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# GEOHISTORICAL ANALYSIS OF ECOLOGICAL PROBLEMS OF LAND RESOURCES OF LUHANSK REGION (UKRAINE): PRE-WAR RETROSPECTIVE

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The article highlights the results of a geohistorical analysis of ecological problems of land resources in the Luhansk region before the start of a full-scale Russian military invasion of Ukraine. The influence of human economic activity (in particular, agriculture and coal industry) on the nature of land use in Luhansk region (separately for the right-bank and left-bank parts) is considered. Emphasis is placed on the importance of soil contamination and planar erosion in the process of soil and land degradation, which is especially pronounced on the Donetsk ridge (right bank of the Seversky Donets). The role of the semi-mountainous relief of the Donetsk ridge as a natural factor in the spread of erosion processes is noted. A brief historical overview of attempts to combat the development of ravines in the Luhansk region, which were carried out since the second half of the nineteenth century, but in the vast majority were not effective. One of the negative factors influencing the structure of land use is the allocation of an increasing area for pastures, which increases the intensity of erosion processes. The detrimental influence of mine production on the structure of land use in the studied region is highlighted. The ecological consequences of physical alienation of lands as a result of their occupation by waste heaps, heaps and other anthropogenic forms of relief formed by mining activities are noted. It is emphasized that not only the mines themselves, but also concentrators, communication facilities, etc. play a role in reducing the area occupied by agricultural land, and thus cause negative changes in the structure of land use in the right bank of the Luhansk region. It is noted that extensive as well as excessively intensive land use in agriculture and coal mining in Luhansk region has led to the degradation of large areas of land and impoverishment of the land fund. It is emphasized that the current structure of land use needs radical changes, which should be based on new conceptual principles and a systematic approach to the problems of nature management. Of course, all these principles and approaches will be possible to implement and put into practice only after the complete de-occupation of the studied region. *Key words:* land using, degradation of lands, plane washing, extensive using of lands, nature using.

**Геоісторичний аналіз екологічних проблем земельних ресурсів Луганської області (Україна): довійськова ретроспектива. Сопов Д.С.**

В статті висвітлено результати проведеного геоісторичного аналізу екологічних проблем земельних ресурсів Луганської області до початку повномасштабного російського військового вторгнення в Україну. Розглянуто вплив господарської діяльності людини (зокрема, сільського господарства та вугільної промисловості) на характер землекористування в Луганській області (окремо для правобережної та лівобережної її частин). Наголошено на значенні заяруженості території й площинного змиву в процесі деградації ґрунтів і земель, що особливо виражено на Донецькому кряжі (правобережжі р. Сіверського Дінця). Відзначено роль напівгірського рельєфу Донецького кряжа як природного чинника поширення ерозійних процесів. Наведено короткий історичний огляд спроб боротьби з розвитком ярів на Луганщині, які проводилися, починаючи ще з другої половини XIX ст., але в переважній більшості не були ефективними. Як один із негативних чинників, що вплинули на структуру землекористування, окреслено відведення дедалі більшої площі під пасовища, що підвищує інтенсивність ерозійних процесів. Висвітлено згубний вплив шахтного виробництва на структуру землекористування в досліджуваному регіоні. Зауважено щодо екологічних наслідків фізичного відчуження земель внаслідок їх зайняття породними відвалами, териконами та іншими антропогенними формами рельєфу, утвореними гірничопромисловою діяльністю. Підкреслено, що не лише власне шахти, а й збагачувальні фабрики, комунікаційні споруди тощо відіграють певну роль у зменшенні площ, зайнятих сільськогосподарськими угіддями, а отже – викликають негативні зміни структури землекористування у правобережній частині території Луганської області. Відзначено, що екстенсивне, а також надміру інтенсивне землекористування в сільському господарстві та вуглевидобувній промисловості в Луганській області призвели до деградації великих площ земель та зубожіння земельного фонду. Наголошено, що сформована структура землекористування потребує радикальних змін, які б мали базуватися на нових концептуальних принципах і системному підході до проблем природокористування. Звісно, всі ці принципи і підходи можливо буде впровадити і втілити в життя тільки після повної деокупації досліджуваного регіону. *Ключові слова:* землекористування, деградація земель, площинний змив, екстенсивне використання земель, природокористування.

**Introduction.** The economic development of any territory is always connected with the use of natural resources. With the increase in volumes and rates of production, the pressure on the natural environment also increases. In the Luhansk region, the development of the economy proceeded in two directions: agricultural production and coal production. In both cases, the land experienced the greatest pressure, which caused the physical reduction of the land fund, the deterioration of the physico-chemical properties of the soil, the loss of crops, the deterioration of the sanitary and hygienic living conditions of the population, etc. of special relevance.

