The European Proceedings of
Social & Behavioural Sciences
EpSBS

Future Academy

ISSN: 2357-1330

https://dx.doi.org/10.15405/epsbs.2018.12.124

RPTSS 2018
International Conference on Research Paradigms Transformation in Social Sciences

ECONOMIC EVALUATION OF FUNGAL RESOURCES AS PART OF REGIONAL NATURAL RESOURCE POTENTIAL

M.A. Safonov (a)*.
*Corresponding author

(a) Orenburg state pedagogical university, Sovetskaya St., 19, Orenburg, Russia, safonovmaxim@yandex.ru, +79058886094

Abstract

Biological resources are the part of common natural resource potential of one or another territory. Rational use and efficient management of the potential of biological resources is possible only at the base of the study of qualitative and quantitative indicators of different types of resources and their versatile objective assessment. Objective data on the value of the resources can be used for optimization of environmental impact assessment of the industrial objects. The article discusses approaches to economic assessment of potential biological resources by the example of afungal resources. The total economic value of mycobiota includes the cost of the direct use, indirect costs, the value of deferred alternatives, as well as the value of disuse (value of existence). The results of the assessment of economic, environmental and social functions of fungal biota, including deals with economic effect from measures on the conservation of species diversity of fungi in the region are given. According to approximate estimations, the total economic value of the resource potential of regional mycobiota is approximately 11.6 billion rubles/year.

Keywords: Economic assessment, resource potential, fungal resources.

https://dx.doi.org/10.15405/epsbs.2018.12.124
Corresponding Author: M.A. Safonov
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

1. Introduction

Economic development depends on many factors, one of which is the natural resource potential of the region or country. One of the key points of forecasting economic development is an objective measuring of the state of the region's natural resources and their economic evaluation. The approach to nature as a part of natural capital, which has its own value and can be exploited for profit or must be preserved in order to minimize losses, is becoming increasingly common in the world (Barbier, 1989; Constanza, 1991; Constanza & Daly, 1992; Harte, 1995; Pearce & Turner, 1990).

The economic aspect of assessing the nature resource potential of the territory or the resource potential of separate components of biota makes it possible to assess the economic efficiency of measures to regulate and optimize the natural environment and its components, to assess the profit or loss from the exploitation of resources and it is the basis of the financial and economic mechanisms of regulating the use of resource potential.

Biological resources represent a specific group of natural resources: they are exhausted and only partially renewable. Unlike other groups of natural resources (minerals resources, natural sources of energy, etc.), biological resources are relatively little studied in terms of qualitative and quantitative characteristics, which makes difficult the objective assessment of their economic value.

There are some various approaches to assessing the resource value of biological objects based on the assessment of different aspects of their functioning and use. Some biological resources have operational value (hunting resources, non-timber forest resources, etc.) and therefore are a subject of economic assessment while others have indirect significance for human life and economic activity. This makes it necessary to use special approaches to this type of natural resources.

2. Problem Statement

In recent years, despite the development of technology, there has been a global trend of increasing the share of biological resources using. Meanwhile, the share of bio-resources, the objective value, which the human being installed, remains very small. In relation to the exploited and potentially exploited species ecology, biology, economic reserves and withdrawal limits are poorly studied; effective recycling technologies have not been developed. As a result, up to date, the conditions for their effective operation and recovery remain poorly understood.

The great importance of biological resources as a potential for economic development defines the interest in the study of natural resources by specialists in botanical, geographical, soil, zoological resources (Brown, Pearce, Perrings & Swanson, 1993). The main directions of these studies are to identify the value of natural objects; conducting an objective assessment of the stocks of certain species or the importance of their environmental functions; development of methods of rational use, conservation and restoration of resources. Approaches to solving these problems differ depending on the form of use of resources and their belonging to a particular kingdom of nature (microorganisms, fungi, plants, animals).

The specificity of resource potentials of separate components of biota is manifested through a plurality of their functions, which can be divided into three groups: environmental, economic, social (Holling, 2001).

https://dx.doi.org/10.15405/epsbs.2018.12.124
Corresponding Author: M.A. Safonov
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

The ecological component of bioresources potential includes all the functions of biota or its components that determine the functioning of ecosystems (i.e. they are the resource-supporting components of the ensuring the existence of the human environment).

