby, S. Sörlin & P. Warde (Eds.). *The Future of Nature. Documents of Global Change.* (pp. 101-116), New Haven: Yale University Press. https://doi.org/10.12987/9780300188479-012

Moscardo, G., & Murphy, L. (2014). There is no such thing as sustainable tourism: Re-conceptualizing tourism as a tool for sustainability. Sustainability, 6(5), 2538-2561. https://doi.org/10.3390/su6052538

Müller, H. (1994). The thorny path to sustainable tourism development. Journal of Sustainable Tourism, 2(3), 131-136. https://doi.org/10.1080/09669589409510690

Nepal, S. K. (2000). Tourism in protected areas: the Nepalese Himalaya. Annals of Tourism Research, 27(3), 661-681. https://doi.org/10.1016/S0160-7383(99)00105-X

Ormsby, A., & Mannle, K. (2006). Ecotourism benefits and the role of local guides at Masoala National Park, Madagascar. Journal of Sustainable Tourism, 14(3), 271-287. https://doi.org/10.1080/09669580608669059

Pearce, D., & Atkinson, G. (1998). The concept of sustainable development: An evaluation of its usefulness ten years after Brundtland. Revue Suisse d Economie Politique et de Statistique, 134, 251-270.

Pezzi, M. G., & Urso, G. (2016). Peripheral areas: conceptualisations and policies. Introduction and editorial note. Italian Journal of Planning Practice, 6(1), 1-19.

Pool, C. (2006). Transboundary Protected Areas as a Solution to Border Issues. Nebraska Anthropologist, 23, 41-57.

Prokkola, E.-K. (2010). Borders in tourism: the transformation of the Swedish–Finnish border landscape. Current Issues in Tourism, 13(3), 223-238. https://doi.org/10.1080/13683500902990528

Protected Planet Report 2018. (2018). https://livereport.protectedplanet.net/pdf/Protected_Planet_Report_2018.pdf

Puntscher, S., Duc, T. H., Walde, J., Tappeiner, U., & Tappeiner, G. (2017). The acceptance of a protected area and the benefits of sustainable tourism: In search of the weak link in their relationship. Working Papers 2017-08, Faculty of Economics and Statistics, University of Innsbruck.

Puppim de Oliveira, J. A. (2005). Tourism as a force for establishing protected areas: The case of Bahia, Brazil. Journal of Sustainable Tourism, 13(1), 24-49. https://doi.org/10.1080/17501220508668471

Rasoolimanesh, S. M., Ramakrishna, S., Hall, C. M., Esfandiar, K., & Seyfi, S. (2020). A systematic scoping review of sustainable tourism indicators in relation to the sustainable development goals. Journal of Sustainable Tourism, 9582. https://doi.org/10.1080/09669582.2020.1775621

Reddy, M. V., & Wilkes, K. (Eds.). (2015). *Tourism in the Green Economy*. London: Routledge. https://doi.org/10.4324/9781315885681

Saarinen, J. (2014). Critical sustainability: Setting the limits to growth and responsibility in tourism. Sustainability, 6(1), 1-17. https://doi.org/10.3390/su6010001

Scherl, L. M., & Edwards, S. (2007). Tourism, indigenous and local communities and protected areas in developing nations. In R. Bushell & P. Eagles (Eds.). *Tourism and protected areas: Benefits beyond boundaries.* (pp. 71-88). The Vth IUCN World Parks Congress. CABI.

Sekhar, N. U. (2003). Local people's attitudes towards conservation and wildlife tourism around Sariska Tiger Reserve, India. Journal Of Environmental Management, 69(4), 339-347. https://doi.org/10.1016/j.jenvman.2003.09.002

Seridi, A., & Djebar, A. B. (2017). Proportions of social acceptance in the designation of a marine protected area: Cap de Garde in Annaba, Algeria (SW Mediterranean). Aquaculture, Aquarium, Conservation & Legislation, 10(3), 480-498.

Serwis Regionalnego Programu Operacyjnego Województwa Zachodniopomorskiego (2021, May 12). http://www.rpo.wzp.pl/sites/default/files/polityka_samorzadu_wojewodztwa_zachodniopomorskiego_w_sektorze_turystyki_0.pdf

Sharpley, R. (2000). Tourism and sustainable development: Exploring the theoretical divide. Journal of Sustainable Tourism, 8(1), 1-19. https://doi.org/10.1080/09669580008667346

Smith, A. (1954). *Bogactwo narodów*. Vol. 2. Warszawa: PWN.

Smith, A. (1987). *The Essential Adam Smith*. New York: WW Norton & Company.

Sneddon, C., Howarth, R. B., & Norgaard, R. B. (2006). Sustainable development in a post-Brundtland world. Ecological Economics, 57(2), 253-268. https://doi.org/10.1016/j.ecolecon.2005.04.013

Stoffelen, A., & Vanneste, D. (2017). Tourism and cross-border regional development: insights in European contexts. European Planning Studies, 25(6), 1013-1033. https://doi.org/10.1080/09654313.2017.1291585

Strickland-Munro, J., & Moore, S. (2013). Indigenous involvement and benefits from tourism in protected areas: a study of Purnululu National Park and Warmun Community, Journal of Sustainable Tourism, 21(1), 26-41. https://doi.org/10.1080/09669582.2012.680466

World Economic Forum. (2020). *The Global Risks Report 2020.* https://www3.weforum.org/docs/WEF_Global_Risk_Report_2020.pdf

Tudorache, D. M., Simon, T., Frenţ, C., & Musteaţă-Pavel, M. (2017). Difficulties and challenges in applying the European Tourism Indicators System (ETIS) for sustainable tourist destinations: The case of Braşov county in the Romanian Carpathians. Sustainability, 9,1879. https://doi.org/10.3390/su9101879

United Nations Convention in Biological Diversity (2020). Zero Draft of the post-2020 Global Biodiversity Framework. https://www.cbd.int/doc/c/efb0/1f84/a892b98d2982a829962b6371/wg2020-02-03-en.pdf

UNWTO. (2018). Sustainable Tourism for Development Guidebook – Enhancing capacities for Sustainable Tourism for development in developing countries. In *Sustainable Tourism for Development Guidebook – Enhancing capacities for Sustainable Tourism for development in developing countries*. https://doi.org/10.18111/9789284415496

UNWTO/UNEP. (2005). Making Tourism More Sustainable. A Guide for Policy Makers. http://www.unep.fr/shared/publications/pdf/DTIx0592xPA-TourismPolicyEN.pdf

Van den Bergh, J. C., & Nijkamp, P. (1991). Aggregate Dynamic Economic – Ecological Models for Sustainable Development. Environment and Planning A, 23(10), 1409-1428. https://doi.org/10.1068/a231409

Waldkirch, A. (2010). The effects of foreign direct investment in Mexico since NAFTA. World Economy, 33(5), 710-745. https://doi.org/10.1111/j.1467-9701.2009.01244.x

Walpole, M. J., Goodwin, H. J. (2001). Local attitudes towards conservation and tourism around Komodo National Park, Indonesia. Environmental Conservation, 28(2), 160-166. https://doi.org/10.1017/S0376892901000169

Wheeller, B. (2007). Sustainable mass tourism: More smudge than nudge the canard continues. Tourism Recreation Research, 32(3), 73-75. https://doi.org/10.1080/02508281.2007.11081543

Zeppel, H. (2010). Managing cultural values in sustainable tourism: Conflicts in protected areas. Tourism and Hospitality Research, 10(2), 93-115. https://doi.org/10.1057/thr.2009.28

Zurick, D. N. (1992). Adventure travel and sustainable tourism in the peripheral economy of Nepal. Annals of the Association of American geographers, 82(4), 608-628. https://doi.org/10.1111/j.1467-8306.1992.tb01720.x

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REALISATION OF TECHNICAL INFRASTRUCTURE WITH THE FINANCIAL PARTICIPATION OF COMMUNE RESIDENTS – A REVIEW OF SOLUTIONS AND EVALUATION OF THEIR APPLICABILITY

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ABSTRACT: Financial participation of the commune inhabitants in the implementation of their tasks in building technical infrastructure is not a clearly regulated issue. In local government practice, at least five basic solutions have been developed according to this type of participation. They have been presented based on targeted, critical literature reviews and legal texts and jurisprudence analysis.
The article's main aim is to indicate a set of tools by which the financial participation of residents in the construction of infrastructure can be implemented and to present their comparison and valorisation. Finally, it should be stated that the most complete level of social involvement is achievable due to applying participation under the provisions of the Inland Transport Infrastructure Financing Act and local initiative. These are tools that give citizens the broadest impact on implementing individual investments. According to the participation ladder, they can be considered tools for the co-production of public services and the highest level of social participation.

