Monitoring of anthropogenic impact in the Left Bank Dnipro and the Eastern Ukrainian regions

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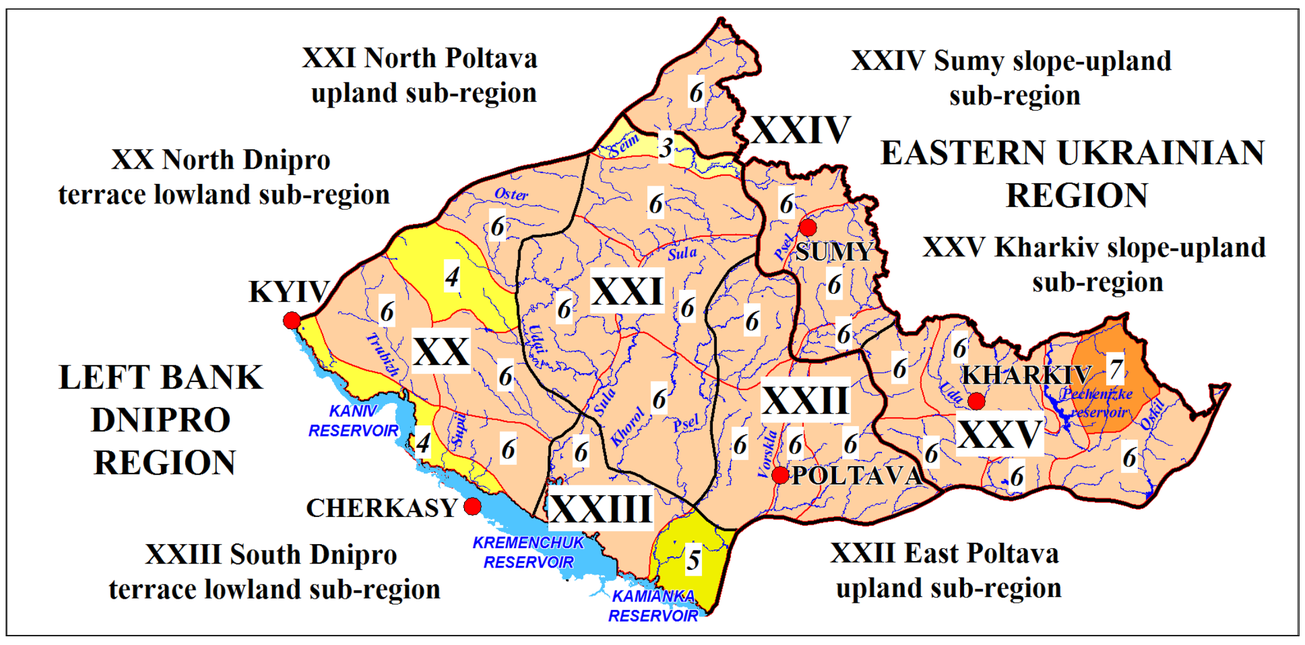

Figure 1 *Digital choropleth of the anthropogenic impact on the physic-geographic districts of the Left Bank Dnipro and the Eastern Ukrainian regions. Legend: boundaries of the physic-geographic taxons: ▬ – region; ▬ – sub-regions, ▬ – districts;* **XX…XIY** *– codes of physic-geographic sub-regions;* ***3*** *…* ***7*** *– districts' anthropogenic impact category*

