

Production of strategic types of field crops in the Samara region in the context of economy digitalization

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Abstract. The digitalization of agriculture is connected with the increase in the efficiency and sustainability of its functioning. The paper studies the dynamics of indicators of the development of agricultural production in the Samara region. First of all, agriculture of the region is represented by crop production, the share of which in the total volume for a number of years has been over 60%. The basis of the regional crop production is the production of high quality food grains. Cereals are one of the most demanded items in the export of agricultural products. For the period from 2009 to 2020 the gross harvest of grain crops increased 1.6 times. The Samara region is one of the ten regions of the Russian Federation in terms of sunflower production. The gross harvest of sunflower, which serves as a raw material for the main export position of the region namely sunflower oil, has increased fivefold over the period. Digital technologies, the need to use which is determined by general trends in the development of the world economy, create new opportunities to increase the competitiveness of products and further develop the export potential not only of a particular region, but also of the country as a whole.

1 Introduction

The innovative digital technologies of the 21st century have enormous potential for economic growth due to precision, automation and new control capabilities. To a large extent, digital transformation can be applied to agriculture, especially on the basis of the technological diversity of agricultural production and crops and the associated diversity and labor intensity of production processes [6]. In turn, the use of innovative digital solutions is one of the conditions to ensure the production of high-quality food products that can compete in the food market and create conditions for food independence of the region.

Food security is a state of economy when food independence is ensured and the physical and economic accessibility of food products for every inhabitant is guaranteed in volumes not lower than rational consumption rates necessary for an active and healthy lifestyle [2].

The potential of agriculture as a high-tech industry is huge, in particular, the development of digital technologies aimed to ensure food security of individual regions and the country as a whole, the use of innovative technologies in order to provide the population with high-quality, environmentally friendly products. Another important component of the modernization of the agricultural sector is the development of export potential [4].

The Samara Region is one of the leading industrial regions of Russia with significant economic and social potential. In terms of food security in the region, the

agro-industrial complex is one of the most important sectors of economy, which is of strategic importance and is able to ensure social stability of society.

In the Samara region, there are 559 agricultural organizations, 1,900 peasant (farm) households, over 365.3 thousand personal subsidiary plots and about 1,000 food, processing organizations and enterprises providing services for the supply and maintenance of agricultural machinery. The total number of people employed in agriculture is 95.6 thousand people (5.6% of the total number of people employed in the Samara region). The region has more than 4 million hectares of agricultural land.

The share of agricultural products in the Samara region in the all-Russian production is 1.7%, in the Volga Federal District - 7.5%. In the structure of gross agricultural production in 2019, crop production amounted to 64.4%, livestock production - 35.6%. The plant growing industry focuses on the cultivation of cereals, oilseeds and forage crops, potatoes, vegetables and fruit and berry products. The regional livestock sector focuses on cattle breeding, pig breeding, sheep breeding and poultry farming [7].

Most of the agricultural products of the region are produced as a result of crop production. In terms of popular crops, the Samara region is among the ten largest producers of sunflower, buckwheat and legumes.

The food security of the region is also determined by the strategic importance of the production of grain and oilseeds. Therefore, it becomes necessary to solve the problems of increasing the efficiency of production and sale of these crops, providing the stabilization of gross

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harvests. The solution to these problems is possible with the development of innovative technologies and the introduction of scientific and technical achievements in the production process. This allows increasing the profitability of processing organizations, meeting the demand of consumers in a wide range. Therefore, according to the level of development of this production, it is possible to assess not only the efficiency of the functioning of the economy of agro-industrial complex and its branches but also the development of the state.

The purpose of the research is to study the dynamics of indicators used for the assessment and the nature of the impact on the level of food security.

The material for the research was the data presented on the official website of the Ministry of Agriculture and Food of the Samara Region and the Federal State Statistics Service of the Samara Region.

2 Results and discussion

The digital economy has an impact on all areas of the agro-industrial complex. Digital technologies are gaining special importance in the crop production industry due to

the direct dependence of production on natural and climatic conditions and the limited agricultural land.

The crop production sector is potentially capable to meet the full needs of the population for basic agricultural products and make a significant contribution in order to increase the agricultural sector of the regional economy. This allows supplying significant volumes of grain and oilseeds to the external market.

In crop production, such indicators as acreage, yield and gross harvest are distinguished as indicators that directly affect production, and, consequently, food security [15].

The seeds of grain crops in the Samara region in 2020 slightly decreased compared to the level of 2009 compared to the level of 2009. In general, the share of this group of crops in the total crops also decreased. At the same time in 2020 there is a slight increase in the studied indicators compared to the previous year. There was a change in the structure of cereal crops: the area under winter wheat sowing decreases with an increase in spring sowing, oat sowing increases, and the size of grain maize sowing sharply increased (by 3.5 times) (Table 1.)

