The system of indicators of the efficiency of reproduction of agricultural land resources

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Abstract. In market conditions, the active innovation policy of agricultural producers is a condition for their survival. At the same time, the lack of positive experience in conducting innovative activities, lack of funding, and low innovation potential of agricultural organizations, including due to the lack of qualified personnel, significantly hinder innovative activity in agriculture, including in the process of reproduction of agricultural land resources. The problem of the efficiency of reproduction of agricultural land resources is also relevant for foreign countries, which determined the purpose of the study. The article deals with the issue of assessing the efficiency of land resources reproduction at the present stage of development, taking into account innovative processes. A refined system of indicators for assessing the efficiency of reproduction of agricultural land resources is proposed, which provides an assessment of the economic feasibility of introducing the latest developments and technologies in agricultural production.

1. Introduction
Currently, many domestic and foreign scientists are studying the problem of rational and effective use of agricultural land resources [1-4]. The solution of this problem is of great state and national economic importance, as it is the basis of agricultural production. In turn, agricultural production forms the basis of food independence, which is a key element of the country's food security system. Accordingly, agricultural land, being the main indispensable means of production in agriculture, plays an important role in providing the country's population with food in sufficient quantity for active life. Effective management of agricultural production should ensure the expanded reproduction of land resources, which will allow to produce a greater number of high-quality products per unit area of land. At the present stage of development, in order to successfully conduct agricultural production, and, consequently, to ensure the expanded reproduction of land resources, it is necessary to introduce informatization and innovations in the agro-industrial complex [5-12]. To assess the efficiency of land resources reproduction, it is advisable to use indicators that reflect changes in soil fertility, productivity of arable land and natural forage land, the proportion of land subject to wind and water erosion, and the specific weight of land involved in economic turnover. In modern conditions, an important factor in the development of agricultural enterprises was the introduction of information, digitalization, innovation in the production process, which led to the introduction of new indicators.
that characterize the process of reproduction of land resources. The purpose of this study is to develop a system of indicators for assessing the efficiency of reproduction of agricultural land resources at the current stage of development, allowing for a more complete and qualitative assessment of this process.

The existing system of indicators for assessing the reproduction of agricultural land resources includes indicators of land productivity, their composition and quality, but does not characterize this process from the point of view of information and innovative development. The proposed indicators of innovative development, such as: the number of land plots equipped with robotic systems and digital technologies; the number of machines and units for tillage equipped with automated complexes; the number of digital technologies used in agrochemical monitoring of the state and fertility of arable land will allow us to assess the effectiveness of the introduction of innovative and information processes in agricultural production. Currently, about one third of all agricultural land in Russia is not involved in agricultural turnover. Arable land is not used, it is overgrown with shrubs. The introduction of indicators of the interest of specialists in the involvement of land in agricultural production, such as: the ratio of the salary of the head to the area of land involved in agricultural turnover; the ratio of the salary of agronomists to the area of land involved in agricultural turnover will help attract the attention of specialists of agricultural organizations to the problem of non-use of agricultural land, reducing the land unused in agricultural production.

2. Methodology
In the Russian Federation, there is a steady trend of reducing agricultural land (figure 1).

![Figure 1. Dynamics and structure of the land fund of the Russian Federation [13].](image)

So, during the past ten years, this category of land has decreased by 3% or 11.7 thousand ha, mainly due to their transfer to non-agricultural land.

In the structure of agricultural land, 55.3% is occupied by arable land, more than 30% is pastures, 10.8% is hayfields. The dynamics, composition and structure of agricultural land in Russia for the period from 2015 to 2019 are shown in table 1.

At the same time, there is a tendency to reduce agricultural land, which will subsequently require significant investments to introduce these lands into agricultural circulation.
In addition, there is a depletion of the soil potential of agricultural land, including due to the loss of humus due to its uncompensated mineralization, wind, water and gully erosion, which ultimately leads to a decrease in crop production due to a decrease in their yield [14-15].

At the same time, in order to restore the natural fertility of the soil and increase the efficiency of agricultural land reproduction, it is necessary to use organic fertilizers.

