



# World Scientific News

An International Scientific Journal

WSN 127(3) (2019) 284-295

EISSN 2392-2192

---

---

## Protection of nature and biodiversity as an ecological aspect of sustainable development

**Justyna Imiolczyk**

Faculty of Management, Czestochowa University of Technology, Czestochowa, Poland

E-mail address: [justynacelica@gmail.com](mailto:justynacelica@gmail.com)

### ABSTRACT

The following study addresses the issues of nature conservation and biodiversity in the country. These issues can be referred to the problem of the concept of sustainable development. Sustainable development is a concept that refers to the social, economic and ecological aspects. Her task is to integrate these areas and ensure the compatibility of goals between them. Protection of nature and biodiversity refers to the ecological dimension of the concept of sustainable development. The theoretical part presents the essence of the concept of sustainable development and environmental protection. The empirical study presents the degree of nature conservation and biodiversity in Poland based on a study by the Central Statistical Office „Environment 2018”

**Keywords:** Sustainable development, biodiversity, environmental protection

### 1. INTRODUCTION

Analyzing the changes taking place in the past, it can be stated that until the beginning of the so-called the industrial revolution, economic development did not exert greater pressure on the surrounding environment, and therefore were not interested in the issues of its protection nor the problems of depleting its capabilities. However, as early as the mid-nineteenth century, when the man started to exploit resources more intensively and affect the environment in the form of side effects, the effects of destructive activities in the natural world have been

increasing. Society however, there was no awareness of how the current activity could affect on the state of the economy and the standard of living of the population and what may have consequences in the future. Meanwhile, in the second half of the twentieth century, there was a rapid acceleration of economic and technological development.

The result was widening spheres of civilization threats, which include climate change, eutrophication of water, acidification and degradation of soils, toxic contamination, urbanization, loss of biodiversity, waste, reduction of water and forest resources, reduction of energy resources, changes in the landscape, etc. The global threats resulting from human activity on Earth have forced so humanity is looking for new ways of farming; looking for therefore, new economic theories and new solutions that will determine how to manage to take into account the welfare of current and future generations. Among others in response to the above problems in Europe at the end of the twentieth century, it has become popular the idea of sustainable development. It is based on the statement that "on the current one the level of civilization is possible development, in which the needs of the present generation can be met without diminishing the opportunities of future generations to satisfy them".

In other words, the concept is:

- aims to improve the quality of life for both current and future generations while maintaining the ability of our planet to maintain life in all its various forms;
- is based on the principles of democracy, the rule of law and respect for fundamental rights, including freedom, equal opportunities and cultural diversity;
- supports a high level of employment in the economy, whose strength is based on education, innovation, social and territorial cohesion, and protection of human health and the environment.

Sustainable development therefore concerns three pillars simultaneously, i.e.:

- the natural environment, which is an essential basis for sustainable development
- an economy that is perceived as a tool for achieving this development;
- the quality of life of all people (social aspect), which means improvement of living conditions and the level of feeling satisfaction with life in certain realities.

Human economic activity is inseparably connected with the transformation of the natural environment. Initially, these changes were limited in nature. However, with the huge development of technology and technology as well as the demographic explosion, the size of emerging pollution began to threaten the ecological balance on the earth, and thus the ability of the environment to fulfill the necessary functions both for the existence of people and their business. [1] In practice, the role of the state is a derivative of the scope of its functions, and these differ in spatial and temporal cross-section because they are under influence many factors of historical, cultural, political or ideological basis. In the 21st century, many of the country's tasks will also include caring for the future of generations as part of the implementation of the ecology economy and especially its derivative - the economy of sustainable development. In relation with the role of the state in the economy has been reduced to the following issues: the state should stimulate long-term economic development and serve improvement of management efficiency now and in the future, i.e. ensure continuous civilization development, and tasks undertaken by the state and institutions state should foster long-term development and efficiency.

At the end of the 20th century, most ruling elites believed that a market economy with a small share of the state was the most appropriate and fastest way to achieving social and economic development. Meanwhile, the market economy despite its many advantages, it also has weaknesses. The market mechanism causes social inequalities, is the source of mass unemployment, large areas of poverty, the occurrence of phenomena destabilizing the economy, uncontrolled environmental pollution, etc. To prevent this phenomena and the scale of their intensification, the need for an active role of the state in a market economy is becoming more and more bold. Most frequently mentioned so far.

