

# Opportunities and problems of digital transformation of small and medium-sized businesses in agricultural production

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**Abstract**—The authors studied the possibilities of digitization of agriculture and the need to use it in modern conditions of economic development, investigate the main directions and tasks of implementing digital transformation of agriculture as a whole and in small-sized businesses. The authors propose three areas of digitalization of agricultural enterprises, and determine the affecting factors. On the example of digitalization of plant culture, with introducing of precision farming technologies, the authors proposed a mechanism for their development, including three main blocks and two blocks related to the infrastructure component, in order to systematize the preparatory and promotional works. Particular attention is paid to the integration of agronomic programs with the 1C accounting software, which will allow you to quickly track fluctuations in production efficiency indicators when external and internal factors change. It was determined that to solve the problems identified by the authors of introducing digital technologies to small-sized businesses, which largely depend on the possibility of financing innovative projects, it is proposed to use the advantages of cooperative-integration formations that combine small and medium-sized agribusiness. It is noted that the consumers of agricultural supply and marketing cooperatives actively use Internet resources. The results of the study of integration systems in the dairy-food subcomplex and the formation of zones of raw dairy factories allowed us to propose the digitization of dairy commodity farms through integration associations.

**Keywords**—*digital economy, precision farming, digital animal husbandry, cooperative integration*

## I. INTRODUCTION

In the global economic space, it is impossible to achieve a high competitiveness of the country's economy without digitization of the main industry segments of market development. The digital economy is becoming one of the top priorities in the modern world and is beginning to be used in all areas of society, including agriculture. The prospects for the development of agriculture cannot be imagined without its digital transformation. The digital economy in agriculture, aimed at meeting the population's need for food, will ensure the growth of production volumes of the agro-industrial complex, especially of the export production, the profit on the use of resource potential, optimize costs, and increase productivity. Despite the

indisputable achievements of domestic agricultural production, especially in import substitution, the level of labor productivity in the agrarian sector of Russia is significantly lower than the similar indicators of the leading countries with developed economies. The production of agricultural products per one employee in the agriculture of the Russian Federation is 3 times lower than in Germany and 24 times lower than in the USA. Considering that the development strategy of the agrarian sector of the economy of developed countries is aimed at increasing the productivity of the agricultural sector and the income per unit of invested resources by digitizing the agrarian sector, the development of digital innovative technologies that increase the efficiency and competitiveness of agricultural production is even more relevant for our country [1]. Reaching the level of advanced countries is only possible with the help of the orientation of modern Russian agriculture towards innovative development. Therefore, the authors set the task to identify the opportunities and problems of digitalization of small forms of management of the agro-industrial complex (AIC) of the country, based on the example of Saratov region, focusing on the interests of agricultural producers. The novelty of the study was to develop approaches and recommendations for the innovative development of digital technologies in relation to small and medium-sized business (SMBs); it was determined that with respect to agricultural SMBs, the use of digital technologies should go in three directions: industry-specific, with highlighting plant-growing and animal-breeding specifics and enterprise infrastructure. Using the example of studied results of using digital technologies in crop production of peasant farms, a mechanism for their development has been proposed, which includes five blocks with the definition of an action algorithm for each block. Studying the need for financial resources and the capabilities of SMBs has allowed us to propose the use of cooperative formations for the implementation of digital transformation of crop farms, which attract Internet resources to carry out their activities. The study of the results of the integration units in the dairy-food subcomplex, the participants of which are the dairy farms of the population, made it possible to substantiate the expediency of their digitalization in the framework of the integrated formations.

## II. THE ESSENCE AND MAIN DIRECTIONS OF AGRICULTURE DIGITIZATION

The basis of the digital transformation of agriculture is a set of technologies united by the common name of the Internet of Things. This is a combination of fundamental discoveries in the field of data analysis (Data Science, artificial intelligence, machine learning), the use of sensors and self-guided (unmanned) equipment. The use of these elements allows creating innovative management systems, platforms and applications; to quickly carry out data collection and control over the activities of objects at a level that was previously unattainable. According to the experts, the use of new generation technologies can increase the productivity of world agriculture by 70% by year 2050 [2].

