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THE ROLE OF LOCAL AUTHORITIES IN THE MANAGEMENT AND PROTECTION OF ECOSYSTEM SERVICES

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ROLA WŁADZ LOKALNYCH W ZARZĄDZANIU I OCHRONIE ŚWIADCZEŃ EKOSYSTEMÓW

STRESZCZENIE: Władze lokalne odgrywają ważną rolę w ochronie ekosystemów i ich struktury, zachodzących w nich procesów i pełnionych funkcji. Jednakże ich wpływ na ekosystemy, a w szczególności na dostarczane przez nie świadczenia jest ograniczony. Zależy od takich czynników, jak: potrzeby (popyt) społeczności lokalnej, dostęp do źródła świadczenia, możliwości techniczne oraz przyzwolenie prawne. W konsekwencji możliwości wpływu władz lokalnych na świadczenia ekosystemów są zróżnicowane. Część z nich, w szczególności świadczenia zasobowe, stosunkowo łatwo poddają się wpływowi władz. Inne, przede wszystkim świadczenia wspierające i regulujące, praktycznie nie poddają się temu wpływowi. Możliwość ingerencji władz na poszczególne świadczenia dostarczane przez ekosystemy zróżnicowana jest również w czasie i przestrzeni.

SŁOWA KLUCZOWE: świadczenia ekosystemów, władze lokalne, wpływ na środowisko

Introduction

The intervention possibilities taken in order to raise the level of services' usage, as well as the possibility of applying safety precautions are varied and depend on several factors. The level of importance presented by a given service for the socio-economic system, and the consequent demand is the first essential factor. In practical terms, a low level of demand causes the influence on a given service to be lower, than when it comes to high-demand services.

The second factor is the location of the source of a given service (structure, process) with respect to the area of the service. The source area, and the area where the service occurs, may be located on the same territorial unit, which gives the authorities a greater chance to intervene. The water cycle services are most commonly located to a very small extent in the area of their occurrence. The range of the water cycle goes far beyond the local authorities area. The third factor is the nature of a service, which is decisive when it comes to the technological possibilities of the socio-economic system influence. The impact of the authorities regarding storing genetic resources is much smaller than on supplying the citizens or the local industry with water. The fourth factor is the law conditions and their consequences on a given area. The intervention of the socio-economic system on the ecosystem is possible only when the law regulations allow for such an activity

The aim of the article is to identify possibilities of managing and protecting ecosystems along with their functions, which are the source of ecosystem services, by the local authorities. An attempt is made to categorize services in order to manage them properly.

The results of analyses present the real impact of the local authorities, when it comes to ecosystem services, and allow for the creation of the typology of services. In practical terms analyses make it possible to find any law imperfections concerning ecosystem services, which may be the guideline for implementing further changes.

Socio-economic system and ecosystem services

The important role of ecosystem services for socio-economic development has been shown by numerous studies. Research has been done on global, regional and local scale. It is worth mentioning G.C. Daily, who presented social dimensions of the functioning of the natural environment, or R. Costanza, along with his breakthrough research from the 90s, concerning the global value of ecosystem services[1]. Projects such as Millennium Ecosystem Assessment (MEA)

[1] G.C. Daily, (ed.), *Nature's Services: Societal Dependence on Natural Ecosystems*, Island Press, Washington DC. 1997; G.C. Daily, *What are Ecosystem Services?* in: *Nature's Services: Social*;

and The Economics of Ecosystems of Biodiversity (TEEB) have also played an important role in popularizing the knowledge about ecosystem services[2]. All the studies and analyses underline the important role of ecosystem services for the management processes, and point to their crucial role in creating the standard of living.

A vast amount of studies concerning the role of ecosystem services for the local and global development has been done. Scholars such as MJ. Metzger et al. and R.S de Groot et al. present the negative influence of soil exploitation change on the ecosystem services[3]. The ground policy's support possibilities using the estimation of a value is presented by E.V. Viglizzo et al.[4]. The guidelines for the government concerning the ecosystem services' management are shown by B. Fisher et al. and GC. Daily[5]. Two reports created for the aforementioned TEEB project, were devoted to issues which are crucial for the local and regional politics.[6] Publications point out to the possibilities to support development, by conscious and balanced usage of ecosystem services.