The economic function of biota is determined by the availability of exploited or potentially exploited species. The first is currently a source of profit, the second group comprises resources that are not currently exploited because of their little knowledge or lack of effective technologies for their use. In particular, they include the resources of several medicinal plants and fungi used mainly in folk medicine but are not official means of income.

The social functions of the resource potential are derived from the first two functions, since the public interest in natural objects is mainly determined by the possibility of their exploitation or use as elements of recreational value of the territory.

Thus, speaking about the determination and evaluation of the resource potential of certain groups of organisms, it is necessary to use two complementary indicators: ecosystem and economic values. Comprehensive assessment of all types of biological resources is a tool for objective forecasting of economic and environmental development of the region.

In the South Urals (Orenburg oblast, Russia), biological resources are poorly understood. To test an integrated approach to the evaluation of these resources, the resources of macromycetes fungi of the Orenburg region were selected. This group of organisms have high species diversity and are numerous in the region (Safonov, 1999); fungi are actively consumed by the population, which makes it a convenient object for assessing the resource potential**.**

3. Research Questions

The following questions are discussed in the article:

1. The study of diversity and distribution patterns of macromycetes (basidiomycetes) of the region.
2. Evaluation and testing of approaches to assessing the economic, environmental and social functions of fungal resources.
3. Assessment of the economic value of the regional resources of macromycetes to determine their potential contribution to the total cost of the natural resource potential of the territory and to substantiate the need to monitor the state of this part of the biota**.**

4. Purpose of the Study

The purpose is to give an economic assessment of the economic, environmental and social functions of the region's fungi resources to use the results as a tool for optimizing environmental management.

5. Research Methods

Studies of species diversity and fungal resources were carried out by conventional methods (Hansen & Knudsen, 1992; Hansen & Knudsen, Corfixen, 1997; Ryvarden & Gilbertson, 1993, 1994). In assessing the value of resources, a methodology to estimate the direct cost of resources, based on the assessment of reserves was used; environmental functions were assessed at the base of the equivalence of the cost of activity of the reducents to the value of carbon dioxide deposited by plants; measuring the cost of existence is based on the current system of fines for the destruction of biodiversity and using the approach "willingness to pay" ("ready to pay") (Costanza et al., 1997; Hannon, 2001; Martín-López, Montes & Benayas, 2007).

6. Findings

6.1. Economic valuation of direct use

The cost of direct use of fungal resources is determined by the availability of exploited or potentially exploited species. The economic value of fungi is determined by the possibility of consumption of their fruit bodies. The number of species of fungi with edible fruit bodies is large enough, but not all species are gathered by population. So, about 30% of the total number of species of basidiomycetes noted on the territory of the Orenburg region, are edible, but only 40% of them are collected by the population. Also, many fungi are cultivated or can be introduced into the culture.

Many species of fungi have potential economic value. These are species that are not used by humans due to their little knowledge or lack of effective technologies for their use. These include, in particular, fungi used mainly in folk medicine and a small number of species used in official medicine. On some data (Wasser, Sytnik, Buchalo, & Solomko, 2002), many basidiomycetes contain bioactive polysaccharides found in 651 species from 182 genera of higher basidiomycetes. They are particularly effective in the prevention of oncogenesis, showing direct antitumor activity and preventing the development of tumor metastases. More than 17% of the total number of species noted in the mycobiota of the Southern Urals have medicinal properties. These include, in particular, *Kuehneromyces mutabilis (Schaeff.: Fr.) Sing.et A. H. Sm., Laetiporus sulphureus (Bull.: Fr.) Murrill, Piptoporus betulinus (Bull.: Fr.) P. Karst., Pleurotus ostreatus (Jacq.: Fr.) Kumm.* et al. (Safonov, 2005).

The estimation of the direct cost of fungal resources is based on the analysis of the market value of the collected biomass and the products of its processing. The value of direct use of fungal resources, i.e. the cost of fungi collected and consumed by the population of the region can be estimated with the help of the following formula:

$C_{du} = F_a \times P_a \times MP_a$

where C_{du} – cost of direct use of regional fungal resources; F_a – forest area of region (ha); P_a – average productivity of fungi in regional forests (kg/ha/year); MP_a – average market price (rub/kg). According to calculations, the cost of direct use of all edible fungi of the Orenburg region is 915.25 million rubles /year, based on the average price of mushrooms 250 rubles/kg.