Table 1. Dynamics, composition and structure of agricultural land in the Russian Federation [13].

| The period | Total | Arable land | Fallow land | Perennial plantings | Hayfields | Pastures |
|------------|-------|-------------|-------------|--------------------|-----------|----------|
|            | Million ha |    | Million ha | Million ha | Million ha | Million ha | Million ha | Million ha |
|            | Share, % | Share, % | Share, % | Share, % | Share, % | Share, % | Share, % | Share, % |
| 2015       | 222.1  | 100     | 122.8  | 55.3   | 4.9   | 2.2   | 1.9   | 0.9   | 24.0  | 10.8  | 68.5  | 30.8  |
| 2016       | 222.0  | 100     | 122.7  | 55.3   | 4.9   | 2.2   | 1.9   | 0.9   | 24.0  | 10.8  | 68.5  | 30.8  |
| 2017       | 222.0  | 100     | 122.7  | 55.3   | 4.9   | 2.2   | 1.9   | 0.9   | 24.0  | 10.8  | 68.5  | 30.8  |
| 2018       | 222.0  | 100     | 122.8  | 55.3   | 4.9   | 2.2   | 1.9   | 0.9   | 24.0  | 10.8  | 68.4  | 30.8  |
| 2019       | 221.9  | 100     | 122.7  | 55.5   | 4.9   | 2.2   | 1.9   | 0.9   | 24.0  | 10.8  | 68.4  | 30.8  |

At the same time, over the past 5 years in the Russian Federation, there has been a positive trend of increasing the application of organic fertilizers to the soil for agricultural crops. The application of organic fertilizers for crops in Russia for the period from 2-15 to 2019 is shown in figure 2.

Figure 2. Application of organic fertilizers for crops in the Russian Federation [16].

In 2019, in the Russian Federation, organic fertilizers for agricultural crops were applied by 10% more than in 2015.

In modern conditions, in order to expand the reproduction of land resources, innovative development of agriculture is necessary, which consists in the introduction of resource-saving and environmentally friendly technologies and biotechnologies, in the cultivation of soil with multi-operational agricultural machines and equipment, precision farming, technologies for regulating the
processes of high crop yield, in the use of varieties and hybrids resistant to adverse weather conditions, pests and diseases [17].

It is necessary to identify a number of main problems that hinder the introduction of innovations in agricultural production. The problems hindering the introduction of innovations in agricultural production are shown in figure 3.

Figure 3. Problems hindering the introduction of innovations in agricultural production (compiled by the authors).

In market conditions, the active innovation policy of agricultural producers is a condition for their survival. At the same time, the lack of positive experience in conducting innovative activities, lack of funding, and low innovation potential of agricultural organizations, including due to the lack of qualified personnel, significantly hinder innovative activity in agriculture, including in the process of reproduction of agricultural land resources.

The peculiarities of innovations in agriculture consist in a rather long period of their development, a large dependence on agro-climatic conditions, and their biological orientation.

It should be noted that the economic effect of the application of innovations in agriculture is defined as the difference in production indicators before and after the introduction of innovations. At the same time, to assess the efficiency of land resources reproduction, taking into account innovative processes, it is advisable to use changes in indicators reflecting the productivity of arable land and natural forage land; the share of land subject to wind and water erosion; the share of irrigated and drained land; the share of land with organic fertilizers; the share of land involved in economic turnover and others.

In addition, for a more objective assessment of the efficiency of reproduction of agricultural land resources, it is necessary to take into account the indicators that characterize the use of digital technologies in agrochemical monitoring of the state and fertility of arable land. Thus, the need for fertilizers, their quantity and composition can be determined on the basis of cartographic models and attribute information of arable soils.

Accordingly, the share of land provided with robotic systems and digital technologies, as well as the number of machines and aggregates for tillage equipped with automated information systems can be used as indicators of the efficiency of land reproduction.

At the same time, in order to motivate the management of agricultural organizations to preserve and increase the fertility of the lands involved in agricultural turnover, it is necessary to establish the appropriate dependence of the wages of this category of workers on the indicators of the use of agricultural land, due to the fact that currently about 30% of agricultural land resources are not used in agricultural production.

The involvement of unused agricultural land in production is aimed not only at more efficient reproduction of land resources by agricultural organizations, in order to obtain more profit, but also is
a national task, due to the fact that currently a significant part of agricultural land is being degraded in Russia, associated with increased erosion processes, their desertification, waterlogging, overgrowth of small woodlands. At the present stage of development, it is necessary to preserve and increase the productive potential of agricultural land, to ensure a balance of the economic interests of society.

