PROSPECTS FOR THE USE OF ARTIFICIAL INTELLIGENCE TECHNOLOGIES IN THE DIGITALIZATION OF AGRICULTURE AND LIVESTOCK FARMING (EXAMPLE IN THE REPUBLIC OF KARAKALPAKSTAN)

Khojanazarov Nazarbek Reypnazarovich
Karakalpak State University
ORCID: 0009-0004-5236-5420
nazarbeknax@gmail.com

Abstract. The article provides detailed reviews and analyzes of the perspective of artificial intelligence in Uzbekistan. The importance of artificial intelligence in the development of firms, companies, as well as in the fields of medicine, agriculture has been need by process of digitalization. Also, the demographic changes of the Republic of Uzbekistan were analyzed and forecast indicators for 2024-2030 were developed. Based on these forecast indicators, it was determined that by 2030, the demand of the population of the Republic for meat and dairy products will increase by 19.2%, and for milk products by 16.3%. To meet this demand, suggestions and recommendations have been developed for the automation of livestock complexes based on digital technologies, the use of robotic CR-1 and MR-S2 remote-controlled digital technologies for increasing the milk yield of dairy cows.

Keywords: artificial intelligence, forecast indicators, milk products, livestock, digital technologies, electronic identification, linear regression.

QISHLOQ XO'JALIGI VA CHORVACHILIK TARMOQLARINI RAQAMLASHTIRISHDA SUN'IY INTELLEKT TEXNOLOGIYALARIDAN FOYDALANISH ISTIQBOLLARI (QORAQALPOG'ISTON RESPUBLIKASI MISOLIDA)

Xojanazarov Nazarbek Reypnazarovich
Qoraqalpoq davlat universiteti

Annotatsiya. Ushbu maqolada, O'zbekistonda sun'iy intellekt istiqbollari haqida batafsil sharh va tahlillar berilgan. Sun'iy intellektning firmalar, kompaniyalar, shuningdek, tibbiyot, qishloq xo'jaligi sohalarini rivojlantirishdagi ahamiyati raqamlashtirish jarayonida zarur bo'ldi. Shuningdek, O'zbekiston Respublikasidagi demografik o'zgarishlar tahlil qilinib, 2024-2030 yillarga mo'ljallangan prognoz ko'rsatkichlari ishlab chiqildi. Ushbu prognoz ko'rsatkichlaridan kelib chiqib, 2030-yilga borib respublika aholisining go'sht va sut mahsulotlariga bo'lgan talabi 19,2 foizga, sut mahsulotlariga bo'lgan talab 16,3 foizga oshishi aniqlandi. Bu talabni qondirish maqsadida chorvachilik komplekslarini raqamli texnologiyalar asosida avtomatlashtirish, sog'in sigirlarning sut mahsuldorligini oshirish uchun robotlashtirilgan CR-1 va MR-S2 masofadan boshqariladigan raqamli texnologiyalardan foydalanish bo'yicha taklif va tavsiyalar ishlab chiqildi.

Kalit so'zlar: sun'iy intellekt, prognoz ko'rsatkichlari, sut mahsulotlari, chorvachilik, raqamli texnologiyalar, elektron identifikatsiya, chiziqli regressiya.

ПЕРСПЕКТИВЫ ИСПОЛЬЗОВАНИЯ ТЕХНОЛОГИЙ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В ЦИФРОВИЗАЦИИ СЕЛЬСКОГО ХОЗЯЙСТВА И ЖИВОТНОВОДСТВА (ПРИМЕР В РЕСПУБЛИКИ КАРАКАЛПАКСТАН)

Ходжаназаров Назарбек Репназарович
Каракалпакский государственный университет

Аннотация. В статье даются подробные обзоры и анализы перспектив искусственного интеллекта в Узбекистане. Значимость искусственного интеллекта в развитии фирм, компаний, а также в сферах медицины, сельского хозяйства обусловлена процессом цифровизации. Также были проанализированы демографические изменения Республики Узбекистан и разработаны прогнозные показатели на 2024-2030 годы. На основе данных прогнозных показателей определено, что к 2030 году спрос населения республики на мясомолочную продукцию увеличится на 19,2%, а на молочную продукцию на 16,3%. Для удовлетворения этого спроса разработаны предложения и рекомендации по автоматизации животноводческих комплексов на основе цифровых технологий, использованию роботизированных цифровых технологий CR-1 и MR-S2 с дистанционным управлением для повышения надоев дойных коров.

Ключевые слова: искусственный интеллект, прогнозные показатели, молочная продукция, животноводство, цифровые технологии, электронная идентификация, линейная регрессия.

Introduction.

At present, the rapidly growing population in the world and in our country, limiting the possibilities of food production, raises the issue of providing the population with quality food products. In recent years, the demand for quality primary food products in the world and in our country is increasing day by day.