Digitalization is one of the main areas of modern innovative development of the agricultural sector of Russia, as evidenced by the materials of the state sub-program “Digital Agriculture”, and is included in the list of priorities of the Federal Program for Digital Economy. When developing the departmental project “Digital Agriculture”, the digital transformation of the industry was defined at the national, regional levels and at the level of the agricultural business, the main directions for each level were identified and the general objectives of the digital transformation of the agricultural sector of the economy were defined [3]:

- development of a system and methodology for digital transformation of agrarian production;
- validation of the use of the platform for optimizing the management of technological processes in the crop and livestock sectors “Effective hectare” and “Effective head” by agricultural producers;
- development of a model for the improvement of domestic differential positioning equipment for using GLONASS/GNSS signals; with the aim of introducing a system of digital “precision” farming;
- formation of special platforms, using Internet resources, in order to improve the management of logistics and the transport infrastructure component of the AIC and their continuous monitoring;
- identification of a group of agricultural enterprises – innovators as centers for learning digital technologies and testing them in practice;
- formation of the “Internet of Things” platform (cyber-physical systems) in order to increase energy saving and controllability of agricultural machines, material flows, traceability systems;
- ensuring the creation of conditions for the compatibility of domestic standards and protocols, which are also applied internationally, which will contribute to the import substitution of foreign technologies for domestic ones;
- localization of telemetry control data;
- changing the system of training top and middle-level specialists in order to gain knowledge of the digital transformation of the agricultural sector and the mechanism of its introduction into production through the system of higher and secondary vocational education and staff training;
- creation of an end-to-end platform for monitoring the processes of agricultural production to improve the performance of social nutrition systems;
- formation of a data system and procedures for creating information management systems for import and export trade operations in the agricultural sector;
- transformation and merging of information state systems and systems of all those participating in market relations into a distribution and open “meta-system” through the integration of information databases on new technologies.

In the project, a special place is occupied by the development and use of the system for optimizing the management of technological processes in crop production – “Effective hectare”. The system includes the use of digital technologies: to study the state of soil resources, their structure and composition; to control the state of crops, yields, the prevalence of pests and diseases, the formation of crop rotations, taking into account natural and climatic conditions on the basis of created digital soil maps and digitized matrices. An effective hectare may also include the use of digital technologies in resource-saving agriculture and the production of environmentally friendly products, as well as the integration of digital analysis and regulation tools to reduce “strip farming” and strengthen control over the use of land resources.

In animal husbandry, the development and use of an efficient process control system “Effective head” includes the digitization of the entire livestock industry and the use of “digital herd” technologies throughout the life cycle to ensure the high quality of all products, including export oriented; digital technologies of domestic genetics (blockchain), accelerated breeding of animal breeds adapted to the specific conditions of the regions, with high potential for productivity and resistance to diseases. The system includes the formation of a private-state digital platform that will integrate the interaction of the veterinary service and the Rosselkhoznadzor (Federal Service for Veterinary and Phyto-sanitary Surveillance).

It is possible to conditionally identify three areas of digitalization with respect to individual subjects of agribusiness: the first two areas are divided according to industry characteristics of crop production and animal husbandry, and the third is associated with the digitization of infrastructure components.

According to the data of the Ministry of Agriculture of the Russian Federation, in terms of digitization of the agrarian sector, Russia occupies the fifteenth place in the world space, and the market segment of agricultural information and computer technologies is estimated at 360 billion rubles [3]. By 2026, it should grow at least five times, including through support for agricultural startups. Digital technologies have evolved and have become much more affordable in terms of the cost of their acquisition and implementation, and they have been advanced to such a level that for the first time in the history of agricultural development it became possible to obtain data on each agricultural object and its environment, mathematically calculate the algorithm of actions and predict the result. In the transition to a digital economy, it is necessary to take into account the level of development of the sectoral economy as a whole, the level of education, the degree of development of

the regulatory and legal system, and the existing technologies for developing information systems [4].

### III. METHODOLOGICAL APPROACHES TO THE DEVELOPMENT OF A MECHANISM FOR THE DIGITAL TRANSFORMATION OF SMALL-SIZED BUSINESS ACTIVITIES

It seems that in the development and implementation of digitalization at the level of agribusiness, it is necessary to take into account the size of agricultural production of the subjects under study. Large enterprises and organizations will be easier to adapt to the conditions of the digital economy. Since they have significant resources and accessibility to loans, it is much easier for them to implement these systems than for the SMBs. According to the statistics, in some regions, as in the Saratov region, most agricultural production is concentrated in the SMBs. Thus, in the production of grain and sunflower, it accounts for more than 50%, and for the production of milk and meat more than 60% of the regional volume. We are exploring the possibilities of SMBs in order to introduce digital technologies in crop production using the example of the Saratov region.

