Territory management based on the arrangement of agricultural landscapes

E V Nedikova
Federal State Budgetary Educational Institution of Higher Education Voronezh State Agrarian University named after Emperor Peter I, 1, Michurina st., Voronezh, 394068, Russian Federation

E-mail: nedicova@yandex.ru

Abstract. Currently, there is degradation of land, ignoring the system of scientifically based crop rotations, all this creates enormous damage to the productive potential of the country's land fund. The paper presents a mechanism for making managerial decisions to preserve land productivity and sustainability of agricultural landscapes, which consists in collecting reliable information about the state of land, then assessing the quality state and land use. Management decisions to preserve land productivity and sustainability of agricultural landscapes are divided into different levels: operational, tactical, strategic). It is necessary to manage the territories based on the rational organization and arrangement of the territory of each specific land use, or, in other words, the management of the territories should be based on the solution of environmental and economic issues in the process of land management, and this, of course, affects the state of the ecosystem of a particular agricultural landscape. The developed mechanism for managing territories based on the arrangement of an agrolandscape consists of 3 stages: creating an agrolandscape structure, assessing its territory and analyzing options for optimizing the territory of each agrolandscape located on the territory. Agrolandscape could be both collapsing and highly resilient. Different specific gravity of arable land can either soften or exacerbate the ecological state of agrolandscapes in different ways, which means that with the help of optimization indicators of various types of agrolandscapes, humanity has the opportunity to influence the stability of the territory. This system of formation of sustainable land use of agricultural organizations has already been worked out in the development of projects in the base farms of the Voronezh region and is a reliable basis for managing territories.

1. Introduction
An analysis of the current state of agricultural land indicates a low level of their efficiency. This is often accompanied by land degradation, ignoring the system of science-based crop rotations. Increasing land degradation processes create enormous damage to the productive potential of the country's land fund. Therefore, there is a need to apply new techniques and methods for managing territories, based on the close relationship between agricultural production and the stability of the territory. Land management should act as a mechanism for the implementation of the tasks set. Practice, as well as foreign experience, show that only on the basis of land management measures on agricultural land, it is possible to create territorial support for the conservation and reproduction of agricultural land and soil fertility, ensure the organization of rational use of land and their protection,
and on this basis ensure the growth of agricultural production for strengthening the food independence of the country.

At the same time, an analysis of the current situation in the field of agricultural land management over the past twenty years indicates a decrease in the role of land management as the main tool for managing land resources in agricultural production - there is no clear program for land management, legal, scientific, technical, financial and other support.

At the present stage, there is a need to apply new techniques and methods for managing territories, based on a complex of land management measures, especially on agricultural lands, while it is necessary to ensure a close relationship between agricultural production and the stability of the territory.

2. Materials and methods
This study was formed on the basis of the works of scientists on the analysis of the current state and development of lands, legislative and regulatory acts, materials related to the arrangement of agricultural landscapes. The research was based on the use of a systematic approach to the subject area under study, as well as monographic, calculation-constructive, economic-statistical and other methods.

3. Results
When managing territories, it is necessary to solve many issues of assessment, organization and arrangement. Under the management of territories, we understand the use of various techniques and methods to maintain or directed change of its main components. When managing territories, one should rely not on any one factor, but on their interaction, aimed at ensuring the productivity and sustainability of the territory as a whole.

Only on the basis of land management measures, it is possible to create territorial support for the conservation and reproduction of agricultural land and soil fertility, ensure the organization of the rational use of land and their protection, and on this basis ensure the growth of agricultural production to strengthen the food independence of the country. Figure 1 shows the mechanism for making managerial decisions to preserve land productivity and sustainability of agricultural landscapes (figure 1).

![Diagram](image_url)

**Figure 1.** The mechanism for making managerial decisions on the conservation of land productivity and the sustainability of agricultural landscapes.
The mechanism for making managerial decisions to preserve land productivity and sustainability of agricultural landscapes consists in collecting reliable information about the state of land, then assessing the quality state and use of land. Management decisions to preserve land productivity and sustainability of agricultural landscapes are divided into different levels: operational (at the level of the land user), tactical (at the level of the municipality), strategic (at the level of the region).

Of course, it is necessary to manage the territories based on the rational organization and arrangement of the territory of each specific land use, or, in other words, the management of the territories should be based on the solution of environmental and economic issues in the process of land management, and this, of course, affects the state of the ecosystem of a particular land use, other agricultural landscape.

