Directions of increasing the competitiveness of livestock products in Russia

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Abstract. The directions of increasing the efficiency of livestock production based on the use of advanced technology and controlled digital technologies for performing processes are considered. The influence of technological, technical, organizational and economic factors on the growth of product competitiveness is shown. The purpose of the study is the justification of a set of measures to increase the competitiveness of livestock products based on the implementation of engineering, technological, organizational, economic, and environmental factors. In recent years, milk production in the country has been ensured mainly by increasing the productivity of cows in agricultural organizations while reducing their numbers, and the tendency for a decrease in milk production in households is steadily continuing. One of the reasons for this is the low level of technical equipment of the facilities, due to the lack of specialized enterprises for the production of innovative equipment in the country, the slow pace of machine renewal, and the use of ineffective technologies for keeping and feeding animals. Measures have been proposed to increase the investment attractiveness of livestock and, especially, dairy cattle breeding, creating conditions for its growth. It was recommended to analyze and select the best investment projects for the creation and modernization of existing livestock breeding complexes and farms and take measures for their distribution, as well as take measures to revive specialized mechanical engineering for livestock breeding and develop a program for the technical equipment of livestock industries. The results of the study should be used in developing programs and directions for improving state support for livestock breeding, ensuring food security in Russia, and addressing issues of import substitution.

1. Introduction

In livestock production in Russia, there has been a positive dynamics in the growth of meat production, achieved mainly due to the pig and poultry industries, which use innovative equipment, resource-saving technologies that contribute to the development of automatically controlled digital technologies and process execution (optimization of microclimate parameters, as well as feeding and watering of animals, free milking of cows by robots). Compared with 2012, the production of livestock and poultry for slaughter (in slaughter weight) in Russia increased by 31.0% in 2018 (table 1).

In 2017, the threshold values for meat and meat products production stipulated by the Food Security Doctrine of Russia were exceeded by 5.4% (actual level - 90.4, stipulated by the Doctrine - 85%).
Table 1. Production of main types of livestock products in the Russian Federation (thousand tons) (Source: Russian Federal State Statistics Service (Rosstat) data).

| Product name                                    | 1990  | 2000  | 2010  | 2016  | 2017  | 2018 (preliminary) |
|------------------------------------------------|-------|-------|-------|-------|-------|-------------------|
| Farms of all categories                         |       |       |       |       |       |                   |
| Cattle and poultry for slaughter (in slaughter mass) | 10111.6 | 4445.8 | 7164.8 | 9853.3 | 10319.0 | 10585.4 |
| Including:                                       |       |       |       |       |       |                   |
| cattle                                          | 4329.3| 1897.9| 1711.5| 1588.8| 1569.3| 1605.6           |
| pigs                                            | 3480.0| 1578.2| 2337.4| 3355.1| 3515.7| 3710.0           |
| sheep and goats                                 | 395.0 | 140.3 | 184.4 | 213.2 | 219.5 | 220.5            |
| poultry                                         | 1801.0| 767.5 | 2855.4| 4622.4| 4941.0| 4975.6           |
| milk                                            | 55715.3| 32259.0| 31507.8| 29787.2| 30184.5| 30639.7 |
| Agricultural organization                       |       |       |       |       |       |                   |
| Cattle and poultry for slaughter (in slaughter mass) | 7603.5 | 1786.5| 4342.3| 7515.8| 8040.4| 8349.6           |
| Including:                                       |       |       |       |       |       |                   |
| cattle                                          | 3756.6| 815.8 | 565.3 | 536.2 | 544.4 | 572.3            |
| pigs                                            | 2290.6| 435.8 | 1228.0| 2717.0| 2912.8| 3152.7           |
| sheep and goats                                 | 228.6 | 15.1  | 16.4  | 16.2  | 15.6  | 16.8             |
| poultry                                         | 1259.0| 502.0 | 2515.7| 4232.0| 4552.2| 4594.4           |
| milk                                            | 42452.1| 15271.1| 14313.2| 15061.2| 15673.7| 16231.4 |
| Households                                      |       |       |       |       |       |                   |
| Cattle and poultry for slaughter (in slaughter mass) | 2507.0 | 2579.5| 2612.6| 2045.3| 1973.3| 1917.3           |
| Including:                                       |       |       |       |       |       |                   |
| cattle                                          | 572.1 | 1048.1| 1065.2| 916.6 | 877.9 | 871.9            |
| pigs                                            | 1188.9| 1107.2| 1040.1| 590.9 | 558.7 | 515.6            |
| sheep and goats                                 | 166.4 | 119.5 | 133.9 | 150.7 | 153.2 | 152.4            |
| poultry                                         | 542.0 | 262.5 | 320.5 | 337.5 | 336.8 | 329.2            |
| milk                                            | 13261.4| 16420.2| 15719.9| 12552.0| 121135.4| 11914.9 |
| Peasant (farm) enterprises and individual entrepreneurs |       |       |       |       |       |                   |
| Cattle and poultry for slaughter (in slaughter mass) | 1.1   | 79.8  | 209.9 | 292.2 | 305.3 | 318.5            |
| Including:                                       |       |       |       |       |       |                   |
| cattle                                          | 0.6   | 33.9  | 81.0  | 136.0 | 147.0 | 161.4            |
| pigs                                            | 0.5   | 35.2  | 69.3  | 47.2  | 44.2  | 41.8             |
| sheep and goats                                 | -     | 5.7   | 34.1  | 46.3  | 50.7  | 51.2             |
| poultry                                         | -     | 3.0   | 19.2  | 52.9  | 52.0  | 52.0             |
| milk                                            | 1.8   | 567.7 | 1474.7| 2174.0| 2375.4| 2493.3           |

