ECOSYSTEM SERVICES IN SPATIAL PLANNING – STUDY CASE OF THE WIELKOPOLSKA NATIONAL PARK, POLAND

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Abstract

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The notion of „ecosystem services” as presented by P.R. Ehrlich and A.H. Ehrlich (1981) concerns not only services but also goods which are acquired thanks to the functioning of ecosystems. For ecological economy, the different concepts constitute a foundation for methodological assumptions pertaining, in fact, to determining the subject of research. From the legal perspective, a service is a conduct performed by a debtor whose goal is to fulfil a legal duty to the satisfaction of the creditor. Accepting this definition in the evaluation of the environmental-human relationship, the environmental-human service is based on the following: on giving something (Lat. *dare*), doing something (*facere*), not doing (*non facere*) and bearing something (*pati*). The identification and evaluation of services are significant reasons supporting nature arguments when making economic decisions, especially in making decisions concerning localization. The goal of this work is to determine, in categories of *dare*, *facere*, *non facere* and *pati*, the relationships between the natural environment, including ecosystems, and human behaviour in the Wielkopolska National Park in Poland and within its buffer zone boundaries. The Wielkopolska National Park buffer zone areas are currently among the most urbanised areas of Wielkopolska. In many places, this buffer zone is no longer a barrier limiting negative influences of human economy on the national park. Economic rules and administrative boundaries have nothing in common with the ecosystem and landscape boundaries, so it is possible to introduce and perform services for ecosystems of the national park (*dare*) using a protection plan.

Key words: ecosystem services, spatial planning, national park

Introduction

Human attitudes towards natural resources have always been shaped by economic factors. The motives for economic profits have always been fundamental during the generally wasteful exploitation of the Earth's natural resources. The economic balance, however, rarely took into account the true cost of future results of the utilisation of natural resources.

Human changes introduced into the natural environment, and the vision of negative future effects of biosphere exploitation, currently point to a very urgent need for more effective protection of ecological systems, especially ecosystems. The traditional approach towards protection of natural resources, including the ecosystems, is based on establishing and enforcing legal prohibitions and orders. This approach is insufficient, as is the propagation of certain ethical standards connected with biodiversity protection, which differ in various cultures throughout the world.

Therefore, now seems to be the appropriate time for research into benefits and losses resulting from ecosystem management. It is not only the foundations of the ecosystem theory that form the basis for this claim, but it also involves the differing economic views concerning the relationship between economic processes and the environment which has been developing since the 1950's (e.g., Mooney, Ehrlich, 1997). It has been claimed, among other things, that the resources of capital and labour and market mechanisms would create a remedy for shortages in natural resources (Solow, 1956; Hubacek, van der Bergh, 2006). However, this is a false statement stemming from the very level of its theoretical assumptions. In addition, degradation of the environment on a global scale quickly created issues concerning the possibility of determining external costs and benefits connected with natural environmental protection. Decisions concerning geographical space required and geographical space which is currently increasing, require that environmental quality and natural resources issues be taken into consideration.

Accepting that the ecosystem is a subject for research, which is necessary also for the development of economic theories, basic functions of the ecosystem from which humans can benefit were determined. These basic functions include the following: pest outbreak prevention, plant pollination, shaping of fish resources, impact on the climate, soil erosion prevention, flood-wave control, the soil-forming processes and the matter cycle (Man's Impact, 1970). Presenting an attempt at imparting a financial value to ecosystem services on a global scale, 17 ecosystem functions were separated. These functions were assigned to material and non-material services. This assignment constituted the foundation for assessment of the global pecuniary value of ecosystem services (Constanza et al., 1997). This method was used, for the Millennium Ecosystem Assessment – MEA (2005) global project. The goal, here, was to assess consequences for human well-being resulting from ecosystem changes. In fact, the basic function of the ecological system is the matter cycle and energy flow. The remaining functions mentioned above are only its derivatives, or they have no connection with the processes occurring in the ecosystem.

The notion of "ecosystem services" as presented by P.R. Ehrlich and A.H. Ehrlich (1981) concerns not only services but also goods which are acquired thanks to the functioning of ecosystems. However, formation of the theoretical concept of ecosystem services does not yet have explicitly determined ecological foundations. This is noticeable, for example, by interchangeable usage of notions of "ecosystem", "landscape", "environment", or "nature", which is frequently encountered in the literature. These conceptual differences cannot be treated exclusively as discussions about terminology in the field of ecology, because these were settled a long time ago. For the ecological economy, the different concepts constitute

a foundation for methodological assumptions pertaining, in fact, to determining the subject of research.