Considering the foregoing, the management of territories based on the arrangement of agrolandscapes should ensure the preservation of land productivity and the sustainability of agrolandscapes with the high quality of agricultural products obtained and the elimination of negative natural and anthropogenic processes. This implies the rational use of agricultural landscape resources in order to form their sustainability.

An important role in increasing the sustainability of agricultural landscapes is played by:

- Protection of lands from erosion, deflation, flooding and groundwater flooding.
- Reducing the negative impact of adverse natural and climatic phenomena (dry winds, droughts, etc.).
- Formation of the optimal ratio of land areas of the territory - fields, meadows, forests and water. – optimization of the agrolandscape structure.
- Designing a set of measures (organizational and economic, agroforestry, agrotechnical, hydrotechnical, etc.) that allow the formation of agricultural landscapes with an optimal structure of land and a stable ecosystem.

In the modern concept of territory management, it is necessary to bear in mind, first of all, the formation of the stability of the territory through the implementation of a complex of land management works on the land use of agricultural organizations, which is aimed at the formation of environmentally sustainable agricultural landscapes with an ecosystem where all modes are balanced for adaptive farming. Such an integrated symbiosis in the management of territories is a symbiosis of land management and farming systems.

It is possible to manage the territories on the basis of the landscape organization of the territory, where the functioning of the natural, anthropogenic components of the agrolandscape and human economic activity in the production of agricultural products are ecologically balanced.

After analyzing a number of scientific and methodological works of many scientists on the issues of territory management, summarizing the information and significant production experience in the development of projects for ecological and landscape systems of agriculture in the Voronezh region, it was found that the emerging actual process of organizing the territory conflicts with the content of classical land management projects. Moreover, this fact is currently a brake on making informed decisions on the management of territories. For example, when addressing issues of arrangement of arable land, often the landscape and ecological component of territory management is not considered, only the nature of the use of a given land plot is considered.

In our opinion, the management of the territories should be aimed at constructing the optimal ratio of land in the agrolandscape, the correctly established structure of the agrolandscape and the spatial mosaic of land is created on the basis of the formation of various elements of the organization of the territory, such as forest belts, roads, hydraulic structures, ponds, etc., which will subsequently create a territorial basis for the functioning of agroecosystems for various land uses of agricultural organizations.

During the arrangement of agricultural landscapes, new ecosystems are formed or existing ecosystems are improved. In the process of territory management, it is necessary to solve the issues of
optimizing the structure of agrolandafts and their arrangement, and then proceed to the design of various elements of the organization and arrangement of land use by agricultural organizations. These activities should be based on the construction of types of agricultural landscapes, and the components of the agricultural landscape that are in close interdependence form a single ecosystem. The territorial organization of ecosystems of agricultural landscapes involves the establishment of a certain ratio of areas of arable land, pastures, hayfields, forest plantations, settlements and other anthropogenic environmental elements that leave an imprint on the processes of energy exchange occurring in the agroecosystem. Optimization of the composition and ratio of lands (environment stabilizing and destabilizing) contributes to the improvement of self-regulation processes in the ecosystem of agricultural landscapes. And already on the basis of the organization of the eco-system of the agricultural landscape, land use of agricultural organizations should be formed. The essence of the formation of land use lies in the fact that for each land mass of an agricultural enterprise to establish the optimal parameters for the intensity of use, i.e. land use should be close to the natural landscape, thereby ensuring a balanced reproduction of agricultural resources.

Figure 2 shows the developed mechanism for optimizing the structure of the agricultural landscape. Territory management is divided into 3 main stages.

**Figure 2.** Mechanism for optimizing the structure of agricultural landscapes.

| Stage | Activity |
|-------|----------|
| I stage | Determination of the structure of the agricultural landscape |
| II stage | Definition and classification of indicators and factors that determine the ecological state of the use of agricultural enterprises in the structure of agricultural landscapes |
| | Rationing of indicators and factors that determine the ecological state of agricultural landscapes |
| | Determination of the degree of influence of the level of load on the ecological state of the territory of agricultural enterprises |
| | Determination of the dependence of the ecological state of the territory on the ratio of agricultural land in the structure of agricultural landscapes |
| | Determining the contribution of each type of agricultural land to reducing the level of pressure on the territory of land use |
| | Determination of the contribution of each type of agricultural land to the improvement of the ecological state of the territory of an agricultural enterprise |
| III stage | Analysis of options for optimizing the territory of an agricultural enterprise |
The first stage is represented by the need to determine the function, the goal of creating the structure of the agricultural landscape (ratio of land).

