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Assessment of ecological state of soils of the lands of agricultural purpose

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The purpose. Toassess ecological state of soil sof agricultural purpose of Forest-steppe on anexample of Vinnitsa area and to of fermeas ures on optimization oftheir agroecological conditions. **Methods.** Techniq ueisused of assessmen to flands of agricultural purpose on the scale of assessment of ecological state of agrolands capes on the ratiooflands. **Results**. Ecological state is assessed of agrolands capes of the region whichis characterized by range of values from crisis to catastrophicthatis the consequence of excessive economic development and ecological misbalance of lands. **Conclusions.** Forimprovemen to fecological situation it is of feredtodecreas eploughing of territory for 25%, to implement scientificall yprovedcroprotations, anti-erosionmeas ures of soilcultivation, resources-saving technologies of chemical amelioration, top ass to biological agriculture.

Keywords: soil, ecologicalstate, ecological-and-economicassessment, agriculture, resources saving technologies, chemical melioration.

The basis of the protection and restoration of land resources of Ukraine is optimization of the ratio of arable land and ecological stabilizing lands in conditions of intensification and ecologization of the agro-industrial complex. On the intensively cultivated lands, it is necessary to fundamentally change the structure of crop areas in crop rotation so that the cultivation of them on the crops is accompanied by an increase in the fertility of the soils [1, 2].

The ecological sustainability of land resources is characterized by the degree of plowed land. Unfortunately, for the Vinnytsya region, which is representative of the forest-steppe area, it accounts for 65% of the total area of arable land. The most volatile are the areas in which the area of arable land significantly dominates over the conditionally stable lands, which include: pasture, hayfields, lands covered with forest and shrubs and swamps [3, 4].

In particular, to reduce the level of cultivation of the territory of the Vinnytsya region to the ecologically optimal possible use of measures for the improvement of land use, in particular, the removal of intensive cultivation and conservation of ecologically unsustainable farmland, which, according to the State Institution " Soil Protection Institute of Ukraine", consist of almost 500 thousand hectares of agricultural land. This will enable to concentrate agricultural production on the best lands, which will ensure an average much larger volume of production per unit area and increase its competitiveness [5].

One of the main criteria for assessing the ecological status of agricultural lands is the level of soil fertility, as the basis for the functioning of this category of land. The combination of natural factors of the region (soil surface, natural vegetation, climate) and anthropogenic influence contributed to the formation of different properties and soil fertility. The use of soils over a long period of time for crops cultivation under unbalanced fertilization leads to the acute shortage of nutrients, that is, a decrease in fertility [6, 7].

Water erosion damaged 851.1 thousand hectares, of which 743.8 thousand hectares of agricultural land (41.1%

of the total land area), including 598.3 thousand hectares of arable land in Vinnytsya region, [3, 4]. Under such conditions, an important task in the field of optimizing the structure of the land-based fund of the forest-steppe of Ukraine as a whole and in the Vinnytsya region, in particular, should be measured for the removal degraded low productive land from intensive cultivation and to transfer of significant parts of them in natural forage lands.

The purpose of the research is to carry out an assessment of the ecological status of the agricultural soils of the Forest-Steppe zone as the example of the Vinnytsya region and propose measures to optimize their agro-ecological status.

Materials and methods. Numerous modern studies prove that the agro-landscape can be sustainable if the ratio of environmentally hazardous lands, and, first of all, arable land, to ecologically stabilizing lands (forests, natural forages, reservoirs, etc.) is about 50% [3, 4, 8].

The ecological stability of agro-landscapes directly depends on the area of preserved natural phytocoenoses. Improvement of the ecological situation is achieved by reducing the share of arable land and increasing the share of ecologically stabilizing lands, functioning on natural analogs with minimized anthropogenic impact.

A wide database of information materials about the structure and condition of the land fund of the Vinnytsya region was analyzed in the article.

The assessment of the ecological state of agricultural landscapes was carried out according to the degree of violation of the ecological balance in the ratio of arable land (AL) to the total ecological stabilizing lands (ESL) according to the methodology given in the Methodological Recommendations on the Comprehensive Agroecological Assessment of Agricultural Land [9]

Table 1 - Scale for assessing the ecological state of agro-landscapes by the ratio of land

Specific gravity of lands,% to total area		Ecological state of agricultural landscapes	Score, score	Ecotype of the territory
AL	ESL			
<20	>80	Optimal	1	0
20-36	64-80	Satisfactory	2	I
37-55	45-63	Critical	3	II
56-70	30-44	Crisis	4	III
>70	<30	Disastrous	5	IV

The specific weight of the indicators AL and ESL is calculated as a percentage of the total area of arable land and ecological stabilizing lands by the formulas (1) and (2):

$$AL = \frac{S_{AL}}{S_{AL} + S_{ESL}} x100, \qquad (1)$$

AL — specific gravity of arable land in the group of lands AL+ESL, %;

S_{AL} – area of arable land, ha;

S_{ESL}– amount of areas of natural components of agro-landscape (forests, meadows, pastures, shrubs, swamps, reservoirs), ha.

$$ESL = \frac{S_{ESL}}{S_{AL} + S_{ESL}} x100, \qquad (2)$$

ESL — the proportion of ecologically stabilizing lands in the group of lands AL+ESL,% [9, 10].