However, state economists can not keep pace with rapidly changing social and economic conditions occurring in the economic reality.

Rapid economic development in the second half of the twentieth century affected not only the growth of prosperity in many developed countries (Western Europe, North America), but also led to "accelerated consumption of nature and pauperization of the population. The concept of sustainable development is the answer to these problems. Although the essence of this concept seems understandable, the precise definition and interpretation of what sustainable development is all about gives rise to discussions on both theoretical and practical grounds, and over time, it is possible to gradually expand the scope of the issues covered by this concept. [2]

In the modern world, where development is focused on quantity and speed, alternatives are being sought for sustainable, stable, sustainable development. The concept of sustainable development means meeting current needs without jeopardizing the ability of future generations to meet their own needs. In Poland, the principle of sustainable development has been raised to a constitutional level. The Environmental Protection Law defines the concept of sustainable development understood as "such socio-economic development, in which the process of integrating political, economic and social activities takes place, preserving the natural balance and sustainability of basic natural processes, to guarantee the ability to meet the basic needs of individual communities or citizens both the modern generation and future generations."

## **2. PROTECTION OF BIODIVERSITY IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT**

In the 1970s, the main idea of sustainable development was the problem of diminishing natural resources in the perspective of increasing economic and demographic growth and related pollution. The concept of sustainable development, despite many years of discussion, has not been precisely defined so far. It was used for the first time at the Stockholm Conference, in connection with discussing the goals and tasks of global environmental policy. At that time, the concept of human right to the environment was formulated, according to which man has the right to freedom, equality and appropriate living conditions in an environment of quality guaranteeing life in dignity and prosperity. At the same time, he is responsible for protecting and improving the environment for current and future generations. [3]

Many arguments have been formulated in the economic literature so far for the economic role of the state in a market economy. To more important ones of them include:

- the need to secure the economic system from the instrumental and legal side;
- eliminating market imperfections and competition in practice, related with monopolisation of the economy and other factors, leading to an incorrect allocation of economic resources and lowering the level of well-being society;

- taking actions to reduce the negative effects external to production and consumption;
- providing public goods (due to their indivisibility and common consumption; leaving a decision to the market alone could lead to too small or even disappearing);
- the existence of socially desirable goods (eg education, public order protection, clean water and air) and particularly disadvantageous goods (e.g. drugs, alcohol, cigarettes, gambling) forces the state to be on guard good choices, because the assessment of goods and services from the point of view of the whole society and individuals may be different;
- the fight against large fluctuations in economic activity, unemployment, incomplete utilization of production capacities, inflation, etc.
- providing care for elderly, infirm, handicapped and sick people who are unable to cope;
- equalizing large, unacceptable income differences and property;
- implementation and coordination of long-term activities, the effect of which is to improve the quality of human resources, modernize infrastructure in a broad sense, support basic research, introduce technical standards and quality standards and compliance with intellectual property rights.

Considering the above, it was considered that a new system should be created a value that takes into account not only profit and usability, but above all common good that meets environmental requirements. It was therefore emphasized in the economic literature that the economic system is the subsystem of the ecosystem, not vice versa, which gave rise to the development of the theory of environmental economics and conservation of resources and a more restrictive ecology economy. First of them is the science of rational use of environmental resources in conditions limited resources to maximize prosperity

The definition formulated at the Rio de Janeiro summit set the sign of equality between the environmental and socio-economic factor, recognizing sustainable development as a strategy for recognizing and solving contemporary economic, social and environmental problems. Its essence is therefore to ensure a lasting improvement in the quality of life of present and future generations by shaping the right proportions between the three types of capital: economic, human and natural.

The idea of sustainable development, also called the idea of eco-development, was based on considerations about the necessity of introducing fundamental changes in the global economy. These considerations were the result of the appearance of many unfavorable processes that occurred both in the living conditions of people and in the conditions of functioning of ecosystems. Progressive degradation of the natural environment, increasing poisoning of air, water and land caused a health threat to an increasing number of people. There were also economic arguments about the threat to future economic growth as a result of depletion of natural resources [4].