The second stage is the assessment of the territory of the agrolandscape according to the degree of influence of the anthropogenic load on the ecological state of its territory. For this, it is necessary to normalize the indicators and factors that determine the ecological state of agricultural landscapes. Then there is a transition from the agrolandscape as a whole to the land use of agricultural organizations located on its territory. Definition and classification of indicators and factors that determine the ecological state of agricultural organizations in the structure of the agricultural landscape.

At the third stage, the dependence of the ecological state of the territory on the ratio of agricultural land in the structure of the agricultural landscape is determined by determining the contribution of each type of agricultural land to reducing the level of load and vice versa, determining the contribution of each type of agricultural land to improving the ecological state of the territory of an agricultural enterprise. Based on this, an analysis of options for optimizing the territory of each agricultural enterprise is carried out.

Let us dwell in more detail on the optimization of the structure of agricultural landscapes by determining the ratio of stabilizing and destabilizing lands.

The formation of sustainable land use of agricultural organizations has a practical focus with an emphasis on agro-landscape features of land use and, therefore, without claims to complete coverage of all issues.

After carrying out a set of measures to form sustainable land use, their environmental assessment should be carried out. Then the parameters of the structure of the agricultural landscape as a whole are determined.

\[ K_1 = \frac{526.61}{1118.39} = 0.47 \]
\[ K_1 = \frac{699.87}{946.11} = 0.74 \]
\[ K_2 = \frac{526.61}{1645} = 0.32 \]
\[ K_2 = \frac{699.87}{1645} = 0.43 \]

Where \( K_1 \) is the ratio of stabilizing lands (A) to destabilizing lands (B); \( K_2 \) is the ratio of stabilizing grounds (A) to the total area of the landscape; (A+B) – agricultural landscape optimization coefficient.

Conclusion: the results of the environmental assessment showed that the agrolandscape has moved from the state of "collapsing" to the state of "medium stable".

Calculations of individual land uses of agricultural organizations are the basis for determining the parameters of the structure of the agricultural landscape as a whole.

Thus, the application of new techniques and methods of territory management, based on the implementation of a complex of land management measures for the arrangement of agricultural landscapes, by optimizing its structure, will contribute to the preservation of land productivity and the sustainability of agricultural landscapes.

4. Discussion

Practical significance and approbation of the study: the developed theoretical and methodological recommendations for the management of territories based on the arrangement of agricultural landscapes can be demanded by state and municipal authorities. The research materials are used in the educational process of the Voronezh State Agrarian University at the Faculty of Land Management and Cadastre in the implementation of educational programs in the direction of "Land Management and Cadastre".

The system of formation of sustainable land use of agricultural organizations has been worked out in the development of projects in the base farms of the Voronezh region and is a reliable basis for managing territories based on the arrangement of agricultural landscapes.
5. Conclusion
The paper presents a mechanism for making managerial decisions to preserve land productivity and sustainability of agricultural landscapes, which consists in collecting reliable information about the state of land, then assessing the quality state and land use. Management decisions to preserve land productivity and sustainability of agricultural landscapes are divided into different levels: operational (at the level of land user), tactical (at the level of the municipality), strategic (at the level of the region).

Of course, it is necessary to manage the territories based on the rational organization and arrangement of the territory of each specific land use, or, in other words, the management of the territories should be based on the solution of environmental and economic issues in the process of land management, and this, of course, affects the state of the ecosystem of a particular land use. other agricultural landscape.

Considering the foregoing, the management of territories based on the arrangement of agrolandscapes should ensure the preservation of land productivity and the sustainability of agrolandscapes with the high quality of agricultural products obtained and the elimination of negative natural and anthropogenic processes. This implies the rational use of agricultural landscape resources in order to form their sustainability. It is noted that an important role in increasing the sustainability of agricultural landscapes is played by: protecting land from erosion, deflation, flooding and groundwater flooding; reduction of the negative impact of adverse natural and climatic phenomena (dry winds, droughts, etc.); formation of the optimal ratio of land areas of the territory - fields, meadows, forests and water - optimization of the structure of the agricultural landscape; designing a set of measures (organizational and economic, agroforestry, agrotechnical, hydrotechnical, etc.) that allow the formation of agrolandscapes with an optimal structure of land and a stable ecosystem.

The developed mechanism for managing territories based on the arrangement of an agrolandscape consists of 3 stages:

The first stage is represented by the need to determine the function, the goal of creating the structure of the agricultural landscape (ratio of land).

The second stage is the assessment of the territory of the agrolandscape according to the degree of influence of the anthropogenic load on the ecological state of its territory. For this, it is necessary to normalize the indicators and factors that determine the ecological state of agricultural landscapes. Then there is a transition from the agrolandscape as a whole to the land use of agricultural organizations located on its territory. Definition and classification of indicators and factors that determine the ecological state of agricultural organizations in the structure of the agricultural landscape.

