ORIGINAL ARTICLE

Ensuring a rational nature management in the transition of land use onto the basin principles and organization of large nature protection areas

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Abstract

Background and Objective: It is proposed to use the basin concept of organization of the territory as a preliminary stage of a detailed design of the functional zoning of the natural park. The principles of creating natural parks are substantiated. **Materials and Methods:** The projects for basin nature management in the Vorskla and Gotnya river basins in the Belgorod region were implemented within the framework of the concept of the basin nature management, which was approved by order of the Government of the Belgorod Region No. 166-rp dated 27.02.2012. **Results:** The project works on the basin-based nature management and functional zoning of the natural park were carried out on the basis of integration of geoanalytical procedures with spatially distributed information using ArcGIS. The developed measures will improve the ecological stability of the area of the river Vorskla and the River Gotnya, and in the natural park «Hotmyzhsky» the following functional zones have been created: Reserved, specially protected, recreational, cognitive tourism, protection of historical and cultural sites, servicing of visitors, and economic purposes. **Conclusion:** The application of basin principles of organization of the territory allows optimizing the structure of the land resources of the territory, improving its ecological stability, and outlining the main functional zones, among which may include nature parks.

Key words: Catchments, GIS-technology, land use planning, protected areas

INTRODUCTION

Overcoming the conflict between the biosphere and humanity should be the leitmotif of the world strategy for introducing energy-efficient, resource-saving and environmentally friendly technologies and industries.[1] The task of territorial planning for the purpose of a rational nature management is solved by different methods, but the basin approach to nature management and the concept of basin sustainable development have clear advantages.[2,3] In the natural sciences, the integrity of basins is viewed through the prism of their natural organization and linking processes.[4] When solving the problems of the territorial planning of lands, it is important to find the optimum between the established practice of nature management in the basins and the prospects for the development of the territory, the natural resource potential, measures for the reproduction of natural resources and for ensuring the environmental safety. In addition, a regional network of nature protection areas should be established.[5,6]

Natural parks, especially for old and highly urbanized areas, are a key component of the natural and ecological

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framework of the region.[7,8] They allow combining the aims of protection and reproduction of biosphere resources, to perform the functions of stabilization and ecological restoration of degrading lands and may contribute to the improvement of ecological situations.[9] The concept of the development of natural parks of regional importance proposed by the authors is guided by the principles established on the basis of the rationale for creating and allotting specially protected natural territories (SPNT), as well as the mission entrusted to them to solve specific tasks defined by the Law of the Russian Federation No. 33-FZ "On SPNT" dated 14.03.1995.

MATERIALS AND METHODS

The projects for basin nature management in the Vorskla and Gotnya river basins in the Belgorod region were implemented within the framework of the concept of the basin nature management, which was approved by order of the Government of the Belgorod Region No. 166-rp dated 27.02.2012. The basin nature management concept is closely related to the projects and environmental programs of the Belgorod region, including the "green capital" project within the framework of the "greening and landscaping," with the projects of "creation of protective forest belts," "construction of springs," "500 parks of Belogorie" and "social development of rural territories of the Belgorod region" within the framework of the "district - park" provisions, and others.

The collection of geodata about the natural and socioeconomic potential of the catchments allows assessing the current ecological and economic situation. GIS provides an effective coordination of the received information. In such case, the GIS acts as a means of data analysis, modeling and designing, which contributes to the interdisciplinary integration of ecology, land management and economics of the agricultural production[4] and are used as a key tool for supporting decision-making.[10] Comprehensive geo-planning should ensure finding an optimum between the economic efficiency of land use types and the ecological stability of the territory.[11-13]

The understanding of the territorial organization of the basins of the Belgorod region, which were marked out on electronic maps on the basis of unified principles, was formed with the help of *ArcGIS 9.3* geographic information system.[14,15] The project works on the basin-based nature management were carried out on the basis of integration of geoanalytical procedures with spatially distributed information.

To create a nature management project for Hotmyzhsky nature park (NP) to 1:25,000 scale, the *ArcGIS 10.2* software package and the basin nature management methodology were used.[14]

RESULTS AND DISCUSSION

An assessment of the ecological stability[16] of the basins of the Gotnya and Vorskla rivers has shown that the territory is in an unstable state, the anthropogenic transformation being 67%. Using the developed methodology of the basin-based organization,[10,17] a new structure of the land resources was proposed, which provides for a decrease in the impact on the arable land through the introduction of soil-protecting crop rotations, grassed waterways, conservation of lands, and planting of forest belts. In addition, it provides for the restoration of forests, conservation measures in water protection zones of rivers, creation of specially protected natural areas, including natural parks, and wildlife micro-refuges.