KEYWORDS: participation, financial participation, technical infrastructure, public finance, own tasks of the commune

Introduction

Social participation in a broad, general sense is understood as the voluntary participation of citizens in public activities. In narrower terms, it is a public-private partnership between local authorities and residents, which is to serve the purpose of taking action for local development (Hausner, 1999). However, Wójcicki (2013) argues that the detailed definition of this concept depends on the adopted analytical perspective – legal, administrative, political, sociological or management science. From the point of view of the further content of the study, it seems expedient to adopt the legal-administrative perspective, according to which participation is understood as the right of individuals or groups to participate in the decision-making process at different levels of governance, which is guaranteed through legal acts or other documents setting the standards of partnership cooperation between institutions of power and citizens (Wójcicki, 2013). Boryczka (2015), on the other hand, indicates the legal provisions constituting the legal basis for local government units to undertake activities with the participation of the local community, including: Constitution of the Republic of Poland of 1997 (Journal of Laws of 1997 No. 78, item 483 as amended), the Act on communal self-government of 1990 (Journal of Laws of 2020 item 713 as amended), the Act on Public Benefit Activity and Voluntary organizations of 2003 (*Journal of Laws* of 2020, item 1057), the Act on the provision of information on the environment and its protection, public participation in environmental protection and environmental impact assessments of 2008 (Journal of Laws of 2020, item 283 as amended), the Act on the Trilateral Commission for Social and Economic Affairs and provincial commissions for social dialogue of 2001 (*Journal of Laws* of 2001 No. 100, item 1080 as amended), the Act on spatial planning and development of 2003 (*Journal of Laws* of 2020, item 293 as amended), the Act on the principles of conducting development policy of 2006 (*Journal of Laws* of 2019, item 1295 as amended) and the Act on employment promotion and labor market institutions of 2004, as well as the Act on social assistance of 2004 (*Journal of Laws* of 2020 item 1876)[1]. Additionally, the Act on powiat self-government (Journal of Laws of 2020, item 920 as amended) and the Act on voivodship self-government of 1998 (*Journal of Laws* of 2020 item 1668). Regarding the government level, the legal

[1] More recently, the strengthening of participation in some of the acts indicated above has taken place, i.a. as a result of the adoption of the 2018 Act amending certain laws to increase the participation of citizens in the process of electing, functioning and controlling certain public authorities. (*Journal of Laws* of 2018, item 130). This was a legal act, at least in its part, dedicated as strengthening participation, i.a. by introducing the obligation to create participatory (civic) budgets in cities with powiat rights (Article 1. paragraph 1. b).

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basis may also be the Act on Departments of Government Administration of 1997. (*Journal of Laws* of 2020, item 1220), the Act on the Council of Ministers of 1996 (*Journal of Laws* of 2019, item 1171 as amended), the Act on Trade Unions of 1991 (*Journal of Laws* of 2019, item 263), the Act on Employers' Organisations of 1991 (*Journal of Laws*, of 2019 item 1809) (see the Bureau of Research, 2019).

The literature also often raises issues of the scope and forms of participation, referring to a 'ladder of participation' (originally Arnstein, 1975; later, i.a. Swianiewicz et al. 2004; Olech and Kaźmierczak, 2011; Siemiński 2015; Wójcik, 2016; Kotus et al. 2019), through the categorisation of citizen participation in public life (Boyte, 2004; Michels, 2011; Rytel-Warzocha and Uziębło, 2013; Kubas, 2014; Goworek, 2015) to models of participation, ending with models of participation (e.g., Webler et al. 2002; Callahan, 2007; Shrik et al. 2012).

However, there are relatively few studies on residents' direct, financial participation in the implementation of their own community tasks (Rolbiecki, 2007). On the one hand, this is because it is just one of many manifestations of co-determining participation when a social/private entity (citizen, group of citizens, NGO, or enterprise) cooperates in executing a given task on equal terms. Moreover, it involves a solid formal involvement of the subject in public action, which is still not common (Mikolik, 2013; Serowaniec, 2016; Gawłowski, 2018; Fleszer, 2019). This issue is also not standardised in administrative practice, related to the numerous ways of organising this process within different institutions and legal solutions.

A different concept in which the issue of financial or in-kind participation of municipality residents in the implementation of public tasks can be placed is co-production. It originated in the field of management sciences. In the literature, it is presented as 'production (at least to some extent) of public services by the members of the local community themselves, as well as their provision of these services independently of the state, while maintaining public financing and legal regulations' (Pestoff et al. 2006, following Heffner and Klemens, 2017). Therefore, it is a voluntary, and not required by law, active and non-profit participation of citizens in the design, implementation, and evaluation of public service delivery (Heffner and Klemens, 2017). At the same time, as examples of this type of activities, indicated can be activities of the nature of:

- consultation and opinion – where citizens actively participate in the processes of creating and giving their opinion on strategic and operational documents in local government units,
- activation and inclusion – participation in local initiatives, civic budget, or village fund,

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- prosumer – in which the resident becomes a co-producer of services (both 'soft' – volunteer activities, local support centres, etc., and 'hard' – co-production of energy, self-service of citizens within CRM) (Kowalik, 2014; Gawłowski, 2018),
- indirect – when the effect of co-production is or may be unintentional (e.g., replacing a stove, resulting in a contribution to the improvement of the local air condition or installing photovoltaic panels, increasing the RES share in the energy balance of the municipality).

Both perspectives presented here, which have many features in common, seem to be an appropriate commencement point to start the description of the phenomenon of financial participation of commune residents in the implementation of their own commune tasks, including the construction of technical infrastructure. However, the most important challenge is to indicate possible legal and organisational solutions based on which this task may be realised in the local government practice. At the same time, attention should be paid to the premises that argue for the inadmissibility of financial participation of residents in certain activities related to the construction of infrastructure, including, above all, situations that make access to a specific type of infrastructure dependent on the payment of a fee (cf. Mikolik, 2013; Hyski, 2009, among others).

It is worth mentioning that this study does not use a uniform understanding of the notion of 'inhabitant', as individual institutions define the circle of addressees of norms differently. Each time, however, it should be assumed that what is meant here is the subject remaining in a factual or legal relation, relevant from the point of view of a given participation mechanism with a municipality. The starting point for discussing individual solutions must be a constitutional observation. By Article 7 of the Constitution, state bodies act exclusively on the basis and within the limits of the law.

Therefore, each of the institutions presented below is described by indicating the legal basis. Their compilation was based on a purposeful review of the literature and a legal analysis of possible solutions in this area. For this purpose, the method of targeted, critical literature review and analysis of legal texts and jurisprudence were used. The adopted and described solutions of the financial participation of commune's residents constitute a closed set and exhaust the issue from the legal and organisational point of view. Presenting individual solutions, the focus was on comparing their potential as "positive aspects" and shortcomings – "negative aspects", supplementing them with an indication of application possibilities.

In summary, selected tools were assessed based on objective comparative criteria. Therefore, the article's main aim is to indicate a set of tools by which the financial participation of residents in the construction of infrastructure can be implemented and to present their comparison and valorisa-

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tion. It is worth mentioning that no comparisons of the indicated tools have been made so far, which is a significant research gap. The local government practice does not have studies compiling the tools of financial participation in infrastructure construction, presenting their advantages and disadvantages and the possibilities of their use. At the same time, this is not a more widely described issue in the research community, and the emerging studies are rather fragmentary and describe selected issues, which was indicated in the description of individual tools.

Participation of residents in the construction of infrastructure based on the Act on Real Estate Management (betterment levy)

Construction of technical infrastructure, according to Article 143(2) of the Act on Real Estate Management, is the construction of a road and the construction of water supply, sewage, heating, electricity, gas and telecommunication lines or facilities underground, on the ground or above the ground. Under Article 144 of the Act mentioned above, the owners, and in certain situations also perpetual usufructuaries of real property, participate in the costs of construction of technical infrastructure facilities by paying to the municipality betterment levies (*Journal of Laws* 2020 item 1990). Thus, the legislator tied the fee issue not so much to the residence in a given municipality as to the status of the owner of a given real estate, i.e., the issue of the property only. There will often be a situation in which the actual resident, e.g., a lessee, is not an addressee of the norms of the act under discussion. It will be an entity that may be an inhabitant of another local community (or another state). It should be noted that there is a dispute in the jurisdiction and doctrine on who is the subject of the betterment levy in the situation of transferring the ownership between various entities in the period between the construction of a given installation and the time when the decision on the fee becomes final. According to one of the standpoints, the party who is the owner at the moment of construction of the equipment is obliged to pay the fee (the Supreme Administrative Court in its judgment of 29 May 2001 in case No. II SA/Po 336/00, the judgment of the Voivodship Administrative Court in Szczecin of 11 February 2009 in case No. II SA/Sz 931/08, the judgment of the Supreme Administrative Court of 7 April 2001. 2010 r. I OSK 514/09). In practice, however, there are also opinions that the moment of issuance of the decision is decisive (e.g., the Supreme Administrative Court in the judgment of 16 January 2002, I OSK 1433/00 or the judgment of the Voivodship Administrative Court in Łódź of 6 May 2009, II SA/Sz 931/08).

Participation through the betterment levy relates to the facilities constructed with the State Treasury's participation, local government units,

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funds from the European Union budget or non-refundable foreign sources (Article 143 Section 1 of the Act on Real Estate Management)[2]. The head of the commune, mayor or city president may impose, in the form of a decision, a betterment levy each time from the day on which the conditions were created for the property to be connected to the technical infrastructure facilities or to be able to use the road, provided that on that day the resolution of the commune council establishing its percentage rate was in force. The time for imposing the fee is 3 years. Its maximum amount is generally 50% of the increase in the property's value, understood as the difference between the property's value before and after the construction of the said facilities (Sulczewska 2014; Ziniewicz 2011)[3]. The jurisprudence of administrative courts and the doctrine of administrative law (Jaworski et al. 2017) emphasise that while the construction of a road may result in the imposition of a betterment levy, the municipality may not charge a fee for the reconstruction of the road, even if it increased the value of the property (judgment of the Supreme Administrative Court of 17 October 2014 in case I OSK 453/13).

The use of the betterment levy as a tool for participation of residents in the costs of construction of infrastructure is a derivative of the non-fiscal functions of the fee as a form of public contribution. Apart from the redistributive function, these functions include intervention and recording and control functions. The positive and negative aspects of using this tool include both operational aspects and long-term consequences of the commune's functioning and its budget condition (Table 1). At the same time, its positive or negative influence may be related to its functions: intervention and redistribution.