From the legal perspective, a service entails conduct performed by a debtor whose goal is to fulfil a legal duty to the satisfaction of the creditor. Accepting this definition in the evaluation of the environment-human relationship, one can endeavour to determine areas within which the environment-human service is based, such as: on giving something (Lat. *dare*), doing something (*facere*), not doing (*non facere*) or bearing something (*pati*). The identification and evaluation of services provide significant reasons which support nature arguments when making economic decisions, as in decisions concerning localization. It is important for environmental management to limit costs incurred by the environment and to ensure the proper functioning of ecosystems.

The goal of this work is to determine, within the categories of *dare*, *facere*, *non facere* and *pati*, the relationships occurring between the natural environment, including ecosystems, and humans, in the Wielkopolska National Park and within the boundaries of its buffer zone.

Material and methods

The analysis of the issues of ecosystem services, using the example of the Wielkopolska National Park, Poland used expert evaluations and studies (Fig. 1). These studies were from the field of environmental protection, environment shaping and spatial planning, conducted for state and local administration of this province. Moreover, documents

Fig. 1. Location of the Wielkopolska National Park (Poland). (by authors)

for this analysis concerned the spatial planning at the community level, forecasts of the influence of spatial development, planned decisions for the environment and research and planning studies for Wielkopolska National Park. This work took advantage of various experience in issues of natural environment-shaping in the analyzed area, with special emphasis on the ecological foundations for spatial-order shaping, on protection of natural resources in urbanized areas and the planning of ecological systems in the river Warta valley (Raszka, 2003).

Results

All external influences on a national park should be eliminated by the buffer zone where various areas, often including greatly transformed ecosystems perform various functions. The biocoenotic function in considerable parts of the buffer zone, especially the urbanized ones, is significantly limited, or it has been completely displaced by different functions. These functions are: housing, tourism and recreation, economy and transportation. They have a direct influence on the disappearance of open areas, changes in habitat conditions and hindering the spread of some species as a result of creating ecological barriers, while simultaneously creating conditions for the spread of alien species, the synanthropization of plants and animals and landscape degradation.

Another result of economic transformation is progressive change in the possibility of plant spreading. The range of plant species is a dynamic spatial phenomenon which is mainly affected by climate and evolutionary and genetic phenomena. These factors determine the species tolerance range. Other factors influencing the range, such as environmental change as a result of economic activity, are factors which clearly shape the actual ranges compared to potential ranges (Szmajda, 2004).

At present, the phenomena also intensify in the buffer zones of national parks, such as in the Wielkopolska National Park (Fig. 2). This has become increasingly isolated over the last 40 years as a result of the development of spatial barriers around its boundaries. These barriers arise mainly in the buffer zone, and one example of this influence is the increasing urbanization of buffer zone areas. Such influence is also apparent in the parts adjacent to the boundaries of the Wielkopolska National Park, including enclaves of arable land which enter the park although they are formally considered to be outside its boundaries. Built-up zones move into the interior of the park along communication routes and enclaves which evolved as a result of the revision of the park boundaries. Such revisions form one of the causes of fragmentation of this park area (Raszka, Kasprzak, 2007). The Pożegowo Moraine and the western part of the buffer zone along the Mosina-Stęszew road are urbanized areas which have been intensively developed for several dozen years, and urbanized areas such as these have had a direct influence on the spatial isolation of the Wielkopolska National Park (Fig. 3).

In many places, the park's buffer zone is no longer a barrier limiting the negative influence of human economy on the national park. The buffer zone in itself has become a serious threat to the park, becoming an isolating spatial barrier. This has happened because it is in the area of the buffer zone where changes in land use occur. As a result of the conversion of arable land into land intended for building development, this land irretrievably loses its

Fig. 2. Ecosystem services in the Wielkopolska National Park (based on the Protection Plan of the Wielkopolska National Park, 1999, changed by authors).
Protected elements: l – nature monuments, 3 – forest areas
Other: 2 – boundary of the buffer zone
Elements of the culture landscape covered by conservation: 4 – historic monumental objects, 5 – tree alleys, 6 – monumental urban and rural complexes (incl. old grange complexes)
Elements protected for composition and landscape reasons: 7 – vista foregrounds
Ecosystem services (dare): 8 – zones of economic activity concentration, 9 – zones of summer houses, 10 – building complexes exceeding the local composition- and landscape scale, 11 – zone of technical infrastructure (existing and planned)
Important zones of function conflicts (dare): 12 – conflict centres – technical elements crossing areas with special ecological functions, 13 – zones and directions of influence of the transformed areas (incl. those urban developed) on the protected areas, 14 – built-up areas.

