



## Impact of technical and technological modernization and special measures in addressing food security

## Impacto de la modernización técnica y tecnológica y medidas especiales en el abordaje de la seguridad alimentaria

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### ABSTRACT

The paper assesses food security in the consumption of milk and dairy products in the Russian Federation and shows the role of individual categories of farms in solving the food problem. Analysis of trends and factors in the development of dairy cattle breeding substantiates the directions for providing the country's population with milk according to the rational nutritional standards in light of international sanctions. The agrarian policy pursued by the state has increased milk production and reduced its imports but has not solved the problem of food security in the consumption of dairy products. The authors conclude that food security in the consumption of milk and dairy products will be supported by import substitution in the food market, the increase in milk production through technical and technological modernization of dairy farming, improvement of selection and breeding work and state support, concentration of milk production in specialized agricultural organizations and farms, the development of cooperation, improvement of livestock productivity through the use of modern technologies, improved use of the genetic potential of cows, strengthening of the feed base, and optimization of feed rations.

**Keywords:** food independence, economic affordability of milk, state support, technical and technological modernization, cooperation.

### RESUMEN

El artículo evalúa la seguridad alimentaria en el consumo de leche y productos lácteos en la Federación Rusa y muestra el papel de categorías individuales de granjas en la solución del problema alimentario. El análisis de las tendencias y factores en el desarrollo de la ganadería lechera fundamenta las orientaciones para abastecer de leche a la población del país de acuerdo con los estándares nutricionales racionales a la luz de las sanciones internacionales. La política agraria seguida por el Estado ha incrementado la producción de leche y reducido sus importaciones pero no ha resuelto el problema de la seguridad alimentaria en el consumo de lácteos. Los autores concluyen que la seguridad alimentaria en el consumo de leche y productos lácteos se sustentará en la sustitución de importaciones en el mercado de alimentos, el aumento de la producción de leche a través de la modernización técnica y tecnológica de la ganadería lechera, la mejora

de las labores de selección y crianza y el apoyo estatal, la concentración de la producción de leche en organizaciones y granjas agrícolas especializadas, el desarrollo de la cooperación, la mejora de la productividad ganadera mediante el uso de tecnologías modernas, la mejora del uso del potencial genético de las vacas, el fortalecimiento de la base de alimentación y la optimización de las raciones de alimentación.

**Palabras claves:** independencia alimentaria, asequibilidad económica de la leche, apoyo estatal, modernización técnica y tecnológica, cooperación.

## 1. INTRODUCTION

The primary objective of state agrarian policy is to ensure the country's food security. Measures taken by the Russian state helped many types of agricultural products and foodstuffs (grain, vegetable oil, sugar, meat and meat products, etc.) to reach the threshold values of the Food Security Doctrine of the Russian Federation. However, the problem of supplying the population with milk and dairy products remains unsolved. In 2021 the per capita consumption of these products was 241 kg, with a rational dietary allowance of 325 kg. Meanwhile, the share of imports amounts to 19.6%. The indicated problem can be addressed through import substitution based on the development of Russian mild farming with state support. The State Program for the Development of Agriculture and Regulation of the Markets of Agricultural Projects, Raw Materials, and Food pays less attention to the development of dairy farming than to other branches of livestock farming (meat, egg, and pork farming).

There are objective reasons hindering the development of dairy farming. Pastoral farming is the most complex branch of agricultural production that requires a systematic approach. One of its distinctive features is high labor intensity, which necessitates the introduction of comprehensive mechanization of the main technological processes. The high capital intensity of the industry is also a constraint. The successful development of pastoral farming depends upon a high level of zootechnical work. Strict requirements are imposed on the organization of proper feeding, which presupposes the creation of a solid fodder base. Furthermore, the products of the industry are easily perishable. Failure to realize these products in time thus results in large losses. Dairy farming is a less profitable industry compared to the production of grain, sugar beets, sunflowers, etc., with a long payback period of investment (more than 10 years), which makes it less attractive for investment (Kulikov and Minakov, 2019).