**The purpose of the article** is a pre-military excursion into the history of land use in the Luhansk region

and the identification of the causes and consequences of the impoverishment of the land fund – the basis of the socio-economic development of the region.

**Review of recent publications.** Among Ukrainian scientists whose focus is on researching the history of the development of land relations and land use in Ukraine and the world as a whole, L. M. Boyko [13], A. M. Tretyak [15], V. V. Medvedev and T. M. Laktionova [18]. In particular, with regard to the Luhansk region, these questions and problems are investigated by such scientists as O. O. Kiselyova, Yu. O. Kiselyov, L. V. Denischenko [14; 16; 17] and others. In their works, the historical and geographical aspects of land evaluation are considered, the issues of geoplanning and regional planning are raised, ecological problems of land use are highlighted, etc.

**Presenting main material.** The economic development of the territory of the modern Luhansk region began with agriculture, which was associated with favorable natural conditions and rich natural resources – a temperate climate, fertile lands, large areas of forests confined to the valleys of navigable rivers and large streams [20].

The bulk of the inhabitants of Slobozhanshchyna and the Donetsk steppes were engaged in land cultivation. Two systems of agriculture operated here: three-field and fallow. In the presence of large reserves of land, the peasants used the fallow system, which was gradually replaced by the three-field system, according to which the land was divided into three parts: two of them were cultivated and sown, and the third was left for steam. In the future, there was an alternation of used plots. After two years of processing, the land remained free and rested for the third year [7]. Such a system was determined by the fact that there was plenty of land, and there was no point in worrying about the problem of preserving their fertility.

In the first half of the 18th century only a small part of the land was cultivated. As the territory was settled and developed, starting from the middle of the century, the cultivated areas began to expand. Wasted lands were abandoned, transferred to new, virgin lands. Gradually, arable lands advanced on the slopes of river valleys and large streams, fallow lands were plowed; steppe fires and fires, unregulated livestock grazing led to disruption of the turf cover, physical rejection of land for buildings, roads, etc. took place. The extensive form of land ownership caused a low yield of grain crops.

The structure of nature management in the Luhansk region has changed qualitatively since the end of the 18th and the beginning of the 19th centuries, when, after the discovery of hard coal in the Donbass, coal mining began and spread more and more. At this stage, human activity in the natural environment began to lead to its significant changes [19].

The systematic influence of man on the environment increased, which caused a violation of the ecological balance in nature. This was especially noticeable on lands, as the most vulnerable component of the natural environment.

Already from the beginning of the economic development of the modern territory of the Luhansk region, the land began to be destroyed. But official data on the condition of the lands and the structure of land use date back only to the 18th century, when in 1789–1804, the General Demarcation was carried out. According to his data, until 1861, the plowed area of the territory did not exceed 1–2 % [12]. The reform of 1861 removed the invisible barrier that prevented the settlement of the rich, but unexplored region. And the first result of mass settlement was a sharp increase in arable land by the end of the 18th century – up to 31–45 % [6], which entailed increased erosion.

Plain washing from the sloping lands, common in the region, almost did not attract the attention of researchers. The most obvious consequence of erosion processes was the formation of ravines. Thus, characterizing the Lysychan parish of the Bakhmut district, I. F. Levakivskyi (1871) noted: «there are many ravines, they occupy an area of up to 40 acres on the estate of 648 acres, not counting the beams…» [4]. Based on these figures, it can be calculated that the area occupied by ravines was more than 6 % of the area of the estate. There is no reason to believe that the author cites the most developed territory as an example, so we apply these figures to the entire Lysychansk Volost, which is homogeneous both in terms of nature and development.

The plowing of more and more new territories, mainly slopes, the formation of numerous borders served as the cause of accelerated erosion. And I. F. Levakivskyi gives the following example: «In 1890, in the fall, a furrow was made in the direction of the slope; by the fall of 1990, a ditch about 40 fathoms long, two-quarters deep, and the same width formed from this furrow» [4]. It was about the village Nagalno-Tarasivka, located in the central part of the Donetsk ridge.

Immoderate and unreasonable plowing with all its consequences «has a long history and its own historical reasons: firstly, the possibility of selling cereals and their export, which continuously grew, and later – the growth of the population – forced to constantly increase the arable area» [5]. The increase in the area of arable land led to the destruction of natural vegetation, the reduction of virgin steppes, which further strengthened erosion processes (natural erosion changed to more intensive accelerated or anthropogenic erosion).