natural value. Land management in current market conditions, and inhabitants and local governments who accept views on protection of the buffer zone and its use contrary to the the national park's interesrs, determine the shape and value of the park itself (Kasprzak, Raszka, 2010). The former services of ecosystems have been abolished (*pati*).
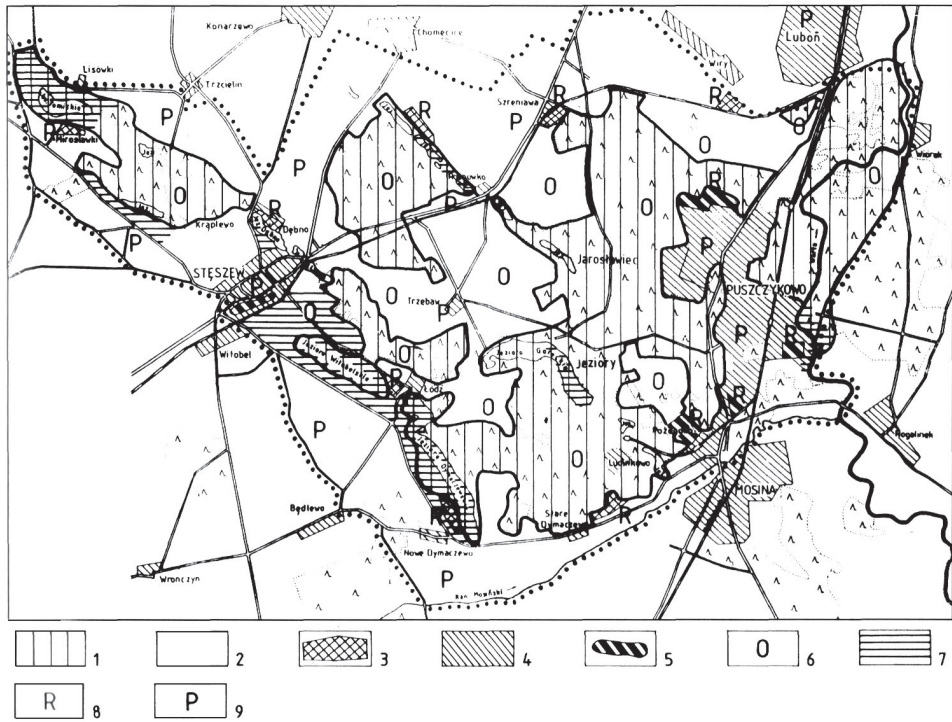
Fig. 3. Areas strategic for the execution of the protection policy and operational zones of the spatial policy in the Wielkopolska National Park: *non facere - pati* (based on the Protection plan of the Wielkopolska National Park, 1999, changed by authors).

Types of landscape: l – forests of natural character *(non facere)*, 2 – agricultural (cultivated) and agro-settlement – harmonious *(non facere)*, 3 – agro-settlement – deteriorated *(pati)*, 4 – urban developed *(pati)*, 5 – developed – deteriorated *(pati)*

Planning guidelines for the zone of: 6 – landscape protection *(non facere)*, 7 – special view protection *(non facere)*, 8 – landscape reclamation *(pati)*, 9 – landscape transformations *(pati)*.

Continuous building development of the open areas which still exist around the park is always initiated by investors. These investors endeavour to erect the first buildings favoured by the existing legal regulations and conducted administrative proceedings. This also concerns efforts to construct buildings in open areas within ecological corridors in lake troughs, as has occurred in the Samica river valley. The practice of recent years shows that the first houses in the buffer zone are always followed by efforts of other land owners to introduce further buildings and intensify urbanization. Current data shows that in the near future a north-western, western and southern, "arm of urbanization" will extend from the village of Trzcielin, effectively isolating the Wielkopolska National Park, and intensifying the existing isolation of the area. Urbanization will finally shape the form of the national

park into an "environmental island". Such isolation will eventually lead to the termination of biocoenotic services of the ecosystems. In order to guarantee biocoenotic services and, in general, the existence of many environments within the Wielkopolska National Park, it is important to leave a sufficiently large number of uninvested connecting areas to this park. This particularly concerns the river Warta valley. However, in the case of the Wielkopolska National Park, these connections are already virtually non-existent (Raszka, 2003, 2005; Kasprzak, Raszka, 2010).