The project works in the basins of the river Gotnya and river Vorskla made it possible to create an unevenly stable landscape while maintaining a high percentage of arable land, as well as to carry out general works on the organization of the land resources of the territory of Hotmyzhsky Park (10,662 ha) located on their territory. The general organization of the territory should be followed by the detailed design of individual territories.

When creating and organizing regional natural parks, the following principles should be observed:

a. The principle of organizing nature reserves and preservation of biodiversity (deriving from the provisions of Article 18 (2) of the RF Law No. 33 "On SPNT");
b. The principle of negation (inadmissibility) of the parcellation consists in the integrity, indivisibility and absence of fragmentation of the park area;
c. The principle of environmentally reasonable equilibrium, based on the use of scientifically-grounded planning organization of all zones, except for the nature reserve areas, where no planning elements that distort the appearance of the natural environment should be introduced;
d. The principle of self-sufficiency, investment attractiveness and inclusion into the economic space of the region, implying that NP should be unique platforms for the development of the environmental innovation business sector, social and environmentally responsible practices, innovative products in the field of organization of environmental economic activities;
e. The principle of management effectiveness, which presupposes the existence of own administrations for an effective management of the functioning of parks, will ensure their independence in both the legal and economic fields.

The basis for the initiation of the process for the creation of the "Hotmyzhsky" NP of regional significance was the results of studies that allowed establishing significant and unique natural, historical and cultural areas and objects on this territory. The studies conducted by the authors fully

revealed the nature protection, scientific, cultural, aesthetic, and recreational significance of this territory.

The project design works within the "Hotmyzhsky" NP resulted in the identification of seven internal zones [Table 1] and one external zone, which is necessary to limit the anthropogenic activity.

Over one-third of the "Hotmyzhsky" NP is occupied by economic zones, of which about 75% is arable land.

The use of geo-planning of arable lands makes it possible to apply ecology and landscape approaches to their arrangement and to introduce biological farming systems.[10,18-20]

The results of the project design of the "Hotmyzhsky" NP, which was based on the results of functional zoning and the concept of the basin nature management, are shown in Figure 1.

Figure 1: The results of designing a basin-based organization of nature management on the territory of "Hotmyzhsky" NP

Important nature is protecting, recreational and educational functions are performed by the specially protected and recreational areas, which along with agricultural lands became (after land resources planning), one of the dominant zones in terms of area: 33 and 24%, respectively [Table 2]. The allocation of functional zones allowed the use of adapted approaches for the development of detailed planning solutions.

Reorganization of the structure of acreages must facilitate the improvement of ecological stability and natural protection of the territory.[21] The geo-planning of the park through the allocation of functional zones will allow fulfilling the tasks that are set for the natural parks in the regional ecological framework.

The protection regime zone of the "Hotmyzhsky" NP, which should perform the reference and reserve functions, includes the best preserved and typical for natural conditions biocenoses, habitats of valuable species of animals and birds, habitats of rare plants, including those entered into the Red Data Books of the Belgorod Region and Russia. The northern part of the park and the continuous biological corridor of the river Vorskla's floodplain, which connects the "Forest on the Vorskla" reserve land with the closely situated land type areas, reflects not only the biological diversity of our region, but also fully discloses the unique landscape diversity of the geosystems of the river Vorskla basin.[21] Due to the weak anthropogenic transformations, it is these territories that were substantiated to be the reserve nuclei of the NP. The river valley landscapes along the section of the Vorskla river course from Hotmyzhsky to the border with the Grayvoron District reveal the functional connection of the relic marshes of lowland areas with the floodplain.[22] The ancient Russian city of Hotmyzhsky (area of 2.2 hectares) is included in the reserve zone, which will ensure the protection of the objects and territories of historical and cultural heritage. The main criterion for including archaeological sites into a specially protected area is the presence in the "Hotmyzhsky" NP of a unique historical landscape that was formed as a result of the interaction of the man and the nature (the rampart that surrounds the Hotmyzhsky settlement and the unfortified part of the city on the Western side).

The specially protected areas include pine woods, buffer zones of relic sphagnum bogs, and habitats of protected animals, including entomological refugees, zonal standard soil habitats, and rare and different age soils.

