

POLARIZATION OF AGRICULTURAL LANDSCAPES AS A PATH TO ENVIRONMENTAL STABILITY: CASE STUDY OF BREST PALESSE

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Abstract

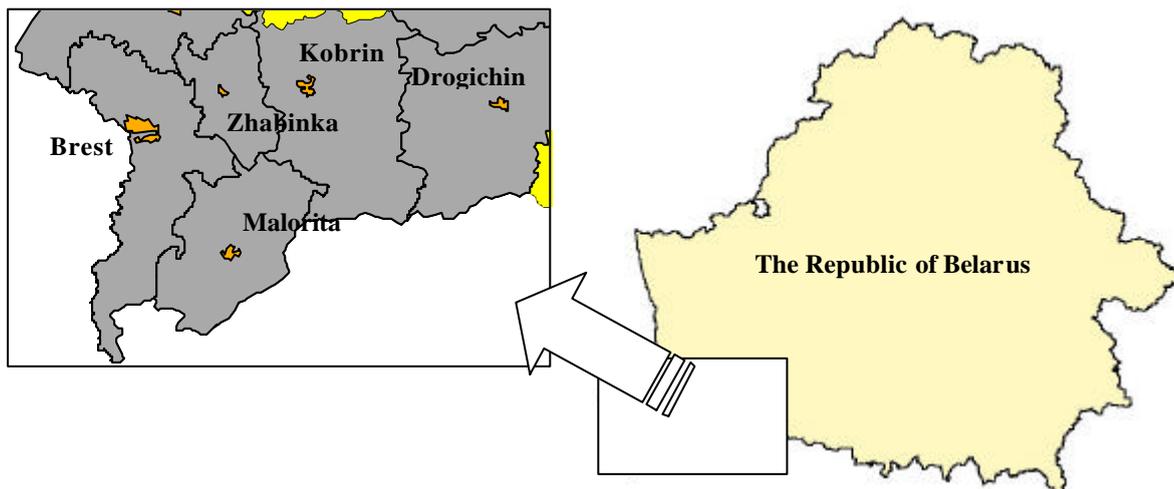
Agricultural landscapes are most common in Europe, therefore all measures for maintaining their environmental stability should be taken into account. Land-use polarization, i.e. further distancing intensive land-uses and indigenous areas, is suggested as an efficient tool for regional environmental re-planning. This concept has been applied to the study of environmental frame in Brest Palesse. The area has been selected because its relevance to Pan-European ecological network, and diversity of land-uses. The databases on spatial pattern, areal extent and ecological features have been compiled and analyzed in GIS (ArcView 3.1).

The Southern part of Brest Palesse is more forested and boasts of big forests. The Central part is almost deforested (15%) and features only small woods. However, as far as it is the only common kind of natural ecosystems in the area, they are considered as an important component of local environmental frame, in spite of their relatively small economic and ecological value. As the study's outcome, the environmentally sound regional planning scheme, based on the principles of polarization is proposed. Nevertheless it is unlikely to implement because of current economic problems in Belarus. Since Belarusian Palesse is an essential element of European ecological network, additional funding from the EU might be negotiated.

Introduction

Brest Palesse – physical-geographical district of Belarusian Palesse. It is located within southern and central administrative districts of Brest region in the south-western part of the Republic of Belarus (illustration 1).

Illustration 1: Geographical Position of the Study Region.



The process of anthropogenous modification of Brest Palesse landscapes passed the most intensively during the last decades of 20th century. Land resources being the cultural basis of the mastered landscapes have undergone to strong influence of socio-determined factors during this period.

The major factors from socio-economic group are: the organization of large factory-farm enterprises, complex land management, water-land reclamation, etc. The most urgent among all the complex of their negative consequences is the problem of wood geosystems fragmentation.