Using the experience of farms when introducing such systems, we propose the following mechanism for introducing digital technologies in crop enterprises of SMBs. Currently, the “effective hectare” digital technology is integrated with the 1C accounting program and allows to obtain economic indicators of agribusiness development and track their fluctuations when changing certain initial parameters and data [5] in addition to regulating the management of technological processes. The mechanism for the development and implementation of a digital program for managing technological processes in crop production based on “precision” farming can include three main blocks: the assessment of land resources of the farm, a technological and technical block, and two blocks related to the infrastructure component: investment and training (Fig. 1).

The **first block** includes an assessment of the land resources of the farm, and the following algorithm of actions can be proposed:

1. Definition of contours and landscape of fields using satellite communications and their presentation in electronic form. Introduction to the program of the existing crop rotation system.
2. Presentation of a digital model of the field using satellite communications;
3. Analysis of crop yields by crop fields and individual areas for the last 35 years based on satellite imagery data, study of the prevalence of weeds, pests, plant diseases.
4. Conducting an agrochemical survey of field soils of the farm with the involvement of laboratories and research institutes, with the subsequent introduction of the results of an agrochemical survey into the program.
5. Identification of the obtained results with real farm data. All data must be digitized and noted into the program.

According to the results of the assessment, “dead or anomalous zones” are identified; those areas of the fields, where the company consistently receives low yields and low marginal income, regardless of climatic conditions, changes in technology and crop alternation. Only a proper assessment

of farm fields makes it possible to withdraw from the turnover the land plots of the “dead” zones, which for some agricultural enterprises made up from 7% to 10% of all land.

The **second block** allows you to identify the possibilities of existing agricultural equipment in the enterprise. The possibilities of computer control of technical means are determined. The possibility of using GLONASS, GPS, computer management of certain types of equipment, the possibility of acquiring and installing various types of equipment with a digital interface is being investigated. The possibilities of tractors, seeders with computer-controlled seeding rates, cultivators, agricultural machinery for fertilizing and processing crops, the possibility of combines, etc. are being carefully studied. Weighing sensors and equipment are installed on combines that allow mapping of crop yields across fields; diesel fuel control sensors are installed on the agricultural machines in order to prevent inefficient use and unauthorized discharge, etc. This is the most expensive step of introducing digital technologies that is directly related with an investment block.

A block related to staff training is very important, including the training of specialists, especially agronomists, with the aim of learning how to use digital technologies to ensure effective communication and interaction online. Wireless communication is established by a specialist in agronomic service with a mechanic, which makes it possible to monitor compliance with seeding standards, control the route, unit speed, identify the risks of machine breakdowns and troubleshoot, regulate fertilizer and toxic chemicals standards, control fuel and lubricant consumption, etc.

Based on the data obtained during preparation, an agronomic program of a specific farm is completed, which is then integrated with the 1C accounting software.

When the farmer wants to join the introduction of “smart” technologies, he must be motivated. First of all – the economic rationale: what will he receive as a result of investing in this area? It is possible to highlight the advantages and economic effect of the introduction of the above described technologies [6]:

- identification of anomalous (dead) zones in the fields of crop rotation, which give low yields, regardless of the technologies used, varieties, hybrids; and require land reclamation associated with capital costs or their withdrawal from agricultural use;
- the ability to track the status of fields and crops, daily price analysis, unit cost, its structure, salary level, depending on the labor invested by each employee;
- the ability to regulate: seeding rates depending on soil and climatic conditions, soil quality; norms for the application of fertilizers and herbicides, depending on the climatic conditions, types of weeds, the spread of plant diseases and pests in the fields and individual areas;
- control of changes in the unit cost of production and structure in real time, depending on price fluctuations, demand, application rates of fertilizers, herbicides, seed consumption and other material resources;
- monitoring and tracking changes in economic indicators in the real-time system, depending on the fluctuations of external and internal environment

factors, as a result, the possibility of optimizing the reception of timely management decisions;

- the ability to develop a system of storage, sale, delivery of finished products to end users.