In the conditions of the Donbass, where virgin steppes were confined to watersheds with a ridge-ridge-basin relief, both basins and slopes were destroyed, which intensified erosion processes. V. I. Taliyev [9] noted that the majority of exposed slopes with washed away soils occur near settlements, which clearly indicates the anthropogenic origin of erosion. The same opinion was shared by E. M. Lavrenko, who linked the presence of large areas of stony wastelands with unmanaged human activity [3].

Abandoned eroded lands, which were previously used for arable land, were collapsing. Unregulated live-

stock grazing had a detrimental effect on the condition of the turf. Even in bairach forests, which play an ameliorating role and contain rich fodder resources, livestock grazing led to the disturbance of the sod cover, the washing away of forest soils, the exposure of the root system of trees and shrubs, the young growth being eaten by cattle, the forests withered, gradually losing their water protection and forest improvement significance. The destruction of forests for the purpose of increasing arable, garden and meadow land is evidenced by the names of some streams – Gorikhova, Lypova, etc. The so-called «unsuitable» lands were formed on the slopes of these beams [19].

Solid runoff, which increased due to erosion, worsened the hydrogeological conditions of the once navigable rivers of Donbas. Fine soil, carried in large quantities from ravines and gullies, caused siltation and shallowing of rivers, their waterlogging in some areas. Surface runoff from sloping plowed lands reduced the humus horizon and worsened soil quality.

The extent of erosion in general and furrow erosion in Donbas, in particular, is evidenced by the materials of the report of forester V. Reich to the head of the Luhansk sand-furrow district of the Donetsk regional department in 1918: «Everyone knows too well what inconvenience growing ravines present to the plowman. In particular, in our county (Slavyanoserbsky), they are simply a scourge for any peasant, because it is absolutely impossible to find a single road in the county that is not cut by one or another ravine. According to survey data, I can say that in our county there are about 3000 ravines, which, together with the beams, take almost a tenth of the entire land from the plowman, that is, about 34000 acres» [1].

In another «Report on the fortification of ravines in the past, present and future» of 1918, it is also noted that, according to survey data, there are more than 3000 ravines with an area of over 3000 acres in the Slavyanoserbsky district [1].

The fragmentation of the territory, which was growing more and more, and the growth of areas unsuitable for agricultural use of land, caused a decrease in plowing. The damage caused by ravines became so significant that they were one of the causes of crop failures. In particular, the cause of the crop failure of 1891, which covered twenty-one of the best agricultural provinces of the Russian Empire, «many considered… the draining and destructive activity of the ravines» [9], which were gradually formed from previous farming. Destruction of any woody vegetation in steppe areas and plowing of steep slopes of valleys and streams led to a decrease in soil moisture.

The strengthening of erosion processes in the region began in the second half of the 19th century, that is, much later than in the entire territory of European Russia. Intensive plowing, incorrect agricultural techniques, bordering in combination with peculiar natural conditions (significant dismemberment by an ancient erosion network, large areas of steep slopes, weak soil resistance to erosion, the nature of precipitation, etc.) led to such a rapid development of erosion that by 1917 it had reached catastrophic proportions. In order to get the maximum benefit from the land at minimum costs, eroded areas were abandoned and new ones were developed. The «unsuitable» land used for cattle grazing was turned into stony and crushed stone and was finally taken out of economic use. Thus, the increase in arable land eventually led to its reduction [20].

It cannot be claimed that no attempts were made to improve the situation, but they were of a local nature. All attempts to stop the effect of erosion by means of forest improvement without combining them with agrotechnical measures did not give the proper effect [11]. The main task – complex regulation of runoff and soil protection throughout the eroding catchment area – remained unsolved.

M. A. Rozov noted that a whole complex of extremely favorable conditions and reasons for alluvial erosion was formed on the Donetsk Ridge. In his opinion, the Luhansk district was the most affected: «…the highlands, which diversify the relief, increased plowing, lack of trees, obviously, and the pronounced continental climate – all this contributed to spring formation» [8].

The evaluation of the territory of Donbas in terms of erosion is confirmed by the above materials of E. E. Kern, who singled out the Katerynoslav province, and especially the Bakhmut district, as strongly charged. In many villages, he wrote, «the area under active ravines was from 5 to 30 % of the total area of the poviats» [2].

After the Second World War, anti-erosion measures were carried out on a limited scale and were reduced only to remedial ones. Their effect was insignificant due to the plowing of «virgin» lands. Further measures were not effective, there was no systematic fight against erosion in Donbas [19].

The processed literary, archival and fund materials testify to the fact that the problems of the catastrophic state of agricultural lands not only did not disappear, but deepened over time.