Table 1. Sown area of agricultural crops (in farms of all categories), thousand hectares

Indicators	Years											
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total sown area	1846	1831	1796	1785	1950	1997	2009	2047	2043	2097	2114	2130
including:												
- grain crops	1175	990	818	930	1042	1104	1102	1130	1113	1121	1099	1149
- the share of crops in the total area, %	63,7	54,1	45,5	52,1	53,4	55,3	54,9	55,2	54,5	53,5	52,0	53,9
- sunflower	330,0	428,4	527,9	452,9	554,2	518,3	550,4	572,2	595,3	625,3	699,2	680,0
- the share of crops in the total area, %	17,9	23,4	29,4	25,4	28,4	26,0	27,4	28,0	29,1	29,8	33,1	31,9

Source: [14]

The decisive factors in the cultivation of oilseeds in Russia are natural and climatic conditions. This is largely due to the fact that sunflower has become widespread among the whole variety of oilseeds in Russia. In addition, Russian consumption of oilseeds also explains the structure of production, where sunflower occupies a leading position. Statistics show an annual growth in the consumption of vegetable oils, among which sunflower is 83% [17]. Sunflower seeds contain up to 57% sunflower oil. Currently, Russia produces about 82.9% of vegetable oils from sunflower seeds. In the total volume of production of oilseeds, the culture occupies about 65.2% [5]. In terms of the area occupied by sunflower crops, Russia ranks first place in the world - more than 5 million hectares, or 22.9%. The overwhelming volume of sunflower oil is produced in the Southern, Central and Volga Federal Districts. According to Russian Statistic Service they occupy 97% [3].

In the Samara region for the period from 2009 to 2020 the sown area of sunflower has more than doubled. At the same time, the share of crops in the total sown area increased by 14.

The results of 2020 showed that the crop production industry of the Samara region has the potential to fully meet national needs and develop export supplies during the implementation of the international cooperation and export national project [7]. However, in the Strategy for the development of the agro-industrial complex of the Samara region for the period until 2020, the final indicator of the sown area for grain crops should have reached the size of 1200 hectares [1]. As for sunflower, in the Strategy the sown area for oilseeds is determined by 2020 in the amount of 510 hectares.

The basis of the crop production industry in the Samara region is the production of high-quality food grain. In addition, grain production is the basis for animal husbandry and a number of processing industries.

Table 2 presents the data on gross harvests of grain and sunflower for the period from 2009 to 2020.

The rationality of grain production directly affects the efficiency of the functioning of the entire agro-industrial complex. Cereals are one of the most demanded items in the export of agricultural products. The increase in the gross harvest of grain crops

amounted to 1,787 thousand tons (1.6 times) for the period from 2009 to 2020.

In 2020, the farmers of the Samara region exceeded the target indicator exposed to the region by the Ministry of Agriculture of Russia in the amount of 2,072.5 thousand tons of grain. The region has received such a harvest for the first time in the past 30 years. The leaders in gross grain harvest are the Stavropol region, where

218 thousand tons were harvested, Koshkinsky - 185 thousand tons and Kinel-Cherkassky - 177 thousand tons. In addition, a unprecedented grain yield was recorded in the municipal district of Chelno-Vershinsky (100.2 thousand tons). In general, more than 100 thousand tons of grain was harvested in 13 municipal districts [7].

Table 2. Gross harvest of crop products in farms of all categories (after processing weight), thousand tons

Crops	Years											
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Grain	1128	489	1213	1107	1629	2070	1333	2119	2751	1831	1893	2915
Sunflower	216	158	543	499	703	550	537	715	675	966	1120	880

The Samara region was included in the top ten regions of the Russian Federation in terms of sunflower production in 2019. The gross harvest of sunflower, which serves as a raw material for the main export position of the region namely sunflower oil, amounted to 1120.2 thousand tons. It was a fivefold increase in production from 2009 to 2019. In 2020, the gross sunflower harvest decreased as a result of severe drought.

In the Strategy for the development of the agro-industrial complex of the Samara region for the period up to 2020, the indicator of production (gross harvest) of sunflower in farms of all categories is determined at 360 thousand tons [1].

Sunflower is one of the most profitable crops. However on the one hand, there is high profitability (an indisputable advantage), and on the other, an excessive increase in sown area. This leads to the fact that some farmers deliberately violate the crop rotation and sow crops in the same field after 3 years, or even earlier. The result of this approach is expressed in a decrease in soil fertility, the accumulation of various diseases and pests. The modern task of agricultural producers is to sow less and get more.