Speaking of the economic importance of mushrooms, it is necessary to note not only the possible positive but also negative aspects of their life, which can lead to economic losses or have a negative impact on the person. Primarily that concerns to poisonous macromycetes such as *Amanita virosa Lam.: Secr., Hypholoma fasciculare (Huds.: Fr.) Kumm., Amanita pantherina (DC: Fr.) Kromb., Amanita muscaria (L.:Fr.) Hook* et al. (Safonov, 2005).

Another aspect of the functioning of fungi, leading to economic losses - the mycogenic wood destruction. A group of wood-destroying basidiomycetes are quite numerous and mainly includes aphyllophoroid and also a number of agaricoid fungi. The negative effect of the activity of wood-

https://dx.doi.org/10.15405/epsbs.2018.12.124
Corresponding Author: M.A. Safonov
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

destroying fungi is determined by the destruction of treated wood and wooden structures and by causing root and stem rot of living trees. In the Orenburg region the most active pathogens are *Heterobasidion annosum (Fr.) Bref., Porodaedalea pini (Brot.:Fr.) Murrill, Fomes fomentarius (L.: Fr.) Fr., Phellinus igniarius Niemela, P. tremulae (Bond.) Bond.& Boris., Polyporus squamosus Huds.:Fr., Fistulina hepatica (Schaeff.:.Fr.) Fr., Fomitoporia robusta (P.Karst.) Fiasson & Niemela, Inocutis dryophila (Berk.) Fiasson & Niemela* (Safonov, 2005).

6.2.Economic evaluation of mycobiota ecological functions

The ecological component of biological resource potential includes all the functions of biota or its components that ensure the functioning of ecosystems. For fungi, these functions first of all are represented by their activity as reducents. The evaluation performed by the mycobiota ecosystem functions is the sum of the values fulfilling certain functions – destruction, production, regulation and indication.

Probably the cost of implementation of ecosystem functions makes a significant contribution to the total value of mushroom resources. In the world practice, the calculation of such value of biological resources is based on the assessment of participation in the deposition of carbon dioxide by plants, as well as taking into account the economic effect of recreation (Dixon, Scura, Carpenter & Sherman, 2013). Destruction of wood by fungi can be considered as an inverse process of the deposition of carbon dioxide, i.e. from an economic point of view, it should be assessed as unprofitable. However, the destructive activity of fungi ensures the supply of the ecosystem of a number of compounds in a relatively easily digestible form, essential for plant growth, i.e., they are the condition of carbon sequestration in forest ecosystems in the next period of time. Thus, the activity of the system of reducents is an integral part of the system of circulation of carbon and other elements in ecosystems. Consequently, the activity of the system of reducents can be indirectly estimated by taking into account the amount of carbon deposited by the forest ecosystem.

According to data (Lefsky et al., 2002), the annual growth of wood and green mass in broad-leaved forests is accompanied by carbon deposition in the amount of 3045 kg/ha. The conversion of deposited carbon by the amount of carbon dioxide gives an amount equal to 11.17 tons of CO_2 /ha. According to the Kyoto Protocol, the cost of depositing one ton of carbon dioxide is USD $10-50. In this case, the indirect cost of fungi in forest ecosystems will be equal to:

$$C_i = M_{CO2} \times F_a \times C_{CO2},$$

where: C_I-indirect cost of fungi of region; M_{CO2} – the amount of carbon dioxide deposited in the annual increase (tons); F_a-forest area of region (ha); C_{CO2} – cost of 1 ton of deposited CO_2 according to Kyoto Protocol (USD $/ton). The cost of the existence of fungi in the forest ecosystems of the region can be estimated at 3.5 – 17.5 billion rubles / year.

6.3. Economic evaluation of social functions of mycobiota

Separate species, their communities and the habitat as a whole can be perceived as a public necessity; they can be assessed for their beauty and as a result for increasing the recreational potential of the territory. The criterion of aesthetic value is often criticized because of the subjectivity, since aesthetic appeal has the personal features (De Leo & Levin, 1997).