The so-called ideal ratio of the elements of the land tenure structure (the ratio of arable land, forest, the natural forage, and water) is recommended - 30: 30: 19: 20. Thus, the optimal situation is when 1 ha of arable land has 1.6 hectares of natural forage land and 3.5 hectares of forest.

Results and discussion. Determination of the area of plowed land in the Vinnytsya region showed that the area of plowed land was 65.3%, which is 10% more than this indicator in Ukraine. Area of arable land is respectively 85.6% and 6.1% of the structure of the land fund of the Vinnytsya oblast. Agricultural lands make up 75.7%, forested area - 13.8%, built-up land - 3.6%, water resources - 1.6%, other land - 2.5% [3].

The conducted studies have found that the actual situation is significantly different from the optimal (Table 2).

Table 2 - The ratio of elements of the land tenure structure in Ukraine and the Vinnytsia region

Farmland	Value of the area of farmland			
	theoretical		actual	
	the ideal	optimum	in Ukraine	in Vinnitsa region
Arable land	1,0	1,0	1,0	1,0
Natural fodder land	1,6	0,6	0,23	0,14
The woods	3,5	1,0	0,30	0,22
Wetland	-	0,7	0,11	0,04

The ecological situation in any region depends on the state of the agricultural land. Vinnytsya region is an agricultural region of Ukraine. The total area of land is 2651.9 thousand hectares in the Vinnytsia region. The area of agricultural land is 2008.5 thousand hectares (75.7%) (Fig. 1).

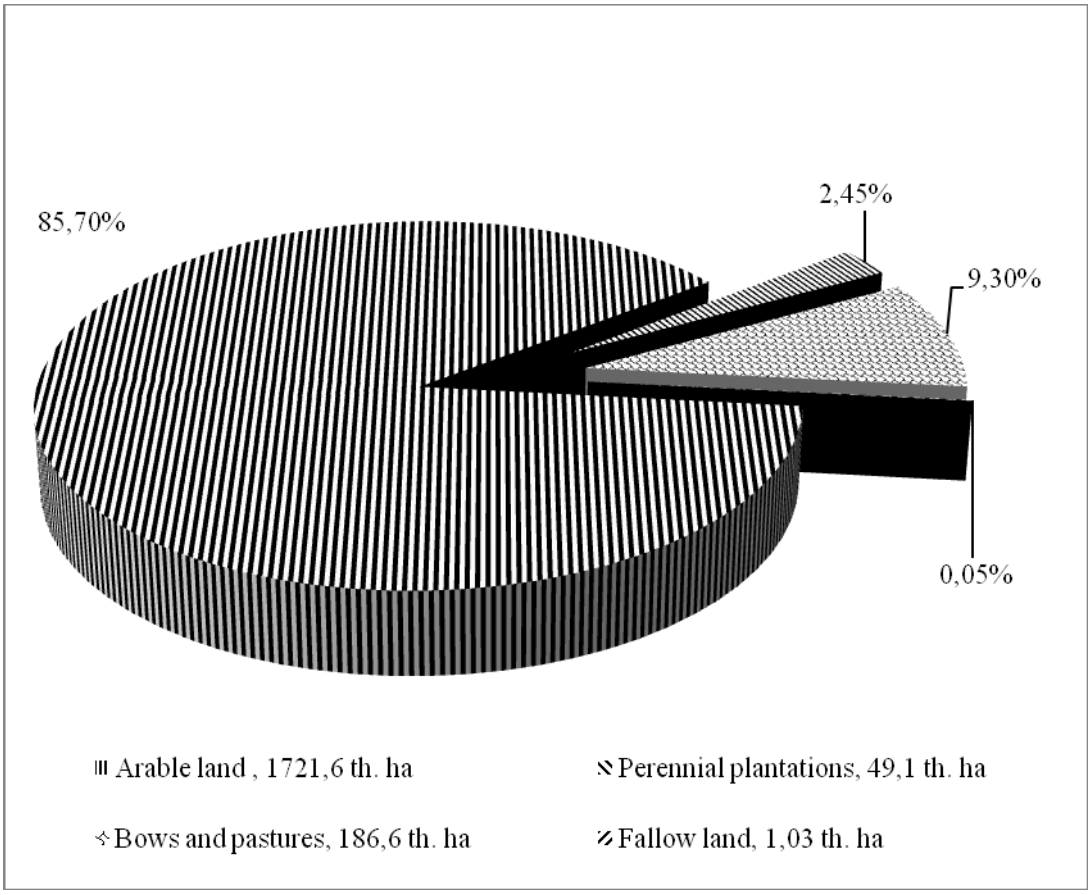

Fig. 1. The structure of agricultural land in the Vinnytsya region

The high level of soil cultivation in the Vinnytsya region leads to negative consequences for the conservation of fertile lands. The terrain is hilly and wavy. A broad hydrographic network of rivers and reservoirs dissects the relief of the region. Soil-forming rocks are easily blurred and this causing the development of erosion processes.

