

# Landscape and ecological optimization of nature management in the Tunkinsky National Park of the Republic of Buryatia

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**Abstract.** The article considers the processes of development of agriculture in the Tunkinsky National Park as its territory coincides with the Tunkinsky district of the Republic of Buryatia. Trends in the formation of the ecological and economic characteristics of the territory and ecosystem components were analyzed. Component-by-component and cumulative values of the cost of direct and indirect use of ecosystem services in the study area were calculated. Forestry, nature conservation, recreational and agricultural nature management are the main types of the contemporary structure of nature management of the national park. According to our estimations, the average cost of ecosystem services in the park is \$35 per 1 ha per year. The calculations performed show not only the ecological but also the economic value of the ecosystems of the Tunkinsky National Park.

## 1 Introduction

At present, the issues of nature protection and environmental management are becoming increasingly important. The development of permitted economic activities in specially protected natural areas (if properly organized and managed) can make a significant contribution to nature protection, environmental education of the local population and the development of environmental ethics among tourists, as well as to the socio-economic development of the region.

The pressure on nature has become enormous because of technological progress. We can state a systemic crisis of nature management, which resulted in the existing environmental, economic and social problems. The key to their solution is in the assessment of the socio-economic efficiency of various types of nature management [1].

The boundaries of the Tunkinsky National Park completely coincide with the boundaries of the Tunkinsky District of the Republic of Buryatia, therefore, the nature management of the area should be developed in accordance with the environmental legislation provided for economic activities in the national park. On the one hand, such situation requires the protection of nature and, on the other hand, the development of economic activity. The population of the district is 20,795 people. The population consists of the Buryats (61%), the Russians (37%), the Soyots (0.4%), the Tatars, the Ukrainians,

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the Belarusians, and the Chuvashs. The average density is about 1.8 person per/km<sup>2</sup>. There are only 14 rural settlements in the district with the center in the village Kyren. About 80% of the population are employed in agriculture. Currently, about 13% of the total area is suitable for agriculture; the main industry is cattle breeding.

The area under study has long been a place of traditional use of natural resources. People settled on the banks of lakes and rivers. They hunted, fished, gathered wild plants there, and bred aboriginal cattle. In the Soviet years, agriculture and recreational activities developed due to active tourism development. There appeared the problem of understanding the vector of evolution of nature management [2] on a specific territory, its correspondence to modern economic management and possible control of future interaction of nature, economy and population.

The study carried out can be considered as an interdisciplinary one, reflecting one of the main trends in the development of modern science.

## 2 Materials and methods

The result is prepared on the basis of expeditionary research data, as well as on the materials of generalization and analysis of laws and legislative acts, published sources of the Faculty of Geography of Moscow State University, the Buryat Institute of Nature Management, the Irkutsk Institute of Natural Resources of the Siberian Branch of the Russian Academy of Sciences, the Ministry of Natural Resources of the Republic of Buryatia, the administration of the village Arshan, local history museums, personal archival documents of local residents, etc. Also we used cartographic materials (Figure 1), forest inventory; forest management plans; schemes for forestries, districts, materials on recreation [3]; materials on the issuance of licenses for hunting animals; rules related to the harvesting of forest resources and the collection of medicinal plants, which are approved by the order of the Federal Forestry Service for the Republic of Buryatia, "economic calendars" of old indigenous people, survey data from hunters, local population, administration workers, etc. Space images of the Aster, Spot, Landsat survey systems were used; they were processed in the SASPlanet program.



**Fig. 1.** Tunkinsky National Park on the map

The following research methods were used: ecological-economic, comparative-descriptive, historical-geographical, sociological, ethnological, cartographic, toponymic, statistical.

To optimize nature management structure and resolve conflicts of nature management, it is necessary to have an idea of the ecological and economic component of the territory

and ecosystems. The confrontation between the "ecological" and "economic" contradictions of nature management can be resolved by conducting the ecological and economic assessment of the territory. Having identified the most valuable components of the ecosystem and areas of the territory for various types of nature management, we can draw some conclusions about its optimization in order to create harmonious relationship between man and nature.

### 3 Results

The procedure for the ecological and economic assessment of the territory was preceded by the historical and geographical analysis of nature management, which made it possible to trace the long-term dynamics of landscapes because of the interaction of natural and anthropogenic impacts - such a study is necessary to develop proposals for its improvement. The analysis of the information allows us to say that over a long period a kind of mixture of cultures of different peoples has formed in the park. They also differ from each other in the features of nature management, which has slightly changed some of the natural complexes of the study area and has significantly preserved their natural potential for future generations.