The increase in milk production in 2018 from 30.2 to 30.6 million tons was achieved by increasing the productivity of cows while reducing their numbers.

A steady downward trend in the production of milk and meat in private (subsidiary) farms remains. In 2018, farms of all categories, according to estimates, produced 14.9 million tons of cattle and poultry in live weight for slaughter (2.6% more than in 2017). Production of pigs increased by 6.2%, cattle - by 2.3%, and sheep and goats decreased by 1.5%.

As of December 1, 2019, in the farms of all categories, it was estimated that there were 18.1 million heads of cattle, including 7.9 million heads of cows; the number of pigs amounted to 23.8
million heads, sheep and goats - 24.2 million heads, poultry (in agricultural organizations) - 448.6 million heads.

The measures provided for by the Decree of the Government of the Russian Federation dated February 8, 2019 No. 98, which approved the updated state program for the development of agriculture until 2025, will also influence the growth of agricultural products.

The budget allocation of the program will be more than 3.5 trillion rubles, of which 2.3 trillion rubles will be directed from the federal budget to the development of the agricultural sector in the period 2019–2025.

In 2019 and 2020, 303.6 billion rubles and 294.8 billion rubles are provided for the implementation of the state program, respectively.

In 2025, financing of the agricultural sector from the state budget will amount to more than 300 billion rubles.

The concessional lending mechanism provides for short-term loans for the purchase of raw milk for the production of dairy products and cheese.

We believe that the adoption of this resolution will contribute to the active development of animal husbandry in Russia.

2. Aim of the study
The aim of the paper is to study ways to increase livestock production, achieve high indicators of its effectiveness and quality that meets the best international standards, justify a set of measures to increase competitiveness based on the implementation of engineering, technological, organizational, economic, and environmental factors.

3. Methods
Under market conditions, the main criteria for investment attractiveness of the development of livestock production are the level of unit costs of resources, profitability and quality, which determine its competitiveness.

The competitiveness of livestock products is characterized by a number of indicators, the most important of which are:
- production costs;
- unit costs of material, labor and energy resources for its production and processing;
- quality of manufactured marketable products;
- cost of resources to preserve consumer properties;
- environmental impact during the production, processing and sale of products (pollution of air and water basins, soil by weed seeds, manure, etc.);
- impact on the health and life expectancy of the population.

Here, indicators reflecting the cost of its production are of great importance - the unit cost of resources (feed, energy and working time), as well as the quality of marketable products and raw materials.

The natural and climatic conditions of Russia are less favorable compared with more southern countries for livestock production. These factors naturally reduce the competitiveness of agricultural products.

However, the creation of innovative equipment adapted to the conditions of various zones ensures the use of resource-saving technologies (automatically controlled (digital) technology for process execution) in Russia on the basis of automated machine systems, the rational organization of labor and management, and make it possible to produce high-quality competitive products in Russia and receive 7-8 thousand liters of milk per year from one cow, weight gain of pigs for fattening more than 750 g per day, and cattle - 950 g per day [1-3].
4. Results
The country has a large number of farms and complexes for the production of milk, pork, beef, which have achieved high rates of animal productivity, production efficiency and product quality that meet the best international standards. Such organizations work on the basis of the application of innovative technology and resource-saving technologies [2,4].

