Food security as a result of the effective use of agricultural land in the agricultural region

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Abstract. The level of land use in agricultural regions has a major impact on the degree of ensuring their food security. The result of thirty years of land reforms is the creation of a system of multi-layered economy in rural areas. The studies were conducted on the basis of data from the Tambov Region, a region with a soil cover mainly represented by leached chernozems. The most effective use of land resources was carried out in 2015-2019 in the households of the population, which have a major role in ensuring food security in the region. In general, in the Tambov region, the level of full self-provision for milk, eggs, fruits, and vegetables has not been reached. The solution of this problem lies in the restoration and improvement of soil fertility in farms of all categories of management. The article outlines its main methods that allow the greatest use of the biological potential of agricultural production.

1. Introduction
The lands involved in agricultural production are the production basis for ensuring the country's food security. They are the main producers of agricultural products, forming their quantitative parameters and, as a result, the physical saturation of the consumer market, as well as their qualitative characteristics, which determine the directions of production use along the technological chains of the agro-industrial complex of the national economy. In the light of this message, the economic potential of agricultural land forms the initial costs of agriculture as a fundamental branch of the agro-industrial complex as a whole. On the one hand this is a factor of increasing the profitability of agricultural sector which stimulates the expansion of agribusiness and the increase of food availability, in the end; on the other hand, it is a condition of its affordability for the general population [1].

In Russia, agricultural production is carried out in 50 regions (58.8% of the total); one of them is the Tambov region. On the average during 2015-2019, agricultural producers located on its territory produced 2.3% of the country's gross agricultural output, having 0.6% of the total area of agricultural land in Russia. In absolute terms, 2724.3 thousand hectares of agricultural land were used in agriculture in the Tambov region in 2019, of which 78.1% (2127.5 thousand hectares) were arable land, deposits - 0.4% (9.6 thousand hectares), perennial plantings - 1.2% (32.4 thousand ha), hayfields and pastures - 20.4% (554.8 thousand ha) [1, 2].

The soil cover of agricultural land in the region is mainly represented by chernozems of different subspecies (meadow - 38.6%, typical - 27.3%, leached - 25.9%).

In the process of reform, a multi-level management system was created in the region. Considering it in the context of land use, it should be noted that agricultural organizations use 1879.4 thousand hectares
(67.8%), peasant (farmer) farms - 458.7 thousand hectares (16.8%), households - 98.2 thousand hectares (3.6%), farms of other categories (subsidiary farms) - 288 thousand hectares (11.7%). From the point of view of property relations, the attraction of land plots in agricultural organizations and peasant (farmer) farms is carried out by involving land in the turnover owned and used on a rental basis (in the redistribution fund and from individuals), in the farms of the population - on the right of ownership [3, 4].

The difference between producers of different categories of management in ensuring effective land use is dictated by different targets for meeting the needs and interests in solving food and socio-economic problems of development, the possibilities of attracting production resources. There were the reasons that determined the scale of activity of these groups of farms: in the structure of production of gross agricultural output, in 2015-2019, agricultural organizations on the average occupied 70.5%, households - 18.1%, peasant (farmer) farms - 11.4%. But they have not become decisive in terms of the efficiency of the use of agricultural land [1, 5].

The most effective land users in the Tambov region during 2015-2019 were private households of the population. In 2019, they produced agricultural products per 1 ha of agricultural land at comparable prices in the amount of more than 221 thousand rubles, which is 6.4 times more than in peasant (farm) farms - the least efficient form of management (table 1).

The reason for such differences is the different assortment of agricultural products produced. The population's farms are focused on the predominant production of the most popular food products and the most labor-intensive types of crop production (potato, vegetable, horticulture, livestock products), as well as on peasant (farmer) farms and agricultural organizations which are represented by the most mechanized and intensive industries focused on grain, sugar beet, pig and poultry. It should be noted that, ultimately, the use of agricultural land is aimed at solving the problem of ensuring food security in the region and realizing the economic opportunities of interregional and foreign trade in agricultural products and food [4, 6-8].

### Table 1. Efficiency of agricultural production in different categories of farms in the Tambov region in 2015-2019, thousand rubles/ha (in comparable prices)

| Economy category               | 2015  | 2016  | 2017  | 2018  | 2019  | Deviation of 2019 to 2015, % |
|--------------------------------|-------|-------|-------|-------|-------|-----------------------------|
| Farms of all categories        | 57.6  | 45.8  | 42.4  | 49.9  | 58.5  | 101.4                       |
| Agricultural organizations     | 52.9  | 40.7  | 38.7  | 46.3  | 55.8  | 105.3                       |
| Households of the population   | 287.5 | 230.2 | 209.0 | 205.0 | 221.3 | 77.0                        |
| Peasant (farmer's) economy     | 32.3  | 28.1  | 21.8  | 71.2  | 34.7  | 107.3                       |

Food security is assessed from the point of view of the physical and economic availability of food for general population [6].

