Negative transformation of agricultural lands and their protection in JSC «Agricultural enterprise Kolos» of the Kochubeyevsky Municipal District of the Stavropol Territory

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Abstract. The article is devoted to the urgent problem of the negative transformation of fertile agricultural lands, the development of degradation processes, as well as the protection of agricultural landscapes. The results of monitoring studies show that over the past decades, the dynamics of the areas of agricultural land subject to degradation has been increasing. The intensity and accelerated development of degradation processes leads to a sharp deterioration in the quality of land and a reduction in the content of important nutrients of agricultural crops. Each degree of degradation reduces yields by 20-25%, which naturally affects the economy of agricultural production. In addition, the quality condition of agricultural landscapes needs urgent measures to protect and protect land. Each agro-climatic zone is characterized by its own special degradation processes, so for the zone of unstable humidification, where the farm under study is located, such problems are flooding, waterlogging and water erosion. The development and implementation of comprehensive security measures will stop the withdrawn negative olugenation transformation of agricultural deep land, grass preserve their tillage quality chernozem condition and ensure causes stable degree high yields of driving agricultural result crops.

1 Introduction

The problem of rational and efficient use of agricultural land remains very relevant for all agricultural territories of the region, regardless of agro-climatic conditions. The land fund of the Kochubeyevsky Municipal District is subject to various negative processes and in our research we chose the territory of the Kolos agricultural enterprise to develop comprehensive measures for the protection and protection of agricultural land [1]. Prolonged and intensive use of the land in combination with natural factors has led to deterioration of the condition of the land and the lack of the possibility of further effective use [2]. The main causes of degradation of the lands of the Kochubeyevsky municipal District are flooding, water erosion and deflation. To remedy the situation, urgent comprehensive measures are needed to combat negative processes [3].

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2 Materials and method

The land use of the farm is located on the left bank of the Kuban River and is an integral part of the foothill plain, which is a fairly homogeneous area. The territory of the farm belongs to the III agro-climatic zone with GTC = 0.9-1.1. Unfavorable natural conditions include strong and frequent winds that cause dry winds and dust storms, as well as not deep groundwater, which is the cause of flooding and waterlogging of agricultural land [4].

The farm lands are located on terraces in the first and second floodplains of the Kuban River and consist of rocks of the Maikop clay, which are highly saline. The soils are covered with low-power ordinary carbonate chernozems [5]. The soils are dense and hydrophilic due to high salinity and high content of silt and physical clay. During the wet season, when the amount of precipitation exceeds the norm, waterlogging phenomena are observed in large areas [6].

The modern relief of the territory was formed as a result of flooding and accumulative activity of the Kuban River, the floodplain terraces of which are swampy. Topography, climatic conditions and anthropogenic activities have also dictated the presence of groundwater in the immediate vicinity, and groundwater plays an important role in the formation of soils in wet areas. [7]. The land fund of JSC «SHP Kolos» has a large plowing, which also affects the manifestation of various degradation processes. The total land use area of JSC "SHP Kolos" is 18090 hectares, of which 15204 hectares are occupied by agricultural land. The main share of agricultural land belongs to arable land (59.74%) and pastures (21.09%). Non-agricultural land accounts for 2,886 hectares or 15.96% of the farm's territory. This type of land is represented by roads, protective forest plantations, building lands and under water.

In the preparatory period after the establishment of the objects of soil surveys, materials were collected on the natural conditions of the territory, taking into account the assessment of the impact of farming systems, economic entities or other activities from the state of the soil cover. To assess the state of the soil cover of the territories, the materials of previous research and design and survey works and soil surveys were also collected.

When laying out control plots, natural and industrial conditions were taken into account in order to characterize as much as possible all the variety of factors affecting agricultural production. The soil of the plots is in agricultural use and is not excluded from the current crop rotation. All work on local monitoring was carried out in accordance with the guidelines. A detailed ecological and toxicological examination was carried out by the method of continuous examination. According to the results of soil analyses for safety and fertility indicators, agroecological passports were issued for each controlled field.

Field and laboratory studies were carried out according to the methods approved in the system of the State Standard of Russia. Determine the degree of degradation and characterize degraded lands, calculate their areas. Develop measures to restore degraded lands. Statistical processing of research results is carried out in the computing center of the Agrarian University by the method of variance analysis.

Agricultural lands are located on various soils, such as ordinary chernozems, ordinary moist chernozems, meadow-chernozem superficially gley mochary, chernozem-meadow saline gley mochary, meadow-gley saline mochary and chernozem-meadow saline residual gley mochary. All these soils are formed in conditions of excessive moisture [8].

