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Monitoring of landscape diversification according to space exploration *

The purpose. To justify application of indexes of landscapes for analysis of dynamics of land-use with use satellite snapshots. Methods. Landscape-metrical, statistical. Result. Maps of soil cover and indexes of landscapes diversification for 2001-2012 are developed. Conclusions. Zones of degradations of landscapes diversification are specified. Inverse relation is fixed between landscape diversification and area of fields. Correlation between indexes according to data with the resolution of 30 and 250 m is also determined. That allowed using snapshots with low resolution at regional level.

Key words: agro-landscape, land-use, index of landscape diversification.

Due to high plowing on the territory of the flat part of Ukraine almost no natural landscapes remained. Due to the unbalanced structure of agro-landscapes, predominantly rectangular organization of agricultural territories in difficult terrain, non-compliance with soil protection measures, water protection zones, negative balance of humus and biogenic elements in various landscape landscapes, various degradation processes took place, and Also the depletion of soil fertility. Excessive fragmentation of the natural vegetation cover on isolated isolated plots and the change in the morphostructure of landscapes as a result of agricultural use of lands violate the spatial integrity of the ecosystem and its sustainable functioning [1,8]. The insufficient density of the network of forest protection and anti-erosion objects and the saturation of crop rotation with intensive crops reduce not only ecological stability, but also the productivity of agricultural landscapes. The absence of a system for monitoring and control over the structure and use of land deepens the mentioned problem and leads to the irrational use of the biotic potential of agricultural landscapes. One of the key objectives of sustainable land use is the achievement of an ecologically optimal organization of the territory, taking into account the integrity of habitats of biological species. Consequently, the structural heterogeneity of the landscape, which can be estimated using indices of landscape diversity, is crucial for the stable functioning of both the general agricultural landscapes and land use systems [2,6]. Some scientists consider the notion of landscape-diversity as synonymous with ecosystem diversity and thus define it as "the size, form and combination of various ecosystems in large territories" [4, 7]. In official documents [2] the term "landscape diversity" (GIR) is defined as the formal expression of the numerous connections existing between an indi viduum or society and a topographically defined territory, the external appearance of which is the result of the influence of natural and Human factors, as well as their combinations for a certain time. The purpose of the research is to probe the use of landscape diversity indices to assess changes in the land use and landscape diversity structure using satellite information. To achieve the goal, the task is set: to find out the relationship between the scale of input data for the definition of landscape diversity; To establish the dynamics of the land use structure by the indices of landscape diversity in time (2001-2012) and to identify zones of increase and / or decrease of landscape diversity within the territory of the study, as well as to trace with what changes in the structure of land use they Connected Materials and methods of research. The research was conducted within the administrative districts of the Kaniv region of Cherkasy and Myronivskyi of the Kyiv oblast, a significant part of which is represented by the agrolandscapes of the Central Forest-steppe of Ukraine with complex dissected terrain, high rooting and the manifestation of erosion degradation. For example, according to the decryption of satellite images, the share of agricultural land within the Mironovsky region reaches 85%. As a benchmark for the landscape diversity of the region, the territory of the Kaniv Nature Reserve, located in the north of the Kaniv region, was used.

As data on land use structure-tion cards were used ground pokry¬vu division into classes using the classification Mosiiz I_apsisoueh [10] water bodies, coniferous forests, deciduous forests, mi¬shani forests, shrubs, grass Vegetation, wetlands, agricultural lands, urban development and industrial territories, mixed natural vegetation, and liquid vegetation. To assess the possibilities of mutually yemozaminy input ground cover maps of different scales examined the relationship between HR index value determined by land cover maps of the spatial resolution of thirty (map developed by the classification of educational choice Coy series of images I_aps! ZaI 5 in different phases ve -generation) and a spatial resolution of 250 m (developed according to the standard Mosiiz-C01201 product) [10] with the data on the ground cover with ground-based verification on the test agrarian landfills [5]). Kore¬lyatsiyi Pearson coefficient was determined for the average values of the indices LR raster surfaces agrarian test ranges (size 5x5 km, selected according to the method [5]) derived according to the 30-meter and 250-meter land cover maps. Landscape diversity indices were determined with the help of the software Rhadvia 4 [9]. The analysis of the spatial distribution of the dynamics of indices of LR was carried out using the AgsSIB software [11]. Research results and their discussion. As indicators of the landscape structure, the following indices of landscape diversity were selected: the index of fractal dimension (RICHAS), the index of the diversity of the IIIenon (BNU!), The Simpson homogeneity index (BIBI). They were chosen on the basis of these indices for the area in various aspects of landscape structure, ie index fraktalnoyi dimension reflects the degree sklad¬nosti perimeter area landshaftu elements, Shannon diversity index - the number of classes and levels proportional distribution area of each class , And the Simpson homogeneity index is the level of dominance of a certain class of landscape structure (see Fig. 1 on the cover). Analysis of the relationship between the extent of their input-data (distinguishing between thirty and 250 m) showed correlation with Pearson coefficients of 0.67 - for Shannon diversity index of 0.69 - for the index and fractal dimension 0.74 - for Simpson index homogeneity ($p < 0{,}01$), which gives grounds for substituting the data of secondary spatial resolution (to ZO m) for the data of low spatial distinction (250 m) at the regional level. One of the main benefits of using Mosiis data at the regional level is the possibility of using already established terrestrial maps for the entire territory of Ukraine, which are part of the standard annual Mosihis products [10] and are freely available, while The processing and classification of I_apsisa1 images requires a lot of time and specialist expertise, which makes it difficult to use them in the system of operational monitoring. Consequently, to study the dynamics of the land use structure maps of the terrestrial cover were used according to Moshiz