A number of systematic measures have been implemented in recent years in order to further improve the sustainable supply of cheap and high-quality milk and dairy products to the population. Therefore, on February 8, 2022, the decision of the President of the Republic of Uzbekistan No. PQ-121 "On measures to further develop animal husbandry and strengthen the livestock feed base" was adopted. According to this decision, in 2022-2024, 751 thousand 916 head of cattle will be bred in livestock complexes of 310 cotton-textile, grain and rice clusters. In 2022-2023, at least 1 meat and milk-producing and processing enterprises in each district will deliver livestock to the population in a cooperative manner, and the produced products will be re-sold.

In addition, in the decision of this President, the interest rate on loans of up to 20 billion soums allocated to economic subjects in the field of animal husbandry, which have established the production and processing of meat and milk in the cooperative method, is set by the Central Bank. compensation for the part exceeding the rate, but not more than 8%, and a guarantee in the amount of 50% of the loan amount. More than 10 percentage points of the cost of credit and leasing of agricultural machinery purchased by livestock farms on the basis of credit and leasing conditions will be reimbursed from the Republican budget. A subsidy in the amount of 8 million soums per hectare will be allocated to livestock farms that have introduced sprinkler and drip irrigation technologies. 20% of the cost of purchasing equipment for growing feed for livestock by hydroponics method is covered by the Republican budget. It was noted that the cost of this equipment does not exceed 100 million soums.

In recent years, many positive, organizational, economic and social activities have been carried out in order to implement the priority tasks specified in the adopted regulatory documents for the sustainable development of the livestock sector. As a result, today the number and productivity of agricultural animals is significantly increasing. As a result of

economic reforms in Uzbekistan, the system of different ownership and management is improving. Personal assistants, farmers and farms are becoming the main factor of economic stability in the production of agricultural and livestock products.

It is worth noting that, along with all other sectors, attention is being paid to the comprehensive development of the livestock sector, raising it to a new level in terms of quality, creating suitable conditions for livestock farmers, in particular, the issue of allocating pastures for livestock. One of the main factors in the development of the livestock industry is to increase the volume of production by reducing the cost of production.

In recent years, in developed countries, labor productivity in agriculture has increased significantly, production and sales costs have decreased, and new technologies have been widely used. As a result of monitoring the world experience, several approaches to the use of modern digital technologies in the development of animal husbandry sectors have been identified. According to approaches to the development of the livestock sector, the application of digital technologies to farms engaged in livestock activities, the use of cost-effective technology in the production of products with the help of modern technologies, electronic identification of individual animals or groups of cattle, process and product information provides an opportunity to receive information such as registration, processing.

The use of digital technologies in animal husbandry should be widely used to solve the following issues:

a) determining and monitoring the number of livestock using modern information technologies (diet, milk quality, weight gain, body temperature, activity) to meet their individual needs;

b) automatic regulation of microclimate and control of harmful gases;

c) monitor the state of health of the herd;

d) monitoring the quality of livestock products;

e) sieve of production process

Currently, in the world, digitalization of the livestock industry is widely used to increase the productivity of dairy and meat products, integrating advanced technologies such as big data, sensors, and the Internet of Things (IoT).

Literature review.

A.V. Goncharov, I.N. Tarkanovsky and others' scientific works are based on methodologies for the formation of skills in the use of digital technologies in the processing of dairy products and increasing the production efficiency in animal husbandry complexes (Мотузко, 2013). In these research works, scientific proposals and recommendations on the development and use of effective technologies for milking dairy cows are presented. Also, in the scientific works of A. V. Goncharov, S. S. Briket and I. N. Tarkanovsky, the means of individual and group milking of dairy cows were analyzed in the process of milking. During the analysis of this study, it was found that the use of digital technologies is effective in determining the quality and characteristics of milk in the process of milking dairy products (Попков, 2018). N. S. Motuzko's research shows ways to improve the processes of feed preparation and feed use, to increase their energy and protein nutrition, and to control the full feeding of cows. Advantages and disadvantages of different methods of keeping animals, requirements for volume-planning solutions for industrial complexes, microclimate of buildings, milking equipment, reproduction, increasing the duration of economic use and management issues have been studied. Fedorenko (2011), Shlyakhtunov (2017), and Popkov researched the theoretical foundations of digitalization and application of information technologies in the development of animal husbandry.

The use of the models, methods and theoretical foundations presented in the scientific works of the above-mentioned researchers in the management and digitalization of livestock farms leads to effective results. How to use artificial intelligence in livestock and dairy

production. First, we will assess the level of use of artificial intelligence technologies in the economic networks of the Republic of Uzbekistan.

Methodology.

Artificial intelligence methods are used in the digitization and management of livestock industries. In this case, we can use the linear regression method, which is one of the most reliable methods of artificial intelligence in the economic analysis of livestock production.

Developing a simple mathematical model of artificial intelligence (AI) for managing livestock complexes involves creating a system that can make decisions based on data input to optimize livestock management. Here's a basic outline of such a model:

We can start with a linear regression model to predict one of the outputs, such as milk production, based on input features.