Determination of the type and degree of soil degradation based on the results of field surveys; mapping of the current ecological state of the soil cover, the state of plant groupings on pastures and crops on arable land, terrain slopes, identification of sources of flooding and waterlogging of soils was carried out taking into account modern requirements
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In carrying out this work, the following research methods were used: comparative historical (retrospective), descriptive, system analysis, forecasting method, cartographic, and a number of methods of territorial planning [9]. Satellite satellite images and aerial photographs obtained from UAVs Geo Scan were used to conduct a survey of agricultural lands Landsat 7.

3 Results

Surveys of the land fund in the «SPK Kolos» of the Kochubeyevsky Municipal District of the Stavropol Territory showed that twenty-seven plots of agricultural land on the territory of the farm have signs of degradation [10]. The main cause of land degradation in most of the identified areas is seasonal waterlogging, leading to oppression or wetting of crops. Most of the land has the first degree of degradation, which does not cancel the use of soil protection measures based on the removal of excess moisture [11].

Each agro-climatic zone of Stavropol has features related to soil and climatic conditions, relief, specialization of agricultural production and problems of land use. All these conditions have a direct impact on the state of agricultural land and the development of specific types of land degradation. Accordingly, the prevailing types of negative processes that are most widespread in the territory of an administrative district or an agro-climatic zone affect the specifics of measures to preserve and improve agricultural land [12].

Nine plots of degraded arable land, with a total area of 102.7 hectares, have the III degree of degradation. The steepness of the slopes is up to 1°. All sites are subject to conservation for 4-5 years with the development of measures to remove excess moisture. The main causes of degradation are waterlogging and waterlogging due to rising ground water levels and unfavorable redistribution of surface runoff, water erosion, salinization. Failure to take appropriate measures to remedy the situation leads to the loss of specific land, as due to the development of negative processes, their natural properties are lost. [13].

Three degraded areas with an area of 50.5 hectares, with a slope steepness of up to 1°, have been identified on natural forage lands [14]. The first plot is an improved pasture, with an area of 17.1 hectares. As a result of the flood, deposits of sand and stones were formed, reeds appeared in the grass. This plot is being transferred to a clean pasture [15]. The second degraded plot has an area of 12.2 hectares, the type of land is pasture clean and is subject to conservation for 4-5 years. The causes of degradation are flooding and overgrowing with reeds. Plot No. 3 is an improved pasture with an area of 21.2 hectares. Salinization, depression and sparseness of vegetation. It is necessary to preserve and sow salt-tolerant perennial grasses (Table 1).

Table 1 Proposals for the conservation of agricultural landscapes within the boundaries of JSC «SEC Kolos» Kochubeyevsky municipal district, ha

№	Type of land	Area, ha.	Degree of degradation	Further use			
				conservation	without changing the destination	with the change of purpose	transfer to unused lands
1.	Arable land	30,9	III	30,9	-	-	-
2.	Arable land	5,4	III	5,4	-	-	-
3.	Arable land	12,2	III	12,2	-	-	-
4.	Arable	14,2	III	14,2	-	-	-

	land						
5.	Arable land	4,2	III	4,2	-	-	-
6.	Arable land	3,4	III	3,4	-	-	-
7.	Arable land	7,6	III	7,6	-	-	-
8.	Arable land	10,4	III	10,4	-	-	-
9.	Arable land	14,4	III	14,4	-	-	-
Total		102,7		102,7	-	-	-
10.	Pastures	17,1	III	-	-	17,1	-
11.	Pastures	12,2	III	12,2	-	-	-
12.	Pastures	21,2	III	21,2	-	-	-
Total		50,5		33,4	-	17,1	-

Source Developed and compiled by the authors

In addition to the above-mentioned degraded agricultural lands, flooded areas with I and II degrees of degradation have been identified in the land use area. Their area is 723 hectares and all of them are arable land and pastures. For their further use, it is necessary to ensure the removal of excess moisture and the introduction of perennial grasses into the crop rotation.

Monitoring studies and their results make it possible to carry out zoning of farm lands according to their productivity (Table 2). As a basis for zoning, we take the system of land distribution developed by us according to the degree of their degradation. A positive aspect is the absence of unsuitable lands on the territory of the farm, that is, lands that have the fourth degree of degradation and are not subject to restoration. The area of unsuitable land is 153.2 hectares, of which more than 100 hectares are represented by arable land, which is withdrawn from their turnover and is subject to conservation with the introduction of soil protection measures.