This task can be solved through the improvement of the quality of the seed and the level of agricultural

technologies. Nowadays, a large proportion of the seed material is made up of seeds of foreign selection. Therefore, it is difficult for small producers to purchase quality seeds. It is not only about the development of special hybrids for a given region, but also the creation of hybrids for a certain category of agricultural producers which are in the “middle” price range. In the Samara region, the work on this issue has already begun [12].

The increase in crop production can be in two ways: extensive and intensive. According to the extensive way, the increase in sunflower production can be achieved by the increase in the size of the cultivated area. However the specific features of agricultural production are associated with limited land resources. Therefore, the increase in production volumes in this area is also most often associated with restrictions. In this regard, an intensive way, which is expressed by an increase in the yield indicator, is of great importance for the gross harvest of crops.

The yield of grain crops as a whole for the studied period increased by 57.2% and reached a maximum value of 26.1 c / ha (Figure 1). The sunflower yield increased from 8.6 c / ha in 2009 to 12.9 c / ha in 2020, while the highest yield indicator was in 2019 (16.1 c / ha).

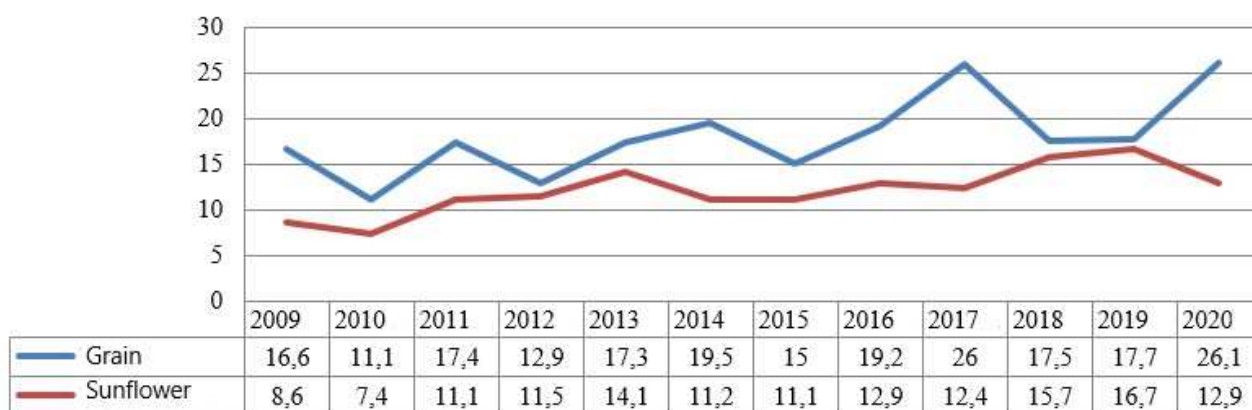


Fig. 1. Yield of agricultural crops in farms of all categories, c per 1 hectare of harvested area

The high yield of crops is ensured by the renewal of agricultural equipment, the development of land reclamation and an increase in the use of mineral

fertilizers. For the 2020 harvest, 114 thousand tons of mineral fertilizers in physical weight were applied, which was 25% more than in 2019. The fertilized area

was 880 thousand hectares, which was 156 thousand hectares higher than the last year's level.

The Samara Region remains in first place among the regions of the Volga Federal District in terms of the export of agricultural products. In the structure of agricultural exports of agricultural products in 2020, as in the previous year, products of the fat and oil industry dominate namely sunflower oil. It accounted for 48.4% of supplies in value terms - 157.3 million US dollars. This is 224.2 thousand tons. The key importers of these products are Uzbekistan (33.5 million US dollars) and Turkey (24.6 million US dollars) [11].

The third place in the structure of Samara agricultural exports is occupied by cereals, which accounted for 9.9% of supplies in the reporting period, or US \$ 32.1 million (189.7 thousand tons). Barley (USD 18.3 million; 114.3 thousand tons), wheat and meslin (USD 11.1 million; 62.3 thousand tons) were mainly shipped abroad. Most of the grain was shipped to Saudi Arabia (US \$ 4.6 million), Turkey (US \$ 4.0 million) and Libya (US \$ 3.9 million) [11].

Moreover, since the beginning of the year, the Samara Region has exported ready-made products from cereals, flour, starch, flour confectionery products in the amount of 19.5 million US dollars (6.5 thousand tons), oilseeds in the amount of 15.1 million USD (32.6 thousand tons), various food products in the amount of 14.7 million USD (19.2 thousand tons), sunflower meal and bran for 14.4 million USD (75.7 thousand tons) [11].

One of the factors requiring special attention and consideration to increase the production of high-quality products is material and technical components, associated with a more complete provision of the industry with production resources.