It is assumed that social and economic development must be permanently balanced with the adaptation possibilities of nature. The implementation of these objectives will ensure socio-economic development harmonized with the environment, i.e. development in which the limit of undertaken activities is the durability of environmental resources, savings in the management of space and resources, protection of biodiversity. [5]

The development of modern economies is based on its assumptions on a sustainable development strategy. In practical activities, it assumes running production processes in such a way that, with rational use of energy and raw materials as well as possibly low pressure on the

environment, products that are needed, durable and of high quality are produced. The condition for achieving this goal is, among others:

- taking into account environmental standards in macroeconomic policy and sectoral policies,
- reducing material, water and energy consumption of the economy,
- applying the best available techniques and production technologies, good management practices and environmental management systems to achieve economic effects along with environmental effects,
- limiting consumption pressure on the environment through shaping pro-ecological behavior patterns.

In the second half of the 20th century, the concept of sustainable development played an enormous role in shaping the way of thinking about mutual relations between society, the economy and the resources of the natural environment. It has contributed to the search for new directions of development that will harmonize with each other in three areas (economic, ecological, social).

According to the Brundlandt Report, sustainable development "is a development that meets current needs without jeopardizing the ability to meet the needs of future generations. It is based on two basic concepts:

- the concept of "needs", in particular the basic needs of the poorest in the world, which should be given the highest priority;
- the concept of "restrictions", imposed capacity of the environment to meet current and future needs by the state of the art and social organization.

The term biodiversity (biodiversity) was first used by Raymond Dalesman (1968) in a book in which he justified the need to protect nature. There are many definitions of biodiversity, and one of them specifies that "Biodiversity is the variability of living organisms of all environments occurring on Earth, including terrestrial, marine, other water ecosystems and ecological complexes composed of these habitats; it includes interspecies diversity, between species and the diversity of ecosystems. Biodiversity forms the basis of a wide range of ecosystem services, which significantly shapes human well-being. [6]

One of the most serious European environmental problems is the loss of biodiversity. Research in this respect, they indicate five main factors affecting biodiversity: loss and fragmentation habitat, over-exploitation and misuse of natural resources, pollution, invasive species extraneous and climate change (cited in: Guide on mainstreaming climate change and diversity biological for assessing the environmental impact. In Europe, Natura 2000 areas are the main tool to protect biodiversity, but it is important to remember that that this protection is also implemented through the protection of species and habitats outside Natura 2000 areas, and in Poland also through other spatial forms of nature protection and environmental regulations.

The necessity to take into account biodiversity in the assessment of environmental impact is due to Polish regulations legal issues, but recently it was additionally underlined by Directive 2014/52 / EU of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public projects and private on the environment. The EU strategy for the protection of biodiversity for the period up to 2020 indicates that the environmental impact assessment should not only focus on minimizing the impact of projects, but on ensuring the so-called "zero

net loss of natural values and restoring biodiversity. The issue of biodiversity is particularly important in the aspect of co-financing projects with funds EU.

Human activity has usually adversely affected and affects biodiversity, and especially for several thousand years, since agriculture has become the basic method of food production. Improper use of the environment led to degradation of soil, water and plant cover.

### **3. PROTECTION OF NATURE AND BIODIVERSITY**

It follows from the Constitution of Poland that it is the State's duty to preserve natural resources that are national heritage and to provide ecological security for present and future generations. Nature protection consists in maintaining, sustainable use and restoration of resources, creations and elements of nature. Poland belongs to the group of European countries with high biodiversity, both in terms of the number of species and environmental values. This diversity is shaped by a relatively large area of forests and wetlands as well as by extensive use of agricultural areas. The preservation of biodiversity guarantees the proper functioning of ecosystems and maintains a balance between all elements of nature. Striving to preserve natural values, Poland has been developing various forms of legal protection for areas and facilities as well as individual plant and animal species and their habitats for many years.

The ratio of areas of legally protected areas per one inhabitant was 2648 m<sup>2</sup>. The highest value of this indicator was recorded for the Warmian-Masurian Voivodeship (7879 m<sup>2</sup>), and the lowest for the Śląskie Voivodeship (598 m<sup>2</sup>).

The area of legally protected areas at the end of 2017 was over 10.2 million ha, which accounted for 32.5% of the country's area. The largest share of these areas in relation to the province area was held by the Świętokrzyskie Voivodeship (65.0%), the smallest Lower Silesian Voivodeship (18.6%).

The forms of nature protection are: national parks, nature reserves, landscape parks, protected landscape areas, Natura 2000 sites, nature monuments, documentary sites, ecological lands, nature and landscape complexes, species protection of plants, animals and fungi.