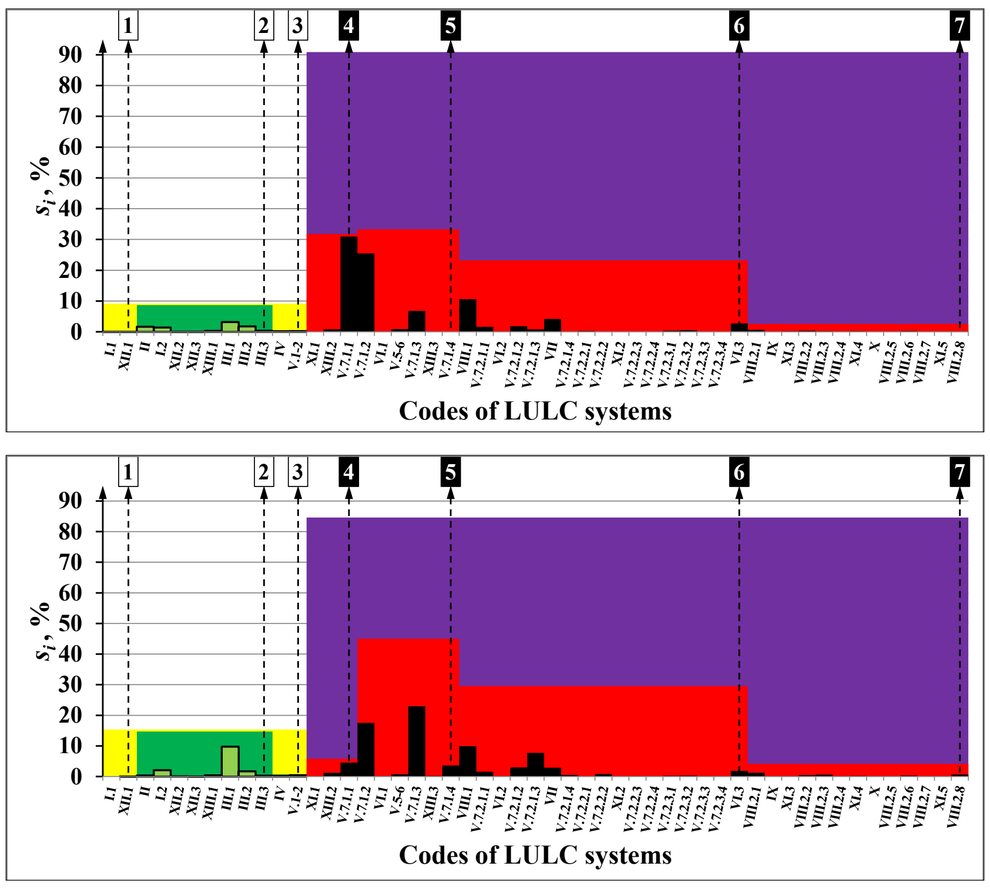

Figure 2 *Quasi-spectrum of LULC system areas in the Left Bank Dnipro (**above**) and the Eastern Ukrainian (**below**) regions. Legend: 1 … 7 with dashes – upper limits for categories of LULC system geoecological positivity / negativity (1 – very geo-positive, 2 – geo-positive, 3 – moderately geo-positive, 4 – moderately geo-negative, 5 – geo-negative, 6 – very geo-negative, 7 – excessively geo-negative); ▬ and ▬ – categorical sums for percentages of the geo-positive (▬) and geo-negative (▬) LULC system total areas; ▬ and ▬ – the total amount of such percentages; codes of LULC systems according to (Samoilenko et al., 2018a, b).*

Introduction. The monitoring of anthropogenic impact on landscapes and their aggregations in the form of physic-geographic taxons is the most actual problem for ensuring of environment sustainable development. So, the principal task of this paper, was to monitor anthropogenic impact on the Left Bank Dnipro and the Eastern Ukrainian physic-geographic regions and their sub-regions and districts. The second was the task to perform analysis of mentioned impact conditionality by the peculiarities of regional land use and/or land cover (LULC) systems.

Methods and data. Modern geoinformation model analytic tools developed in our previous publications (Samoilenko et al., 2018a, 2018b, 2019, 2020, 2021) were used. Among these tools, the progressive scheme of the LULC system areas' cumulative distribution in physic-geographic taxons operates with ten codes and types of distribution which reflect categories of different by intensity anthropogenic impacts on taxons, namely: 0 – excessively convex distribution – weak impact; 1 – very convex distribution – moderate impact: 2 – convex distribution – low-categorical moderate-strong impact; 3 – weakly convex distribution – high-categorical moderate-strong impact of the 1st level; 4 – close to rectilinear distribution – high-categorical moderate-strong impact of the 2nd level; 5 – weakly concave distribution – high-categorical moderate-strong impact of the 3d level; 6 – concave distribution – low-categorical strong impact; 7 – essentially concave distribution – high-categorical strong impact; 8 – very concave distribution – very strong impact; 9 – excessively concave distribution – excessively strong impact.