In the case of the betterment levy, it may be assumed that its intervention function may have a positive impact in connection with 'paid' access to the infrastructure device by the inhabitant, i.e., access to certain benefits in connection with the payment incurred, which refers to compensatory justice and not to the traditionally understood distributive justice (Sulczewska, 2014). At the same time, the assumption by the resident of financial co-responsibility for constructed infrastructure elements results in treating them 'as their own', which makes greater care during their operation. Raising residents' awareness of the entire investment process, its time and cost intensity, and thus the formulation by residents of more 'realistic' demands in terms of

2 The other circumstances provided for in the provisions of the Act on Real Estate Management for calculation of the betterment levy are division of real estate and merger and division.

3 With respect to real estate located in the area of the Special Revitalization Zone referred to in Chapter 5 of the Act of 9 October 2015 on revitalization, the amount of the fee referred to in paragraph 2 shall be no more than 75% of the difference between the value the real estate had before the construction of the technical infrastructure facilities and the value the real estate has after their construction.

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infrastructure needs (although Mikolik (2013) argues that the betterment levy does not ensure that the municipality will recover the costs of infrastructure construction, because it may be collected only after the investment process is completed. Its amount, which depends on the increase in the property's value, does not necessarily have to translate into the amount of expenses incurred by the municipality in connection with the construction. Thus, there is no certainty that this aspect will be revealed each time during the investment process, as the property value change is not directly connected with the amount of infrastructural outlays made).

Table 1. Positive and negative aspects and application possibilities of the participation of residents in the construction of infrastructure based on the Act on Real Estate Management (betterment levy)

Positive aspects	Negative aspects
– "paid" access to infrastructure by residents, resulting in compensation justice for the residents, – financial co-responsibility for constructed infrastructure elements, in effect treating them 'as their own', – raising residents' awareness of the entire investment process, its time and cost intensity, and thus the formulation by residents of more 'realistic' demands in terms of infrastructure needs, – financial involvement of the residents at earlier stages of the investment, resulting in counting the contribution made towards the betterment levy.	– social expectations towards the implementation of compensatory justice by municipalities, – constitutes a forced financial burden for the residents, often of a considerable amount, – may be a source of social tensions, protests and arouse much controversy resulting, because its implementation at a given moment may cause a feeling of injustice among the inhabitants who will be directly affected by the regulation, in relation to those who received access to infrastructure earlier and "free of charge", – possible questioning of the amount of the fee charged in connection with questioning the valuation of the real estate.
Application possibilities	
– easy to implement and execute the legal tool, partially obligatory, in the scope of calculating fees for infrastructure construction – voluntary, – a manifestation of the ruling activity of municipal authorities, the introduction of the fee does not require consultation with residents or their approval, – simple enforcement procedure.	

Source: author's work.

At the same time, the betterment levy for the construction of technical infrastructure may have a negative effect (within the intervention and redistribution functions). This is because it constitutes a forced financial burden for the residents, often of a considerable amount. Therefore, it may be a source of social tensions protests and arouse much controversy resulting both from the manner it is established, legal loopholes identified in connection with it in the regulations and, first of all, its amount (Kańduła, 2008; Jasiołek, 2011; Hełdak & Stacherzak 2011). Both resolutions of municipal councils defining the percentage rate of the fee and individual valuations

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made by property appraisers are contested. However, it should be emphasised that it is a relatively easy-to-implement tool with an established line of judgments and entrenched in practice, which may affect the effectiveness and ease of its implementation.

Self-taxation vs residents' participation in the construction of infrastructure

An alternative to the betterment levy may be the popularisation of participation using the provisions of the Local Referendum Act (*Journal of Laws* of 2019, item 741) in connection with the Act on Municipal Self-Government (*Journal of Laws* of 2020 item 713 as amended). Article 2(2)(2) of the Local Referendum Act stipulates that the subject of a municipal referendum may be 'self-taxation of residents for public purposes falling within the scope of tasks and competencies of municipal authorities. Kosikowski and Ruśkowiak (1995) specify that self-taxation is a situation in which a certain group of subjects, which are not authorised to create tax obligations, decide to voluntarily charge themselves with certain monetary payments to the state budget or another special purpose fund (In contrast to the solution in the form of a betterment levy, the institution of the local referendum does not apply to the owner (perpetual usufructuary), but a resident with voting rights, and therefore only to a natural person. Here participation is most fully connected with the notion of 'inhabitant'). The income from self-taxation may be earmarked only for public tasks that are the local self-government's responsibility.

Hyski (2009), similarly to Piasecki (2005b, 2017), states that initiatives of this type are relatively rarely undertaken or are even in decline. Less than 50 have been performed in 25 years (Piasecki, 2017). This is a worrying finding as the institution of self-taxation had the potential to become a stimulator of civil society in local communities (Piasecki, 2005a) (Table 2).

Although the least used, the referendum is the most frequently initiated by the municipal council (Piasecki, 2017). It provides an opportunity for broad social inclusion and gaining acceptance at the stage of formulating its assumptions. Working out rules and principles within the local community, combined with a comprehensive explanation of the subject matter, factual argumentation and, above all, in the face of the perspective of achieving concrete, factual goals, may meet with universal acceptance.

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Table 2. Positive and negative aspects and application possibilities of the self-taxation of residents as a form of participation in the construction of infrastructure

Positive aspects	Negative aspects
– provides an opportunity for broad social inclusion, – with a comprehensive explanation of the subject matter and in the face of the perspective of achieving concrete, factual goal, may meet with universal acceptance.	– political risk, – high cost, – the imprecision of the law, – the lack of unambiguous court rulings, – the high turnout (30%) and acceptance (2/3), – lack of the mutual benefit.
Application possibilities	
– a complicated procedure, carried out based on fairly general regulations, with a simultaneous high risk of failure due to the statutory validity thresholds, – very rarely used in local governments in relation to self-taxation, – the envisaged changes in the law with regard to the turnout thresholds for the validity of the referendum provide an opportunity to popularise this tool.	

Source: author's work.

The disadvantage of this type of solution, used as a source of obtaining funding for infrastructural measures, is not the universality of the mutual benefit. In most cases, referenda on self-taxation concerning matters in which the entire local community was involved and concerned the community as a whole, e.g., referenda on self-taxation to improve the quality of waste management. In the current legal conditions, they have no de facto raison d'être. In relation to the municipality's remaining tasks of the municipality, it is difficult to identify those that would apply to each of the residents to the same extent. As a rule, the construction of technical infrastructure concerns a specific area of the municipality, sometimes limited to a single locality, a quarter of streets, or most often a street or a fragment of a housing estate. Therefore it isn't easy to obtain public support for such an investment from 2/3 of at least 30% of the residents who must participate in the referendum for it to be valid. Also, the decision in the referendum itself does not settle the execution of a given investment, the execution of which depends on a number of factors. Moreover, as Mikolik (2013) argues on the grounds of using the institution of a referendum on self-taxation, doubts arise concerning the possibility of its application in relation to the collection of funds for the construction of water supply and sewage facilities. They refer, among others, to a possible collision with Article 15 of the Act on collective water supply and collective sewage disposal (*Journal of Laws* of 2017 item 328 as amended). Moreover, some doubts may be raised by the very fact of universality and the compulsory nature of the levy regarding persons who did not participate in the vote or cast a vote 'against' in it. And as specified in Article 65 of the Act on Local Referendum (*Journal of Laws* of 2019, item 741) 'If the referendum

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ends with a conclusive result on the issue submitted to the referendum, the competent authority of the local self-government unit shall immediately take measures to implement it'.

Participation of residents in the construction of infrastructure under the provisions of the Inland Transport Infrastructure Financing Act

Residents' participation under the provisions of the Act of 16 December 2005 on financing land transport infrastructure (*Journal of Laws* of 2018, item 203 as amended) results directly from the provisions of Article 3(5) stating that 'the construction, reconstruction, rehabilitation, maintenance and protection of public roads may be implemented with the participation of in-kind and cash resources provided by natural persons and legal persons, domestic and foreign, and organisational units without legal personality, including under public-private partnership'. A necessary condition for applying this solution is the voluntary participation of these entities. It is often cited in the case law that resolutions of municipal councils, referring to residents' participation, assume obligatory participation in the form of a levy/tax, make access to infrastructure dependent on incurring certain costs or impose fees connected with connection to the infrastructure. There is a risk that resolutions containing such provisions may be invalidated (Hyski, 2009). Therefore, based on the regulations above, it is possible to involve residents in financing infrastructure construction costs by establishing the principle of voluntary participation in construction costs.

The municipal councils adopt the principles of participation based on the article mentioned above by:

- adopting an appropriate position or resolution,
- determining the minimum amount of financial contribution from residents (usually indicated as a percentage of the total investment value),
- differentiating the amount of contribution for different types of investments (construction of water supply system, sewage system, pavements, roads, lighting, etc.),
- definition of a specimen of application for construction of infrastructure and the manner of declaring the residents' contribution,
- definition of rules for consideration of applications and their processing.

Concrete, communicated to the public, and clear rules may contribute to popularising this type of solution. It is worth mentioning the related Article 148 (4) of the Act on real estate management, which states that if the owner or perpetual usufructuary incurred cash benefits for the construction of particular technical infrastructure devices, their value is credited towards the

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betterment levy (if, of course, a relevant resolution on its calculation is in force in the given municipality). Thus, the residents who participate in the costs do not bear a double financial burden due to voluntary participation and the betterment levy provided for in the local regulations. Interestingly, 'in practice, it happens that the municipality council initiates making (in cash or kind) expenditures, which later may be credited to the betterment levy. However, a possible resolution of the council adopted in this respect may in no case have the character of a normative act. Still, only an act in the nature of a postulate, an appeal, at the same time drawing attention to the content of Article 148(4) of the Act on real estate management, that any possible benefits in cash or kind for the construction of appropriate facilities will be credited towards the betterment levy (cf. judgment of the Voivodship Administrative Court in Warsaw of 2 July 2014, VIII SA/Wa 124/14, LEX No. 1493669), (Bończak-Kucharczyk, 2021).