Protective status of national parks and their buffer zones proved insufficient to guarantee sustainable development in the Wielkopolska National Park. The increasing isolation of the national park is also a result of secondary division of real property. This is property which complies with the legal regulations, but leads to a growing environmental loss of value in the Wielkopolska National Park space.

In order to keep the importance of the Wielkopolska National Park and to maintain its set biocoenotic functions, it is necessary to strengthen its bonds with its surrounds. This must be done through the restoration of connecting areas among other things, by the elimination of spatial surface barriers such as urbanized areas and also through stimulation of the development of planned ecological connectors. This is no longer possible, for example, in the Krosinko village because urbanization from within the village has progressed towards the centre of the park. The most important goal for the protection of the buffer zone is to guarantee the functioning of river valleys as ecological corridors. Their biggest threat, which practically destroys their basic function, is the introduction of building development. The consequence of the development here is the practical elimination of the corridor function.

In an effort to harmonize spatial development with the natural environment and to develop the appropriate methods and techniques of active environmental protection, considerable responsibility should be taken to provide a protection plan which would also define the importance of ecosystem services.

Discussion

Ecosystem as the organism ↔ environment system

A paradigm determining that life exists only at the organism ↔ environment meeting point is the essence of understanding ecosystem processes. For all levels of biological systems there exists a common meaning of life. It is a feature of self-organisation which leads to decreasing entropy in the system. It also leads to reaching an optimal developmental state in the form of a dynamic balance of continuity. This balance is achieved due to levelling factors affecting the system. Balancing production and decomposition processes, through utilisation of energy and maintenence of the closed element cycle, constitutes a system called the ecosystem. The occurrence of living organisms is the essence of this system and is its most characteristic feature. No other system exists in nature which has such specific properties

as the ecosystem, and species with evolving and changing characteristics are a fundamental element of the ecosystem. Individuals of each species form populations which are lasting and living systems. These systems can persist in time in more or less unaltered states, while a constant exchange of matter, energy and information exists within their environment. This process leads to the creation of successive generations of individuals of the same population (Weiner, 1999).

In the ecosystem, the struggle for existence is the foundation of natural selection. This struggle continues not only between individuals of the same species but within the entire organism ↔ environment system. Presence or absence of individuals of different species is of key importance to natural selection results. The internal organisation of ecosystems, to a great extent, determines what species and what population size, are permissible in this system. Some species are accepted in the ecosystem and others are definitely rejected. It is widely accepted that species rarely occupy one ecosystem. Local populations of species almost always occupy a home range which is considerably larger than the ecosystem they are generally related to. Their population space is variable and, excluding the ontogenetic space, goes beyond each ecosystem. In many ecosystems, there are also alien species from neighbouring ecosystems. In general, these often only periodically enter the trophic cycle of transformations from a given system in which, for different reasons, they are present. For ecosystems, however, biological diversity is completely neutral. The question whether there is a high or low number of species is of importance only to humans (Kasprzak, 2009). The achievement of relatively stable processes of production and decomposition may occur over a given range of time. These changes occur not only with various numbers of species but also with significantly changing sizes of populations. Similarly, it is only important to humans whether ecosystems are stable and display an ability to return to their initial state after being disturbed. Thus, these exchanges between ecosystems become a factor which integrates adjacent ecosystems. The populations from a given ecosystem, adapting to an ecosystem's occurrence space, respond to individual offers from the ecosystems located in their vicinity. However, in many cases, individuals do not choose the nearest offer situated near the local population. Instead individuals choose an offer which will be the most effective from the perspective of the population's life cycle. This includes various feeding and ontogenetic areas.

On the surface, it would appear that to determine the effect of a specific ecosystem or its service, for other ecosystems or humans, it is important to clearly determine its boundaries. However, often poorly marked boundaries of some ecosystems do not by any means point to the fact that these boundaries are non-existent (Kasprzak, 2002). Ecosystem cohesion represents a much more important feature than clear boundaries. It causes the ecosystem to act as one entity. Such an entity is internally conditioned by the structure of connections between particular components. However, a homeostatic system it is not a complete entity because there are no ecosystems which would automatically maintain some undefined, pre-established, equilibrium point. Weiner (1999) reported that occasionally occurring states of dynamic equilibrium in ecosystems do not serve any established or predetermined purpose.

