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Mapping the erosion damage of agricultural landscapes in Cherkasy region

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SUMMARY

Among the ecological problems of the use of agricultural land, soil degradation is important, primarily related to water erosion. Erosion processes have a certain geographical reference and are most active in the steppe zone of Ukraine. Thus, the most eroded are the eastern lands - Luhansk and Donetsk regions. Cherkasy region belongs to the regions with an average level of soil erosion development and ranks ninth among the regions of Ukraine according to this indicator. Thus, the issue of soil degradation due to water erosion is relevant for many regions of Ukraine. The eastern regions suffer the most from this process, while Cherkasy region has a moderate level of erosion damage. Nevertheless, even in Cherkasy region, where soil erosion is less pronounced, a significant share of agricultural land has already been affected by this process. For effective management and conservation of agricultural land, it is important to take into account the level of erosion in different regions and take appropriate measures to prevent further soil degradation. Compared to other regions, the erosion vulnerability of Cherkasy region is not high: the share of eroded soils from the total area of agricultural land in Cherkasy region is 28,3 % (Regional report, 2021). On its territory, the share of weakly eroded soils accounts for 14 %, for moderately eroded soils – 47 %, and for strongly eroded soils – about 2 %. Erosion processes occur in two interrelated phases: planar washing and linear washing, which lead to a decrease in the content of humus and nutrients in the soil, the transfer and accumulation of washed material in streams and watercourses, which give them the character of an ecological hazard, and therefore lead to loss of natural sustainability by agro-landscapes.

*Keywords:*mapping, agricultural landscape, soil degradation, erosion damage, erosion processes, degraded and unproductive lands

Introduction

Among the ecological problems of the use of agricultural land, soil degradation is important, primarily related to water erosion. Erosion processes have a certain geographical reference and are most active in the steppe zone of Ukraine. Thus, the most eroded are the eastern lands - Luhansk and Donetsk regions. Cherkasy region belongs to the regions with an average level of soil erosion development and ranks ninth among the regions of Ukraine according to this indicator (Kiptach, 2010).

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Method and Theory

In carrying out our research, we used both general scientific and interdisciplinary and special methods of constructive geography, geoecology and land management, including logical methods of cognition (analysis, synthesis, comparison, etc.), mathematical and statistical methods (cluster analysis, factor analysis, etc.), historical and geographical, cartographic, cartometric, etc.

The cartographic method is widely used in the work, starting with the characterization of the natural prerequisites for the formation of the land use structure and the dynamics of erosion processes and ending with an integrated assessment of the erosion damage to agricultural landscapes in Cherkasy region.

Results

The main features of the relief of the Cherkasy region are determined by ancient geological and tectonic processes and have an established character.

In the western part of the region, a denudation-accumulative loess plain was shaped within the boundaries of the Dnieper Highlands, dissected by terraced alluvial-accumulative river valleys and gullies, which led to the formation of a wide-wave type of relief. The inter-beam and inter-river areas here are wide, the slopes are laid out, but due to the high hypsometric position, their steepness reaches from 3 to 7°, which makes them erosion-dangerous. In the eastern and northeastern directions, the relief becomes narrowly undulating, due to which the steepness of the slopes increases, flat accumulative and terraced lowland formations prevail on the plakors (Sopova, 2022).

The spectrum of exogenous processes includes landslides (the slopes of the Kaniv Mountains and the slopes of the Kremenchuk Reservoir), glaciodislocation formations, water-glacial valleys, etc. Erosion processes occur everywhere, but with varying intensity. Gully erosion has a particular importance, it inspires gullies functioning as channels for the transport of matter and energy, and play a major role in the movement of large volumes of soil washed away by planar erosion from sloping lands (Shchetyna, 2016).

The analysis of the map scheme of arable damage of the Cherkasy region developed by us (Figure 1) revealed the worst condition in the territory of the former Kaniv administrative district (2,1 % of the area of agricultural land), as well as some other former districts (Horodyshche, Smila, Kamianka and Chyhyryn (from 0,51 to 0,74 %), which are located in the North-East of the denudation-accumulative upland and bordered from the South-West by the territory with a wide undulating topography, and where erosion cuts are common both within the denudation-accumulative loess uplands and lowlands, and on the accumulative flat and terraced alluvial lowlands. (Kravtsova et al., 2023).