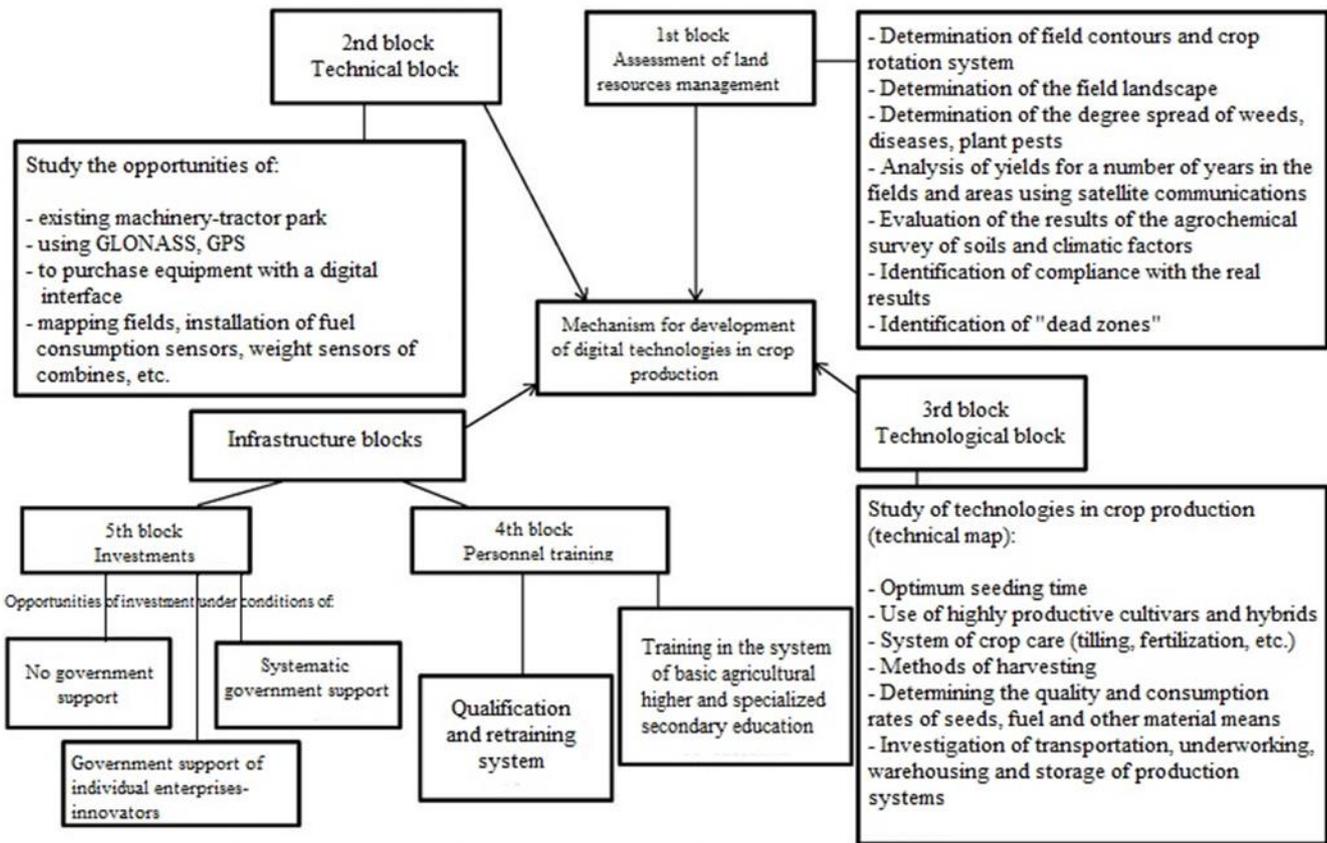


Fig. 1. Block diagram of the SMBs transition to digital technologies in crop production

The study of the experience of introducing such technologies has increased the efficiency of agricultural production with a 15% increase in profitability.