Cognitive tourism is based on hiking trails and routes that take into account the interests of recreationists, their age and cultural level, as well as the seasonality and capacities of the park itself. Important objects for showing and representation are the burial kurgans, religious buildings, the territory of the ancient Russian city and a number of monuments. The most interesting natural cognitive objects are springs, geological outcrops (residual outcrop), long-living trees, and habitat areas of avifauna. It is also the exemplary apiary of the "Krasivo" sanatorium that deserves the attention. The possibility of reconstructing a fragment of the Belgorod abatis line has certain prospects. On the high bank of the river Vorskla, near the walls of the Resurrection Church, with the purpose of preserving and developing interethnic cultural cooperation and strengthening of friendly ties, an interregional festival of Slavic culture "Hotmyzhskaya Autumn" is held since 1997.

The recreation and tourism zone within the natural park includes the main part of the tourist routes with vista points and weatherproof shelters, campfire sites with fuel supplies, signs, information boards, and accommodation schemes. The recreational zone included forest parks and special aesthetically attractive landscapes meeting the listed criteria,

Table 1: The structure of the functional zones of the "Hotmyzhsky" NP as a result of the geo-planning of the territory

Functional zone	Area	
	Ha	% of the park area
Nature reserve zone	230	2.16
Specially protected zone	3530	33.11
Cognitive tourism zone	93	0.87
Recreational zone	2580	24.20
Historical and cultural objects protection zone	30	0.28
Visitor servicing zone	180	1.69
Economic zone	4019	37.69
Total	10662	100
NP buffer zone	5400	