Aesthetic value is one of the components of the cost of non-use, which also includes the cost of existence and the cost of inheritance. The cost of existence reflects the benefits of the individual or society derived only from the knowledge that the goods or services exist. In assessing the cost of existence, simplified economic approaches based on the concept “willingness to pay” are used (Martín-López, Montes & Benayas, 2007). At the same time, sociological methods (questioning or population survey to assess the resource potential) or indirect methods such as the method of transport and travel costs, reflecting the value of objects, are used. Usually, the cost of non-use is calculated for natural complexes but we used the same sociological methods to obtain information about the cost of the existence of fungi in the region.

According to data from Russia (Bukvareva et al., 2015), the willingness to pay for the existence of natural complexes in our country is about $ 1 /year per person. The allocation of readiness to pay for fungi from the total aesthetic value of natural complexes is difficult, since the “willingness to pay” includes not only the aesthetic value of mushrooms, but also their potential consumer utility.

We conducted a survey to find out “willingness to pay” of the population of the Orenburg region for the conservation of natural resources. The results of the study showed that the majority of respondents (74.8 %) positively assess the possibility of their own financial contributions to the conservation of natural resources of the region. Respondents were also asked to evaluate the idea of making their own funds available to preserve the most productive habitats of fungi in their residence areas. More than half of respondents (66.4 %) agreed to invest personal funds in the conservation of fungal resources in the region.

The willingness of the population of the region to pay for the conservation of fungal resources can be estimated by the following formula:

$$C_{ae} = P \times R \times C$$

where C_E - esthetic cost (”ready to pay"); P – population size; R – proportion of residents, ready to pay (%); C – annual contribution (rubles /year). The aesthetic value of fungal resources in the region is approximately 146.1 million rubles / year.

To the cost of existence of the species own value is also applied. From the point of view of species own value, each species has its own true value, which is independent from any direct or indirect utility for people (Callicot, 1986; Naess & Rothenberg, 1989). From a biological point of view, each species of fungi is a product of long-term evolutionary development, which determines the treasure of each species. However, there are still no well-developed approaches to the real valuation of biodiversity (Barbier, 1989). This is primarily due to the difficulties encountered in assessing the benefits of the existence of individual species. Only several types of biodiversity has its own economic value – they can be sold and measured through the direct use of certain species or ecotourism.

One of the possible forms of partial economic evaluation of species diversity – valuation of rare species through the determination of avoided damage to these species based on forfeits for damages. The value of the prevented damage to rare species is determined by the formula:

$$D_A = \sum_{i=1}^{N} (No_i \times H_i) \times K_R$$

where: D_A - assessment in monetary form of the size of the prevented ecological damage, thousand rubles, i=1,2,3,..., N - quantity of species; No_i – total number of individuals of the i-th species living in this territory; H_i – fee for damage to this species, rubles; K_R – regional coefficient of biodiversity for the Orenburg region.

The coefficient of regional diversity for the Orenburg region is 8.1; tax is for the destruction or illegal collection of each sample of the fungus, according to the order of the Ministry of natural resources of Russia of 04.05.1994, № 126 – 0.15, on minimum wage. Based on the above-mentioned conditions and the number of rare fungi species on the territory of the Orenburg region, the approximate value of its own value species is only 31.6 thousand rubles/year**.**

7. Conclusion

Thus, the cost of the resource potential of regional biota of fungi includes the cost of the used resources, the cost of conservation of biological species, the aesthetic value of mycobiota (willingness to pay). A large part of the economic value of the resource potential is represented by the value of indirect use, since in nature there is no native alternative to the mycobiota on the specifics and intensity of the perform ecosystem functions. Taking this into account, the total value of the region's mycobiota resources is approximately 11.6 billion rubles/year.

Effective resource estimation of biota and, in particular, the biota of fungi, should combine the two approaches: the economic, based on the calculation of real and potential profit (in monetary form) from the use of any part of the biota; environmental, based on the recognition of the resource values of each of the elements of biota and aims to identify the relative value of the contribution of the individual components in the maintenance of the environment of human existence within a defined territory. This integrated approach enhances the objectivity of ongoing evaluation.