For the tool of voluntary participation of residents to be effective and to have a raison d'être in a given unit, it is necessary to have a real conviction about the rightness of the idea of those residents in whose interest the realisation of a given investment lies. The introduction of this legal solution, on the one hand, determines the concrete commitment of the residents, which is at the same time the highest form of social inclusion. In addition to influencing how an investment is implemented, they also take partial responsibility for its success (Table 3).

Table 3. Positive and negative aspects and application possibilities of the participation of residents in the construction of infrastructure under the provisions of the Inland Transport Infrastructure Financing Act

Positive aspects	Negative aspects
– possibility to accelerate the implementation of infrastructure investments due to partial financial relief of local government, – in the case of a clearly defined procedure and promotion of the solution among the residents, it is possible to gain public support for this solution and actually involve the residents in the co-production of public tasks.	– solution favouring certain groups of residents, primarily perpetuating economic and social inequalities, – defining the conditions for participation in a completely arbitrary manner by the decision-making bodies of local government units, which causes large discrepancies in their availability in different municipalities/powiats/voivodships, – not always clear and transparent procedures for selecting investments for implementation.
Application possibilities	
– various forms of implementation (position of the commune council, resolution, regulation), – often used especially in large and wealthy municipalities, – clear and clear forms of organisation and implementation of the task through established regulations and procedures.	

Source: author's work.

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It may be questioned by the local community especially influencing less wealthy or those with lower social capital, which may be deprived of the opportunity to implement investments in their area due to unattainable levels of participation (both financial and organisational). At the same time, streets inhabited by more affluent and efficient residents, even if from the point of view of the entire administrative unit, they are less significant in terms of, e.g. transport, may be equipped relatively quickly with good quality infrastructure built with the participation of residents. This is an undoubted disadvantage of using this type of solution.

Local initiative as a form of residents' participation in the construction of infrastructure

The amended Act on Public Benefit and Volunteer Activity (*Journal of Laws* of 2020, item 1057) introduced in 2010, the local initiative as a form of cooperation between residents and local government to jointly implement public tasks important for a given community. In accordance with the definition of Article 2(4) of the Act, a local initiative is 'a form of cooperation between local government units and their residents to jointly implement a public task for the benefit of the local community'. Residents in its framework not only report a specific need but also participate in the implementation of the project, taking joint responsibility for it, which is a manifestation of moving away from top-down management towards increasing the subjectivity of citizens and bottom-up integration (Bovaird and Loeffler, 2013). The submission and implementation of tasks can occur either directly or through NGOs or entities listed in Article 3(3) of the Act (church organisations, associations of local government units, joint-stock companies and limited liability companies and sports clubs that are companies).

The local government has a choice between two models of funding a local initiative. The first consists of setting aside a pool of funds in the budget (going to the specific purpose reserve) for tasks to be implemented as part of the local initiative. The second model assumes allocating funds for a local initiative in the budgets of individual departments and organisational units. Both solutions have advantages and disadvantages, relating both to the assessment of how budget funds are managed and the time possibilities and efficiency of task implementation (Stelmaszczyk, 2016; Serowaniec, 2016).

The criteria, as well as the mode of recruitment and assessment of applications and then implementation of tasks, are determined by the constituting body of the local self-government unit in the form of a resolution. In accordance with the disposition of art. 19 c. (1) the criteria should, above all, consider the contribution of social work in the implementation of the planned

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project. This contribution may include providing social work or financial or in-kind contributions. The scope of tasks that can be implemented with the use of a local initiative is determined by the provisions of the Act on Public Activity and Volunteer Benefit. They include tasks in the scope of revitalisation, physical culture and tourism, construction or renovation of roads, sewage systems, water supply systems, architectural objects owned by local government units, nature protection, education and upbringing, promotion and organisation of voluntary work, public order and safety, culture, art, protection of cultural assets and national heritage, tradition and Polish identity, development of national, civic and cultural awareness, charitable activities, activity for the benefit of national and ethnic minorities and regional language (art. 19 b, (1)).

As emphasised by the Supreme Chamber of Control in its report on the results of the audit entitled Implementation of public tasks under the local initiative, the local initiative can be an opportunity for the local government to increase the activity of citizens in solving local problems, bringing both social (greater responsibility for their environment) and financial benefits, since part of the costs associated with the implementation of public tasks are borne by the residents themselves (NIK, 2018). However, some doubts may be raised by the statement in the same report that 'the local initiative may also be a tool for local governments to effectively direct financial support to the places where it is most needed, and in the long run it may become a way to generate savings in the local government' (NIK, 2018, p. 5). This is because it is difficult to unequivocally demonstrate the effectiveness of this tool, bearing in mind the barrier to 'entering the procedure', which is the aforementioned bottom-up initiative, as well as the requirement for participation, which in some places, although requiring support, is impossible to achieve. The audit itself also showed that, in addition to the limited awareness of residents of this solution and the relatively small percentage of municipalities that in the survey showed the use of this tool, a more popular form of participation is village funds and civic (participatory) budgets, which are limited to the need for citizens to submit a given idea, without the requirement of the participation in its implementation. This is also confirmed by the results of causal studies (Stelmaszczyk, 2016; Biga, 2016; Mojkowski, 2016; Gawłowski, 2018; Zielińska & Kraszewski, 2019) (Table 4).

However, it is always pointed out that for the success of a local initiative, the quality of the resolution of the municipality council, powiat council or voivodship assembly concerning detailed criteria for evaluation of the application, its effective operationalisation in the form of internal regulations and promotion of this solution among the residents is crucial. Also important is the local government practice of implementing a local initiative at the same time as a participatory budget and/or village fund so as not to cause confu-

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sion among the residents and not to identify these tools since their legal basis, scope, and purpose are different.

Table 4. Positive and negative aspects and application possibilities of the local initiative

Positive aspects	Negative aspects
– a wide range of tasks that can be implemented using this tool – not only infrastructural investments but also tasks falling within the sphere of physical culture, tourism, nature protection or ecology, – the possibility for residents to make a non-monetary contribution in the form of preparation of project documentation, investor cost estimates, provision of social work, transport services, etc., – depending on the chosen financing model – the possibility of the current implementation of tasks or the possibility of implementing long-term projects, – relieving the local government by providing support in a targeted manner and, consequently, involving residents in the implementation of the task, – reducing the formal nature of the procedure, consisting in releasing the residents from the necessity to create one of the organisational forms provided for in the law.	– limited universality of application of this tool, which results in the small practice of local governments in this scope – the applied solutions are not always coherent and clear, the scattering of regulations is also underlined, especially as regards the application of criteria for evaluation of applications or formal and legal organisation of the task (also as regards executive documents and internal regulations in local government units), – the need to promote this type of solution among the residents, and even to train them in the possibilities of using this type of tool, – lack of statutory requirement to establish a committee implementing a local initiative, which is not in every case sufficient for effective implementation of the initiative's objectives.
Application possibilities	
– the implementation procedure is clearly defined in the act; the quality of the implemented solution depends on the detail of the resolution, – clear and transparent forms of organisation and implementation of the task through established regulations and procedures, – low level of residents' awareness of this tool, the need to conduct extensive information activities.	

Source: author's work.

Financial participation of entrepreneurs – Article 16 of the Act on Public Roads, public-private partnership

The involvement of entrepreneurs in the construction of road infrastructure may be carried out in at least two ways. Concerning investments connected with construction or reconstruction of public roads related to non-road investments, Article 16 (1) and further of the Act of 21 March 1985 on public roads (*Journal of Laws* 2020, item 470 as amended), concerning other investments – the Act of 19 December 2008 on public-private partnership (*Journal of Laws* of 2020 item 711 as amended). The first situation applies to an investor who is obliged to construct a new road system, its reconstruction or finance a road investment in a situation when a non-road investment implemented by it will cause deterioration of the existing road system. Detailed conditions for the construction or reconstruction of the road are

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specified in the agreement between the road administrator and the investor of the non-road investment. The obligation to implement the project arises by operation of law, and the said agreement determines its scope. The relevant road manager has a claim against the investor for financing the road investment, and in case of refusal, the possibility to pursue its rights before the court.

The literature indicates that the scope of the investor's obligation to participate in the construction (reconstruction) of the public road is not arbitrary. It is determined primarily by the extent to which the necessity of the road investment was caused by the planned (or ongoing) non-road investment (Wielańczyk-Grzelak, 2015). The executive body most often establishes the principles and procedure for preparing and handling such agreements in the municipality/powiat/voivodeship using an order. In administrative practice, as a rule, traffic analysis is performed to determine the impact of a non-road investment on the existing traffic system. This is followed by the conclusion of an agreement by and between the investor and the public road manager, the subject of which is the determination of the scope and detailed conditions for the execution of the road investment and its financing. As part of the control procedures, supervision over the realisation of the investment is applied, and its culmination is technical acceptance and financial settlement. There is no research on whether the municipalities often use this institution and how effectively investments of this type are realised in the literature.