The present study aims to assess Russia's food security in the production and consumption of milk and dairy products and to substantiate the directions for its attainment through the development of agricultural production.

The established goal is achieved by solving the following objectives:

- to study the economic affordability and self-sufficiency in milk and dairy products;
- to identify trends and factors in the development of dairy farming;
- to substantiate the directions for ensuring food security based on import substitution in the market of agricultural products and food.

## 2. METHODS

The methodological foundation of the study is constituted by the achievements of economic science, as set out in scientific works on food security. The study employed a comprehensive approach emphasizing simultaneous coverage of all elements of the studied phenomenon and identifying cause-and-effect connections between them, which allows substantiating the methods and techniques of a comprehensive

resolution of the investigated problem. In conducting research within the framework of the declared subject, statistical-economic, computational-constructive, and monographic methods were used.

The main indicators used to assess food security were indicators of food independence, which is determined by the level of self-sufficiency and affordability. The level of self-sufficiency is calculated as the percentage ratio between the volume of domestic milk production and the volume of its domestic consumption, including personal and industrial consumption and losses. Economic affordability is identified as the percentage ratio between the actual consumption of dairy products per capita to the rational nutritional standard. In addition, the problem was investigated using the indicators of annual milk production and consumption per capita and the share of imports in personal consumption of milk.

The research used official data from the Federal State Statistics Service and the Ministry of Agriculture of the Russian Federation, the State Program for the Development of Agriculture and Regulation of the Markets of Agricultural Projects, Raw Materials, and Food along with national reports on its implementation, the Food Security Doctrine of the Russian Federation, and scientific papers on the topic of the study.

### 3. RESULTS AND DISCUSSION

The Food Security Doctrine of the Russian Federation specifies a threshold level of self-sufficiency in milk and dairy products (in terms of milk) of not less than 90% and economic affordability of 100%. Over the years of implementation of the State Program for the Development of Agriculture and Regulation of the Markets of Agricultural Projects, Raw Materials, and Food, these indicators rose but still did not reach the threshold (Table 1). In 2015-2021, the level of self-sufficiency in milk, which characterizes the country's food independence, increased from 79.9 to 84.3%, i.e. by 4.4%, and the economic affordability of milk, which is determined considering domestic and imported products, rose from 71.7 to 74.3%, or by 2.4%. Personal milk consumption went up from 34,148 to 35,176 thousand t, or by 3.0%. As a result, annual per capita milk consumption rose from 233 to 241 kg. Imports of dairy products decreased from 7,991 to 6,890 thousand t, or by 13.8%, and its share in personal milk consumption dropped from 23.4 to 19.6%, or by 3.8%.

Table 1. Economic security in milk consumption in Russia

	2015	2016	2017	2018	2019	2020	2021
Personal milk consumption, thousand t	34,148	33,833	33,737	33,552	34,328	35,183	35,176
Milk imports, thousand t	7,991	7,579	6,997	6,493	6,728	7,044	6,890
Share of imports in personal consumption, %	23.4	22.4	20.7	19.4	19.6	20.0	19.6
Milk consumption per capita, kg	233	231	230	229	234	240	241
Economic affordability of milk, %	71.7	71.1	70.8	79.5	72.0	73.8	74.2
Level of self-sufficiency in milk, %	79.9	80.7	82.3	83.9	83.9	84.0	84.3

Source: compiled from Rosstat data

The consumption and economic affordability of dairy products vary across the country's federal districts (Table 2). In 2021, the lowest annual per capita consumption of milk and dairy products was observed in the Far Eastern (203 kg) and Ural (208 kg) districts, and the highest values were found in the Volga (274 kg) and Northwestern (272 kg) districts. However, regions with high milk consumption do not necessarily

have well-developed dairy farming, since the consumption rate includes imports and supplies from other regions. For example, the Northwestern federal district produced 145 kg of milk per capita, which is 65.3% of the national average. Annual per capita milk production ranged from 121 kg in the Far Eastern district to 348 kg in the Volga federal district.