At present moment anthropogenous landscapes of researched territory represent a mosaic combination of the mastered grounds (reclaimed agricultural grounds of the Brest region in Belarus occupy over 700 thousand hectares or 47,5 % of all grounds of agricultural purpose) and different-sized isolated land sites of wood-scrub vegetation. The major part among anthropogenous landscapes of the region are the agricultural landscapes, i.e. the landscapes which are intensively used for obtaining agricultural production and which are submitted by various kinds of grounds (arable lands, pastures, hayfields, etc.).

Agricultural landscapes are most common in Europe, therefore all measures for maintaining their environmental stability should be taken into account. Natural vegetation, first of all – wood and marshes is of primary importance in maintenance of ecological stability of agrolandscapes.

Intensity of influence of wood geosystems on major factors of ecological stability is determined not only by their typological quality and morphological attributes, but also by the character of their spatial distribution. (1) The ecological role of wood plantings in the agrolandscapes is defined as their potential ability for redistribution of moisture and chemical substances, for protection of waters, soils, air, flora and fauna. (2, 3) Besides, wood plantings carry out important social functions, by eliminating discomfort of the environment, forming recreational zones, especially in the combination with water objects. (4) Dustproof, soundproof and camouflaged (for hiding of not aesthetic sites) functions of wood plantings are also of great importance.

Brest Palesse is characterized by insufficiently polarized structure of agricultural landscapes. In this connection special importance in the organization of spatial structure is gained with the transitive (buffer) zones, separating sites of intensive use from sites of ecological balance and protected territories. These should be not only strips and sites of natural vegetation, but also territories with limited economic activities.

The approval of optimum territorial structure of agrolandscapes from the point of view of nature protection aspects can be based on the concept of "spatial system of landscape ecological stabilization", developed in Czechoslovakia and the USA in 60-s' of 20-th century. (5) The core point will be as follows: it is possible to achieve greater stability of the agrolandscapes and efficiency of influence of sites with natural vegetation on adjoining agrocenosis by their certain distribution, despite of the small sizes of each of them. Sites with natural vegetation are known as the biocenters. In order to provide the stability of their population structures, biodiversity and expansion of influence zones on adjoining agrocenosis it is necessary to observe the possibility of free living organism migration between them. Consequently, the distance between the biocenters should be small; otherwise they should be linked with each other through biocorridors.

Methods

As it is said above, this study was based on the concept of "spatial system of landscape ecological stabilization", according to which the stability of agricultural landscape is graded using qualitative and quantitative balance between areas with agricultural and natural vegetation (especially forests).

The technique of the research is submitted on the figure 1. Spatial data was analyzed using ArcView GIS 3.1 software by superimposing the above listed maps. Besides, additional studies were carried out at key sites in areas with rather not optimum structure of agrolandscapes. As the result of the research we have got the data base necessary for the development of the scheme and guidelines for conducting a set of activities aimed at optimization of distribution of the structures the most important for the stability of agricultural landscape. The area has been selected because of its relevance to Pan-European ecological network and diversity of agricultural land-uses.

Results

The analysis of distribution of the wood-scrub sites within natural-anthropogenous landscapes of Brest Palesse made it possible to come to the following conclusions:

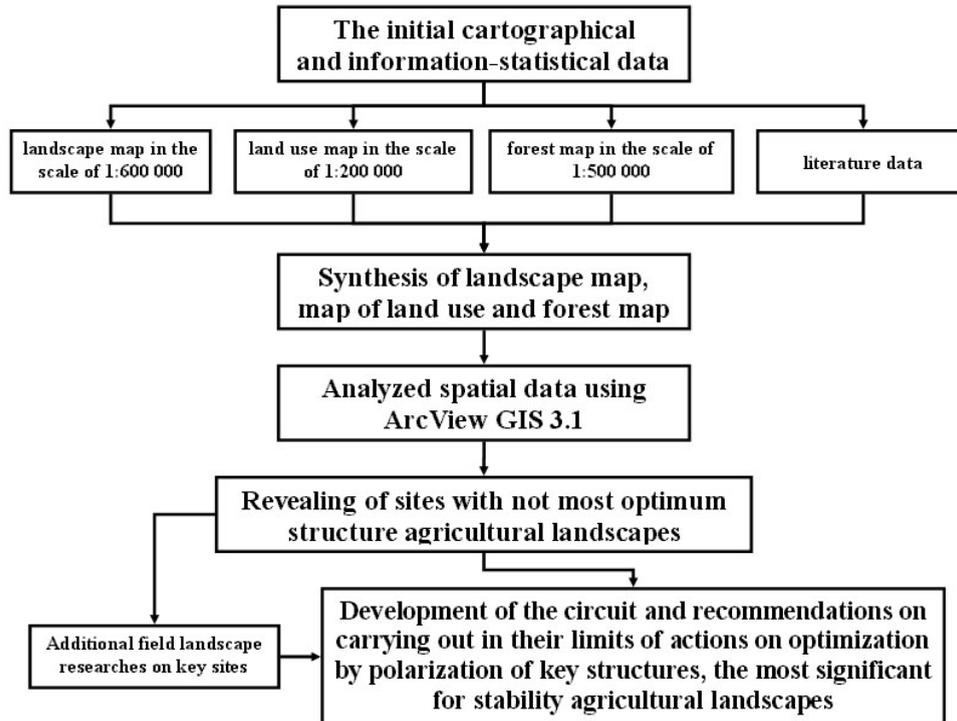
the highest percentage of forest cover and largest forested areas are found in the southern part of Brest Palesse (southern boundaries of Brest and Malorita administrative districts of Brest region);

in the beginning of 2000 year the greatest part of wood grounds of the territory was owned by the state wood fund and was at disposal of the Brest timber enterprise; the share of collective-farm and state-farm woods was insignificant;

except for southern and southwest sectors of the region where large forested areas are widely submitted; medium and small-sized sites of natural and human-made wood and scrub vegetation dominate on the other part of the region;

fine structure of bush and forest cover in the agricultural landscape and the lowest percentage of forest cover is found in the central part of the study area;

Figure 1: The technique of the research



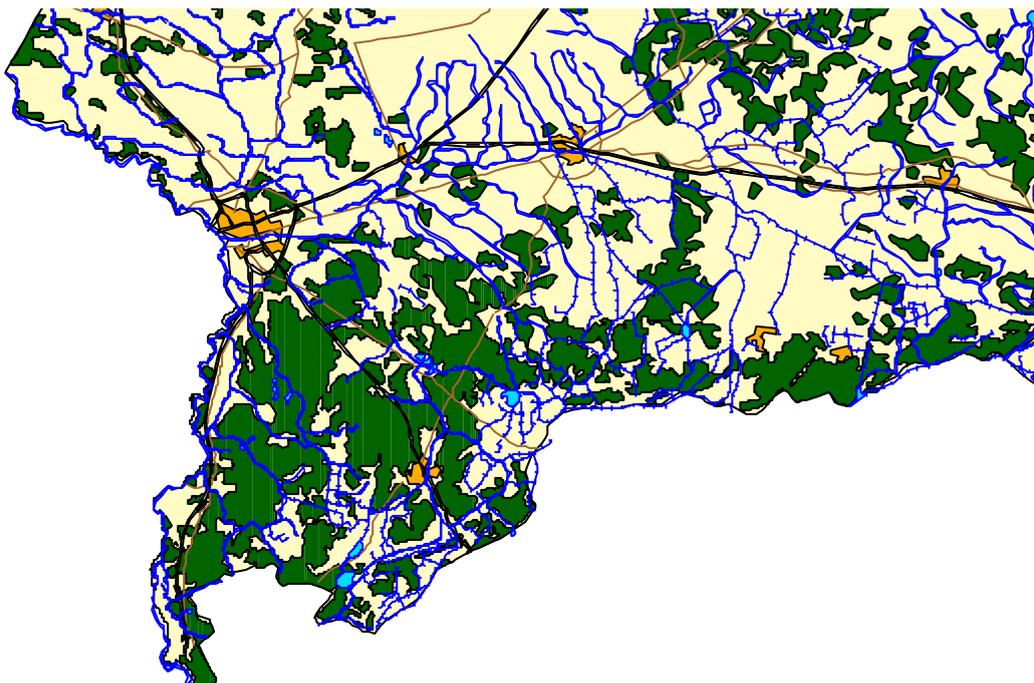
the lowest proportion of such areas within natural-anthropogenic landscape (less than 15 %) is typical for 10-15-kilometer zones around settlements of Zabinka, Kobrin and Drogichin in Brest region, which are almost lacking natural forest vegetation;