We also used the spatial data bases on land use and land cover developed in our publications (Samoilenko et al., 2018a, 2020). They were created by geoinformation processing of modern open digital sources (ESA, 2015; NGCC, 2011; National Atlas, 2007 etc.). We obtained also the so-called quasi-spectra of LULC system areas in certain taxons (Samoilenko et al., 2018a).

Results. The anthropogenic impact on the selected regions was simulated and analyzed with the help of MapInfo Pro 2019 GIS tools (Figure 1). The results of such analysis demonstrated the following.

The Left Bank Dnipro region is characterized by not very high variability of the LULC system areas' cumulative distribution types. Such distributions in the sub-regions of the region (see Figure 1) correspond to their only type, namely concave. Consequently, all sub-regions fall under the low category of strong anthropogenic impact.

Four LULC system areas' cumulative distribution types are simulated already for 17 districts of the Left Bank Dnipro region. Among them, a concave distribution is also prevalent, concerning 76% of the districts and marking the low-categorical strong anthropogenic impact on them with code 6. The less unfavorable geoecological situation was monitored in only four other districts of the region.

Such environmental state of the region is caused by the fact that here only 9% of the area belongs to geo-positive LULC systems in total (see Figure 2, above). Broad-leaved and coniferous forest (III.1 and III.2), wetland (II) and nature-protection (I.2) systems predominate among such systems of the 2nd category. Their area together is 8.4% of the regional. The distribution of the leading geo-negative systems here is the same in composition as in the Podilsko-Prydniprovskyi region, analyzed in our previous publication (Samoilenko et al., 2021). Thus, non-forest tilled systems of the 5th and 4th categories cover more than 61% of the regional area. The same composition of very geo-negative systems of the 6th category, that are the broad-leaved forest tilled systems, the village built-up and the recreational systems with the addition of the geo-negative hydromelioration system occupy almost 23% of the specified area.

The *Eastern Ukrainian region* is essentially anthropized in the forest and forest-steppe zone megaregion of Ukraine. Both sub-regions of the region are subject to low-categorical strong anthropogenic impact due to the fact that the cumulative distribution of their LULC system areas is concave. In 10 districts of the region there is practically no variability of the LULC system areas' cumulative distributions. In 90% of these districts, a concave distribution is monitored, which is corresponding to the low-categorical strong anthropogenic impact on the districts with code 6.

Quasi-spectrum of LULC system areas in the Eastern Ukrainian region (Figure 2, below) shows an extremely unfavorable geoecological situation in the regional land use. Only 15.4% of the region's area is under environmentally friendly systems. Among them, broad-leaved and coniferous forest (III.1 and III.2), nature-protection (I.2) and wetland (II) systems own 12.6% of the area. The composition of geo-negative systems of the Eastern Ukrainian region is the same as in the Left Bank Dnipro region. Thus, non-forest tilled systems with more than 47% of the regional area and the same set of very geo-negative systems with more than 25% of this area dominate here. Such set consists of broad-leaved forest tilled, village built-up, recreational and geo-negative hydromelioration LULC systems.

Conclusions. Monitoring of anthropogenic impact as a system of its observation and evaluation analysis was implemented for the Left Bank Dnipro and the Eastern Ukrainian physic-geographic regions. Monitoring used modern spatial data bases and a progressive model scheme for cumulative distribution of land use and/or land cover (LULC) systems in physic-geographic taxons. The scheme operates with 10 types of this distribution and the relevant 10 categories of anthropogenic impact intensity from weak to excessively strong.

Quasi-spectra of LULC system areas in taxons were also applied. The monitoring results show that a concave distribution is prevalent in the Left Bank Dnipro region, concerning 76% of its districts and marking the low-categorical strong anthropogenic impact on them. This is caused by the fact that here only 9% of the regional area belongs to geo-positive LULC systems, such as broad-leaved and coniferous forest, wetland and nature-protection systems. And more than 90% of the regional area are covered with geo-negative and very geo-negative systems, primary non-forest tilled systems, broad-leaved forest tilled, village built-up, recreational and geo-negative hydro-melioration systems. The Eastern Ukrainian region is also essentially anthropized. In 90% of its districts a concave distribution is monitored, which is corresponding to the low-categorical strong anthropogenic impact on them caused by similar to the first region LULC systems. The applied procedure and the obtained results can be used in regional schemes and projects to optimize the environmental management and to ensure environment sustainable development.

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