A plethora of publications and documents pertaining to the ecosystem services' management on the regional and local level, underline the important role of the local authorities. What may optimize the socio-economic development and the growth of the prosperity is the proper attitude of local government concerning the management of ecosystems. The lack of knowledge about ecosystem services, as well as the lack of management skills, may negatively affect developmental processes.

Dependence on Natural Ecosystems, G.C. Daily (ed.), Island Press, Washington 1997; R. Costanza et al., *The value of the world's ecosystem services and natural capital*, "Nature" 1997, Vol. 387.

[2] *The Millennium Ecosystem Assessment, Ecosystems and Human Well-being: Synthesis*, Island Press, Washington 2005, The Economics of Ecosystem and Biodiversity, European Communities 2008.

[3] M.J. Metzger et al., *The vulnerability of ecosystem services to land change*, "Agriculture, Ecosystems and Environment" 2006 Vol. 114; R.S. de Groot at all, *Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making*, "*Ecological Complexity*" 2010 Vol. 7.

[4] E.F. Viglizzo et al., *Ecosystem services evaluation to support land-use policy*, "*Agriculture, Ecosystems and Environment*" 2012 Vol. 154.

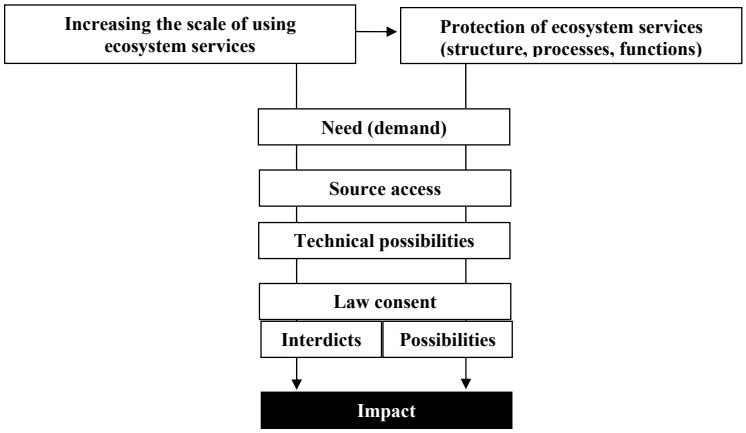
[5] B. Fisher, R.K. Turner, P. Morling, *Defining and classifying ecosystem Services for decision making, "*Ecological Economics" 2009 Vol. 68; Management objectives for the protection of ecosystem services, "Environmental Science & Policy" 2000 Vol. 3.

[6] *The Economics of Ecosystem and Biodiversity. TEBB for Local and Regional Policy Makers*, 2010; H. Wittmer, H. Gundimeda (eds.), *The Economics of Ecosystem and Biodiversity in Local and Regional Policy and Management*, Earthscan, London 2011.

Necessities and possibilities of the intervention of the socio-economic system in the ecosystem services

The reasoning behind the intervention of the socio-economic system, especially local authorities, in the functioning of the ecosystem may be double-sided. On one hand, the source may be the need to increase the usage of ecosystem services, on the other hand – the will to protect them. There is a relation between these two – the need to protect ecosystems and their functions, and as a consequence – ecosystem services may be the result of their previous exploitation (Figure 1).

Figure 1.
The mechanism of socio-economic system impact on ecosystems



Source: Own elaboration.

In order for the socio-economic system to show interest in the intervention in an ecosystem and its functions, there is a need for an appearance of positive circumstances. Among such circumstances are the need of intervention, access to the source of service, technical possibilities of an intervention, and law consent.

Each of the elements stimulating the intervention in ecosystems and its services is of different nature. The need to intervene in the service or a process of ecosystem is based on the demand for a given service. The greater the social demand is, the greater the scale of an intervention. The need characterizes the side of the demand: it occurs within the socio-economic system, so the authorities along with their voters. It must be observed, however, that not each and every demand may be fulfilled. Each ecosystem has a given capacity to create a service. In economic terms, it is about its entire productivity and capability.

The extreme productive possibilities of an ecosystem are determined by various factors. For example, for an ecosystem of a river, categories such as, the river bed, the flow, or the species living there, determine the maximum amount of services which may also, to certain degree, be increased by a specific human activity. The range of services may be increased by both protective measures (limiting the biogenic inflow, in order to increase self-cleaning abilities) or degrading the ecosystem (regulation of the river bed)[7].