The federal districts with higher per capita milk consumption per year have the highest economic affordability of milk, and regions with low consumption levels have lower affordability. In the Volga federal district, the level of affordability amounted to 84.3%, in the Northwestern – to 83.7%, in the Far Eastern – to 62.5%, and in the Ural district – to 64.0%.

The greatest food independence, characterized by the level of self-sufficiency, is observed in the Volga (110.2%), North Caucasian (105.8%), Southern (96.2%), and Siberian (95.2%) federal districts. The level of self-sufficiency depends on the volume of milk production in the region and shows its share in domestic consumption. In the four listed federal districts, the level of self-sufficiency in milk and dairy products reaches beyond the threshold value specified by the Food Security Doctrine, and the economic affordability of these products is below the threshold. The Northwestern federal district, which has the highest economic availability of milk (83.7%), has the lowest level of self-sufficiency at 50.8%.

Regional self-sufficiency in milk depends on its production volume. Dairy farming is developed in all regions of Russia, but the largest share of milk production is concentrated in the Volga (31.0% of the total volume), Central (20.1%), Siberian (13.6%), and Southern (11.6%) federal districts. They account for 76.3% of the milk produced.

Table 2. Self-sufficiency and economic affordability of milk in the federal districts of Russia, 2021

Federal District	Production, total		Production per capita, kg	Consumption per capita, kg	Self-sufficiency level, %	Economic affordability, %
	thousand t	%				
Russian Federation	32,339	100	222	241	84.3	74.2
Central	6,382	20.1	163	231	66.5	71.1
Northwestern	2,012	6.1	145	272	50.8	83.7
Southern	3,746	11.6	228	224	96.2	68.9
North Caucasian	2,824	8.6	282	244	105.8	75.1
Volga	10,034	31.0	348	274	110.2	84.3
Ural	1,968	6.0	160	208	72.7	64.0
Siberian	4,396	13.6	260	242	95.2	74.5
Far Eastern	977	8.1	121	203	54.4	62.5

Source: compiled from Rosstat data

The affordability of dairy products depends not only on the volume of milk production and its imports but also on the level of prices in the food market. Over 2015-2021, consumer prices for butter increased from 397.75 to 719.21 rubles per kg, or by 80.8%, for pasteurized drinking milk (2.5-3.3% fat content) – from 47.61 to 64.89 rubles per l, or by 36.3%, and for hard and soft cheeses – from 418.61 to 641.22 rubles per kg, or by 53.2%. The increase in prices for dairy products in the context of declining real incomes of the population impedes the growth of their economic affordability.

The economic affordability of dairy products is also driven by contributions from private subsidiary farms (bypassing market channels). There are about 13.8 million private farms in Russia with a total area of 12.0 million hectares of agricultural land and more than 3.1 million cows, which produce 35% of the total amount of milk. A part of the population is provided with dairy products from this source. However, a considerable part of the country's population (18.9 million people, or 13% of the population) is below the poverty line

and has no opportunity to purchase milk and dairy products that meet the standards of quality, assortment, and rational nutrition.

In order to increase the economic affordability of milk, the state must take measures to increase the solvent demand of the population, reduce poverty, and support the most disadvantaged segments of the population. To improve the physical availability of food, it is necessary to develop interregional integration in the sphere of agricultural and food markets, to increase the transport accessibility of individual regions for supplying food to their populations, and to create the conditions necessary for the development of market infrastructure (Minakov and Nikitin, 2019).

Furthermore, food independence in the consumption of milk and dairy products is shaped by the level of development of dairy farming. All categories of Russian farms show an increase in milk production with a reduction in cattle population (Table 3). In 2015-2021, milk production rose by 2.4 million t, or by 8.0%. At the same time, the cattle population decreased by 0.9 million heads, or by 4.8%, and the livestock of cows decreased by 0.3 million heads, or by 3.7%. The gain in milk production was obtained due to an increase in cows' productivity. Milk yield per cow went up from 4,134 to 4,988 kg, or 20.7%.