At the third stage, the dependence of the ecological state of the territory on the ratio of agricultural land in the structure of the agricultural landscape is determined by determining the contribution of each type of agricultural land to reducing the level of load and vice versa, determining the contribution of each type of agricultural land to improving the ecological state of the territory of an agricultural enterprise. Based on this, an analysis of options for optimizing the territory of each agricultural enterprise is carried out.

Thus, the stability of agricultural landscapes is affected by a different ratio of land in the land use of agricultural enterprises (stabilizing and destabilizing), therefore, the state of the agricultural landscape can be both collapsing and highly stable. Different specific gravity of arable land can either soften or exacerbate the ecological state of agrolandscapes in different ways, which means that with the help of an integral scale of optimization indicators for various types of agrolandscapes, humanity has the opportunity to influence the stability of the territory. Such a system for the formation of sustainable land use by agricultural organizations has been worked out in the development of projects in the base farms of the Voronezh region and is a reliable basis for managing territories based on the arrangement of agricultural landscapes.
References

[1] Chechin D I, Ecolodical Arrangement of Land of Voronezh Agricultural Enterprises for Environmental Management

[2] Chechin D I, Nedikova E V, Postolov V D and Linkina A V 2019 AER - Advances in Engineering Research 182 361-364

[3] Linkina A V and Nedikova E V 2019 Assessment of the State and Management of Modern Agricultural Landscapes in the Central Black Earth Region. AER - Advances in Engineering Research 182 369-373

[4] Bukhtoiarov N I and Nedikova. E V 2019 Design of Environmental Technologies on Agricultural Land. AER - Advances in Engineering Research 182 365-368

[5] Chechin D I and Nedikova E V 2020 The influence of adverse natural phenomena, anthropogenic factors on the efficiency of land users (regional aspect). Earth and environmental science: 6th International conference on Agriproducts processing and Farming.-2020. IOP Conf. Ser.: Earth Environ. Sci. 422 012099

[6] Zotova K Y and Nedikova E V 2020 Improving the optimization methodology for the structure of Agrolandscapes. Earth and environmental science: 6th International conference on Agriproducts processing and Farming.-2020. IOP Conf. Ser.: Earth Environ. Sci. 422 012100

[7] Langhammer J and Roedlva S 2013 Changes in water quality in agricultural catchments after deployment of wastewater treatment plant. Environmental Monitoring and Assessment 185(12) 10377-10393

[8] Abdo M T, Vieira S R and Martins A L M 2013 Gully Erosion Stabilization in a Highly Erodible Kandistalf Soil at Pindorama, São Paulo State, Brazil. Ecological Restoration Journal 31 246-249

[9] Hamitowa S M, Glinushkin A P, Avdeev Y M, Nalyuhin A N, Beliy A V, Zavarin D A, Snetilova V S, Lebedeva M A, Danilova E D, Semykin V A, Pigorev I Y and Lichukov S D 2017 Assessment of Microorganisms and Heavy Metals’ Content in The Soils Of Arboretum Named After Nikolai Klyuev. International Journal of Pharmaceutical Research & Allied Sciences 6(3) 47-55

[10] Linkina A and Nedicova E 2016 Ways to preserve soil fertility based on agrolandscape. Agrofor 1(2) 112-118

[11] Shein E V, Dembovetskii A V, Kiryushin V I, Korchagin A A and Mazirov M A 2017 Il'in L.I. Assessment of agronomic homogeneity and compatibility of soils in the vladimir opolie region. Eurasian Soil Science 50(10) 1166-1172

[12] Kiryushin V I 1997 Agroecological classification of lands as a basis for development of agricultural systems. Eurasian Soil Science 30(1) 67-73

[13] Kotlyarova E G, Ryazanov M N, Titovskaya L S, Nuzhnaya N A and Garmashov V M 2018 The effect of soil cultivation on contamination of sunflower crops in the result of technology intensification in the last 40 years in the central black earth region. Research Journal of Pharmaceutical, Biological and Chemical Sciences 9(5) 1261-1268

[14] Kotlyarova E G, Gritsina V G, Titovskaya A I and Litsukov S D 2017 Formation of the symbiotic apparatus and yield of soy varieties depending on the level of fertilization. International Journal of Advanced Biotechnology and Research 8(4) 1156-1164

[15] Kotlyarova E G and Gritsina V G Productivity and economic efficiency of soybean varieties cultivation upon application of organic and mineral fertilizers