In agricultural firms “Ruchi” of the Leningrad Region, “Dmitrov Gora” in the Tver Region, on the collective farms “Russia” of the Stavropol Territory, named after V.Ya. Gorin in Belgorod Region, agro-industrial complex “Zelenogradsky” in the Moscow Region, cow productivity complies with the best international standards and amounts to 8.0–9.5 thousand liters of milk per year, with a minimum unit cost of resources.

However, the expenditures of working time for the production of feed and energy for the production of milk, beef and pork of the whole country exceed the indicators of the EEC countries by 1.5-3.0 times, while the productivity of animals is lower by 35-50%.

The aforementioned is explained by a complex of technological, engineering and organizational factors, the main of which are: insufficient level of technical equipment of farms, the lack of innovative production facilities in the country, the collapse of the technical service system and the training of engineering and technical personnel, and the slow rate of machine renewal, the use of ineffective technologies in animal husbandry.

In private subsidiary farms, the specific expenditures of working time and feed per unit of output are significantly higher than the all-Russian indicators due to the extremely insufficient level of mechanization and concentration of production.

Market reforms of the economy negatively affected the development of agriculture, including livestock in agricultural organizations. Thousands of specialized farms have been reduced.

At the same time, in households with a land area of up to 1 ha and with 1-2 cows, there are no conditions for the efficient use of advanced technology. Production processes are carried out mainly by hand.

The production of necessary equipment has not been established for these forms of farms, and as a result, in recent years, the share of private household plots in milk production has decreased to 38.8%, while the share of agricultural organizations has increased to 53.0%.

Livestock development is supported from the federal budget as part of the subprogram “Development of agricultural sectors” of the State Program for the Development of Agriculture.

Stimulation of increasing milk production and its quality, increasing the number of cows is carried out through the implementation of targeted programs. However, experience shows that the allocated financial resources for these programs are not enough, especially in connection with the increase in prices for energy and animal feed consumed in the industry.

Despite the increase in purchase prices, the introduction of surcharges for the quality of milk and its processing, milk production in Russia covers only 82.5% of its needs [1].

Insufficient production of milk and beef is also due to low animal productivity. The average daily weight gain of cattle in agricultural enterprises does not exceed 570 g with fluctuations from 260 to 710 g, the mass of cattle being sold is 380-400 kg, pigs - 105-111 kg.

Animal productivity indicators in Russia are 1.5-2.0 times lower than indicators achieved in many countries of Europe and the USA. In Russia, due to the short periods of use of dairy cows (less than three lactations), the costs of forming a herd in the total costs of milk production increased to 25-30%.

In recent years, in Russia, the solution to the problem of the formation of a dairy herd has been carried out through the mass purchase of cows abroad. Significant amounts of budget funds have been spent on these purposes — more than 2.3 billion rubles per year. At the same time, farms often do not create the necessary conditions for the efficient use of imported livestock - feed supply, construction of facilities, staff development. As a result, the duration of the productive longevity of purchased livestock remains low and amounts to less than three lactations.

There is a weakened attention on improving traditional domestic livestock breeds adapted to the climatic conditions of the country - Yaroslavl, Kostroma, Kholmogorsk.
The proportion of pedigree dairy cows in the general herd of Russia is only about 14.0% [2]. Low indicators of the quality of products sold - milk, fatness of animals, as well as the quality of feed consumed, reduce the competitiveness and efficiency of livestock products. According to the Ministry of Agriculture of Russia, the average daily gain of cattle in growing, fattening and feeding in agricultural organizations amounted to 614 g in 2017.

Insufficient protein supply of feeds leads to their increased consumption, especially of grain, increase in cost and, as a result, decrease in profitability of livestock products. According to the data of FWRC FPA, in agricultural organizations, 54.2-56.0 centners of feed units are consumed for feed cow with a productivity of 4841 kg of milk, including 21-22 centners of concentrated feed. Due to the protein imbalance in the diet, the total cost overrun per cow per year is 4.8-5.0 centners of feed units (11%) and concentrated feed - 22.0%.