Table 3. Development of dairy cattle breeding in the Russian Federation

	2015	2016	2017	2018	2019	2020	2021
Cattle population, million heads	18.6	18.3	18.3	18.2	18.1	18.0	17.7
including cows	8.1	8.0	8.0	7.9	8.0	7.9	7.8
Milk production, million t	29.9	29.8	30.2	30.6	31.4	32.2	32.3
Milk yield per cow, kg	4,134	4,218	4,368	4,492	4,642	4,839	4,988

Source: compiled from Rosstat data

However, not all categories of farms increased their milk production. Between 2015 and 2021, private farms experienced a decline in milk production from 13.2 to 11.2 million t, which amounts to 15.2%. Meanwhile, milk production by agricultural organizations went up from 14.7 to 18.2 million t, or by 23.8%, and production by farms increased from 2.0 to 2.9 million t, or by 45.0%. These positive results in the development of dairy farming were achieved in agricultural organizations and farms as a result of technical and technological modernization. During the analyzed years, 1,442 new and modernized dairy complexes and farms were put into operation, which led to an increase in the number of cattle places by 640.1 thousand units. Additional milk production due to these measures amounted to 1,723.2 thousand t.

According to the All-Russian Agricultural Census, only 11 thousand agricultural organizations, or 39.8% of their total number belong to the pastoral farming sector. Of these, most farms (66.3% of the total number) have livestock of less than 300 cows. The share of agricultural organizations with 300 to 1,000 cows is 27.6%, and the share of farms with more than 1,000 cows is only 6.1%. However, the majority of the cow population is concentrated in medium- and large-sized enterprises. The first group of farms has 20.2% of cows, the second – 45.2%, and the third – 34.6%. On average, there are 785 heads of cattle per agricultural organization, including 330 cows.

The largest agricultural organizations by cattle population are the Agrokompleks named after N.I. Tkachev JSC in Krasnodar Krai with 104 thousand heads, the Ak Bars Holding Company JSC of the Republic of Tatarstan with 98 thousand heads, EkoNivaAgro LLC in the Voronezh Oblast – 89 thousand heads, the Krasny Vostok agricultural holding of the Republic of Tatarstan – 72 thousand heads, and the Agrosila Holding JSC of the Voronezh Oblast with 42 thousand heads.

Dairy farming is successfully developing in farms. Out of 115.8 thousand farms only 31.3% are engaged in milk production. The majority of them (93.3%) have less than 100 cows; the share of farms with 101-300

cows is 6.0%, the share of farms with over 300 cows is 0.7%. The main share of cow livestock, 58.9%, is found in the first group of farms, the second group accounts for 30.1% of cows, and the third group has 11.0%. On average, there are 62 heads of cattle per farm, including 32 cows. The farms with more than 100 cows successfully use modern milk production technologies.

Milk is produced by 1.4 million private farms, or 9.9% of their total number. On average, each farm has five heads of cattle, including two cows. Some private farms produce milk for self-sufficiency, others sell it to generate additional or primary income.

Gross milk production depends not only on the number of cows but on their productivity as well. Its growth was facilitated by the intensification of production and its transition to an innovative basis. In 2015-2021, the milk yield per cow in agricultural organizations increased from 5,140 to 7,007 kg, or by 36.3%, specifically from 5,699 to 7,671 kg, or by 34.6%, in medium and large enterprises, from 3,465 to 3,963 kg, or by 14.4%, in farms, and from 3,500 to 3,538 kg, or by only 1.1%, in private farms. The productivity of cows in private farms thus remained virtually unchanged.

The highest cow productivity is observed in large agricultural organizations, which widely use modern milk production technologies. For example, in 2021 the milk yield per cow in the Step Agroholding JSC in Krasnodar Krai with 1.7 thousand cows and 24.5 thousand t milk production amounted to 15,140 kg. In the Plemzavod Irmen CJSC, Novosibirsk Oblast, these indicators were 3.8 thousand heads, 46.4 thousand t, and 12,832 kg, respectively. The Kilachenskii APC, Sverdlovsk Oblast, had 3.2 thousand cows, 41.3 thousand t of milk produced, and 12,594 kg of milk yield per cow. The Russian Milk Company LLC of the Penza region had 13.4 thousand heads, 133.2 thousand t of milk produced, and 12,482 kg milk yield per cow. Finally, the Zolotaia Niva LLC of the Smolensk region had 2.2 thousand heads, 27.6 thousand t, and 12,416 kg, accordingly.