The provision in the region with the main types of equipment per 1000 hectares is 3.2 units for tractors, and 2.2 units for grain and forage harvesters.

The normative standard for the saturation of agricultural machinery for the Volga region per 1000 hectares is 6 units for tractors and 4.5 units for grain harvesters and forage harvesters.

In 2020, more than 9 thousand tractors, 3 thousand grain and forage harvesters, over 3 thousand units of freight transport, as well as 14.5 thousand units of trailed and mounted agricultural machinery were involved in the production of agricultural products. In the Samara region, the level of provision of agricultural producers with the main types of equipment corresponds to the average Russian.

Nevertheless, it is necessary to update and purchase equipment, because without proper equipment it is impossible to ensure timely and high-quality implementation of the entire range of agro-technical measures. In this regard, it is necessary to additionally purchase 8.3 thousand tractors, 2.1 thousand combine harvesters, 200 forage harvesters, 1.8 thousand seeding and tillage machines for a total of 27.4 billion rubles.

The farmers of the region actively use the mechanism of preferential leasing and crediting, as well as regional subsidies in order to buy modern high-performance machinery and equipment. To support the inflow of private investment in modernization, the regional

government subsidizes up to 40 percent of acquisition costs from the regional budget.

One of the conditions for stable work and economic well-being in the zone of risky farming is timely crop insurance. In addition, the regional agricultural department, understanding the importance of insurance of agricultural risks, increases state support for this area, and enterprises that insured their crops will receive more subsidies than those who do not have insurance.

In order to increase the efficiency of agricultural production the farmers of the Samara region began to use unmanned aerial vehicles. They provide farmers with the opportunity to perform a wide range of work: from the simplest aerial photography and scanning of the terrain and creating a 3D model of the landscape of an architectural or industrial facility to spot spraying of chemical and biological plant protection products and monitoring their states [16, 18]. Having studied the information obtained in this way, agriculturists can decide on further actions. Test flights took place in 2020 in the fields of the Koshkinsky region and within the framework of the XXII Volga region agro-industrial exhibition [7].

Nowadays it is necessary not only to receive information, but also to form trends based on them that will allow spending less and growing more. Big data is becoming smart and is helping to assess the potential and productivity of the land in the long term using expert systems. Information for these systems is taken from sensors installed in the fields. For these purposes weather stations, satellite data and drones are used. The understanding where and when it is necessary to influence the size of the crop will allow farmers to reduce costs. This task is solved with the help of smart agriculture. In this type of agriculture the work is build not according to the principle of "here and now", but in the long term. According to the analysis of the data that is loaded into such a system, it issues the necessary reminders: what, when and in what order to do, what chemicals and how many to use. Thus, farmers will be able to influence the potential of the land and increase the productivity of each hectare. Due to the analysis of the data, a company can optimize the costs of chemicals, reduce waste per hectare and increase yields in general [8].

The elements of digital economy can be used to monitor land and crops; optimize settlements between producers and buyers; rationalize the investment and lending system and social insurance. Digitalization involves the active use of marketing techniques, opposition to monopoly, the creation of conditions for electronic interaction between all participants of economy [9].

Digitalization of crop production will make it possible to effectively manage all technological links of production based on the principles of optimization, an individual approach, rationality and predictability.

Digital agriculture will create a system for the production of strategic types of crops, which will be characterized by high productivity, predictability and the ability to adapt to changes, including those that provoke a changing climate and conditions in external markets.

This fact can improve food security, profitability and sustainability [13]. This is especially important in the context of food security and the increase in the export potential not only of an individual region, but also of the country as a whole.

3 Conclusion

The development of economic relations under high competition not only between producers within the country but also between different countries leads to the need to reduce the cost of production while maintaining and improving its quality. The introduction of the digital economy in the production of strategic types of crops will increase productivity, reduce production costs and product sales. In addition, it can help to reorient production towards the production of products that are in demand on the global market.

The level of digital transformation in the production of strategic types of crops will be determined by the level of economic development in the region, the readiness of farmers for such changes, the availability of specialists and the level of applied technologies. The digital economy in the agro-industrial complex can ensure the sustainability of the development of agricultural production in compliance with environmental standards, as well as the development of agricultural science and education. Each producer wants to obtain the largest volume of quality products at the lowest cost. However at the same time, the digital transformation of the industry should not be seen as a final goal, but as a means used to optimize the existing potential in an innovative way.

A well developed agro-industrial complex of the Samara region is undoubtedly capable of making a significant contribution to the increase in the health of the population not only of the region, but of Russia in general. The stable enhancement of production potential, introduction of a well-grounded system of digitalization of production processes and improvement of the mechanism of state support for agricultural producers creates the basis to provide the residents of the region with high-quality agricultural products in the required volumes.

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