These data show that a comprehensive assessment of different aspects of the use and functioning provides a sufficiently high cost of the regional fungal resources. The results of the calculations can be used for the economic assessment of the damage caused by man-made activities and decision-making on the rationalization of environmental management**.**

References

Barbier, E. B. (1989). *Economics, Nature-Resource Scarcity and Development*. Earthscan Publications. London.

Brown, K., Pearce, D., Perrings, C., & Swanson, T. (1993). Economics and the Conservation of Global Biological Diversity. *Global Environment Facility Working Paper*, .2. Washington.

Bukvareva, E. N., Grunewald, K., Bobylev, S. N., Zamolodchikov, D. G., Zimenko, A. V., & Bastian, O. (2015). The current state of knowledge of ecosystems and ecosystem services in Russia: A status report. *Ambio*, *44*(6), 491-507.

Callicot, J. B. (1986). On the intrinsic value of nonhuman species. *The preservation of species*. Princeton Univeristy Press. Princeton, New Jersey, USA. 138-172.

Constanza, R. (1991). Ecological Economics: a research agenda. *Struct. Change Econ. Dyn.*, *2*, 335-342.

Constanza, R., & Daly, H. E. (1992). Natural capital and sustainable development. *Conservation Biology*, *6,* 37-46.

Costanza, R., d'Arge, R., De Groot, R., Farber, S., Grasso, M., Hannon, B., ... & Raskin, R. G. (1997). The value of the world's ecosystem services and natural capital. *Nature*, *387*(6630), 253.

De Leo, G.A., & Levin, S. (1997). The multifaceted aspects of ecosystem integrity. *Conservation Ecology* [online] 1(1): 3. URL: http://www.consecol.org/vol1/iss1/art3.

Dixon, J., Scura, L., Carpenter, R., & Sherman, P. (2013). *Economic analysis of environmental impacts*. Routledge.

Hannon, B. (2001). Ecological pricing and economic efficiency. *Ecological Economics*, *36*(1), 19-30.

Hansen, L., & Knudsen, H. (Eds.). (1992). *Nordic Macromycetes, 2. Polyporales, Boletales, Agaricales, Russulales*, *2,* Nordsvamp, 382.

Hansen, L., Knudsen, H., & Corfixen, P. (1997). *Nordic macromycetes: heterobasidioid, aphyllophoroid and gastromycetoid basidiomycetes*, 3, Nordsvamp, 383-620.

Harte, M. J. (1995) Ecology, sustainability, and environment as capital. *Ecological Economics*, *15,* 157-164.

Holling, C. S. (2001). Understanding the complexity of economic, ecological, and social systems. *Ecosystems*, *4*(5), 390-405.

Lefsky, M. A., Cohen, W. B., Harding, D. J., Parker, G. G., Acker, S. A., & Gower, S. T. (2002). Lidar remote sensing of above‐ground biomass in three biomes. *Global ecology and biogeography*, *11*(5), 393-399.

Martín-López, B., Montes, C., & Benayas, J. (2007). The non-economic motives behind the willingness to pay for biodiversity conservation. *Biological conservation*, *139*(1-2), 67-82.

Naess, A., & Rothenberg, D. (1989) *Ecological community and lifestyle*. Cambridge University Press, Cambridge, UK.

Pearce, D., & Turner, R.K. (1990) *Economics of Natural Resources and the Environment*. Harvester Wheatsheaf, Hemel Hampstead.

Ryvarden, L., & Gilbertson, R. L. (1993). *European polypores: Part 1: Abortiporus-Lindtneria*. Fungiflora A/S.

Ryvarden, L., & Gilbertson, R. L. (1994). *European polypores: Part 2: Meripilus-Turomyces*. Fungiflora M/T, 394-743.

Safonov, M.A. (2005). *Bases of management of resource potential of biota of xylotrophic fungi*. Yekaterinburg, Ural Branch of RAS.

Wasser, S.P., Sytnik, K.M., Buchalo, A.S., & Solomko, E.F. (2002). Medicinal mushrooms: Past, present and future. *Ukrainian Botanical Journal*, *59,* 5. 499-524.