Based on the concept of total economic cost [4], component-by-component and cumulative values of the cost of direct and indirect use of ecosystem services in the study area were calculated. The following direct services were assessed: operational hunting and fishing resources, wild plants, recreational and pasture resources. The unit cost of environmental services for various natural-territorial complexes was calculated; the average unit cost of environmental services in the park only for calculated services is \$35 per 1 hectare per year. Based on the data obtained, the map was created that allows identifying areas with the highest and lowest unit cost of ecosystem services. Thus, in the park, the unit cost of direct services is maximum in the forest-steppes and steppes, which have pasture resources for cattle, but they are limitedly provided with hunting resources, as well as in cedar forests, where there are big opportunities for collecting wild plants (primarily pine nuts) and harvesting valuable commercial species of animals. Valleys of rivers and streams have a high unit value (fishing, hunting, recreational resources). High unit cost is also in the forest-steppes and steppes.

The analysis of the collected materials made it possible to get an idea of the modern structure of nature management, the main types of which are forestry, nature conservation, recreation and agriculture. The conflicts of nature management between nature conservation, agriculture, residential areas and areas of resource harvesting were identified.

The recreational nature management develops in the warm season in the settlements located near mineral water sources (arshans). The analysis of the information allowed us to assume that the prospects for the development of the region may be associated with agriculture, which can be effective, and its products will be in good demand, because the are environmentally friendly.

Agricultural nature management has been one of the leading types of nature management in the region for many years, despite the fact that it is limited by natural conditions, primarily climatic and orographic. The study area can be attributed to the natural-agrarian system of development of meat and dairy and beef cattle breeding, herd horse breeding, meat and wool sheep breeding with limited agriculture [5].

At present, this type of economic activity is developed only in the river valleys and in the vicinity of settlements, the locals of which breed cows, horses, and, to a lesser extent, yaks and khaynaks (hybrids of a cow and a yak); there are crops of fodder crops (rye and buckwheat), there are hayfields in the river valleys and along the shores of lakes. The

residents grow vegetables in their gardens. Near Tunka there are farms that grow vegetables and grains.

Hayfields and pastures take the largest part of the land, the smallest part is arable land (3-4%). The pasture productivity ranges from 3 to 6.8 centners per hectare. Pastures along the rivers are used unevenly: they are used most intensively only near settlements. Natural lands in the forest zone remain almost unused.

## 4 Discussion

Cattle breeding predominates in the structure of nature management. Unfortunately, during the Soviet period (and even earlier), instead of developing nomadic cattle breeding, imported Simmental cattle and fine-fleeced sheep were introduced, which replaced the native (Buryat) coarse-haired sheep and cattle. These animals were not adapted to the harsh local conditions, so they did not achieve the high productivity indicators. After Perestroika and new opportunities for free development, people began to realize the wrong practice of breeding imported animals that require stall keeping and abundant feeding, which is very expensive [6]. Therefore, in the livestock breeding of the region, there is a desire for its significant reconstruction, aimed at maximizing the use of local resources and the skills of local people.

As an example, we can consider the neighboring Okinsky district, where there are territories similar in natural conditions to the Tunkinsky district. There they decided to revive the breeding of the Okinsky yaks (sarlyks) and Khaynaks. It was also decided to conduct an experiment on breeding a special breed of pigs – Mangalitskaya as it is profitable to grow them here. In the Okinsky district, unlike the Tunkinsky district, there is a meat processing enterprise that works on local products, there is also a dairy processing enterprise. Despite the remoteness of this region from consumer centers, its products are in great demand: they are transported to Irkutsk, Ulan-Ude and other settlements. In the Tunkinsky district, there was previously a milk processing plant in Kyren, but it was closed in the 1990s. Currently, there are no enterprises for processing agricultural products here, although the prospects for creating such an enterprise are great.

The strategy for the development of nomadic livestock breeding as a way to increase the production of livestock products with a lower cost includes the following tasks: increasing the number of pasture animals at the expense of nomadic animals (horses of native breeds, yaks, deer, coarse-haired and semi-coarse-haired sheep); assessment of the state of pastures in each region and their capacity to determine the optimal number of pasture animals; creation of experimental farms for breeding nomadic animals and studying the experience of traditional cattle breeding [7].

For the rational use of pasture resources, it is required to establish the optimal density of animal grazing. Now, the greatest pressure on pastures occurs near settlements, while pastures far from settlements are used less frequently. The natural areas of mountains and forests remain almost unused. Available meadows and forest-steppe pastures are used unevenly.

Our calculations showed that the cost of pasture resources in terms of possible income from grazing Simmental cows in the region can be 136.404 million rubles per year. The following criteria are taken into account: the area of pastures, the number of farm animals currently grazing, the market value of one individual, and the average optimal rate of removal of animals from the livestock.