In the northern part of Luhansk region, which has been in the middle of the 17th century was settled mainly by people from Zadnipryan Ukraine, settlements were concentrated along rivers and large streams. Since mineral deposits had not yet been found there, the peasants grew bread, vegetables and raised livestock. The ancient erosional dismemberment of the region became stronger here as well due to human economic activity, and the steppes receded into watersheds, the rich natural pastures were subjected to intensive and unregulated livestock grazing, planar washing occurred on the slopes, ravines were formed. The formation of ravines became more and more intense due to the fact that the peasants abandoned the lands disturbed by erosion and developed new areas, the so-called «wastelands», but the erosion processes did not stop even on the abandoned lands, because an impetus had already been given due to the disturbance of the turf cover, mainly on the slopes surfaces.

It is known that planar washing leads to a decrease in soil fertility due to the deterioration of the physical and chemical properties of the soils themselves and the air-water regime. There are no data on the intensity of planar washout in the territory of the modern Luhansk region over the past centuries, but modern studies testify to the gradual and steady nature of this process. Currently, 63,6 % of agricultural land in Luhansk region suffers from planar erosion alone.

At that time, quite widespread bayrak forests, which played a reclamation role and contained rich fodder resources, were intensively affected by cattle grazing, which led to disturbance of the turf, washing away of forest soils, exposing the roots of trees and bushes; the young growth was eaten by livestock, so the forests degraded and lost their water protection and forest improvement significance. Thus, the spontaneous use of land caused the strengthening of erosion processes, in particular planar washing, and, therefore, led to soil degradation, especially from the second half of the 19th century.

The semi-mountainous nature of the relief of the right bank, especially its highest part – the Donetsk ridge, was not favorable for agricultural development, and therefore for a long time there was no large permanent population here [1].

The right bank of our region was somewhat late, but underwent the same changes in the landscape contours of the environment as the left bank, which was also connected with the agricultural development of the territory.

Despite the predominant development of the mining industry on the right bank of Luhansk region, agricultural production here also played its role in the degradation of the land fund. Fertile chernozems confined to the Main Donetsk watershed were intensively exploited, which, together with negative natural processes, could not but cause their rather rapid impoverishment. The lands were subjected to a great violent agricultural load. As a result of the combined action of various anthropogenic factors, there is a greater transformation of the natural environment, and therefore the environmental stress on land resources is greater.

After the reform of 1861, the rapid development of industry began in the region. This was facilitated by the presence of huge natural resources, which at that time were not only explored, but were already being developed. In 1792, coal deposits were discovered in the area of present-day Lysychansk. A little later, ore was discovered here and the first blast furnaces were built, which were soon abandoned.

With the discovery of hard coal deposits, this region began to take shape as an industrial one, which left a certain mark on the structure of the land. After all, the area of disturbed land, unsuitable for agricultural use, was also increased due to both underground excavations and surface excavation works.

Industrial coal mining began in the second half of the 19th century, and during the first ten years, 500000 poods (about 8 tons) of coal were mined monthly. Over a century and a half, coal production has increased more than 200000 times.

Today, the number of mines in Luhansk region, together with closed ones and those in private ownership, is more than 300. About 30 beneficiation factories should be added to them, since the latter play the same role in reducing the land fund.

The contour of influence of mining operations within the mining region of Luhansk region covers an area of more than 1300 $km^2$, mainly on the right bank of river Siversky Donets. The area of mine fields exceeds 8000 $km^2$, which is 31 % of the area of the coal region [10].

The urgent problem of the coal region of the region has long been the physical loss of land, that is, the reduction of land resources as a result of their occupation by rock dumps and branched ground structures and communications, which make up more than 4 % of the area of the coal region. Annually, 12 million tons of «empty» rock is accumulated in the dumps of mines and beneficiation factories. The total volume of rock removed to the earth's surface within the Luhansk region is more than 10 billion $m^3$ [10].

For several centuries, significant areas under agricultural and forest lands were destroyed or significantly reduced, significant areas were used under various man-made constructions and communications. Thus, only the mining industry reduces the land fund of the region by 4,1 %.

**Conclusions.** Intensive and extensive agricultural activity in the Luhansk region over the centuries has led to the degradation of land in agriculture due to anthropogenic, accelerated erosion, and in mining – due to the physical removal of land due to intensive mine construction and soil intoxication by mine waters and runoff from rock dumps.

The structure of land use has acquired violent features, the use of land in the region has become irrational and ineffective and requires the development of new conceptual principles and a systematic approach to the formation of an optimal structure of nature use in general and land use in particular.

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