One of the most important forms of nature protection of the country are national parks. National parks are considered the highest national form of area and conservation nature protection. A national park is considered to be a public good, which is manifested, among other things, in the fact that using it by one person does not mean that another person can not use it at the same time<sup>2</sup>. National parks, as a public good, are financed from the state budget. For consumers, this means that public goods are provided free of charge or at most partially for consideration.

The national park covers an area distinguished by specific natural, scientific, social, cultural and educational values, with an area of not less than 1000 ha, on which all nature and landscape values are protected. The table below presents the areas of national parks in Poland.

The Nature Conservation Act obliges Polish national and landscape parks to develop a long-term conservation strategy. Developed in national and landscape parks. Natural values plans the protections were based on interdisciplinary scientific studies from current or verified research on natural environment resources. In these studies attention was paid to the natural and anthropogenic threats of individual environmental components. The occurrence of landscape and natural environmentally valuable objects or phenomena of inanimate nature and soils in national parks was taken into account as part of environmental valorisation.

The principle was adopted that the occurrence of even individual objects or small areas valuable in terms of nature or didactic, allows to classify such areas as a category with high natural values

**Table 1.** National parks in Poland in 2017

<b>National parks</b>	<b>Area in hectares</b>
Total	315087
Biebrza National Park	59223
Kampinoski National Park	38544
Bieszczady National Park	29202
Slowinski National Park	21573
Tatra National Park	21197
Magura National Park	19437
Wigry National Park	15090
Drawieński National Park	11342
Bialowieza National Park	10517
Poleski National Park	9760
Roztocze National Park	8483
Woliński National Park	8199
Ujście Warty National Park	8074
Świętokrzyski National Park	7627
Wielkopolski National Park	7597
Narwiański National Park	7350
Gorceński National Park	7039
<u>Stołowe Mountains National Park</u>	6352
Karkonosze National Park	5951
Bory Tucholskie National Park	4613
Babiogórski National Park	3399
Pieniński National Park	2372
Ojcowski National Park	2146

[Source: Environment 2018, Statistics Poland, Spatial and Environmental Surveys Department, Warsaw 2018, p. 108]

By 2017, 23 national parks with a total area of 315.1 thousand were created in Poland. ha, which accounted for 1% of the country's area. The oldest of them is the Pieniny National Park, while the youngest, created in 2001, is the "Ujście Warty" National Park. The Biebrza National Park, located in the Podlasie Voivodeship, covers an area of 59.2 thousand. ha, which makes it the largest national park, while the Ojcow National Park with an area of 2.1 thousand located in the Małopolska province. ha is the smallest national park.

The national parks in 2017. Dominated forest land (61.8% of parks), including in the MNP and Roztoczański PN such land accounted for over 95.0% of the park. Agricultural land occupied 14.5%, water 6.5%, wooded and shrubbery land 1.0%, and other areas accounted for 16.2%.

Another important element of the environment that affects the preservation of biological diversity are landscape parks. The landscape park includes a protected area due to its natural, historical and cultural values as well as landscape values in order to preserve and promote these values in conditions of sustainable development. The creation of a landscape park or enlargement of its area takes place by way of a resolution of the voivodship parliament.

In order to carry out protective measures for the parks are prepared conservation plans, taking into account: the characterization and assessment of the state of nature, identification and evaluation of existing and potential internal and external threats, characterization and evaluation of its social and economic analysis of the effectiveness of current methods of conservation, the characterization and assessment of spatial development, landscape audit results. The most important indications contained protection plans include: the adoption of the division of functional and spatial separation zones being implementation of conservation areas and determine how the protection, management and use within each zone functional and spatial. The basis for the separation of functional and spatial zones, for which the scope of works related to nature conservation is defined, is their spatial and natural coherence.

The landscape parks, protected landscape area includes areas protected because of distinguishing landscape characterized by various ecosystem, valuable because of the possibility of satisfying the needs of tourism and recreation and functions of ecological corridors. The area of protected landscape is determined by way of a resolution of the voivodship parliament.

As of the end of 2017, there were 122 landscape parks in Poland with a total area of 2.6 million ha. They occupied 8.3% of Poland's area. Since 2000, two landscape parks have been created, while the total area of landscape parks has decreased by 2.8 thousand. ha, which was a decrease of 0.1%.