3. Results and discussion

Currently, to assess the efficiency of land resources reproduction, land productivity indicators are used, which include: crop yield; production of the main types of crop production per 100 ha of arable land; production of milk, cattle and sheep meat in live weight, wool per 100 ha of agricultural land; production of poultry meat and eggs per 100 ha of grain crops; the cost of gross agricultural output in comparable prices per 100 ha of agricultural land and indicators of the composition and quality of land, which include: the composition of agricultural land; the share of land involved in economic turnover; the share of arable land in the area of agricultural land; the share of land with organic fertilizers; the share of land affected by wind and water erosion; the share of irrigated and drained land. However, these indicators do not fully characterize the process of reproduction of agricultural land resources.

In modern conditions, it is necessary to clarify the existing system of indicators of the efficiency of reproduction of agricultural land resources by including indicators of innovative development and indicators of the interest of specialists in involving land in agricultural turnover, which will allow a more complete and qualitative assessment of this process, determine ways to improve the efficiency of using these resources.

Indicators of the efficiency of reproduction of agricultural land resources are proposed to be divided into 4 groups: indicators of land productivity, indicators of the composition and quality of land, indicators of innovative development, indicators of the interest of specialists in involving land in agricultural turnover.

The first group of indicators of the efficiency of reproduction of agricultural land resources included natural indicators that characterize the production of products from the area of agricultural land and arable land, as well as the indicator of the value of gross agricultural output in comparable prices per 100 ha of agricultural land.

The second group of the system of indicators of the efficiency of reproduction of agricultural land resources includes indicators that characterize the composition and quality of agricultural land resources: the structure of agricultural land, the share of land involved in economic turnover, the share of arable land in the area of agricultural land, the share of irrigated and drained land in the area of agricultural land.

The above indicators of productivity, composition and quality of land do not fully characterize the process of reproduction of agricultural land resources at the present stage of development due to the need to take into account informatization and innovation.

The third group of the system of indicators of the efficiency of reproduction of agricultural land resources includes indicators of information development, which include: the number of land plots equipped with robotic systems and digital technologies; the number of machines and aggregates for tillage equipped with automated complexes; the number of digital technologies used in agrochemical monitoring of the state and fertility of arable land.

Also, for the efficiency of reproduction of agricultural land resources, it is necessary to use indicators of the interest of specialists in involving land in agricultural turnover: the ratio of the salary of the manager to the area of land involved in agricultural turnover; the ratio of the salary of agronomists to the area of land involved in agricultural turnover. In table 2, a system of indicators of the efficiency of reproduction of agricultural land resources is proposed.
Table 2. System of indicators of the efficiency of reproduction of agricultural land resources (compiled by the authors).

| Land productivity indicators | Indicators of land composition and quality | Indicators of innovative development | Indicators of the interest of specialists in the involvement of land in the turnover |
|------------------------------|------------------------------------------|-------------------------------------|---------------------------------------------|
| Crop yield, tons per 1 ha    | The cost of gross agricultural output in comparable prices per 100 ha of agricultural land | Composition of agricultural land | The number of land plots equipped with robotic systems and digital technologies |
| Production of the main types of crop production per 100 ha of arable land, tons | The share of land involved in economic turnover, % | Number of machines and aggregates for tillage, equipped with automated complexes | The ratio of the manager's salary to the area of land involved in agricultural turnover |
| Production of milk, meat of cattle and sheep in live weight, wool per 100 ha of agricultural land, tons | Share of arable land in the area of agricultural land, % | The number of digital technologies used in agrochemical monitoring of the state and fertility of arable land | - |
| Production of poultry meat and eggs per 100 ha of grain crops, tons, thousand pcs | Percentage of land with applied organic fertilizers, % | - | - |
| Percentage of land affected by wind and water erosion, % | Proportion of land with applied organic fertilizers, % | - | - |
| Share of irrigated and drained land, % | - | - | - |

4. Conclusions
The land potential of the Russian Federation is huge. One of the main problems today is the problem of effective reproduction of land resources, their rational use, as ensuring food security and economic stability of Russia. At the same time, the assessment of the efficiency of reproduction of agricultural
land is of great importance for the continuous conduct of agricultural production. It allows you to determine the most effective directions of reproduction of these lands. The assessment of land resources according to the system of indicators of the efficiency of reproduction of agricultural land resources presented above will allow us to more fully characterize the process of reproduction of agricultural land resources, will give a more complete, visual picture of the validity and feasibility of using the latest developments and technologies in agricultural production.

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