The analysis shows that the competitiveness of livestock products will be ensured through the integrated implementation of the following engineering, technological, organizational, economic and environmental measures:

- technical re-equipment, modernization of existing ones, construction of new objects with optimal level of concentration using highly effective innovative equipment, comprehensive mechanization and automation of processes and resource-saving technologies;
- improving the conditions of keeping and feeding animals, optimizing the indoor climate, balancing feed rations that increase animal productivity by 20-25%, rational use of feed, eliminating their spoilage and losses, and thereby reducing production costs - growth investment attractiveness of the industry;
- improving livestock farming - optimizing the size of enterprises, increasing the qualification of personnel and remuneration, improving the organization of labor and management, strengthening economic incentives, financial support, improving the credit system, introducing preferential tariffs on energy and consumed industrial production resources (vitamins, medicinal and feed additives, building materials, etc.);
- elimination of pollution of water, air basins, soil with manure, emissions of harmful gases, pathogenic microorganisms, weed seeds, preparation of high-quality organic fertilizers from excrement.

The need to increase the level of technical equipment of livestock farms with innovative equipment is caused not only by the existing low level of mechanization and automation of production processes due to the destruction of specialized agricultural machinery in Russia, the moral and physical wear and tear of applied machinery and equipment. Integrated mechanization and automation are important conditions for raising the level of productive potential of animal breeds, improving animal welfare and, on this basis, using resources, increasing labor productivity and improving its conditions, protecting the environment, reducing costs and improving product quality. Digital technologies and economics provide additional opportunities for a significant increase in production.

The “Strategy for the development of mechanization and automation of animal husbandry for the period up to 2030” defines the main areas of technology development, providing for its adaptability to the physiological characteristics of the functioning of various species of animals and birds, organizational and climatic conditions of use [2].

Strengthening research and design work to justify and develop innovative technology for mechanization and automation of processes in the production of livestock products, the revival of domestic specialized engineering for the industry and mass production of machines are key and urgent problems in modern conditions for eliminating the country's dependence on imports of food, primarily milk, dairy products and beef, as well as on imports of equipment, the specific weight of which is currently reached almost 90% of total supply, and the purchase price and operating costs are higher than domestic analogues in 1.5-2.0 times.

Russian scientific and research organizations (with the participation of scientists from agricultural universities) have developed highly effective technical solutions for the mechanization and automation of machine milking of cows (installations with “Parallel”, “Herringbone” machines with automatic
management of technological operations - preparation of the udder, removal of milking machines, final massage of the udder), effective systems for cleaning stalls and removing manure from the premises (automated boom conveyors), technological lines for the preparation of high-quality fertilizers, automated workshops for the production of animal feed with a capacity of 1.5 to 12.0 t/h, mobile universal machine complexes for loading, grinding, mixing the components of the feed ration for cattle and enriching it with compound feeds, automatic climate control systems, automated complexes of machines for the production of poultry, pig and sheep products, reservation of energy supply facilities and other types of innovative technology, but their industrial production is not carried out [2].

In recent years, the increased budgetary support to machine-building enterprises has affected the increase in the production of tractors, grain and forage harvesters, but has not had a noticeable positive effect on the increase in the production of machines for livestock subsectors.

The reconstruction and modernization of existing facilities, as well as the construction of new farms, are extremely slow.

For the production of milk in 2013 - 2017, 1163 facilities were commissioned, reconstructed and modernized in the country, and the volume of milk production from the creation of new and reconstruction of existing facilities amounted to 725.1 thousand tons [1].

An important factor in increasing the competitiveness of livestock products along with enhancing the technical equipment of facilities, modernizing and reconstructing existing buildings and equipment, and increasing the pace of new construction are technological and organizational factors - improving the way animals are kept, providing the livestock with high-quality feed and balanced diets, staffing farms with highly productive animals and skilled personnel.

In Russia, about 95% of cows are housed in the tie barns. Given that when using loose housing due to more technological conditions, the complexity of the maintenance of animals is reduced to two times.

In the future, the proportion of the loose housing of cows must be brought up to 80%.

In pig breeding, it is necessary to use standardized machines and automatic feed stations.

An analysis of domestic and foreign experience shows that the improvement of technology should be aimed at increasing and decreasing production costs, increasing the productivity of animals, obtaining high-quality products, and protecting the environment. At the same time, the highest efficiency of mechanization and automation in animal husbandry is ensured by its comprehensive implementation and transfer to machine execution of all processes and operations, including processes and operations of animal livelihoods, rearing of young animals, reproduction of the herd (watering, feeding, veterinary protection, air exchange, indoor temperature), as well as when creating optimal (comfortable) conditions of keeping. In dairy cattle breeding, the most significant processes that affect the productivity of animals, the duration of their productive use and production costs are milking cows, preparing and distributing feeds, cleaning stalls, and watering [5-9].