Ecotonal systems usually appear at the meeting point of two ecosystems. Their specific properties are the best confirmation of the objective existence of ecosystems. Ecotones differ from the adjacent ecosystems in habitat, biological diversity and structure which are unique only in a transition zone. Ecotones are marked by a lack of continuity, by a high diversity of energy and matter dynamics, as well as by a species composition which is similar and at the same time different to that of the adjacent ecosystems. They come into existence almost entirely in anthropogenic conditions (Kostrowicki, 1983).

However, very frequently in organism ↔ environment systems one does not deal with ecosystems but with the "environmental islands" created by humans. An "environmental island" is a space with a fragment of the natural environment which is surrounded by another environment (MacArthur, Wilson, 2001; Andrzejewski, 2002). An "environmental island's" size, and in some situations also its shape and the enormous influence of the surroundings, do not enable formation of ecosystem features. Ecological processes in an "environmental island", either do not occur or are considerably upset, in comparison with similar phenomena in an ecosystem. These processes are a result of the predominance of the external influence in its area. On the other hand, services of "environmental islands" in the organism ↔ environment system can be very immense. A field under cultivation, sometimes regarded as a specific agro-ecosystem, but being in fact an "environmental island" which gives (*dare*) a part of its primary production (yield) for economic use of the human, can serve as an example.

Services of ecosystem as its function

Changes occurring in the space shaped by humans are an outcome of a planning activity in the environment ↔ human system. Spatial planning shapes fragments of the biosphere, including ecosystems which provide their functions. Services for the ecosystem are usually very limited or do not occur because it is mainly the ecosystem that is the provider. Legal imposition of compensation as an obligation addressed to an indicated entity is of minor or of no importance to the ecosystem. Legal impositions come into being when actions taken by the entity result in negatively assessed and impossible to be prevented environmental transformations (Act of 27 April 2001 – The Environmental Protection Law). The goal accepted as part of the compensation is supposed to be a state of natural equilibrium, where there is a balance between mutual influence of the human, the components of the living nature and a system of habitat conditions, and this goal proves unattainable. As mentioned above, none of the ecological systems, and especially the ecosystem, display homeostatic regulation. There is no equilibrium established at a set level and ecosystem services are not performed according to the conditions of its equilibrium, but in the course of dynamically occurring transformations, as during secondary recreative succession.

The natural and shaped functions of an ecosystem, fulfilling or being able to fulfill specific social needs, including the economic ones, constitute ecosystem services. However, the required services do not necessarily have to be provided by the ecosystem. In the case of a forest, which is the most complex land ecosystem, many similar or identical services are provided by for-

est crops, which are by no means ecosystems. From the perspective of ecosystem procesess, services often conflict, especially in maximisation of simultaneous functions.

Performance of the same function by one and the same ecosystem does not always have to be uniform. Without well-founded reason, it is simply assumed that biological processes occur in the same way in each part of the ecosystem, as in a lake, for example. In these ecosystems however, macroscopic spatial heterogeneity of the environment clearly occurs for most of the year. However, this spatial heterogeneity does not basically pertain only to shallow lakes, with strongly mixed waters from top to bottom, it affects many fundamental chemical and biological processes in these ecosystems, which are often also subjected to anthropopressure. Transitions between alternative states usually include hysteresis, which represents a temporal delay in reacting to external factors (Schröder et al., 2005). For instance, the lake's reaction to reduced phosphorus inflow is not a simple reversal of its reaction to an increase in this element in the ecosystem.

To a certain extent, some market instruments used in environmental management aimed at biological diversity protection constitute services for ecosystems. Such market instruments include taxes, charges for using the environment, subsidies, licenses, and emission limits. These are administrative and economic procedures, such as reduced hunting and fishing permits which may contribute to limiting the use of some components of natural resources, and the institution of these practices has a direct effect on ecosystems.

Protection of predatory species enables at least partial preservation of natural predator–prey relationships. Limiting the use of natural resources allows the level of some species to take place only up to a level determined by humans, and not of that set by the environment. A level set by the environment does not exist. From the perspective of the human economy, financial support by compensatory payments for services provided for ecosystems may be temporarily effective. These may include compensation payments for owners preserving forests, wetlands, small water reservoirs and chosen protected habitats, wherein the owners have reduced their earnings for the sake of the common good. Up to a certain point in time an ecosystem or an "environmental island", as a result of such activity, will be preserved and will provide services for adjacent areas through its functions.