The second factor influencing the possibility to control the ecosystem services is the access to the source. An ecosystem service is usually its structure (e.g. a water tank as a water reserve), or a process taking place within the system (e.g. cellular respiration being the source of oxygen). The place where the service occurs may be remote from the place where it is created. From the point of view of the local authorities the service in this context may be divided into:

- both the source and occurrence in one area, e.g. recreational services of water tanks,
- source in a given area, but the occurrence out of it e.g. the production of oxygen by a big forest ecosystems located in a given area,
- source out of a given area, but the occurrence in the area e.g. oxygen incoming to an highly urbanized area,
- both the source and occurrence out of the area, e.g. water self-cleaning service in case of an area without any water tanks.

From the point of view of a territorial unit, and its management, services from the first category are the most important. Services from the second and third category have limited importance, whereas the fourth category have no practical meaning for the authorities.

The technical possibilities of intervention depend on the current level of technological development. It is an external feature, independent from the authorities. Internalizing such factors is possible when there are technical possibilities of intervention, but due to various reasons (e.g. financial) they are not available for each and every unit.

Law regulations, which determine the possibility and the range of intervention, may be classified as both external and internal features, depending on the unit's competences to create regulations in a given environment-economics area (The European Council, The European Commission, national parliament, the authorities of a territorial unit). There are two contexts in which legal consent for intervention in ecosystems may be interpreted: bans protecting the environment and incentives to take protective actions.

Each of the aforementioned factors is an essential condition which need to be fulfilled. The need, source access, technical possibilities and law consent must all occur at the same time. The lack of any of them makes it impossible, completely or partially, to influence the ecosystem and its services.

[7] The issue is illustrated by Siebert's ecological utilization space: H. Siebert, *Nature as a life support system: renewable resources and environmental disruption*, "Journal of Economics" 1982 Vol. 42.

Possibilities for the local authorities to manage ecosystem services – results of research

Bearing in mind the aforementioned factors, each service has been rated according to the possibility for the local authorities to intervene in their structure and processes, and to manage the services of the ecosystem. The typology of the Millennium Ecosystem Assessment was assumed. Each of the services has been rated according to four factors: the need, source access, technical possibilities and law consent. The 0-2 scale was taken, adequately to growing possibility of intervention (Table 1). As a result each service is characterized by four figures. The greater the value for a given service is, the greater the possibility to intervene.

Table 1.
Assesement criteria

Level	Need (demand)	Source access	Technical possibilities	Law consent
0	No need for the socio-economic intervention; service does not affect the life of humans or is perceived as not affecting it.	The source is impossible to establish, dispersed or located out of the subject's range.	The nature of service cannot be affected by human; a technology allowing for such process does not exist.	The law forbids socio-economic intervention.
1	Little need for the socio-economic intervention in the service; service affects the life of humans to a limited extent or is perceived as affecting it to limited extent.	The access is limited; either partial or limited in time.	The nature of service shows a large resistance to human intervention; existing technologies allow only for a partial intervention.	Partial consent for an socio-economic intervention.
2	An essential need for socio-economic intervention in the service, service affects the life of humans to a large extent.	Full access; source is easy to identify, possible to locate in the subject's range.	The nature of service shows great susceptibility to human intervention.	Law does not limit the intervention in any way.

Source: Own elaboration.

In the next stage the results obtained by each of the services were multiplied. The result is a coefficient of a service showing the susceptibility of service to the intervention of the local authorities. Such calculations allow to obtain six different values of coefficients: 0, 1, 2, 4, 8 and 16. The higher the value is, the easier for the authorities to affect structures, processes and services of an ecosystem. On such a basis, adequately to the coefficient, it is possible to distinguish between six different categories of ecosystems as for the intervention possibility: 0 – lack of possibility, 1 – small possibility 3 – small+ possibility 4 – medium probability 8 – great probability 16 – certainty. It must be noted, that the aforementioned condition of necessity for each of analyzed factors, causes that obtaining value 0 in any of the criterion, makes the final factor value 0. Such dependency was obtained through multiplying values obtained in each criteria.

The results of the analyses show the limited possibility for the local authorities to intervene in structures and processes which take place in the natural environment, and as a consequence in ecosystem services. Among 37 services listed in the Millennium Ecosystem Assessment typology, only nine obtained value equal, or higher than 4. Only three of them were listed in the 'certainty' category, having obtained the result of 16 – plant production, water supply and tourism. There were seven services which do not undergo any intervention at all. Four of them are supporting services, two are regulating services and one is a cultural service (Table 2).