Fig. 1. Dynamics of the land use structure of Kaniv district for 2001 -2012 pp .: I am agricultural land; □ - natural flatness; - water objects

With a resolution of 250 m for 2001 -2012 pp., The graphs of changes in the percentage of the area of each class of the structure of the landscape (Fig. 1) were plotted, as well as the dynamics of the indices of landscape diversity separately for Kanivsky (Figure 2) and Mironivsky raions (table). According to the results presented in the graphs (Fig. 3), within the boundaries of the Kaniv district there is a decrease in the values of landscape diversity in 2002-2003, 2005 (for SHIDI and SIEI) and in 2009, And its increase in 2006 and 2011-2012 (except for the FRAC index, which is decreasing in 2012). This trend is also observed on the territory of Mironovsky district - the increase in the values of landscape diversity indices in 2006 and 2011-2012 pp., While the decrease is in 2008 (table). Comparing the values of landscape indices with the schedule of land use dynamics (Figures 2, 3), the inverse proportional relationship between the share of agricultural land in the structure of land of the Kaniv region and the indices of the LR with the Pearson correlation coefficient is -0.85 ($p < 0 , 01$). Thus, with the decrease in the area of agricultural land, the level of landscape diversity increases. This tendency is especially noticeable in 2007-2008 and 2012 pp. When the area of agricultural land is the smallest throughout the period of observation, and the values of the indexes SHIDI and Si EI are the highest. At the same time, in 2001, the largest area of agricultural lands was registered, but the value of the SHIDI index for this period is one of the highest. This can be confirmed by the fact that the value of the indices of landscape diversity is influenced by Fig. 2. Dynamics of indices of landscape diversity Kaniv district for 2001 -2012. Not only the area, but also the spatial distribution of elements of the landscape. For the FRAC index, the dependence on the area of agricultural land is less pronounced than the other represented indices, since it depends more on the shape of the elements of the landscape, which is determined by estimating the perimeter of the area of land use objects. Through comparative analysis of the distribution of indices of landscape diversity in different years, zones of increasing and / or reducing the level of landscape diversity can be identified and the spatial and structural factors of such changes can be identified. Using the functions of the raster algebra in ArcGIS, the dynamics of the terrain diversity of the Mironivsky district (2001 -2012) was calculated as the difference between the values of the BIEI index for the years when there was a sharp change in the values, in particular, in 2008-2009 (the decrease of the GIR level), And in 2011-2012 (growth of values of LR). Results of the analysis of the values of EeI and the highlighted areas of increase (green) 1 decrease (red color) is given in Fig. 2 on the cover. Consequently, it became possible to identify areas where there is a decrease in the level of landscape diversity, to determine their area and to localize places that require changes in the land use structure, in particular due to the reduction of negative agrotechnological impact on land and water resources and conservation of degraded and unproductive Lands.

Conclusions

The use of indices of landscape diversity as an effective tool for assessing the ecological state of agrolandscapes, analysis of the dynamics of land use and the identification of degradation zones of the country-lake variety, which may be used to validate optimized management decisions for improving the terioryal structure of agricultural landscapes, is demonstrated. And land-use systems within the administrative districts. A high correlation was found between the values of the indices of the LR determined by the data of the remote sensing with the spatial resolution of the LO and 250 m, with the Pearson coefficient greater than 0.67 (p <0.01), which gives grounds for the use of data with low spatial resolution, MOSCOW, for monitoring of LR at the regional level. As a result of studying the dynamics of LR indices and land use structures, an inversely proportional relationship between the level of landscape diversity and the area of agricultural lands is revealed, but an analysis of the distribution of values of LR indexes in space and time using GIS functions is important for the estimation of land use structure.

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