The use of automation when milking cows in stalls allows the operator to milk up to 35-40 cows per hour, and in case of pipeline milking - up to 45 cows. With loose keeping of cows and milking in milking parlors, labor productivity rises to 60-70 cows, minimum labor costs for milking animals are achieved, compared to tethered cows [3,8].

Economic indicators of the use of innovative milking plants are presented in table 2.

Table 2. Economic indicators of milking plants (farm for 400 cows).

| Indicators                          | stall milking in a portable bucket | stall milking in a milking pipeline | milking by automated plants in milking parlors |
|------------------------------------|-----------------------------------|-----------------------------------|-----------------------------------------------|
| Capital investments, thousand rubles | 1.1-1.2                           | 1.4-1.6                           | Tandem                                       |
|                                    |                                   |                                   | Herringbone                                  |
|                                    |                                   |                                   | Carousel                                     |
Milking in milking parlors reduces the laboriousness of servicing animals by 51.2-63.0%. The use of loose housing and milking cows in the halls with automatic control over the implementation of technological operations allows not only increasing labor productivity, reducing costs, but also improving milk quality and eliminating the disease of cows with mastitis.

The necessary conditions for achieving high productivity are ensuring optimal conditions in the premises for keeping all types of animals and birds — temperature, humidity, air composition, timely cleaning of excrements, air purification, provision of feed, water, lighting and radiation [2].

The experience of leading farms in Russia and other countries using new technologies and technical means shows that by optimizing the conditions of keeping and feeding, it is possible to obtain high animal productivity with labor costs for the production of 100 kg of milk 0.8-1.0 man-hours and have a profitability of production of at least 30-40% [10].

In order to increase labor productivity, production efficiency and competitiveness of pig products, it is necessary to create and mass produce new equipment, automatic machines for feeding and watering.

An important link in the technology of production of pig products is the management of technological processes based on automation and computerization.

Cleaning manure from the premises with stationary technical means requires high manual labor for laying and cleaning stalls - up to 29 man-hours. The technical level of machines and equipment for cleaning manure from the premises and preparing it for use, and conveyors of all modifications do not meet modern requirements for hygiene and sanitary safety.

In case of non-compliance with storage requirements, preparation for use, manure becomes a source of environmental pollution - harmful organic and inorganic compounds, pathogenic microflora, helminth eggs [11-13].

The organization of the processes of cleaning and preparing manure for use has a significant impact on the efficiency of livestock production, as well as agricultural production as a whole.

Due to the breakdown of the unified technological chain - cleaning premises from excrement, storing and preparing fertilizers, even in the best years in our country, no more than 35% of accumulated manure was used annually as organic fertilizers. Currently, less than one third of manure is used as fertilizer, and only 1% of arable land is fertilized.

An analysis of the main technical and economic indicators of the application of various technologies and technical solutions for the manure removal from the premises showed that in modern conditions, a significant increase in the efficiency of the process can be achieved through the organization of mass production and mass use of boom conveyors. Which have several advantages in comparison with other designs: their cost and specific energy consumption are lower, and reliability is higher, they provide the removal of manure of any moisture.

5. Conclusion
To significantly increase the investment attractiveness of livestock and, especially, dairy cattle breeding, creating conditions for increasing production, it is necessary at the regional and federal levels:
- to analyze and select the best investment projects for the creation and modernization of existing livestock complexes and farms and take measures to distribute them;
- to revive specialized engineering for livestock;
- to restore the training system;
- to develop a program of technical equipment for the livestock industries, providing for the strengthening of research and development institutes, substantiation of machine systems for subsectors, modernization of existing facilities.

Support should continue to be provided to small farms (beginning farmers and family livestock farms), private farms involved in cattle breeding, and additional subsidies per 1 kg of milk sold or used for own processing should be provided.

Particular attention should be paid to the cooperation of peasant farms, owners of private subsidiary farms, small, medium and large agricultural organizations, which allows participants to ensure competitiveness in the markets for goods and services, as well as to increase the level of income and welfare by improving the organization of labor and eliminating excessive market intermediaries.

The implementation of the above directions in combination with additional financial measures will make it possible to use resource-saving technologies and innovative equipment, ensure the production of high-quality products with minimal unit labor time for the production of milk, beef and pork, profitability of production of at least 30%, provide food security of the country.

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