Milk production is becoming more and more concentrated mainly in agricultural organizations (Table 4). In 2021, they produced 55.6% of total milk production, which is 7.0% more compared to 2015. In the same year, farms produced 9.1%, and their share in total production lowered by 2.4%. Finally, private farms produced 34.7%, and their share decreased by 9.4%. Agricultural organizations have become the main suppliers of milk to the market. Between 2015 and 2021, their contribution to the structure of realized milk went up from 70.2 to 73.2%, while the share of farms grew from 7.1 to only 8.8%, and the share of private farms lowered from 22.7 to 18.0%. However, the share of agricultural organizations and farms in the structure of sold milk increased not only due to greater milk production but also because of its higher marketability. In agricultural enterprises, marketability reached 95.8%; in farms, it was 71.3%, and in private farms – 38.3%. The positive dynamics in milk production by agricultural organizations and farms stem from the implementation of state support measures.

Table 4. The share of individual categories of farms in the structure of the produced and realized milk in Russia, 2021

Farm category	Produced		Realized		Marketability level, %
	thousand t	%	thousand t	%	
All farm categories	32,339	100	23,772	100	73.6
Agricultural organizations	18,164	56.2	17,392	73.2	95.8
Farms	2,942	9.1	2,091	8.8	71.3
Private farms	11,233	34.7	4,289	18.0	38.3

Source: compiled from Rosstat data

State support of dairy farming is based on consideration of the features of the industry, namely the high social importance of milk, stable demand regardless of the season of its production, low elasticity, and limited shelf life of raw milk and is carried out through the development and implementation of targeted

programs (Maksaev, Tkach, Nechitailov, 2020). The State Program for the Development of Agriculture and Regulation of the Markets of Agricultural Projects, Raw Materials, and Food provides for compensatory and incentive subsidies to support dairy farming. Compensatory subsidies are offered to agricultural producers, except for citizens engaged in private farming, and are aimed at:

- financial support (compensation) of part of the costs to support domestic milk production;
- financial support (compensation) of part of the cost of breeding stock of farm animals;
- financial support (compensation) of part of the cost of breeding bulls;
- compensation of part of expenses for insurance premiums, accrued under agricultural insurance contracts;
- financial support (compensation) of part of the cost of purchase of young farm animals from breeding organizations registered in the State Breeding Register.

Incentive subsidies are provided to:

- agricultural producers, except for citizens engaged in private farming, as financial support (compensation) of part of the cost of co-financing the measures of regional programs to ensure the growth of domestic milk production;
- farms and individual entrepreneurs in the form of grants for the development of family farms – in the amount not exceeding 30 million rubles, but not more than 60% of the project cost;
- agricultural consumer cooperatives, except for credit cooperatives, in the form of grants for the development of their material and technical base – in the amount not exceeding 70 million rubles, but no more than 60% of the project cost;
- citizens who keep private farms and use the special tax regime "Professional Income Tax" for financial support (compensation) of part of the cost of co-financing the measures of regional programs to ensure an increase in milk production;
- to agricultural producers in the form of Agropgress grants in the amount not exceeding 30 million rubles, but no more than 25% of the project cost. The planned breeding stock of cattle must not exceed 400 heads.

Imports of milk and dairy products in the Russian Federation have decreased, yet their share in dairy consumption remains rather high (19.6%). In the structure of agricultural imports in monetary terms, milk accounts for 7.7%. For this reason, import substitution is an important precondition for food security in the sphere of dairy consumption. This problem can be resolved only through the transition of dairy farming to the path of innovative development using new technologies. In today's conditions, digital technologies and robotic complexes are of great importance as they reduce human involvement in production processes, cut production costs, and increase yield from animals (Batov, Efendieva, Shogenov, 2022).