Currently, a sufficient number of firms, engaged in the introduction of digital technologies in agricultural production, have appeared on the market. The cost of these services in the Saratov region is about 240 rubles per 1 hectare. However, based on the experience of other farms and our studies, the purchase of machinery and equipment that meets the requirements of digital technology, requires significant investments. The problem of the development of digital technologies in agriculture is aggravated by the fact that there are very few domestic models on the agricultural machinery markets that meet the requirements of the digital transformation of agriculture. Import equipment that allows the use of digital technology is expensive and not always available for purchase, especially for the SMBs with limited financial capabilities and certain difficulties in attracting credit resources.

A survey of managers of many peasant farms in the Saratov region showed that some of them are already using Internet resources to manage technological processes in crop production [7]. However, without a systematic state support of the digitization process in crop production, the integrated implementation of all elements of these technologies is difficult due to the lack of financial resources. But some elements are widely used by these farms. The use of modern agricultural technology satellite navigation system allows for

online monitoring and analysis of technological operations carried out directly in the fields, track performance, location, routes, speed, fuel consumption of each unit; there is a possibility of timely repair in case of equipment breakdown during the operations, the timing of maintenance and technical repairs is optimized due to which the downtime of equipment is reduced, the volume and quality of work by each performer is determined. Installing fuel consumption sensors and monitoring fuel consumption in the online system prevents unauthorized fuel draining; timely adjusting the engines, which, according to the calculations, can save up to 15% of the cost of plant production. The installing of weighing sensors on combines contributes to a significant reduction in losses during harvesting, optimization of logistic systems for its transportation, storage and marketing.

The possibilities of using digital technologies by SMBs are expanding when they join cooperative or integrated agribusiness entities. One of the forms of such associations is agricultural consumer supply and service cooperatives, which are created, as a rule, on the initiative of peasant farms and households [8]. The field of activity of such associations is the provision of cooperation of partners with the means of production, the provision of services related to the sale of their products, marketing and other services for maintenance. Integrated cooperative formations make it possible to combine the resources and efforts of members with the goal of introducing innovative digital technologies. The development of digital technologies contributed to the

emergence of virtual forms of agricultural consumer cooperatives. Supply and sales cooperatives, uniting producers of grain products, using the possibilities of virtual reality through electronic trading, sell a significant part of grain and sunflower via the Internet. The members of a cooperative, whose managers interact online with a supplier or manufacturer of the means of production, are increasingly making co-buying of fertilizers, spare parts, seeds, and other goods and services via the Internet at wholesale at most competitive prices.

The use of digital technologies in order to solve the problems of the dairy-food subcomplex of the AIC in the coming years can carry out integrated formations, since they include the entire technological chain for the production of the final product [9]. That is, the organizational relationship between their enterprises and the availability of the necessary financial resources will contribute to the creation of a digital ecosystem that integrates digital, physical and biological subsystems [10]. This is due to the fact that, having limited financial resources and not having the possibility of using digital technologies, personal subsidiary farms, occupy a large proportion in the production of raw milk. For example, in the Saratov region it is about 80%; and even with the most negative decline rates it will remain decisive [11]. In this regard, there is the problem of accurate accounting of the volume of produced milk, and especially its quality, and in parallel with this problem – the problem of digital population coverage. Consequently, digitalization is necessary in the very first link in the production of the final product of the dairy-food subcomplex — in the production of raw materials.

In general, digital animal husbandry is understood as a set of solutions aimed at a steady increase in production efficiency through the use of information and communication systems, as well as technical means ensuring targeted use of resources and precise control of production processes. Digital technologies in animal husbandry allow introducing animal feeding, milking and housing systems, remotely controlling production processes in real time, provide continuous collection, analysis and use of data to comply with safety measures and respect for the environment, helping to reduce the negative impact of animal husbandry on the ecosystem. Digital livestock technology provides traceability of the origin and quality of products throughout the value chain, which prevents the spread of epidemics and the illegal trade in animal products.

Separate producers will find it difficult to implement the proposed measures, both in organizational and financial terms, but they are interested in processing enterprises, for which the digital format will make the mapping of the commodity zones really accessible and will provide a constant update of information on them. It is the integrated formations, having a certain experience of interaction between their enterprises and the necessary financial resources, most of all are ready for digitalization – especially those that include producers of raw milk. This is demonstrated by such large companies as EkoNiva-Agroholding AIC. The enterprises of the holding are gradually implementing modern digital solutions in the field of monitoring the state of livestock and animal care. In particular, the control of animals can occur using an electronic tag. It is possible to observe where the animal is and monitor its health. As a near and real perspective, the

latest technology of remote feeding control can be used, which can be implemented through various gadgets.

