Theoretical and Practical Aspects of Increasing the Milk Production Efficiency

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Abstract. Scientific research and the experience of leading dairy enterprises show that the level of modernization of production, the quality of various management systems for the maintenance, feeding and use of livestock genetic resources, as well as the professional level of human resources are important components of effective milk production. Nowadays, the active use of “smart” systems for managing production processes has acquired priority importance. At the same time, the implementation of these systems makes relevant the issues of dairy business efficiency and food security. Milk production is a rather complicated process and its efficiency depends on many aspects. The given analytical research is based on the results of the Novgorod region agricultural dairy enterprises and the changes that appeared under the influence of the current regional policy. Particular attention is paid to the development of dairy farming at the regional level, its goals, objectives, and activities. The researcher analyzes the implementation of the State Program of the Novgorod Region “Development of Agriculture in the Novgorod Region for 2019-2024”, that provides for an increase in local milk production due to accelerated solution of socio-economic problems in agriculture. The article argues that the work on milk production efficiency should be carried out within the framework of the priority regional project “Development of Dairy Farming” aimed at increasing the efficiency of investments. Besides, according to this project, regional agricultural organizations can increase milk production to 55 thousand tons by the year 2025. The flexible investment legislation of the region allows implementing large investment projects in the region; in the future, it would increase the milk production. The introduction of modern agricultural solutions at enterprises would ensure the systemic development of dairy farming in the region and, accordingly, effective milk production.

1. Introduction
Dairy farming plays an important role in the country’s food security. To implement the tasks facing dairy production, it is necessary to increase the level of production management and its efficiency. At the same time, dairy farming must be sufficiently productive to maintain profitability and competitiveness [1, 2]. Many researchers [3, 4, 5, 6] specify that the active use of digital technologies by farms is an important aspect for providing an increase in the milk production efficiency. The research results [7, 8] show that the rate of technological modernization of animal breeding remains insignificant, primarily due to a long reproduction cycle.

The experience of leading dairy enterprises proves that the due implementation of scientific, technical and technological progress achievements ensures that the genetic potential of farmed dairy cattle breeds is well-realized, helps increase production efficiency and the competitiveness of products. The use of innovative technologies becomes crucial for the sustainable development of dairy production.
At the same time, the priority is the use of digital technologies, active implementation of “smart” systems for managing production processes.

Currently, in the Novgorod region, investment projects are being implemented in various branches of animal breeding: LLC “Medovy Dom” is introducing an automated and robotic production line for deep and shallow processing of honey; LLC “Belgrankorm-Veliky Novgorod” (poultry farming, meat processing, dairy farming and crop production), LLC “Novgorodskiy Bacon” (agriculture, crop production, pig breeding, poultry farming), etc.

Digital technologies are in high demand for animal identification, feeding, keeping and reproduction of animals. The modernization of technological processes qualitatively changes the parameters of keeping animals, creates more comfortable conditions and increases labor productivity; the use of robotic milking machines provides the farm transition to a new level of innovative production development.

Large farming enterprises achieve the greatest effect in production activities, but along with them, family dairy farms also show high results. Previously the maximum size of livestock for the innovative solutions implementation had to be at least 1.2 thousand head, whereas now, due to digitalization, it is possible to effectively manage dairy farms of any size. An extremely important competitive advantage of smaller farms is their production of organic food, the demand for which has grown significantly all over the world. The population strives to buy local, natural, fresh products. The development in this direction significantly improves the employment situation of the rural population; it reduces unemployment and enhances the development of territories.

Finally, the prerequisite for building effective milk production strategy, based on the use of modern technologies for managing a highly productive dairy herd is to determine the role and place in the regional economy which makes the direction of this research relevant.

2. Objects and methods of research
The research object was the agricultural dairy enterprises of the Novgorod region. Data collection was carried out during the site visits to agricultural enterprises, by studying documents, pedigree and zootechnic records; the SELEX electronic database was used.