the specified territory of the region is the most mastered in Brest Palesse;

in the beginning of 2000 year there was no woods in submission of the Brest timber enterprise – all the large forests were owned by collective- and state-farms;

the most small-sized isolated wood sites (with the area not exceed 25 - 45 hectares) are distributed mainly on fragments of the palaeoriver terraces, water-glacial and moraine plains within the transformed for agricultural use landscapes of unrudded complexes with domination of bogs in the past;

Illustration 2: Distribution of Scrub and Forest Areas within Agricultural Landscape of Brest Palesse.



the former monolithic wood-bogs complexes of the region nowadays represent the system of diffusely placed isolated sites of wood-scrub vegetation among agrocenosis;

the remained small-sized isolated forests sites are of rather low ecological and economic value;

pine and small-leaved plantings dominate within the sites, while deciduous types are not so typical and are represented by oak, hornbeam and ash-trees;

despite of negative consequences of wood geosystems isolation in the region, the sites in this part of Brest Palesse are important environmental stabilizing and system-forming elements of agrolandscapes. Furthermore, they carry out all the functions that large woodlands do.

To maintain the stability of geosystems in the whole region it is necessary to optimize the structure of agrolandscapes by different means, including the method of the polarized distribution of their nature - protection components.

Discussion

Both the percentage of the ploughed and forested areas forms the structure of agricultural grounds of the region. These parameters determine the complex of climatic factors of the region directly influencing the efficiency of agricultural use of the grounds.

Until recently agricultural development was reduced to overall simplification of the agrolandscapes, that was justified by the economic reasons. (6) Simplification of structure and reduction of biodiversity of the agrolandscapes has led to misbalance of their restoration and self-regulation. Nowadays, lots of arable lands of Brest Palesse are being transferred under the authority of state forest enterprise and subsequently planned for afforestation due to their unprofitable agricultural use. Owing to lack of finances on scheduled afforestation, some parts of agricultural land is being naturally overgrown with scrubs (*Salix aurita*, *S. rosmarinifolia*) and tree species of low-value (*Betula pendula*, *B. pubescens*, *Alnus glutinosa*, *Populus tremula*) (illustration 3).

Illustration 3: Natural Overgrowing of Low Productive Agricultural land Excluded from Agricultural Use.



The resulted optimization scheme of Brest Palesse agrolandscapes, providing the organization of the polarized geosystems, is based on the reduction of economic pressure on natural components of the agrolandscapes by means of: - optimization of their spatial structure; - exclusion of low-productive grounds and badlands from agricultural use; - afforestation or flooding of the excluded grounds, - reduction of the percentage of farmland with cultivated crops and expansion of grain-grassy crops, - expansion of the percentage of water-protecting, field-protecting, roadside wood-scrub plantings, as well as small-sized isolated wood-scrub sites among farmland. Special attention has been paid to giving some of the sites the status of protected botanical objects, in case that both rare and endangered species and unique plant associations are found there.