The primary reason for the physical availability of food is the production of agricultural raw materials in the region or the importation in the form of products ready for consumption or requiring minimal additional processing. The Tambov region has sufficient resources (including natural and climatic ones) for the production of the main types of agricultural products. Economic accessibility is expressed in the ability to purchase food in standard volumes at prices that are formed at any given time. The analysis of the food security parameters of the Tambov region showed that the region has achieved an optimal level of self-sufficiency in basic food (grain, sugar beet, potatoes); acceptable - for milk (95.0%), fruit (69.3%), vegetables (66.4%) and low-for egg production (39.1%). The level of satisfaction of the physiological needs for the residents of the region for the period of 2015-2019 ranged from acceptable to optimal values for all major food groups.

From the standpoint of economic availability of food in the Tambov region the following fact should be stated. Reducing the share of the population with incomes is below the subsistence minimum by 0.9 to 9.8 per cent. The share of expenditure on food in the structure of household expenditure on final consumption changed by 0.7% to 3.9%. The degree of (rupture) of the uneven distribution of the
population by income level changed by 0.8% to 33.7. The data indicate a gradual regional improvement in the region in the earnings of the population, diverted for the purchase of food products. An equally important aspect of making affordable food is the continuous improvement of sustainable development of food subcomplexes of agricultural industrial complexes (AIC) in the region, i.e. the organizational-economic mechanism of development, operating in them.

2. Materials and methods
The purpose of the work is to identify possible prospects for solving the problem of ensuring food security in the region for all food groups and to occupy a stable position as an exporter of products with high added value, produced from agricultural raw materials in excess of the standard needs of the population and the food industry at the expense of reserves to increase the efficiency of agricultural land use.

The research is based on the data from Rosstat, the Ministry of Agriculture of the Russian Federation, and the Consolidated Annual Report of Agricultural Organizations of the Tambov Region for 2015-2019. In the course of the research, monographic, abstract-logical, computational-constructive, economic-statistical methods were used. The reliability of the source materials and the use of a set of methods of economic research that mutually confirm the results obtained ensure the credibility and validity of the conclusions made.

3. Results and Discussion
Indicators that characterize the level of achievement of food security in the region from the point of view of the use of land involved in agricultural turnover are [4, 8, 9]:

1. Output of livestock products per unit area of the i-th form of lands, which are grown food for the j-th species of farm animals (Emj), is calculated according to the formula:

$$E_{mj} = \frac{P^n_{mj}}{S_{ij}},$$

where

- $P^n_{mj}$ - gross production of the m-th species of animal production, ensuring food security in the region, for the j-th species of farm animals, t;
- $S_{ij}$ - area of the i-th type of land for growing feed for the j-th type of farm animals, ha.

2. The yield of agricultural crops ($Y$) is calculated by the formula:

$$Y = \frac{P^n_v}{S_{iv}},$$

where

- $P^n_v$ is the gross production of the v-th type of crop production that ensures the food security of the region, t;
- $S_{iv}$ - sown area of the v-th agricultural crop, ha.

3. Food balance difference (surplus (shortage) of the k-th group of food products per 1 ha of the area used for the production of the v-th type of agricultural raw materials ($\Delta$) is calculated by the formula:

$$\Delta = \frac{P^f_{mj(v)} - P^n_{mj(v)}}{S_{ij(w)}},$$

$P^f_{mj(v)}$ - gross production of the m-th type of the animal product or the v-th type of crop products factual (f) or normative (n), ensuring food security, t.

4. The coefficient of food balance ($K_{fb}$) [7, 9].

$$K_{fb} = \frac{Y^f_v}{Y^n_v},$$

where

- $Y^f_v$ - yield of v-th crops actual (f) ensuring the food security of the region (n), c/ha.
Application of the proposed indicators of the levels of achievement of food security of the region Tambov region data showed that in the region there is an underproduction of milk, eggs, fruits, vegetables, sunflower oil (in terms of sunflower seeds), despite the low consumption of these foods compared to the national figures.