Table 2 Distribution of agricultural landscapes of JSC «SHP Kolos» Kochubeyevsky Municipal District by suitability

№	Type of land	Classification of agricultural landscapes, ha			
		highly suitable	suitable	of little suitable	unsuitable
1.	Arable land	9982,3	681,6	102,7	-
2.	Pastures	3764,5	41,4	50,5	-
3.	Haymaking	581,0	-	-	-
4.	Agricultural land	14327,8	723,0	153,2	-

Source Developed and compiled by the authors

About 4.75% of the agricultural lands of JSC «SHP Kolos» are suitable and these areas can be used without restriction, but in compliance with the rules of rational land use. We have classified the main body of agricultural land in the farm as highly suitable, since degradation has not been detected on them. The stages of degradation of flooded and

waterlogged soils during the development of hydromorphism are taken as the basis of classification indicators of the degree of flooding of lands.

4 Conclusion

According to the monitoring results, agricultural lands experience permanent, temporary, long-term and short-term excessive moisture. Under the influence of waterlogging and waterlogging, soil hydromorphism develops. Signs of hydromorphism in the soil profile determine the degree of waterlogging or olugenation of soils. The hydromorphic type of soil formation is observed on an area of 10.8 thousand hectares, which is 69.5% of all waterlogged lands and 8.9% of the area of agricultural land. These lands are represented by alluvial meadow-marsh, alluvial meadow, meadow, meadow-chernozem and salt lakes.

The main causes of degradation were systematic non-compliance with the complex of anti-erosion measures, as well as such socio-economic factors as: non-compliance of economic and on-farm specialization with the requirements of soil protection from erosion; location of land boundaries without taking into account the requirements of protection from erosion and internal organization of the territory, plowing steep slopes prone to erosion; irrational use of arable land; arrangement of the territory crop rotations without taking into account the relief and other requirements for soil protection from erosion; errors in the projects of the organization of the territory. This led to a significant decrease in the soil profile on the slopes and the appearance of washouts, flushing of the fertile layer, and a decrease in humus reserves.

Thus, under the influence of anthropogenic flooding from infiltration from water bodies, large arrays of flooded soils are formed. Flooding of soils with steppe soil formation leads to waterlogging, olugenation and salinization of soils. These processes entail land degradation, reduce its fertility indicators, which contributes to the transfer of arable land to less valuable agricultural land. The prevailing factor in the formation of flooded lands is anthropogenic flooding in the floodplains of rivers and their potyazhines. A set of measures on waterlogged lands aimed at leveling the surface and preventing the deterioration of the reclamation state of the soil, salinization and waterlogging, since saucers contribute to stagnation of water, and elevated soil areas, from which, on the contrary, water flows, include the following measures:

- periodically align fields with long-base planners;
- it is mandatory to alternate the direction of treatments for any configuration of sites;
- make a thorough breakdown of fields into paddocks and observe the straightness of driving tractors during all field work;
- carry out soil treatment in a timely manner;
- observe the maximum possible width of the pens;
- carefully adjust the working bodies of agricultural machines;
- organize a drainage system in problem areas;
- apply surface treatments on plowing during formation of layers and clumpiness of the soil.

To level the soil surface, various tools are used: VP-8, VPN-5,6, KZO-0,3V and graders of all brands, plume harrows that level the soil with irregularities up to 10 cm. It is necessary to take into account the slopes of the soil surface and the amount of water permeability, with its low value, use deep tillage and intermittent crevice. On arable lands, winter tillage is carried out:

- on powerful chernozems up to 32-35 cm;

– on chernozem soils with a small humus horizon, deep chill treatment ranges from 14 to 22 cm.

Deep tillage in crop rotation is alternated with shallow or superficial, which makes it easier and more effective to fight diseases, pests and weeds. In the event that the groundwater is mineralized and lies closer than 3 m, it is necessary to carry out deep loosening by 40-60 cm 1-2 times per rotation to increase water permeability and seepage of water into deeper horizons. The frequency of periods of deep tillage depends primarily on the granulometric composition of soils. On soils with heavy granulometric composition and underlying saline horizon, deep plowing is carried out in a year. If there is no saline horizon, deep plowing is carried out in 2-3 years, and on light loamy soils - in 3-4 years or once per rotation of the crop rotation. The depth of tillage and the choice of the treatment method are determined taking into account the place of the crop in the crop rotation.

Waterlogged hayfields, floodplains of rivers, bottoms of gullies with thickets of shrubby vegetation belong to non-arable lands. A number of cultural and technical measures are carried out on these lands in advance, including the uprooting of swamp and shrub vegetation, the removal of hummocks and stones. Then they proceed to the implementation of drainage techniques and the installation of drainage systems. This is followed by work on tinning with perennial herbs and sowing of grass mixtures. The developed measures are aimed at protecting agricultural landscapes taking into account the specific conditions of land use and the presence of negative processes and are cost-effective.

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