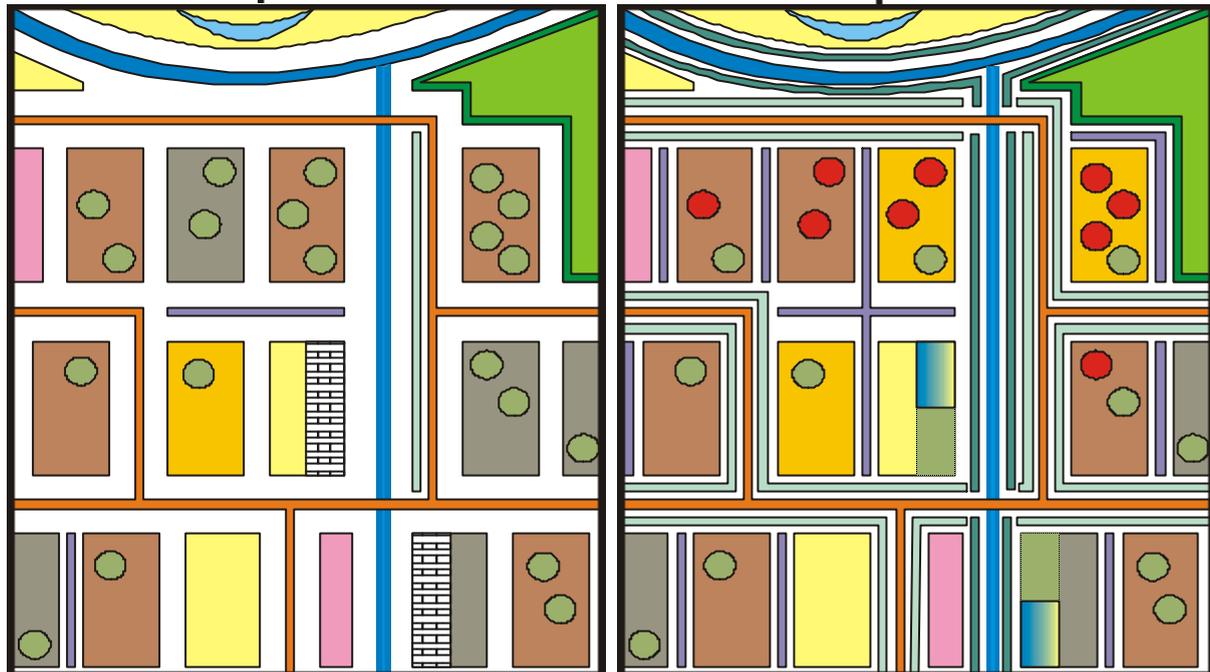
Conclusions

During formation of spatial composition of agricultural landscape it is important for polarized structure to be preserved. That means the intensively used territories should be located at maximal distance from protected areas. This is not always possible due to economical reasons. (5)

Illustration 4: Structure of Agricultural Landscapes Before and After Optimization

Structure of agricultural landscapes before optimization

Structure of agricultural landscapes after optimization



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|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|

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| 1. Farmland with cultivated crops | 11. Man-made wood-scrub small-sized areas within agricultural sites |
| 2. Farmland with grain crops | 12. Lakes, water reservoirs, ponds |
| 3. Farmland with grain-grassy crops | 13. Rivers |
| 4. Haymakings, meadows and pastures | 14. Soil-reclamation canals |
| 5. Gardens (long-term fruit plantings) | 15. Bogs and boggy meadows |
| 6. Wood-scrub water-protecting plantings | 16. Sites with protected status (especially protected natural territories) |
| 7. Wood-scrub field-protecting plantings | 17. Roads |
| 8. Wood-scrub roadside plantings | 18. Large woodlands |
| 9. Margins of large woodlands | 19. Badlands |
| 10. Natural wood-scrub small-sized areas within agricultural sites | |

Operating of this principle in functional zoning makes it possible to design ideal models of agrolandscapes and to forecast the development of biogeocenosis process. As the study's outcome, the environmentally sound regional planning scheme, based on the principles of polarization is proposed. Nevertheless it is unlikely to implement because of current economic problems in Belarus. Since Belarusian Palesse is an essential element of European ecological network, additional funding from the EU might be negotiated.

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