Table 2.
Ecosystem services categorization according to the management possibility

Lp.	16 points services	8 points services	4 points services	2 points services	1 point service	0 point services
1	PS – Crops	PS – Livestock	PS – Aquaculture	PS – Wood fuel	PS – Wild plant and animal products	RS –Climate regulation (global)
2	PS – Fresh water	PS – Capture fisheries	PS – Timber	PS – Biochemical, natural medicines and pharmaceuticals	PS – Genetic resources	RS – Polination
3	CS – Recration an ecoturism	PS – Cotton, hemp, silk	CS – Educational values	PS – Ornamenatal resources	RS –Climate regulation (regional and local)	CS – Cultural haritage values
4				RS – Air quality regulation	RS – Water regulation	SS – Soil formation
5				RS – Natural hazard regulation	RS – Erosion regulation	SS – Photosynthesisi
6				CS – Cultural and religious values	RS – Water purification and waste treatment	SS – Primary production
7				CS – Knowlege systems	RS – Diesese regulation	SS – Nutrient cycling
8				CS – Inspisration	RS – Pest regulation	
9				CS – Aesthetic values	CS – Cultural diversity	
10				CS – Social relations	SS – Water cycling	
11				CS – Sense of place		

PS – provisioning services, RS – regulating services, CS – cultural services, SS – supporting services

Source: Own elaboration.

Table 3.
Factor value for the possibility of intervention in service categories

Category of services	The sum of the products (ratio) in the category	Number of services	No. of points in one service
Provisioning services	72	12	6
Regulating services	11	10	1,1
Cultural services	32	10	3,2
Supporting services	1	5	0,2

Source: Own elaboration.

Provisioning services are the dominant group among the service which easily undergo the intervention of the local authorities. The sum of values for them is 72. There are 12 services in the category, which means that the average factor value for the entire category is 6. Cultural services have relatively high value as well – 3,2. Regulating and supportive services are characterized by low values. For the former it is 1,1, and for the latter only 0,2 (Table 3).

Relations between local authorities and ecosystem services – conclusions

The possibilities for the local authorities to intervene in ecosystems, and as a consequence in their services are varied. Some of the services, especially the provisioning services, are relatively easy to intervene in. The need, easy access to the source, lack of necessity to use advanced technologies, and law regulations which do not limit the possibility of intervention, or limit it to a little extent, are the factors which are supportive for the local authorities to manage such services. However, there are several services, especially in the supporting and regulating category, which are practically impossible to be managed by the local authorities. The most common causes are lack of the source access, and limited technological possibilities. What is more, there is no sufficient demand for many services of these categories. However important may the service be for the socio-economic development, inhabitants may be unaware of its importance and impact on their lives (e.g. pollinating, soil formation process, cycle of substances).

The spatial differences concerning the intervention possibility must be noted. All the factors, presented in the study as necessary factors, show such a difference. The needs of local communities vary in different areas. The diversity may be seen both regionally and locally, and on the higher, global level. The source access is, by definition, dependent on the location of two subjects: source, and the subject trying to obtain the access to it. Technical possibilities may depend

on the innovativeness of the country or region. The financial aspect may also limit the access to proper technologies.

The intervention possibilities may also differ in time. The technological development and legislative changes are both very dynamic areas. However, the former factor usually makes it possible for a wider intervention possibilities, whereas the latter depends on the intention of the legislator and the point of regulation – it may both limit or enhance the existing possibilities. Demand is also a subject to change, depending on the presence of natural threats. The occurrence of such threats is a factor creating higher demand, whereas their lack means no demand for the self regulation of ecosystems.

Ecosystem services management and their protection are characteristic for a given territorial unit at a given time. Services undergo constant evolution, adequately to factors allowing for an intervention, which are constantly undergoing changes as well.

In practical terms, an emphasis must be placed on services which are essential for the socio-economic development, and the standard of living. However, the local authorities do not usually have any chance of intervention. If such an activity would prove essential in order to keep ecosystems and support proper standard of living, the issue of ecological politics shall be defined and fulfilled by the regional or central authorities.

The research which was carried out, pertains to environmental, economic, technological and law determinants functioning in Poland in the year of research (2012). Carrying out similar research under different circumstances (e.g. the countries of the EU), would prove to be an interesting comparative study. Repeating the study after several years would show the direction of changes in the matter. Such research would also analyse the relation between the intervention possibilities and factors such as GDP, investment level or innovativeness.