Public-private partnership (referred to as PPP) is a form of financing public tasks based on cooperation between the public and private sectors, both in terms of implementing investment projects and providing services. Its condition is a consensual will of both parties to achieve benefits from an enterprise and a rational division of risks associated with it (Hajdys, 2013). Its general legal definition is contained in the Act of 19 December 2008 on public-private partnership (*Journal of Laws* of 2020, item 711, as amended), which indicates that PPP consists in the joint implementation of an enterprise based on the division of tasks and risks between a public entity, understood as a unit of the public finance sector or another legal person connected with this sector, and a private partner (understood as an entrepreneur or a foreign entrepreneur) (art. 2 (1) letter b, of the Act of 19 December 2008 on public-private partnership (*Journal of Laws* of 2020 item 711 as amended). Literature on the subject distinguishes two possible forms of cooperation in PPP: the institutional and contractual models. The concluded agreement determines the choice of a given form. It is also worth mentioning that when an investment is realised with the participation of external resources (e.g., the European Union), private capital, and possibly public resources, the so-called hybrid PPP model occurs (Pyka, 2013). The participation of the

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European Union, in addition to financial support, is also aimed at making the project credible to the other partners (including other financing institutions) (Halemba et al., 2014) (Table 5).

Table 5. Positive and negative aspects and application possibilities of the PPP

Positive aspects	Negative aspects
– financial optimisation achieved by the significant reduction of investment costs, reduction of operational costs, reduction of the need for local government units to incur debts, – material effects in the form of realisation of an enterprise and its further exploitation, – transfer of knowledge and technology between the private and public sectors, – minimisation of risk for the enterprise through cooperation with a public entity, – reduction of political influence on economic decisions and the possibility to engage the potential of local government in other areas.	– natural resistance of public authorities to making long-term decisions or fear of losing control over public assets, – a high level of bureaucracy in the undertaking and the requirement of a great deal of knowledge and experience, especially on the part of local government, to properly organise, conduct, and control the process, – difficulty in finding private partners, who are not always willing to commit capital to public purposes, – lack of personal responsibility on the part of local government and insufficient organisational and financial autonomy, – differences in the cost of raising capital by the private and public sectors, which affects the profitability of the project and the issue of user fees related to its further exploitation – the divergent interests of the public (seeking to minimise fees) and private parties (seeking to maximise them) in this respect.
Application possibilities	
– each time depending on individual circumstances, the adopted model of cooperation and the type of investment.	

Source: author's work on the basis of Mikołajczyk (2010), Poniatowicz (2011), Hajdys (2016), Chulska & Sikora (2018).

Conclusions

The range of solutions through which it is possible to ensure financial participation of commune residents in the implementation of tasks related to the construction of technical infrastructure is wide. De facto goes beyond the framework of classically understood social participation and enters the ground of co-production of public services. It is a form of concrete commitment of a financial nature, which is at the same time the highest form of social inclusion. This inclusion may be voluntary or of a compulsory nature. When analysing the possibilities of using individual tools, attention should be paid to their compulsiveness, obligation to use, applicability and level of social participation, financial potential, and popularity (Table 6). Compulsiveness is understood as the obligatory fulfilment of the service by the commune residents or by all infrastructure beneficiaries. Obligatory use is understood as the statutory requirement to use a given tool, applicability – as the degree of

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complexity of the implementation of a given solution, often directly related to the practice developed in this area, the clarity of statutory provisions and executive acts and the level of standardisation of procedures. The level of social participation determines the required level of local community activity when applying a given procedure. Is it a passive subject of implementing the statutory delegation supported by a resolution of the commune council directly impacting the scope, shape, and form of its participation? Finally, the financial potential determines to what extent a given tool is associated with profitability and the possibility of reducing the burden on the commune's budget due to infrastructure construction.

Table 6. Evaluation of tools for financial participation of commune residents in the construction of technical infrastructure*

Aspect	Tool			
	Betterment levy	**Self-taxation**	**Participation under the provisions of the Inland Transport Infrastructure Financing Act**	**Local initiative**
Compulsiveness	Common for all investment beneficiaries	Common for all residents of the commune	Voluntary	Voluntary
Obligatory use	Voluntary regarding the fee connected with the construction of infrastructure	Voluntary	Voluntary	Voluntary
Applicability	Easy	Complicated	Moderately complicated	Moderately complicated
Level of social participation	Low	High at the moment of making a decision, low in the implementation phase	High	High
Financial potential	High	High	Average	Average
Popularity	Moderate	Very low	Low	Moderate

* The participation of entrepreneurs was deliberately omitted in the list, focusing on targeted activities.

Source: author's work.

Considering the presented review of tools, it should be stated that the most complete level of social involvement is achievable as a result of applying participation under the provisions of the Inland Transport Infrastructure Financing Act and local initiative. These tools give citizens the broadest impact on the implementation of individual investments and, despite the

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weaknesses indicated above, have the greatest application potential. They can be considered as tools for the co-production of public services, as well as the highest level of participation, i.e., delegated power and citizen control. A similar significance could be attributed to self-taxation, but the shortcomings of this solution and the low level of applicability determine its relatively low usefulness in this area. By contrast, funding based on the Act on Real Estate Management (betterment levy) in relation to technical infrastructure should rather be considered a kind of public tribute and participation only in the financial sense, without actively involving the community in co-determination.

In each case, however, a systemic approach to involving residents in investment activities is worth considering, as, in principle, it is associated with a number of benefits. First of all, there are financial benefits and social and environmental ones. The social aspect should not be underestimated. In the face of the growing awareness of citizens in the scope of their rights and the related growing attitude of claiming on principle: 'I built a house, so I should be able to get to it by a paved road', the striving above for joint responsibility of the residents for the implementation of the investment may be of considerable importance. It creates their awareness of the conditions of the investment process, its complexity, length, several actions that precede the construction works, etc. At the same time, as mentioned in the introduction – it increases their responsibility for the implemented actions and subsequent care for the state of the infrastructure. Undoubtedly, a further stage of research that should be conducted in this area is the analysis of applicability and commonness of applying the indicated solutions and their effects in Polish communes.

The contribution of the authors

Anna **Bernaciak** – conception, literature research, legal analysis, comparison analysis (65%).

Dariusz **Springer** – legal analysis, legislation, jurisdiction (35%).

References

Act of 05 June 1998, on voivodship self-government (Journal of Laws of 2020 item 1668).

Act of 06 December 2006, on the principles of conducting development policy (Journal of Laws of 2019 item 1295 as amended).

Act of 08 August 1996, on the Council of Ministers (Journal of Laws of 2019, item 1171 as amended).

Act of 11 January 2018 on amendment of certain Acts with the aim to increase the participation of citizens in the process of electing, functioning and controlling certain public bodies of 2018 (Journal of Laws of 2018, item 130).

DOI: 10.34659/eis.2022.80.1.429

Act of 12 March 2004, on social aid (Journal of Laws of 2020 item 1876).

Act of 15 September 2000, on the local referendum (Journal of Laws of 2019 item 741).

Act of 19 December 2008, public-private partnership (Journal of Laws of 2020 item 711 as amended).

Act of 20 April 2004 on promoting employment and labour market institutions (Journal of Laws of 2020 item 1409).

Act of 21 August 1997 on real property management (Journal of Laws of 2020 item 1990).

Act of 23 May 1991, on employers' organisations (Journal of Laws of 2019 item 1809).

Act of 23 May 1991, on trade unions (Journal of Laws of 2019 item 263).

Act of 27 March 2003, on spatial planning and management (Journal of Laws of 2020 item 293 as amended).

Act of 3 October 2008, on disclosure on environmental information, public participation in environment protection and on environmental impact assessments (Journal of Laws of 2020 item 283 as amended).

Act of 4 September 1997, on government administration (Journal of Laws of 2020 item 1220).

Act of 5 June 1998, on powiat self-government (Journal of Laws, of 2020 item 920).

Act of 6 July 2001 on tripartite committee on social and economic issues and voivodship social dialogue councils (Journal of Laws of 2001, No 100, item 1080 as amended).

Act of 7 June 2001, on common water supply and common wastewater discharge (Journal of Laws of 2017 item 328 as amended).

Act of 8 March 1990, on municipal self-government (Journal of Laws of 2020 item 713 as amended).

Arnstein, S. R. (1975). A working model for public participation. Public Administration Review, 35(1), 70-73. https://doi.org/10.2307/975206

Biga, B. (2016). Zagrożenia wynikające z jednoczesnego wdrażania inicjatywy lokalnej i budżetu obywatelskiego. Ekonomia Społeczna, 1, 41-50.

Biuro Analiz Sejmowych (2019). Konsultacje społeczne jako narzędzie partycypacji publicznej. Opracowanie tematyczne, OT-666. Kancelaria Senatu. Warsaw.

Bończak-Kucharczyk, E. (2021). Ustawa o gospodarce nieruchomościami. Komentarz aktualizowany. Komentarze. LEX/el. (Real Estate Management Act. Comment updated).

Boryczka, E. M. (2015). Partycypacyjne instrumenty zarządzania jednostkami samorządu terytorialnego. In A. Nowakowska (Ed.). *Nowoczesne metody i narzędzia zarządzania rozwojem lokalnym i regionalnym* (pp. 39-86), Łódź: Wydawnictwo Uniwersytetu Łódzkiego. http://dx.doi.org/10.18778/7969-530-0.03

Bovaird, T., & Loeffler, E. (2013). We're all in this together: harnessing user and community co-production of public outcomes. Birmingham: Institute of Local Government Studies: University of Birmingham, 1(2013), 15.

Boyte, H. C. (2004). *Everyday politics: Reconnecting citizens and public life*. University of Pennsylvania Press.

Callahan, K. (2007). Citizen participation: Models and methods. International Journal of Public Administration, 30(11), 1179-1196.

Chluska, J., & Sikora, E. (2018). Partnerstwo publiczno-prywatne – szanse czy ryzyko? Studia Ekonomiczne, 369, 29-39.

DOI: 10.34659/eis.2022.80.1.429

Constitution of the Republic of Poland April the 2nd 1997 (Journal of Laws of 1997, No 78, item 483 as amended).