To provide the country's population with milk as per rational nutritional standards and to reach the threshold of self-sufficiency (90%), the production of milk needs to be brought up to 42.4 million tons, i.e. increased by 31.3% compared to 2021. For this, the existing system of support for dairy farming needs to be radically changed. First of all, this system stimulates the development of dairy farming in agricultural organizations and farms. Private farms, which produce nearly 35% of milk in the country, hardly receive any state support.

Therefore, a vital condition for further development of dairy farming is the perfection of state support with due regard for the peculiarities of dairy farming development in farms of different categories. Thus, we suggest that private farms that produce marketable products should be financially supported.

The concentration of livestock in medium and large enterprises will increase the production of milk and improve its competitiveness. Russian experience shows that farms with livestock of 1,000 or more animals are the most competitive since their production costs per unit of milk are almost half of those of farms with less than 100 cows (Altukhov et. al, 2019).

Highly profitable dairy farming is achievable only for large enterprises that have a high concentration of labor and capital and are able to quickly modernize their operations and organize the production of high-quality, competitive products in the shortest possible time (Kastornov, 2022).

The future belongs to mechanized and automated dairy farms and complexes with the most optimal conditions for livestock housing and maintenance but just as importantly, comfortable working conditions for the service personnel. The efficiency and competitiveness of Russian dairy farming will be defined by the use of modern technologies in milk production (Minakov, 2020).

The intensification of dairy farming and its further development as a specialized industry focused on breeding cattle of highly productive dairy breeds will help solve the problem of food security in milk in a shorter time and with significantly fewer resources (Kvochkin and Kvochkina, 2018).

Fodder and feeding have a great impact on the production of milk and its quality. According to the Ministry of Agriculture of the Russian Federation, 53.6% of cows do not receive balanced feed. Proper feeding of animals with protein-balanced feed not only increases milk yields but also raises fat and protein content in milk. Thus, feeding diets must be nutritionally adequate in terms of total and protein nutrition (Goncharov, 2019).

Another facilitating factor in the development of dairy farming will be the revival of Russian pedigree dairy cattle breeding. The implementation of the State Program for the development of agriculture has increased the breeding population of dairy cattle. However, there is a strong dependence on imports of breeding products. In 2020, 9.4 billion rubles were spent on the import of pedigree material out of the total 37.3 billion rubles of state support for dairy farming. It is advisable to direct these funds to strengthen the Russian breeding base. As economic incentives for the development of selection and breeding work, it is necessary to raise the volume of subsidies for the purchase of breeding animals of Russian selection and provide subsidies for the purchase of bull semen from Russian breeding organizations (Chinarov, 2022).

A major prerequisite for scaling up milk production and increasing its efficiency is the maximum use of the genetic potential of livestock by applying the latest methods of selection and breeding work, creating a solid fodder base, as well as introducing progressive forms of labor organization. The genetic potential of livestock breeds bred in Russia is utilized only up to 60-70% (Minakov, 2018).

Further development of dairy farming in private farms will facilitate their integration with agricultural organizations or the formation of livestock consumer cooperatives, which will provide assistance in veterinary activities, the provision of fodder, and the sales of products produced (Kulikov and Minakov, 2018).

Many small farms are experiencing difficulties in selling the milk they produce. The creation of agricultural consumer marketing and processing cooperatives will allow the rational use of all products produced and increase the marketability of dairy farming in regular and private farms.



## 4. CONCLUSION

The agrarian policy pursued by the Russian state has increased milk production and reduced its imports, but has not solved the problem of food security in the consumption of dairy products. As a result of this study, we suggest that this problem will be remedied by import substitution in the food market, the increase in milk production through technical and technological modernization of dairy farming, improvement of selection and breeding work and state support, concentration of milk production in specialized agricultural organizations and farms, the development of cooperation, improvement of livestock productivity through the use of modern technologies, improved use of the genetic potential of cows, strengthening of the feed base, and optimization of feed rations.

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