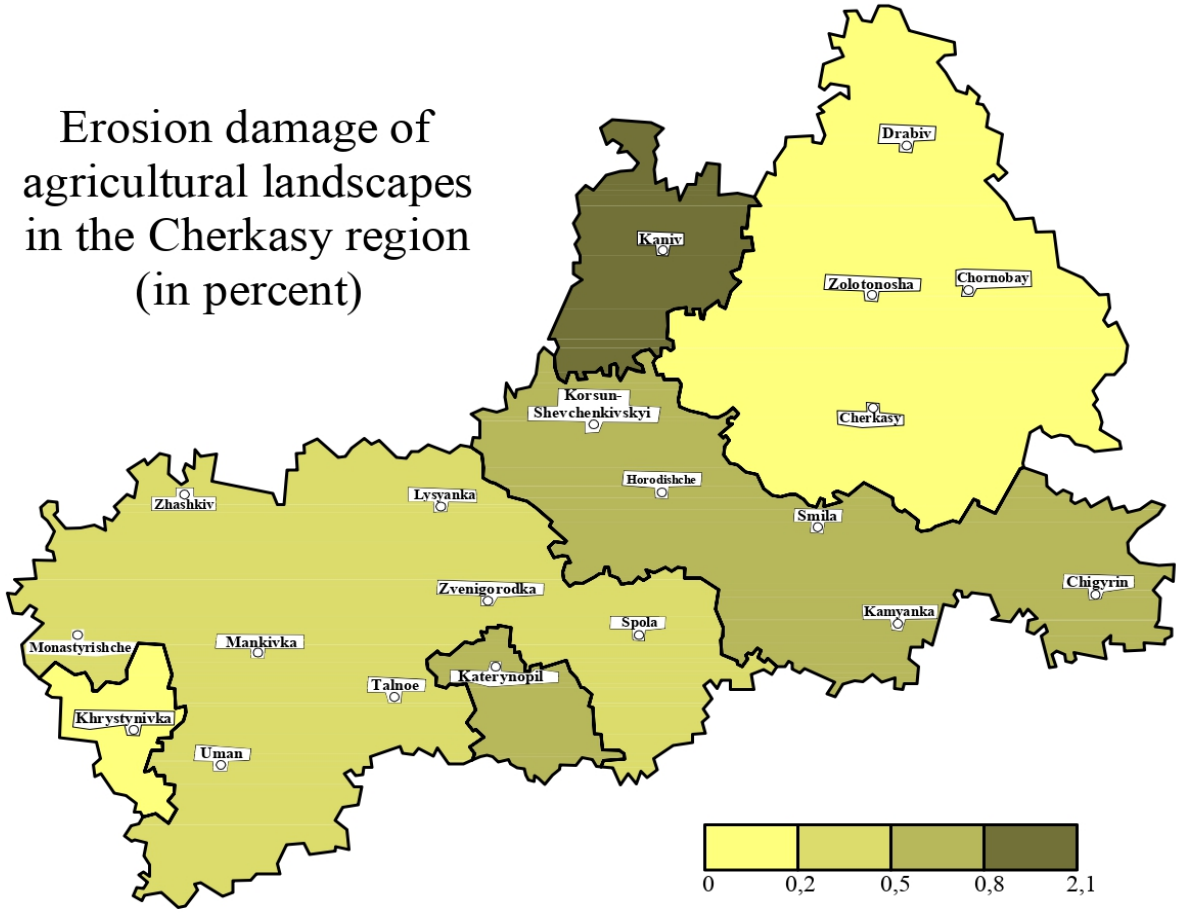

Figure 1. *Erosion damage of agricultural landscapes in Cherkasy region (as a percentage of the total area of former administrative districts)*

In the South of the region, there is another area that corresponds to the former Katerynopil district, where the indicator reaches a relatively high degree of erosion – 0,6 % of the area of agricultural landscapes in the confluence of the Hirskyi and Hnylyi Tikich rivers.

The slope to the South-West decreases (to the value of 0,8–0,5 %) on the loess-accumulative-denudation upland.

The left-bank Dnieper regions, located on the accumulative loess lowland, are more or less safe in terms of erosion.

Comparison of data from ecological passports and reports on the ecological state of the environment in the Cherkasy region over a 10-year period (Ecological passport, 2017; Regional report, 2021) revealed that, for example, the tension of the ecological situation within the boundaries of the former Kaniv district is enhanced by the annual increase in areas subjected to spring formation processes (Figure 2).