The largest number of landscape parks were in the Lubelskie Voivodeship (16) with a total area of 240,000 ha, which accounted for 9.6% of the province's area. The smallest number of landscape parks were in the Opolskie and Podlaskie voivodships (3 each). The total area of parks in the Opolskie Voivodeship was 63 thousand. ha (6.7% of the province's area), while in Podlasie 87 thousand. ha (4.3% of the province's area).

Among the elements of nature protection and preservation of biodiversity, individual forms of nature protection are distinguished. These include, among others, ecological land.

One of the forms of nature protection, according to the Nature Conservation Act of 16.04.2004, is ecological use. This form of protection has been used in Poland since 1991. The main reason to create ecological is the need of protection of the surface of small objects, but valuable in terms of nature or a landscape which due to its small size and lower rank their values can not be covered by other forms of protection, for example. Reserve protection. An important

reason to create ecological is the need of protection of the surface of small objects, but valuable in terms of nature that could not be covered by the reserve protection due to the small size and typically have a lower rank their natural values. Ecological land is most often established on unused or low-production areas of forest or agricultural areas. They are surface-diverse and have from a few ares to even several dozen hectares.

**Table 2.** Ecological areas in Poland

Year	Total number	Total areas in thousand ha
2000	6113	44,9
2005	6421	44,5
2010	6877	51
2015	7130	52,3
2016	7250	53
2017	7661	53,4

[Source: Environment 2018, Statistics Poland, Spatial and Environmental Surveys Department, Warsaw 2018, p. 117]

**Table 3.** Landscape-nature complexes

Year	Total number	Total areas in thous. ha
2000	170	78,1
2005	188	86,8
2010	318	93,5
2015	339	112,4
2016	343	113,8
2017	352	118,7

[Source: Environment 2018, Statistics Poland, Spatial and Environmental Surveys Department, Warsaw 2018, p. 118.]

In 2017 there were 7661 ecological sites with a total area of 53.4 thousand. ha. Since 2000, 1548 objects have arrived, increasing the total area by 8.5 thousand. ha.

The largest ecological land was in the Kuyavian-Pomeranian Voivodeship (1752) with a total area of 5.2 thousand. ha. The smallest number was recorded in the Małopolskie voivodship (45) with a total area of 1.2 thousand. ha. In the Lubelskie Voivodeship, the areas occupied the largest total area of 7.0 thous. ha.

The next element are nature and landscape complexes. Nature and landscape complexes are designated by the voivode or by the commune council. The purpose of their creation is to protect exceptionally valuable fragments of the natural or cultural landscape, to preserve their scenic and aesthetic values. Nature and landscape complexes are fragments of natural and cultural landscape that deserve protection due to their scenic or aesthetic values. Establishment of a landscape and nature complex occurs by way of a resolution of the commune council.

In 2017, there were 352 natural and landscape complexes with a total area of 118.7 thousand. ha. From 2000, the number of teams increased by 182, and their total area increased by 40.6 thousand. ha. Nature and landscape complexes predominated in the West-pomeranian Voivodship (43), occupying a total area of 9.0 thous. ha. The smallest number of teams was in the Podlasie Voivodship (5), occupying an area of 141.2 ha.

#### **4. CONCLUSIONS**

The concept of sustainable development is increasingly being considered at both macroeconomic and microeconomic levels. This means equal treatment of economic, ecological and social goals in the country's development strategy, regions and enterprises. This approach to the functioning of the country and other entities is a response to the challenges of the modern world. Emerging global issues, related among others to: the growing degradation of the natural environment, depletion of natural resources, demographic explosion, increased poverty and unemployment, have had an impact on changing social requirements in relation to social entities. [9]

While functioning in a given environment, societies directly influence it, often exerting negative influence and causing conflicts among various stakeholder groups, which is why the state as the body responsible for legislating should bear responsibility for the activities of business entities and participate in solving existing environmental and social problems. [10] The new challenges that entities must now meet means to operate in accordance with the concept of sustainable development. It is possible only by integrating economic, ecological and social goals into the development strategies of the company. Nevertheless, it is a long-term process that requires many changes in the functioning of the state as an organization. [11]

The essence of the concept of sustainable development is to ensure a lasting improvement in the quality of life of contemporary and future generations through appropriate shaping of the balance between economic, human and natural capital. This concept becomes even more important in relation to biodiversity, which has a direct impact on the natural environment.