In the case of a local development plan, a zoning fee, a form of public levy paid on a one-off basis by a property owner to a community, is an economic measure of a service. A payment obligation arises when, as a result of local development plan adoption or change, the value of a plot covered by the plan increased, and the owner sells the property (Act of 27th of March 2003 on Planning and Spatial Development). However, this measure of a zoning fee is only to compensate the communes/community for expenses incurred while adopting the local development plan. Thus, it is not connected with services for ecosystems which were changed as a result of the undertaken planned actions. The goal of this fee is also to act as a type of incentive for the community to sell out attractive (e.g. agricultural) land and use it for development investments. The assumption in these circumstances is that something fruitful will result from the development.

An improvement levy, for owners or users of real property given in perpetuity, where the value increased from real property integration, real property division or building technical

infrastructure facilities with participation of funds from State Treasury or local government units, has a different function and character (Act of 21st August, 1997 on Real Property Management). Improvement levies do not encompass real property intended in the local development plan for agricultural or silvicultural purposes, and they are not connected with services for the ecosystem, because actions undertaken are only performed for economic profit. Integration from the mosaic of ecosystems and "environmental islands" perspective of the landscape, can most often significantly negatively affect the natural environment. Therefore, the integration, exchange or division of arable land requires preparation of an environmental impact report (Regulation of the Council of Ministers of 9 November 2004).

Such a report refers to land with an area exceeding 300 ha, or forest land not less than 100 ha in area. Examples include the conversion of a forest or wasteland into arable land no less than 1 ha in area, afforestation of areas above 20 ha and deforestation of areas not less than 1 ha, which are aimed at changing the land use.

Many economic activities in the natural environment in relation to ecosystems definitely display the characteristics of *pati*, because they completely change the form of ecosystems. The answer to *dare* of an ecosystem is *non facere* by economic activity, which in a short time leads to changes in an ecosystem's function. Thus, this constitutes changes in future services, or the elimination and termination of services.

Environmental services involving ecosystem services for humans and the economy occur through a given spatial function. This problem also occurs in legally protected areas, such as in. national parks and surrounding areas. The goal of a national park is to preserve the course of ecological processes entirely unspoilt by anthropogenic impact in all ecosystems protected within the park boundaries (Kasprzak, Raszka, 2001). The area of a national park and interconnected ecosystems inside it do not have any services besides biocoenotic ones. Various protective actions are aimed exclusively at supporting biocoenotic processes. These include restoration programmes and exemption from agricultural production through giving areas a new, protective function. Destruction of these connections eliminates the possibilities of providing biocoenotic function services by ecosystems for human actions in a national park, other than protective ones. Such destruction exemplifies the prevalence of *non facere* and *pati.*

Conclusion

The Wielkopolska National Park buffer zone areas are currently among the most urbanised areas of Wielkopolska. Many elements conducive to the rise of spatial conflicts occur in this area. Such conflicts may be connected, for example, with areas of economic activation, involving housing and holiday facility development, and also with technical corridors and scattered housing investments. Planning of new areas for development in the buffer zone in the direct vicinity of the Wielkopolska National Park boundary is consistent with the legal regulations. New development is very undesirable because it will lead to a growing loss of the natural values of the Wielkopolska National Park space. The buffer zone is no longer a barrier limiting the negative influences of human economy on the national park. Instead it poses

a threat to the Wielkopolska National Park, in itself, since it functions mainly as an isolating spatial barrier. Clashes of different social interests, and economic and scientific values occur specifically in this buffer zone. There also exist different views concerning economic rules which, in fact, determine the shape and values of the park itself. The economic rules and administrative boundaries have nothing in common with the ecosystem and landscape boundaries. It is possible to introduce and perform services for ecosystems in the national park (*non facere - pati*) using a protection plan. Among other things, an implemented plan can identify and determine ways of limiting, or eliminating, existing and potential internal and external threats and their effects. It can determine protective actions and implement decisions involving the study of the conditions and directions of spatial development of building communes and local spatial development plans, in accordance with the Act of 16th April 2004 on Nature Conservation. It is possible to introduce services for ecosystems and other ecological systems in the buffer zone (*non facere - pati*) through studies on the conditions and directions of spatial development of communities. These would determine the directions of changes in intended land use and the directions and indices concerning the land's development and use. This could also involve the exclusion of land from planned building development. Moreover, they would define areas where it is obligatory to prepare local spatial development plans, especially those for land requiring integration and division of property. Finally, these would define areas where a community intends to draw up a local spatial development plan. The plan would include areas which required the conversion of agricultural and silvicultural land intended for future non-agricultural and non-silvicultural purposes, and comply with directions and rules instituted for shaping agricultural and silvicultural production space.

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