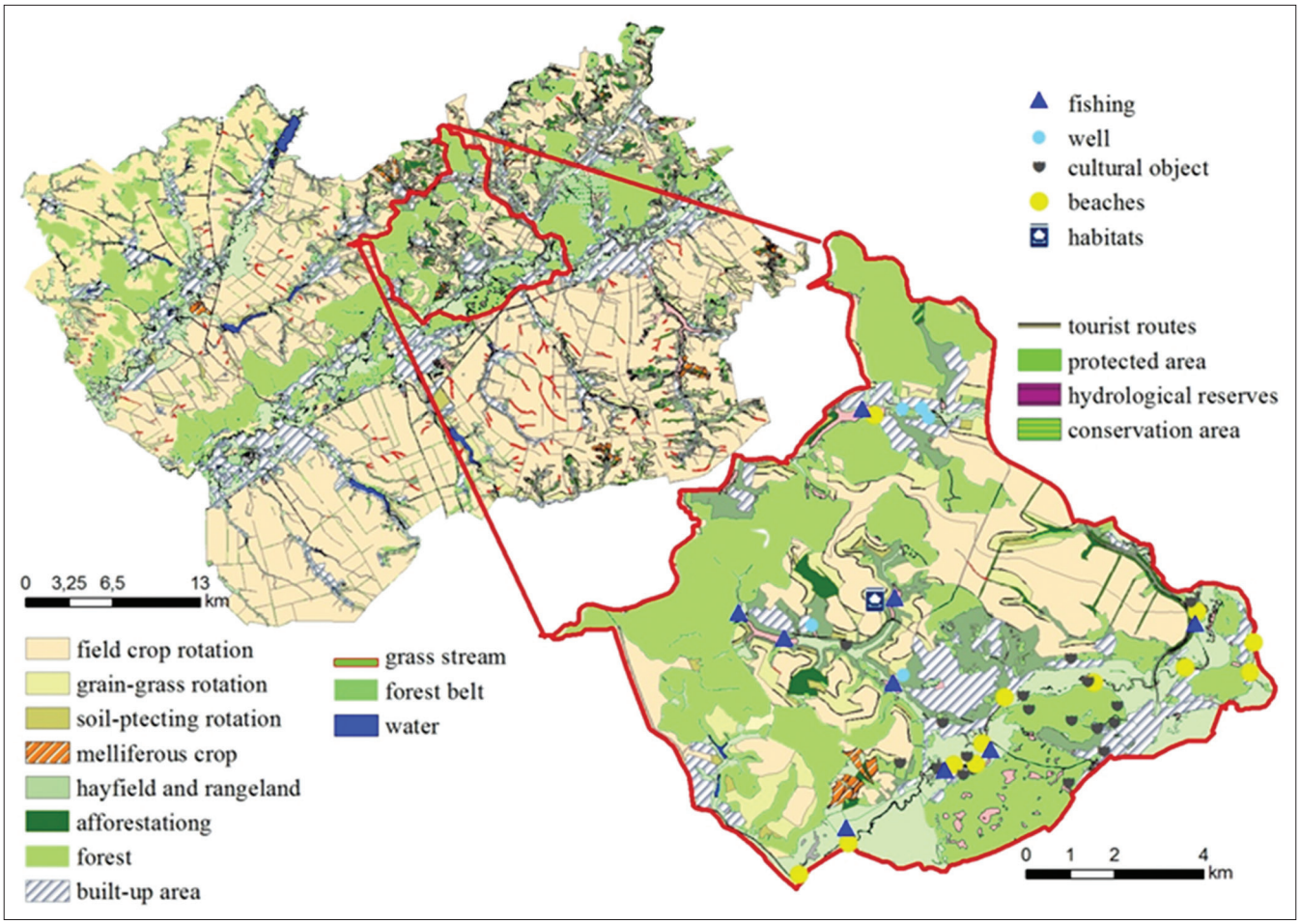

Figure 1: The results of designing a basin-based organization of nature management on the territory of "Hotmyzhsky" NP

coniferous forests with good passability. A number of systems of gullies and ravines are used to create fish ponds that are attractive to waterfowl as nesting and feeding sites.

The economic zone includes the territories of several settlements, arable land, pastures, private vegetable gardens, and fishery water areas. A reduction of the area of this zone is possible through a reduction in the portion of the arable land, the establishment of bee yards and grassed waterways, and the correction of the afforestation schemes.

The proposal to allocate a buffer zone for a 1km wide park will help protect the natural reserves and other functional zones against the anthropogenic impact from adjacent territories. The indicators of planning solutions are the factors of the environmental stability and natural protection, which fully reflect the positive trends in improving the ecology of the natural park and its environs to ensure a sustainable development of the region.

CONCLUSION

The application of basin principles of organization of the territory allows optimizing the structure of the land resources of the territory, improving its ecological stability, and outlining the main functional zones, among which may include NP. Detailed planning solutions for NP contribute to the sustainable social and economic development of the territory, the realization of the citizens' right to a favorable environment, the creation of a comfortable living space.

Summary

NP should be a valid component when planning the territory of river basins.

When arranging NP, it is necessary to abandon the «island» ideology of an absolute reserve, and the strategy of the isolated functioning of a SPNT. We should note the scientifically-justified orientation of the planning organization of the NP, which in the long-term brings the maximum ecological and socioeconomic effect. Functional planning is the basis for an effective territorial management strategy.

The regional NP is not only an element of the ecological networks but also the central link of the tourist and a recreational cluster of the region.

Table 2: The prospective structure of the land resources of the "Hotmyzhsky" NP (based on the planning results)

The structure of the land fund of the "Hotmyzhsky" NP	Area, ha	
	Actual (before 2002)	After implementation
Arable land, including crop rotations on the arable land	3311.4	2957.8
Field crop rotation	-	2070
Grain-grass crop rotation	-	787.9
Soil-protecting crop rotation	-	99.9
Bee yards	-	50.0
Grassed waterways	-	1.9
Garden and summer cottage parcels, vegetable gardens	10.9	10.9
Natural grass vegetation	65.5	76.7
Forage lands, including hayfields and pastures	1574.3	1708.7
Forests, including	3972.4	4105.0
Nature reserve areas and flora-and-fauna micro refugees	-	1433.6
Zonal reference oak groves	-	189.6
Specially protected pine woods	-	114.7
Fauna refuges	-	429.8
Entomological refuges	-	218.3
Habitat of medicinal herbs	-	481.2
Recreational forest and park tract	-	2538.8
Auto regeneration	-	13.3
Overall afforestation	-	119.3
Forest belts	101.8	110.3
Ponds and lakes, including protected ones	114.4	114.4
Bogs, including	443.2	458.2
Hydrological reserves	-	33.0
Water protection zones, including those on arable lands, forage lands, on forest, and tree and shrub vegetation	-	1037.4
Industrial and housing development lands	1068.1	1068.1
Occupied by populated areas	895.8	895.8
Cemeteries	4.8	4.8
Occupied by roads	133.9	133.9
Occupied by industrial facilities	33.3	33.3
Quarries	0.3	0.3
Total	10662	10662
NP buffer zone	-	5400.0
Environmental stability factor	0.21 Unstable	0.56 average stability
Natural protection factor	0.40 Critical	0.54 Tense

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