The variety of forms results from adaptation to the variability of environmental factors. It is thanks to this diversity that nature can survive changes. Along with the change in environmental factors, some individuals, species and ecosystems are lost, but some of them have features that make them survive. Passing on characteristics that are beneficial to future generations, it ensures survival of the species. In the process of evolution, nature produces diversity and sustains it - new species are constantly evolving, and individuals with new traits and new combinations of traits increase the probability of species survival in the event of subsequent changes in the environment.

Biodiversity is therefore a special value of all living nature. It can be described as a variety of life forms with all their variability at the microscopic and macroscopic level. According to the definition officially adopted by the Convention on Biological Diversity, species diversity

means the diversity of all living organisms present on the Earth, including in terrestrial, marine and freshwater ecosystems, as well as in ecological teams, which these organisms are part of.

The concept of biodiversity is currently the starting point for activities related to nature conservation. [10] It covers the full genetic, genre and ecosystem diversity on Earth, and the pursuit of humanity should be its protection at each of these three levels of life organization. The institution of legal protection of biodiversity includes forms of nature conservation. These include objects of high nature value, with a varied protective regime depending on the form. Proper approach to these areas - by covering them with legal protection - will ensure preservation of the most valuable places with rich biodiversity, also at the local level. [11]

An important element of these activities is nature protection implemented at the municipal level. This task is particularly important in relation to the global problem related to the increasing rate of biodiversity loss. Currently, the rate is one thousand times faster than in previous geological periods. All main groups of plants and animals are threatened with extinction. [12-14]

In Poland, as in most European countries, the level of diversity protection is relatively high. Activities are carried out on many levels, from international programs, legal protection of species and creation of protected areas (national parks, landscapes, reserves, etc.) to ex situ conservation in botanical and zoological gardens. Activities in the field of landscape engineering in agricultural landscapes dominating in Poland are very important.

## **References**

- [1] Feiock, R. C., Stream, C. (2001). Environmental Protection Versus Economic Development: A False Trade-Off? *Public Administration Review* 61(3), 313-321
- [2] Cash, D. W., Clark, W. C., Alcock, F., Dickson, N. M., Eckley, N., Guston, D. H., Mitchell, R. B. (2003). Knowledge systems for sustainable development. *Proceedings of the National Academy of Sciences* 100(14), 8086-8091
- [3] Hironaka, A. (2002). The globalization of environmental protection: The case of environmental impact assessment. *International Journal of Comparative Sociology* 43(1), 65-78
- [4] E. Holden K. Linnerud. The sustainable development area: satisfying basic needs and safeguarding ecological sustainability. *Sustainable Development* 2006, Vol. 15, Issue 3, 14
- [5] O. E. Sala, F. S. Chapin, J. J. Armesto, E. Berlow, J. Bloomfield, R. Dirzo, R. Leemans, (2000), Global biodiversity scenarios for the year 2100. *Science* 2000, no 287(5459), 1770-1774
- [6] B. Worm, E. B. Barbier, N. Beaumont, J. E. Duffy, C. Folke, B. S. Halpern, E. Sala. Impacts of biodiversity loss on ocean ecosystem services. *Science* 2006, no 314(5800), 787-790
- [7] L. Fahrig. Effects of habitat fragmentation on biodiversity. *Annual Review of Ecology, Evolution, and Systematics* 2003, no 34(1), 487-515
- [8] K. J. Gaston. Global patterns in biodiversity. *Nature* 2000, no 405(6783), 220

- [9] D. E. Ellis. Sustainable remediation white paper - Integrating sustainable principles, practices, and metrics into remediation projects. *Remediation Journal* 2009, Vol. 19, Issue 3, 25
- [10] R. D. Morgenstern, W. A. Pizer, J. S. Shih. The cost of environmental protection. *Review of Economics and Statistics* 2001, no 83(4), 732-738
- [11] W. Douglas, B. Emerson, X. Wang, C. Yang, Z. Ding. Biodiversity soup: metabarcoding of arthropods for rapid biodiversity assessment and biomonitoring. *Methods in Ecology and Evolution* 2012, no 3(4), 613-623.
- [12] P. Taberlet, E. Coissac, F. Pompanon, C. Brochmann, E. Willerslev, Towards next-generation biodiversity assessment using DNA metabarcoding. *Molecular Ecology* 2012, no 21(8), 2045-2050
- [13] C. Kolstad, C. Intermediate Environmental Economics: International Edition. *OUP Catalogue* 2011, p. 112.
- [14] Chapin, F. Stuart, et al. Consequences of changing biodiversity. *Nature* 2000, 405, p. 234.