Table 2. Level of achievement of food security per unit of applied land resources

| Type of agricultural raw materials | Surplus (+), shortage (-) | Yield of livestock products per unit area, t | Total food security balance coefficient |
|------------------------------------|---------------------------|--------------------------------------------|---------------------------------------|
|                                    | total, t                  | average in 2015-2019                        | ensuring the achievement of food security in the region |
| Meat in live weight                | 23,8                      | 0,2                                         | 0,1                                   | 2,034 |
| Milk                               | -109,2                    | -53,6                                       | 1,0                                   | 1,2   | 0,811 |
| Eggs, thousand pieces              | -116,0                    | -4,4                                        | 1,4                                   | 2,5   | 0,559 |
| Fruits and berries                 | -5,0                      | 43,2                                        | 49,8                                  | 0,867 |
| Vegetables                         | -20,0                     | -151,1                                      | 185,1                                 | 222,9 | 0,831 |
| Potatoes                           | 278,7                     | 0,1                                         | 169,3                                 | 71,5  | 2,368 |
| Grain                              | 2482,8                    | 93,8                                        | 33,3                                  | 9,8   | 3,386 |
| Beet sugar                         | 1164,0                    | 434,9                                       | 427,3                                 | 318,6 | 1,341 |
| Sunflower seeds                    | -4578,6                   | -494,0                                      | 19,1                                  | 14,3  | 1,337 |

Food security at the declared level can be fully ensured if the production of milk per 1 ha of agricultural land in the future will be increased by 18.9%, eggs per 1 ha of grain crops - by 44.1%, fruit yield - by 13.4%, vegetables - by 16.9%.

The main reserve for achieving the threshold values of food security in the Tambov region is to improve the quality of land used in agricultural production. To do this, a system of measures to restore soil fertility must be implemented and a number of conditions must be met to ensure the production safety of agribusiness.

Among the ways to solve the problems of land use in the Tambov region, one should call:
- increasing the scale of chemical reclamation of soils;
- transition to biologized farming systems;
- replacement of clean vapors with occupied ones;
- increasing the doses of organic fertilizers to the standard levels (taking into account the return in the occupied fallows).

The production safety of agricultural production is closely correlated with the issue of ensuring environmental sustainability and safety of agrocenoses and provides for the development and implementation of scientifically based more efficient crop rotation systems, machines and methods of tillage, the use of mineral and organic fertilizers.

4. Conclusion
The quality of agricultural land is of crucial importance in ensuring the food security of the region. In the presence of all available production resources in the Tambov region, effective management of the land fund should be carried out in order to fully saturate the interregional agri-food market and acquire stable seller positions on external trading platforms.

References
[1] Dubovitski A, Klimentova E, Nikitin A, Babushkin V, Goncharova N 2020 Ecological and Economic Aspects of Efficiency of the Use of Land Resources E3S Web of Conferences 210 11004
[2] Antsiferova O Yu, Myagkova E A, Tolstoshein K V 2019 Formation of the development strategy of the agro-industrial complex of the Tambov region on the basis of the scenario approach *IOP Conference Series: Earth and Environmental Science* **274**(1) 012084

[3] Nikitin A V, Trunova S N, Voropaeva V A 2019 The assessment of the effectiveness of the implementation of scenarios for the sustainable development of agriculture *International Journal of Innovative Technology and Exploring Engineering* **8**(10) 3002-3005

[4] Nikitin A, Kuzicheva N, Karamnova N 2019 Establishing efficient conditions for agriculture development *International Journal of Recent Technology and Engineering* **8**(2) 1-6

[5] Nikitin A V, Klimentova E A, Dubovitski A A 2020 Impact of small business innovation activity on regional economic growth in Russia *Revista Inclusiones* **7**(S4-3) 309-321

[6] Zhidkov S 2019 Organizational potential of the cluster structure in grain farming *International Journal of Engineering and Advanced Technology* **8**(6) 2596-2600

[7] Zhidkov S A, Aparin A V 2017 Theoretical foundations for improving the efficiency of agricultural land use in modern conditions *Bulletin of Michurinsk State Agrarian University* **4** 88-95

[8] Shcherbakov N V 2017 Problems of land ownership in agriculture *Theory and practice of world science* **7** 36-38

[9] Turusov V I 2019 Ways of reproduction of soil fertility and increase crop yields in adaptive-landscape farming systems CCZ *Problems and prospects of scientific and innovation support of agro industrial complex of regions. Collection of reports of the International Scientific and Practical Conference (Kursk, September 11-13, 2019) (Kursk: Kursk Federal Agrarian Scientific Center)* pp 8-15