Methods of monographic, comparative and system analysis, logical approach, monitoring and questioning of enterprises have been applied. We also used a theoretical analysis of sources – foreign researchers’ publications on a scientifically grounded system of effective milk production based on the use of innovative technologies [2, 7, 8, 9, 10, 11, 12].

We also analyzed the domestic research and the best practice of economic entities of the agro-industrial complex.

3. Results and discussion
The results of studying the effective development of dairy farming show that nowadays dairy production must be “smart”, that only the maximum use of innovative technologies has a significant impact on improving the industry. At the same time, “digitalization” can lead to a decrease in costs and an increase in the efficiency of dairy production [11, 12] due to the gradual implementation of automated control systems. An example of this is LLC “Peredolskoye” located in the Batetsky district and the APC “Levochsky” located in the Hvoininsky district of the Novgorod Region, where the average annual productivity of black-and-white and Ayrshire cows is, respectively, more than 8000 kg and 7000 kg of milk. It should be noted that they started with 4500 kg which is the average milk production in the region.

According to F. Sitdikov [8], B. Ziganshin [8], R.R. Shaydullin [8], A. Moskvicheva [8], M. Zohair [8], the need to introduce innovative technologies in dairy production ensures complete “digital” display of management objects. The analysis proves that to ensure the effective development of the dairy industry in the region, a choice of strategic priorities and directions is required. A systematic increase in production volumes and an improvement in the quality of milk are possible if a wide range of interrelated measures is implemented and all resources of the industry, including construction of new
industrial dairy farms, intensification of production in existing agricultural enterprises (digital technologies, livestock renewal; profitability of agricultural enterprises, rehabilitation of weak farms), are employed.

In modern conditions, it is necessary to intensify the work on cooperation of family farms to maintain production volumes. It is important to note that the region provides grant support to peasant (farmer) households – “Agrostartup”. In recent years, the volume of grant support has increased by 2.3 times, including for the development of family farms.

One of the main tasks of the agro-industrial complex of the Novgorod region is to increase the gross milk production. In the production structure, the largest share falls on agricultural organizations – 59.1%, on peasant farms – 14.3% of total production and on private households – 26.6%. The introduction of innovative technologies and herd management in the practical activities of farms has significantly increased milk productivity in the region. For 20 years there has been a positive dynamics of the average annual milk yield in the region; the annual growth of milk among agricultural producers is about 5.4%. In 2020, the average annual milk yield per cow in agricultural organizations amounted to 5144 kg, or 106% of the level of 2019. However, 78 thousand tons are not enough for the region to be fully self-sufficient in milk. Unfortunately, a number of factors continue to slow down the development of the industry. These factors are, first of all, the difficult financial situation of farms, their low technological and technical equipment.

As the research and the analyzed experience of advanced farms show, in order to ensure the growth of milk production in the region, it is necessary to increase the efficiency of existing farms and to continue implementing new investment projects. To improve the milk production efficiency in the regional agricultural enterprises with the help of automated control systems is an important decision in the effective development of dairy production.

At the same time, as the research confirms, serious work is currently being done to develop the dairy industry in the region, including attracting strategic investors. For example, in the Krestetsky district of the Novgorod Region, the agricultural holding LLC “Belgrankorm Veliky Novgorod” has implemented a large investment project in dairy farming. A modern high-tech dairy complex for 400 dairy cows was built in 2018. Currently, there are 934 head of cattle, including 400 cows.

To fill the dairy complex, a highly productive young stock was purchased in a breeding reproducer of the Vologda Region. In 2020, the milk yield per cow was 7604 kg (102% by 2019). The farm ranks first in the rating of the best commercial enterprises of the region in terms of milk yield. In the conditions of the complex, loose keeping of animals is used, the same type of feeding - mono-feed all year round, a milking parlor with the “Yochohka” installation. The calves are kept in individual houses in the fresh air which contributes to their early development; for feeding the calves, a “milk taxi” is used, which pasteurizes and warms up the milk to the required temperature. Constant attention is paid to processing.