Fleszer, D. (2019). Inicjatywa lokalna jako forma realizacji zadania publicznego. Samorząd Terytorialny, 6, 39-47.

Gawłowski, R. (2018). Inicjatywa lokalna jako przykład koprodukcji usług publicznych. Zarządzanie Publiczne, 2018, 171-183. https://doi.org/10.4467/20843968ZP.18.013.8451

Goworek, K. (2015). Elementy demokracji deliberacyjnej jako sposób na zwiększenie partycypacji obywateli w polskim życiu publicznym. Refleksje. Pismo naukowe studentów i doktorantów WNPiD UAM, (11), 161-178. https://doi.org/10.4467/20843968ZP.18.013.8451

Hajdys, D. (2013). *Uwarunkowania partnerstwa publiczno-prywatnego w finansowaniu inwestycji jednostek samorządu terytorialnego (Conditions for public-private partnership in financing investments of local government units)*. Łódź: Wydawnictwo Uniwersytetu Łódzkiego.

Hajdys, D. (2016). Partnerstwo publiczno-prywatne w samorządowej infrastrukturze drogowej w Polsce. Studia Ekonomiczne, 273, 119-131.

Halemba, P., Franczak, A. & Grzeganek-Więcek, B. (2014). Hybrydowe modele partnerstwa publiczno-prywatnego jako determinanta realizacji inwestycji sportowych i turystycznych w warunkach kryzysu finansowego. In K. Mrozowicz & P. Halemba (Eds.). *Problemy potencjału społecznego organizacji turystycznych i sportowych w spektrum wielowymiarowych aspektów zarządzania*. Tom pierwszy. (pp. 227-253). Katowice: AWF Katowice.

Hausner, J. (Ed.). (1999). *Komunikacja i partycypacja społeczna (Communication and social participation)*, Kraków: Małopolska Szkoła Administracji Publicznej.

Hełdak, M. & Stacherzak, A. (2011). Opłaty adiacenckie z tytułu podziału nieruchomości na terenie miasta Wrocławia. Studia i Materiały Towarzystwa Naukowego Nieruchomości, 19(4), 109-119.

Hyski, M. (2009). Problemy samoopodatkowania się mieszkańców gminy. Infrastruktura i ekologia terenów wiejskich, 04, 135-147.

Jasiołek, J. (2011). Wykorzystanie katastru w procesach gospodarowania nieruchomościami. Studia i Materiały Towarzystwa Naukowego Nieruchomości, 19(4), 71-80.

Jaworski, J., Prusaczyk, A., Tułodziecki, A. & Wolanin, M. (2017). *Ustawa o gospodarce nieruchomościami: komentarz (Real Estate Management Act. Comment.)*. Warszawa: Wydawnictwo CH Beck.

Kańduła, S. (2008). Opłata adiacencka jako źródło dochodów gmin. Finanse Komunalne, 4.

Kosikowski, C. & Ruśkowski, E. (1995). *Finanse i prawo finansowe (Finance and financial law)*. Warszawa: KiK.

Kotus, J., Sowada, T. & Rzeszewski, M. (2019). Ponad górne szczeble „drabiny partycypacji": koncepcja Sherry Arnstein po pięciu dekadach. Studia Socjologiczne, 3(234), 31-54. https://doi.org/10.24425/sts.2019.126151

Kowalik, I. (2014). Zastosowanie koncepcji CRM w samorządzie terytorialnym a koprodukcja usług publicznych, Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu, 354, 104-115.

Kubas, S. (2015). Konsultacje społeczne jako przejaw obywatelskiej partycypacji w lokalnym życiu publicznym na przykładzie miasta Katowice. Annales Universitatis Mariae Curie-Skłodowska, sectio K–Politologia, 21(2), 169-187. https://doi.org/10.1515/curie-2015-0009

Michels, A. (2011). Innovations in democratic governance: how does citizen participation contribute to a better democracy? International Review of Administrative Sciences, 77(2), 275-293. https://doi.org/10.1177/0020852311399851

Mikołajczyk, D. P. (2010). Teoretyczne aspekty partnerstwa publiczno-prywatnego – zalety, wady, bariery rozwoju w Polsce oraz związek z ideą nowego zarządzania publicznego, prywatyzacji i zamówień publicznych. Acta Universitatis Lodziensis. Folia Oeconomica, 243, 109-124.

Mikolik, M. (2013). Uczestnictwo podmiotów prywatnych w budowie urządzeń wodociągowych i kanalizacyjnych. Administracja Teoria Dydaktyka Praktyka, 4, 110-129.

Mojkowski, K. (2016). *Pięć lat inicjatywy lokalnej. Porównanie przepisów dotyczących inicjatywy lokalnej z praktyką ich stosowania w latach 2010-2014 (Five years of local initiative. Comparison of the regulations on the local initiative with the practice of their application in 2010-2014)*, Warszawa: Fundacja im. Stefana Batorego.

NIK. (2018). Informacja o wynikach kontroli, pt. Realizacja zadań publicznych w ramach inicjatywy lokalnej. https://www.nik.gov.pl/plik/id,20201,vp,22821.pdf

Olech, A. & Kaźmierczak, T. (2011). Modele partycypacji publicznej. In A. Olech (Ed.), *Partycypacja publiczna. O uczestnictwie obywateli w życiu wspólnoty lokalnej*. (pp. 102-109). Warszawa: Instytut Spraw Publicznych.

Piasecki, A. (2017). Szanse i zagrożenia lokalnej demokracji w Polsce. Zarys problematyki. Annales Universitatis Mariae Curie-Skłodowska, sectio K–Politologia, 23(2), 183-194. https://doi.org/10.17951/k.2016.23.2.183

Piasecki, A. K. (2005a). Demokracja bezpośrednia w Polsce lokalnej – błędny model, zła praktyka. Studia Regionalne i Lokalne, 6(21), 67-84.

Piasecki, A. K. (2005b). *Referenda w III RP (Referenda in the Third Republic of Poland)*. Warszawa: PWN.

Poniatowicz, M. (2011). Partnerstwo publiczno-prywatne w sektorze samorządowym a problematyka lokalnego długu publicznego. OPTIMUM. Studia Ekonomiczne 33(51), 33-53.

Pyka, A. (2013), Hybrydowe modele PPP w warunkach gospodarki polskiej. Journal of Mangement and Finance, 11(2), 325-338.

Rolbiecki, R. (2007). Możliwości wykorzystania kapitału prywatnego w finansowaniu infrastruktury transportu jako czynnika determinującego rozwój systemów i usług logistycznych. Logistyka, 1, 78-83.

Rytel-Warzocha A., & Uziębło, P. (2013), Aktualne tendencje związane ze wzmocnieniem partycypacji mieszkańców na poziomie lokalnym. In Z. Witkowski & A. Bień-Kacała (Eds.). *Samorządy w Konstytucji RP z 2 kwietnia 1997 roku*, Toruń.

Serowaniec, M. (2016). Inicjatywa lokalna jako instrument partycypacji obywateli w podejmowaniu rozstrzygnięć na poziomie lokalnym. In W. Skrzydło, W. Szapował, K. Eckhardt & P. Steciuk (Eds.). *Prawo naszych sąsiadów, tom I. Konstytucyjne podstawy budowania i rozwoju społeczeństwa obywatelskiego w Polsce i na Ukrainie – dobre praktyki*. (pp. 252-264). Rzeszów-Przemyśl.

Shirk, J. L., Ballard, H. L., Wilderman, C. C., Phillips, T., Wiggins, A., Jordan, R. & Bonney, R. (2012). Public participation in scientific research: a framework for deliberate design. Ecology and society, 17(2). http://dx.doi.org/10.5751/ES-04705-170229

Siemiński, W. (2015). Zdefiniowane zjawiska partycypacji społecznej w planowaniu przestrzennym i w kształtowaniu przestrzeni. Samorząd Terytorialny, 12, 46-54.

DOI: 10.34659/eis.2022.80.1.429

Stelmaszczyk, Ł. (2016). Społeczna inicjatywa lokalna w zakresie realizacji inwestycji (na przykładzie Poznania i Bydgoszczy). Studia i Prace WNEiZ US, 46/2, 295-304. https://doi.org/10.18276/sip.2016.46/2-25

Sulczewska, K. (2014). Opłata planistyczna i opłata adiacencka – uzasadnienie aksjologiczne i analiza porównawcza. Studia Prawno-Ekonomiczne, t. XCII, 129-147.

Swianiewicz, P., Klimska, U. & Mielczarek, A. (2004). *Nierówne koalicje. Liderzy miejscy w poszukiwaniu nowego modelu zarządzania rozwojem (Unequal coalitions. City leaders in search of a new development management model)*, Warszawa.

The amended Act of 24 April 2003 on public benefit and volunteer activity (Journal of Laws of 2020 item 1057).

Webler, T. & Tuler, S. (2002). Unlocking the puzzle of public participation. Bulletin of science, technology & society, 22(3), 179-189.

Wielańczyk-Grzelak, E. (2015), *Budowa drogi publicznej przez inwestora prywatnego cz. 2.* Ziemski Biznes. https://ziemskibiznes.pl/drukuj-aktualnosc.html&strona=130

Wójcicki, M. (2013). Pojęcie, istota i formy partycypacji społecznej w procesie planowania przestrzennego. Rozwój Regionalny i Polityka Regionalna, (24), 169-184.

Wójcik, M. (2016). Drabina partycypacji obywatelskiej na poziomie polskiego samorządu lokalnego. Studia i Materiały Wydziału Zarządzania i Administracji Wyższej Szkoły Pedagogicznej im. Jana Kochanowskiego w Kielcach, 1 Zarządzanie w sektorze publicznym i prawnym, 215-229.