This is a rather negative factor for the agriculture area. Therefore, there is a great need for the removal of areas with high rates of the steepness of slopes from crop rotation and conducting in these areas of afforestation or inoculation in order to preserve the soil from erosion, improve their physicochemical and agronomic indicators [11].

Large areas in the structure of agricultural land are occupied by perennial plantations (gardens, berries), and meadows and pastures, and haymakers. Fallow lands occupy rather small areas in the structure of the agrarian area.

An assessment of the ecological state of agro-landscapes was carried out using a valuation method of the degree of violation of the ecological balance on the basis of the ratio of arable land (AL) to the total area of ecologically stabilizing lands (ESL). According to the modified scale, the Vinnytsya region is represented by the III

and IV agro-landscape types (ecotypes) of territories, and the ecological state of agricultural landscapes is characterized by a range of values from crisis to catastrophic.So the agricultural landscapes of the Bar, Vinnytsya, Zhmerinka,Illintsi, Litin, Murovano- Kurilovtsy, Nemirov, Pyshchanka, Trostianets, Tulchin and Chechelnykdistricts to the III ecotypes corresponding to the crisis state of the land. The other 16 areas belong to the IV highly unbalanced agro-landscape ecotype corresponding to the catastrophic state.

Thus, degraded agro-landscapes are dominated throughout the Vinnytsya region. This requires the adoption of urgent measures to change their component composition and structure. According to scientists, it is necessary to reduce the area of arable land by at least 10 million hectares and transfer them to the pastures and natural and forage lands.

At the same time, the restoration of the broken relationship between natural complexes - areas of meadows, forest plantations, surface waters, agricultural lands as the first steps to achieving ecological balance in agro-landscapes will be started.

*Functional using the Vinnytsya region's land.*The ecological sustainability of land is largely characterized by their degree of plowing, which in the region is 64.9%, which is 10% more than this indicator in Ukraine. The analysis of the calculated indicators has established that the index of agricultural development of the territory of Vinnytsia region lies within the range of 0.62-0.86, which indicates the excessive economic development of the territory and environmental imbalance of lands in agro-landscapes.

The most stable in terms of ecology are land resources of the Litinsky, Tyvrivsky, Zhmerinsky and Chechelnytsky districts, where the degree of plowing is 52-55%. The highest percentage of land cultivation in Bershad (73%), Lypovets (76%), Teplitsk (79%) and Chernivtsi (74%) districts. Numerous results of the scientific research indicate that in order to achieve optimal indicators of ecological and economic use of land, the area of arable land in Vinnitsa region should be reduced by almost 500 thousand hectares, and the area of grasslands, pastures, and forests should be doubled.

It is the transfer of arable land to natural forage lands and afforestation to ensure their protection and preservation for future generations. Among the main agrotechnical measures to optimize the agro-ecological state of soils, the following should be noted: introduction of organic and mineral fertilizers; conducting agrochemical melioration (neutralization of acidic soils); the most suitable alternation of crops in the crop rotation; soil protection (anti-erosion) measures; introduction of biological systems of agriculture: soil tillage system, fertilizer system (biological preparations), advanced varieties and hybrids, microbiological fertilizers, biostimulants, etc.

All these production processes should create a whole system of measures for the conservation and protection of soil fertility. Execution of these measures will enable not only to preserve fertile land but also to increase their term of use in agricultural production with a high index of their quality.

Conclusions

The ecological state of agricultural landscapes of Vinnytsya region on the degree of ecological equilibrium in the ratio of arable land (AL) to the total area of ecologically stabilizing lands (ESL) is estimated. It was established that the region is represented by III and IV agro-landscape types (ecotypes) of territories and the ecological state of agricultural landscapes is characterized by a range of values from crisis to catastrophic.

An analysis of the functional use of the land fund showed that for the Vinnytsia region the agricultural development index of the territory lies within the range of 0.62-0.86, which indicates the excessive economic development of the territory and ecological imbalance of the land.

To improve the ecological situation in agro-landscapes on the way to sustainable development, it is proposed to: balance the arable land and ecological stabilizing lands; introduction of scientifically grounded crop rotation, anti-erosion measures of soil cultivation, resource-saving technologies of chemical melioration; transition to partial organic farming using organic fertilizers; removal from cultivation and further conservation of highly degraded and unproductive soils.

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