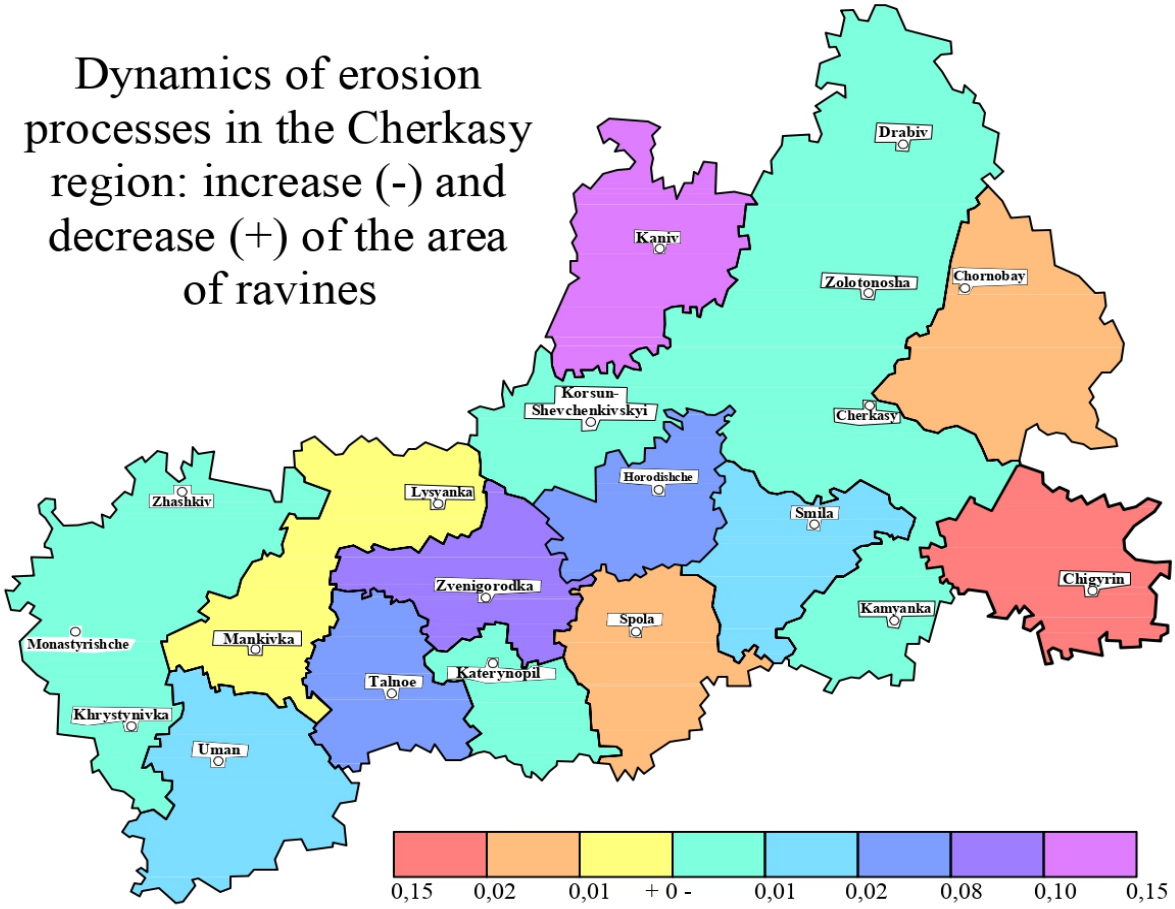

Figure 2. *Dynamics of erosion processes in the Cherkasy region: increase (-) and decrease (+) in the area of ravines*

The area of ravines here is growing by 2,3 % per year. The same trend, although weaker, can be traced along the axis from the territory of Uman to Horodyshche former districts. The flat North-Eastern and Eastern regions of the region remain «calm».

The erodibility of agricultural lands in the region (in the aggregate – linear erosion and planar erosion) ranges from 24,7 to 40,3 % in the western part of the region to more than 45 % in the eastern part. The module of solid runoff, accordingly, ranges from 30 to 64 tons per hectare per year (Regional report, 2021).

Conclusions

Erosion processes cause soil impoverishment and pollution of water sources. The impact of natural conditions alone cannot explain the development of erosion processes in certain areas. This raises questions about the nature of land management and land use, as well as compliance with environmentally sound technological measures in these areas. Given that degraded and unproductive land in Cherkasy region occupies a significant area, it can be assumed that in the future there will be an inevitable shortage of such land. Therefore, it is necessary to look for ways and implement rational methods of using agricultural land to increase its fertility and protect it.

Erosion processes that cause soil impoverishment and pollution of water sources are complex in nature. Their occurrence cannot be explained by natural conditions alone, as the development of erosion in certain areas also depends on human activity. This applies to land management, land use, and compliance with environmental measures. For example, in the Cherkasy region, a significant portion of land is already degraded and unproductive, which indicates a possible shortage of such land

in the future. Therefore, it is necessary to look for effective ways and apply rational methods of using agricultural land. This will help improve soil fertility and ensure its protection.

Responsible land use and the implementation of technological environmental measures shape a key to overcoming the erosion problem. Inappropriate land management only worsens the situation, contributing to soil degradation. This is especially true in Cherkasy region, where a significant portion of land is already unproductive. In the future, if proper measures are not taken, a shortage of fertile land will become inevitable. Therefore, finding ways to rationalize the use of agricultural land is critical. This includes the introduction of modern agricultural technologies, the use of environmentally friendly soil cultivation methods and systematic monitoring of land conditions.

Thus, the problem of soil erosion is complex and requires a comprehensive approach. Appropriate land management, compliance with environmental regulations, and the introduction of new technologies can significantly improve the situation. This is especially true in regions where land degradation is already a significant problem, such as Cherkasy region. Only through systematic efforts and the introduction of sustainable land use practices can land be restored, fertility improved, and preserved for future generations.

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