In the APC “Levochsky” of the Hvoyninsky district, the construction of a milk processing plant with a capacity of 10 tons per day was completed; it helped to increase the processing volume by 3 times. As a result, additional jobs appeared; tax revenues to the budgets of all levels increased; the financial stability of the enterprise was strengthened, because of the transition to the processing of the entire volume of raw milk produced. It should be noted that the breeding reproducer occupies a leading position in the Novgorod Region in terms of the productivity of the Ayrshire breed dairy herd. In 2020, the average annual milk yield per cow was 7125 kg.

The evaluation of zootechnic and pedigree registration data in the collective farm “Rossiya” APC of the Soletsky district [13, 14] showed (table 1) that the milk yield per average annual cow in 2020 was 6001 kg of milk. This is 695 kg of milk or 13% higher than in 2019 and 860 kg or 17% higher than in 2016. Mass fraction of fat in milk is stable and remains at the level of 3.76%. Over the past two years, the mass fraction of protein in milk has increased and amounted to 3.02%. At the same time, the number of dairy cows over the past 5 years has remained at a stable level and amounts to 900 head.
Table 1. Milk production in the collective farm “Rossiya” APC.

| Year | Milk yield for 305 days, kg | MFF, % | MFP, % | Annual feed consumption per 1 conventional head, EFU | Profitability of dairy farming, % |
|------|---------------------------|--------|--------|---------------------------------|---------------------------------|
| 2016 | 5141                      | 3.76   | 2.84   | 53.5                            | +14.9                           |
| 2017 | 5049                      | 3.78   | 2.82   | 48.9                            | +7.1                            |
| 2018 | 4767                      | 3.79   | 2.91   | 45.3                            | +1.5                            |
| 2019 | 5306                      | 3.79   | 3.02   | 47.7                            | +10.6                           |
| 2020 | 6001                      | 3.76   | 3.02   | 54.3                            | +24.7                           |

Intensive rearing of young replacement is one of the main aspects of creating a highly productive dairy herd. Adequate feeding will allow heifers to develop faster. The age of heifers at the first insemination is 15 months with a live weight of 368 kg. Late insemination leads to unnecessary feed costs and a decrease in the efficiency of their use.

During the research period, the profitability of dairy farming on the farm increased from 14.9 to 24.7%. In recent years, the approbation of research developments of Yaroslav the Wise Novgorod State University is carried out jointly with the leading specialists of the collective farm “Rossiya” APC of the Soletsky district during scientific and practical conferences, consulting seminars and the publication of materials.

At the same time, the introduction of research developments demands the high professional level of human resources. Production requires a new generation of specialists. In this regard, the university pays constant attention to the training of professional personnel, including modern managers [2], in the professional development program “Management in the agro-industrial complex”.

Nowadays, an important component of a dairy complex is effective herd management. In many countries most dairy farms are known to be equipped with modern herd management systems. However, in the Novgorod Region, this process has just started, while more and more enterprises acknowledge the efficiency of control systems digitalization and understand that their consistent application can become the key to effective milk production.

4. Conclusion
As a result of the research, it was found out that the Novgorod Region has started to implement the priority regional project “Development of Dairy Farming”, which increases the efficiency of attracting and implementing large investment projects, which in the future will increase the volume of milk production. At the same time, their implementation makes the problems of increasing the efficiency of the agricultural business highly relevant. Along with this, there are problems caused by the risk of non-fulfillment of the activities planned by the regional project. The main ones are connected with the low rate of technological modernization of dairy farming.

The analysis of the domestic experience of advanced farms show that to ensure the growth of milk production in the region, it is necessary to increase the efficiency of existing farms and continue implementing new investment projects. Increasing the efficiency of milk production in the regional agricultural enterprises with the help of innovative management systems is an important decision in the further development of dairy production.

At the same time, modern technologies for efficient milk production make increased demands on the professional level of human resources. In this regard, constant attention should be paid to the training of professional personnel for the dairy industry, including managers.

Consequently, increasing the efficiency of milk production is a rather complicated process depending on many aspects. Agricultural organizations and enterprises should actively use modern technologies; they require appropriate management and support from federal and regional authorities.
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