Zielińska, E. & Kraszewski, D. (2019). *Narzędzia partycypacji lokalnej w Polsce w latach 2014-2017. Konsultacje społeczne, inicjatywa lokalna, inicjatywa uchwałodawcza (Tools of local participation in Poland in 2014-2017. Public consultations, local initiative, resolution initiative)*. Warszawa: Fundacja im. Stefana Batorego.

Ziniewicz, M. A. (2011). Analiza prawno-porównawcza opłat adiacenckich oraz opłaty planistycznej. Studia i Materiały Towarzystwa Naukowego Nieruchomości, 19(4), 91-106.

DOI: 10.34659/eis.2022.80.1.429

SUMMARIES IN POLISH

Agnieszka BECLA, Stanisław CZAJA

SYSTEM RACHUNKU KOSZTÓW WSPÓŁCZESNYCH NEGATYWNYCH ZJAWISK ŚRODOWISKOWYCH – WYBRANE UWAGI METODYCZNE

STRESZCZENIE: Artykuł zawiera pomysł zbudowania systemu rachunków kosztów dla współczesnych negatywnych zjawisk o charakterze katastrof naturalnych oraz antropogennych, w tym ekologicznych. Zjawiska te traktowane są jako „czarne łabędzie", a zatem zjawiska o wysokim poziomie zagrożenia i szerokich, różnorodnych, głównie negatywnych skutkach. Autorzy przedstawili wybrane metodyczne sugestie dotyczące włączenia do systemu ewidencji różnych rodzajów skutków takich zjawisk i ich pieniężnej waloryzacji (czyli ujęcia kosztowego). Artykuł ma charakter wprowadzenia do dalszej, pogłębionej dyskusji nad tymi wyzwaniami. Biorąc pod uwagę pojawiające się problemy (zjawiska i procesy) należą one do najważniejszych zagadnień dla ekonomii, ekonomii ekologicznej i ekonomii środowiskowej. Nie są jednak zbyt często podejmowane w literaturze.

SŁOWA KLUCZOWE: system kosztów, skutki i koszty negatywnych zjawisk, negatywne zjawiska środowiskowe, zjawiska typu „czarny łabędź"

Grażyna BORYS

WSTĘPNA OCENA UWZGLĘDNIENIA NARZĘDZI PLANOWANIA PRZESTRZENNEGO W MIEJSKICH PLANACH ADAPTACJI DO ZMIAN KLIMATU. PRZYKŁAD WYBRANYCH POLSKICH MIAST

STRESZCZENIE: Przedmiotem badań zaprezentowanych w opracowaniu jest ocena uwzględnienia narzędzi planowania przestrzennego w miejskich planach adaptacji do zmian klimatu na przykładzie 15 miast polskich liczących ponad 100 tys. mieszkańców. Ocena została przeprowadzona za pomocą trzyetapowej analizy porównawczej. Na pierwszym jej etapie dokonana została identyfikacja tematycznych obszarów adaptacji, w których wykorzystane zostały narzędzia planowania przestrzennego. Na jej drugim etapie, na tle ogólnego przeglądu narzędzi planowania przestrzennego, wskazano te, które można było przypisać do wyróżnionych tematycznych obszarów adaptacji miast do zmian klimatu. Natomiast na jej trzecim, ostatnim etapie dokonano zsumowania ilości wykorzystanych narzędzi oraz poddano je syntetycznej charakterystyce z wykorzystaniem wybranych kryteriów.

Przeprowadzone badania stanowią pierwszą, wstępną próbę empirycznej weryfikacji powszechnie wysuwanej w literaturze hipotezy, że planowanie przestrzenne i polityka przestrzenna odgrywają kluczową rolę w procesie adaptacji miast do zmian klimatu.

SŁOWA KLUCZOWE: klimat, adaptacja, planowanie przestrzenne

Piotr ADAMIK

OCENA WYKORZYSTANIA PREMII KOGENERACYJNEJ JAKO MECHANIZMU WSPARCIA TRANSFORMACJI SYSTEMU CIEPŁOWNICZEGO W POLSCE W LATACH 2019-2020

STRESZCZENIE: Rozwój kogeneracji stanowi element transformacji sektora ciepłowniczego w Polsce. W związku z tym państwo stosuje różne mechanizmy dofinansowań. Jednym z nich jest premia kogeneracyjna, która ma na celu stymulację inwestycji w wysokosprawną kogenerację. Polega ona na dofinansowaniu wytworzonej energii elektrycznej podmiotom, które wygrały aukcję na premię kogeneracyjną, a następnie dokonały inwestycji w nowe silniki kogeneracyjne. Celem niniejszego artykułu jest ocena wykorzystania premii kogeneracyjnej. Teza zakłada, że premia kogeneracyjna, mimo jej pomocowego charakteru, nie jest wykorzystywana przez inwestorów. Świadczy o tym niski stopień kontraktacji dopłat dostępnych w poszczególnych aukcjach. Dla realizacji celu badania przeanalizowano stosunek wolumenu zakontraktowanych dopłat w ramach aukcji na premię kogeneracyjną do wolumenu dostępnego do zakontraktowania w poszczególnych aukcjach. W ramach badania źródeł wtórnych autor dokonał analizy: wyników aukcji na premię kogeneracyjną, raportów sektorowych, ceny emisji CO_2, rodzajów paliw, jak również zagregowanych danych finansowych ciepłowni działających w Polsce. Badania mają charakter implikacyjny, potwierdzają brak adekwatności premii kogeneracyjnej do sytuacji finansowej potencjalnych inwestorów.

SŁOWA KLUCZOWE: kogeneracja, premia kogeneracyjna, odnawialne źródła energii, mechanizmy wsparcia

Zofia KOŁOSZKO-CHOMENTOWSKA

GOSPODARKA FINANSOWA GMIN O DUŻEJ POWIERZCHNI LASÓW – PRZYKŁAD GMIN WIEJSKICH WOJEWÓDZTWA PODLASKIEGO

STRESZCZENIE: W artykule omówiono sytuację finansową gmin wiejskich województwa podlaskiego o dużym udziale powierzchni lasów.Podjęty problem opracowano na podstawie danych statystyki masowej GUS, analiza obejmuje lata 2016-2019. Ocenę gospodarki finansowej przeprowadzono na podstawie wskaźników: budżetowych, na mieszkańca i wskaźników dla zobowiązań dłużnych. Dla określenia zależności między wskaźnikami przeprowadzono rachunek korelacji. Zarówno dochody jak i wydatki w odniesieniu do mieszkańca są mniejsze niż średnio w gminach wiejskich w kraju.Duże są też różnice w wartości innych wskaźników, co wynika m.in. z polityki prowadzonej przez władze lokalne. Dochody z tytułu podatku leśnego stanowią uzupełnienie innych dochodów z tytułu opodatkowania nieruchomości osób fizycznych.W przypadku wielu gmin udział dochodów z tytułu podatku leśnego jest zbliżony do udziału dochodów z podatku rolnego, a w niektórych gminach nawet wyższy.

SŁOWA KLUCZOWE: budżet lokalny, gmina wiejska, podatek leśny, wskaźniki budżetowe

Nikola SAGAPOVA, Eva CUDLÍNOVÁ

NAUKOWE ZAINTERESOWANIE BIOTWORZYWAMI – ANALIZA BIBLIOMETRYCZNA

STRESZCZENIE: Tworzywa sztuczne kształtują współczesne społeczeństwo i ułatwiają codzienne życie. Jednak w związku z niewłaściwym postępowaniem, odpady z tworzyw sztucznych są wszechobecne nie tylko w naszych domach, wsiach i miastach, ale także w środowisku naturalnym. Zgodnie z koncepcją biogospodarki biotworzywa są przedstawiane jako zrównoważona opcja, która może pomóc gospodarce przezwyciężyć zależność od paliw kopalnych i przyczynić się do zmniejszenia ogólnego zanieczyszczenia tworzywami sztucznymi. Badanie ma na celu zidentyfikowanie obszarów zainteresowań naukowych biotworzywami. Podejście metodologiczne badania opiera się na analizie bibliometrycznej (scientometrii). Stwierdzono, że w środowisku akademickim biologia, chemia i biotechnologia to główne obszary zajmujące się biotworzywami, skupiające się na całym procesie rozwoju produktu. Jednocześnie istnieje znaczny brak badań w takich dziedzinach, jak nauki społeczne, w tym ekonomia. Niniejsze rozważania powinny przyczynić się do globalnego dyskursu naukowego.

SŁOWA KLUCZOWE: biotworzywa, tworzywa sztuczne, biogospodarka, analiza bibliometryczna, gospodarka o obiegu zamkniętym

Abdullah Abbas AL-KHRABSHEH, Maisoon Abo MURAD, Abdelruhman Abbas AL-KHRABSHEH, Sakher A. I. AL-BAZAIAH, Mahmoud H ALRABAB'A, Marwan Muhammad AL-NSOUR

WPŁYW SYTUACJI KRYZYSOWYCH NA ROZWÓJ ZARZĄDZANIA CIĄGŁOŚCIĄ DZIAŁANIA W CZASIE PANDEMII COVID-19 W SZPITALACH JORDANII

STRESZCZENIE: W niniejszym artykule zbadano wpływ różnych sytuacji kryzysowych na rozwój procesu zarządzania ciągłością działania (ang. Business Continuity Management, BCM) w jordańskich szpitalach. Wykorzystano technikę projektowania badań ilościowych. Przetestowano również, czy hipotetyczny model można wykorzystać do opracowania BCM. Dane, uzyskane w wyniku badania ankietowego przełożonych pracujących w 7 prywatnych szpitalach w Ammanie w Jordanii, zostały przeanalizowane za pomocą oprogramowania SPSS. Wyniki badania wykazały, że szpitale w Jordanii dbały o zachowanie bezpieczeństwa i stabilności na wypadek kryzysu. Dodatkowe testy statystyczne dostarczyły dowodów na pozytywny wpływ różnych czynników (takich jak kryzysy zewnętrzne/wewnętrzne, klęski żywiołowe, ryzyka operacyjne i strategiczne, prawdopodobieństwo ponownego wystąpienia kryzysu) na rozwój BCM w jordańskich szpitalach. Autorzy próbowali przedstawić spostrzeżenia i wiedzę, które mogą być pomocne praktykom, naukowcom i decydentom.