The calculation will be different for farm animals that can be classified as nomads. The basis of their existence is pasture forage. According to farmers' associations, more than 80% of the fodder base of nomadic (pasture) livestock is provided by natural and improved pastures, including 90-95% for sheep and beef cattle of nomadic breeds. If we take into

account that the part of the territory of the park is suitable for grazing native breeds of livestock, then the calculation of pasture resources will be as follows.

Yaks. The advantage of a yak (sarlyk) over "pedigreed" cows is its good adaptability to local natural conditions. The offspring obtained by hybridization of a yak with cattle is of great economic value. Hybrids (haynaki) are also well adapted to forage at any time of the year. It is believed that the Buryat breed of yaks (sarlyks) and their first-generation hybrids (2779 individuals) survived only in the Okinsky, Tunkinsky and Bauntovsky districts [8]. The amount of these animals is still decreasing, although yaks and haynaks may occupy a special "ecological niche" suitable for grazing cattle: in winter they can descend into the valleys and graze in the meadows of the foothills and along the river valleys, at this time of the year they are not competitive with cows, which are kept in barns all winter.

The calculations have shown that the possible income from keeping yaks and haynaks can be 6.976 million rubles per year. When carrying out these calculations, the following criteria were taken into account: the area suitable for grazing yaks and haynaks (according to the map of natural territorial complexes with the capacity and natural features of landscapes that we created), the rate of removal of animals from the livestock.

Herd horse breeding is one of the most promising branches of nomadic animal husbandry. Herd horse breeding almost does not require high costs for feed and maintenance. Local horses of the Mongolian breed and their crosses do not require stall keeping, they can graze on remote lands with forests, shrubs, high mountains, swamps, deep snow and on other places, which are not suitable at all for other types of domestic animals. The ecological and economic assessment carried out showed that the income from horse breeding can be about 23 million rubles per year (taking into account pasture resources, slaughter meat yield, the cost of 1 kg of horse meat and the rate of removal from the livestock).

The breeding of coarse-haired sheep is promising, as they are adapted to local natural conditions and do not require stall keeping. Currently, their number is not large, they are kept by local residents. It can also be effective to breed pigs of a special Mangalitsky breed, unpretentious to the living conditions, they can graze on pastures and do not require keeping in warm rooms.

In the study area, reindeer pastures are confined mainly to mountainous areas of slightly sloping leveling surfaces with stony-lichen, shrub-moss and lichen mountain tundra and with larch and less often fir-spruce woodlands with shrub-lichen cover; as well as to the lower parts of the slopes, where pine-shrub-lichen forests are common. Published materials [9] were used in the calculations, and the areas of pastures associated with certain natural terrestrial complexes were calculated. The reindeer capacity of different types of pastures (summer, winter, autumn-spring) was taken into account. Since only natural forage lands are used to obtain reindeer breeding products, the hypothetically possible reindeer breeding products can be estimated as the equivalent of grazing ecosystem services [8]: the possible total income from reindeer breeding can be 3.85 million rubles for the park per year.

Thus, preliminary calculations showed that the total income from non-nomad livestock breeding in the park can be about 170 million rubles, and the rational use of grasslands, based on the experience of traditional livestock farming, will increase the production of cheaper products by 2.5-3.0 times.

## 5 Conclusion

The analysis of the natural conditions and resources of the territory, nature management (both modern and historical aspects), the ecological and economic assessment of the ecosystem services of the park showed that in order to improve the socio-economic and environmental situation and resolve conflict situations, the following ways of optimizing

nature management can be proposed. They are connected with the revival of the traditional ways of economy, which can play a significant role in the conservation of nature and the resolution of conflict situations [10]. Their development can be promising on condition of state support, in particular:

- Development of regulated agricultural nature management with the use of predominantly native species of livestock (nomads) in the steppe, forest-steppe and tundra natural terrestrial complexes; support and development of farms.
- Introduction of changes in the functional zoning of the park and allocation of areas of regulated traditional nature management of the Evenks and the Soyots within the existing recreational zone of the park in mountains and foothills with mountain tundra and with larch and fir-spruce woodlands. The development of this type of nature management can be possible and effective on the basis of partnership between the state and tribal communities based on the experience of adaptive traditional nature management based on innovative principles.
- Development of regulated recreational nature management: creation and provision of proposals for the development of new types of recreation for the park, regulated eco- and ethno-tourism, rural tourism.

Thus, such an assessment helps to show not only the ecological, but also the economic value of ecosystems, which was done on the example of the territory of the Tunkinsky National Park. Conducting an ecological and economic assessment of the territory helps to develop proposals for the rationalization of nature management in order to create harmonious relations between nature and man in such a multifunctional specially protected area as a national park.

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