If there are milk processing enterprises in the integrated structure, as well as laboratories controlling the quality of raw materials and products at each stage, information about the state of the herd and animal ration will be available to them, which will make possible a comprehensive assessment of the efficiency of their effects on the quality of the final product.

When implementing modern information solutions at enterprises participating in integrated formations [11], the basis of the digital interrelation is the already existing information and logistic system of interaction between them. In this case, digital integration will be its next stage, as it will allow to cover a greater number of information sources and to obtain more accurate and reasonable conclusions.

However, it should be noted that not all digital technologies are equally useful and necessary and there is a danger of aimless and unreasoned digitalization. Some digital solutions unduly complicate the processes, and the practical benefits remain unclear. For example, it is proposed to use blockchain technology to optimize value chains in the AIC [12], since these technologies are actively used in the financial sector and allow for secure transactions and digital financial accounting. However, this technology should simplify and make the processes more understandable for the user, in this case, agricultural producers, and the blockchain technology is far from being understood by everyone, even those who was trained to use it. Therefore, the introduction of such innovations should be preceded by serious research and educational work, which would make these technologies as simple as possible to understand and accessible to everyone.

An example of the use of digital technologies for the real solution of the problems of the dairy-food subcomplex of the AIC was proposed at the second Central Asian agro-technological summit “CentralAsianAgTechSummit 2017” in Kazakhstan. An analysis of the current state of the raw milk market in this country has shown that it is internationally competitive by its cost, but only 20% of it meets international quality standards. To identify compliance or non-compliance of raw milk with the requirements of the technical regulations, a mobile application and the accompanying Collect mobile method were developed using a field data collection and analysis for reporting. According to the developer, digital technology helps the processor to clearly and gradually solve the main problems with the quality of raw materials. Using GPS coordinate systems, the program also helps to track the movement of products, which is useful for the buyer, because it helps calculate travel time, depreciation and other required indicators. You can also collect information about the frequency of collection of milk. It is possible to choose those suppliers who are included in the necessary raw materials zone and who have the necessary equipment. The use of such technologies requires certain skills, so in early 2017, FAO conducted a training course for farmers supplying milk in Astana and Almaty. That is, one of the participants in digital integration should be an educational institution, which will provide a continuous process of learning of the new technologies.

#### IV. PRACTICAL SIGNIFICANCE AND IMPLEMENTATIONS RESULTS

The developed mechanism and recommendations for the expansion of information technologies in agriculture can be used:

- in the practice of SMBs management of the agrarian sector of the economy;
- in the federal and regional executive authorities, local governments, regional and local innovation programs of digital transformation of agriculture;
- during the implementation of the state agrarian policy aimed at the development of the digital economy in the agro-industrial complex.

The study of the experience of using the mechanism of mastering the digital program for managing technological processes in crop production on the basis of "precise" farming in peasant farms in the Saratov region showed an increase in the profitability of crop production by 15%.

#### V. CONCLUSION

Digital technologies in agriculture are beginning to play a significant role in the innovative development of the country's agro-industrial complex. We have investigated the need for digitization of agro-industrial production, which is due to modern requirements of the global economy; identified the impact of digitalization on agricultural productivity; justified the need for digitalization in small and medium-sized businesses; studied examples of the use of individual elements of digital transformation in peasant farms and their economic effect. Firstly, the authors, exploring the main directions and tasks of digitization of the economy in the agrarian industries, defined by the departmental project "Digital Agriculture" and the state subprogram "Digital Agriculture", suggest differentiating them in relation to a particular enterprise of small or medium-sized businesses in three priority areas, highlighting digital transformation of crop, livestock and infrastructural component. Secondly, the study on experience of introducing digital technologies in peasant farms made it possible to determine the mechanism of their development, identifying five component blocks. Thirdly, given the insufficient financial resources available to small and medium-sized businesses, it is recommended to introduce lower-cost elements of digital technology into the production at the first

stage. It is proposed to develop digitalization of crop sector through cooperative-integrated formations, combining small and medium agribusinesses, in order to accelerate the process. Fourthly, the integration associations and dairies will initiate the digitalization of not only dairy farms, but the entire system of the dairy-food sector of the economy.

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