SŁOWA KLUCZOWE: kryzysy, szpitale jordańskie, zarządzanie ciągłością działania, prawdopodobieństwo nawrotu kryzysu

Arkadiusz HALAMA, Agnieszka MAJOREK

WYKORZYSTANIE MIKROINSTALACJI FOTOWOLTAICZNYCH (OZE) W WYBRANYCH MIASTACH WOJEWÓDZTWA ŚLĄSKIEGO

STRESZCZENIE: Zmiany klimatu w coraz większym stopniu wpływają na gospodarkę i ludzkie zachowania. W stosunkowo krótkim okresie zmieniło się postrzeganie wpływu człowieka na klimat. Dążenie do zrównoważonej gospodarki energetycznej stało się jednym z głównych wyzwań obecnych czasów. Zrównoważona gospodarka energetyczna powinna zapewniać m. in. bezpieczeństwo energetyczne, niwelować tzw. ubóstwo energetyczne oraz przyczyniać się do zmniejszania emisji gazów cieplarnianych. Przed Polską stoją ambitne wyzwania związane z celami polityki unijnej zwłaszcza tzw. pakietu FIT 55, których nie da się osiągnąć bez wykorzystania odnawialnych źródeł energii (oze). Wykorzystanie energii słonecznej jest jednym z priorytetowych działań. Wykorzystanie fotowoltaiki „rozproszonej" (czyli m. in mikroinstalacji) oprócz oczywistych korzyści wiąże się także z koniecznością modernizacji sieci przesyłowych. Celem niniejszej pracy jest ocena wykorzystania oze, a w szczególności mikroinstalacji fotowoltaicznych, w ciągu ostatnich pięciu lat (2015-2020), w wybranych powiatach. Poddane analizie zostaną także zastosowane instrumenty ekonomiczne i prawne, przyczyniające się do inwestycji w mikroinstalacje.

SŁOWA KLUCZOWE: odnawialne źródła energii, globalne ocieplenie, zrównoważony rozwój, mikroinstalacje fotowoltaiczne

Bartosz ZEGARDŁO

EKOLOGICZNE, TECHNICZNE I EKONOMICZNE ASPEKTY WYKORZYSTANIA ODPADÓW KRZEMIENIA JAKO KRUSZYW DO BETONÓW SPECJALNYCH

STRESZCZENIE: W pracy niniejszej przeanalizowano ekologiczne, techniczne i ekonomiczne aspekty wykorzystania odpadowego krzemienia, który pozyskiwany jest podczas procesu wydobycia kredy. W pracy zaprezentowano problematykę niekorzystnego wpływu górnictwa na środowisko oraz zwrócono uwagę na powstające odpady wydobywcze. Odpadowy krzemień zaproponowano wykorzystać w formie rozkruszonej, jako substytut wysokiej jakości kruszywa do kompozytów cementowych odpornych na działanie środowisk agresywnych chemicznie. Jako kompozyty kontrolne wykorzystano betony tradycyjne, które zawierały w swojej objętości kruszywa żwirowe i bazaltowe. W związku z zadowalającymi wynikami przeprowadzonych testów opisany sposób unieszkodliwiania odpadu przeanalizowano również pod kątem możliwych korzyści ekonomicznych. Wnioski z przeprowadzonych badań dowiodły, że rozkruszone odpady krzemienia pod względem technicznym dorównują wysokiej jakości kruszywom specjalnym, natomiast koszty ich pozyskania i wytworzenia w odpowiednich systemach ich deponowania mogą być niższe niż najtańszych dostępnych na rynku kruszyw tradycyjnych żwirowych.

SŁOWA KLUCZOWE: odpady krzemienia, zielony beton, beton recyklingowy, środowiska agresywne, substytut kruszywa

Katarzyna Anna KUŹMICZ, Urszula RYCIUK, Ewa GLIŃSKA, Halina KIRYLUK,
Ewa ROLLNIK-SADOWSKA

PERSPEKTYWY ROZWOJU MOBILNOŚCI NA OBSZARACH PERYFERYJNYCH ATRAKCYJNYCH TURYSTYCZNIE

STRESZCZENIE: W artykule podjęto problematykę systemów transportowych na obszarach peryferyjnych, zdefiniowanych przez zbiór ograniczeń wynikających z rzadkiego zaludnienia, rozproszonej lokalizacji przystanków środków transportu oraz efektywności kosztowej systemu. Obszary peryferyjne atrakcyjne turystycznie wymagają szczególnego podejścia do planowania systemu transportowego z uwzględnieniem zmienności popytu oraz konieczności zapewnienia rozwiązań transportowych ograniczających szkodliwe oddziaływanie na środowisko. Celem pracy jest identyfikacja i ocena perspektyw rozwoju innowacyjnych rozwiązań mobilności dla mieszkańców i turystów obszarów peryferyjnych w zgodzie z zasadami zrównoważonego rozwoju oraz ocena czynników wspierających lub utrudniających rozwój wybranych perspektyw. Wyniki badania Delphi przeprowadzonego wśród 23 ekspertów z siedmiu państw członkowskich UE, Rosji i Norwegii pozwoliły na identyfikację czynników kształtujących przyszłość mobilności na obszarach peryferyjnych, do których należą m.in. multimodalne systemy transportowe wspierane przez rozwiązania informatyczne, transport reagujący na zapotrzebowanie oraz usługi transportowe dostosowane do specyficznych potrzeb różnych grup użytkowników.

SŁOWA KLUCZOWE: innowacyjny transport, zrównoważona mobilność, polityka transportowa, obszary peryferyjne atrakcyjne turystycznie, metoda Delphi

Arkadiusz MAŁKOWSKI, Beata BIESZK-STOLORZ, Dawid DAWIDOWICZ,
Wojciech ZBARASZEWSKI, Martin BALAS

TURYSTYKA ZRÓWNOWAŻONA JAKO CZYNNIK ROZWOJU OBSZARÓW CHRONIONYCH W EUROREGIONIE POMERANIA

STRESZCZENIE: Celem pracy była ocena opinii mieszkańców obszarów chronionych na pograniczu polsko-niemieckim na temat rozwoju turystyki z wykorzystaniem koncepcji turystyki zrównoważonej. Badano, czy rodzaj obszaru chronionego i kraj zamieszkania były determinantami rozwoju turystyki zrównoważonej. W latach 2019-2020 przeprowadzono badanie ankietowe wśród mieszkańców obszarów położonych w pobliżu 14 obszarów chronionych Euroregionu Pomerania. W analizie danych wykorzystano wielomianowe i porządkowe modele logitowe. Podstawowymi ograniczeniami badania był brak możliwości odniesienia się do podobnych badań z lat wcześniejszych oraz dla innych obszarów chronionych w Polsce i w Niemczech. Uniemożliwiło to przeprowadzenie pełnej analizy przestrzenno-czasowej. Przeprowadzone badanie dotyczące akceptacji przez mieszkańców okolic obszarów chronionych w Euroregionie Pomerania ma charakter unikatowy. Wykazano, że regiony polskich obszarów chronionych w Euroregionie Pomerania mają większy potencjał do rozwoju turystyki zrównoważonej niż regiony niemieckie. Wyniki badania pokazują również, że istnieją pewne różnice w postrzeganiu turystyki przez Polaków i Niemców.

SŁOWA KLUCZOWE: turystyka zrównoważona, obszary chronione, obszary peryferyjne, rozwój zrównoważony, Euroregion Pomerania

Anna BERNACIAK, Dariusz SPRINGER

REALIZACJA INFRASTRUKTURY TECHNICZNEJ Z UDZIAŁEM FINANSOWYM MIESZKAŃCÓW GMINY – PRZEGLĄD ROZWIĄZAŃ I OCENA MOŻLIWOŚCI ICH ZASTOSOWANIA

STRESZCZENIE: Partycypacja finansowa mieszkańców gminy w realizacji zadań własnych z zakresu budowy infrastruktury technicznej nie jest zagadnieniem jednoznacznie uregulowanym. W praktyce samorządowej wypracowano co najmniej pięć zasadniczych rozwiązań, zgodnie z którymi tego typu partycypacja się odbywa. Zostały one przedstawione w oparciu o celowy, krytyczny przegląd literatury, analizę aktów prawnych oraz orzecznictwa.

Głównym celem artykułu jest wskazanie zamkniętego katalogu rozwiązań, w oparciu, o które partycypacja finansowa mieszkańców w budowie infrastruktury technicznej może być realizowana oraz zaprezentowanie ich porównania i oceny. Najwyższy poziom włączenia społecznego jest osiągany poprzez zastosowanie partycypacji w oparciu o przepisy ustawy o finansowaniu infrastruktury transportu lądowego oraz w ramach inicjatywy lokalnej. Są to narzędzia, które dają obywatelom najszerszy wpływ na realizację poszczególnych inwestycji i jednocześnie można je uznać za narzędzia koprodukcji usług publicznych, a także najwyższego poziomu partycypacji społecznej, zgodnie z drabiną partycypacji.

SŁOWA KLUCZOWE: partycypacja, partycypacja finansowa, infrastruktura techniczna, zadania własne gminy

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