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n + m \tag{1}$$

Where:

Y - is the output (e.g., milk production).

$x_1, x_2, \ldots, x_n$ -are the input features (e.g., animal weight, age, temperature).

$\beta_0, \beta_1, \ldots, \beta_n$ -are the coefficients to be determined.

m- is the error term.

This simple linear regression model can be expanded with more features and more complex algorithms, such as decision trees, support vector machines, or neural networks, to improve accuracy and decision-making capabilities in managing livestock complexes.

Analsys and result.

Uzbekistan begins development of artificial intelligence because artificial intelligence has the potential to deliver up to 40% productivity gains, and the countries that apply it will be among the world's economic leaders. There are a number of areas in Uzbekistan in which specialized intelligent systems can be applied. These are health care, the fight against the consequences of natural disasters, agriculture and education. The first place among the priorities for the introduction of artificial intelligence in Uzbekistan should be given to the water management system: saving and rational use of water is the most important task for the country. Such an intelligent system can be built in several stages. First, creating the model of water resources in Uzbekistan, which includes the inflow, flow, and formation of polluted water, taking into account the degree of pollution, treatment, and reuse. This will already have a significant effect. Secondly, the general management system of various is hydraulic structures. Third, an accurate water flow system, especially for agriculture and its irrigation crops.

Uzbekistan has adopted a program for the introduction of artificial intelligence technologies. There are many systems like Tensor flow, Dialog flow, Clarifai, Keras, Melissa, Theano, Lasagne or Blocks that are designed to train neural networks.

The goal of artificial Intelligence is not to automate manual labor, but to reliably and continuously perform numerous large-scale computerized tasks. Automation, communication platforms, bots and smart computers, combined with large amounts of data, can improve various technologies: from security data analysis systems to investment tools. Artificial Intelligence performs deeper analysis of large amounts of data using neural networks with many hidden layers. Deep neural networks enable artificial Intelligence to achieve a high level of accuracy. In the healthcare field, the diagnosis of cancerous tumors on MRI images using artificial Intelligence technologies (deep learning, image classification, object recognition) is as accurate as the conclusions of highly qualified radiologists.

For development of artificial intelligence was adopting resolution of the President of Uzbekistan "On measures to create conditions for the accelerated introduction of artificial intelligence technologies" (No. PP-4996, 17.02.2021).

In Uzbekistan for the development of digital infrastructure will attract in the next two years, $2.5 billion, which will be sent to the launch of three new data centers in Tashkent, Bukhara and Kokand, the expansion of fixed Telecom network and modernization of mobile e-government development and training in the field of IT. Pilot projects on the introduction of artificial intelligence technologies in Uzbekistan, implemented in 2021-2022, will be applied in the following industries and areas (Farmon, 2023):

• in the field of agriculture: application in the process of monitoring the state of soil and crops based on remote sensing data, as well as the operation of agricultural machinery, including combines;

• in the banking sector: to improve the effectiveness of monitoring the activities of commercial banks and simplify their compliance with regulatory requirements (SubTech and RegTech), as well as to analyze the quality of banking services, remote biometric identification (Face-ID) of users and credit risk assessment;

• in the field of finance: to analyze and improve the efficiency of budget expenditures, pension, social and insurance payments, as well as benefits;

• in the tax sphere: the use of artificial intelligence technologies for analyzing tax revenues of legal entities, identifying deviations in tax deductions;

• in the energy sector: the use of artificial intelligence technologies to predict the production and consumption of energy resources, optimize the operation of technological equipment;

• in the field of transport: in the process of managing locomotives to track their movement and warn drivers in dangerous situations, analyze the movement of public transport and determine their optimal routes, as well as monitor road traffic and traffic jams;

• in the field of healthcare: for the diagnosis of pneumonia based on the analysis of computed tomography of human lungs, as well as breast cancer in the early stages based on the analysis of mammography;

• in the field of e-government: for remote biometric identification of users in the provision of electronic government and financial services (Face-ID).

Starting from 2021-2022, five universities in Uzbekistan will start training specialists in artificial intelligence on a grant basis. 15 universities of the country will introduce training courses and subjects on the application of artificial Intelligence in economic sectors, in the social sphere and in the system of public administration, and provide for the creation of a doctoral specialization "Digital technologies and artificial intelligence".

In Uzbekistan artificial Intelligence will: manage the water resources of the region, build canals and allocates water for irrigation, determine the inflow and flow of water, purify polluted water, taking into account the degree of pollution and purifies water reuse, and calculate the exact flow of water for agriculture and its irrigated crops. Artificial Intelligence manages various hydraulic structures in Uzbekistan, as well as records and manages the production, transmission and consumption of natural gas and electricity. These works are closely related to the water resources management system, since thermal energy is a large consumer of water, and part of the electricity is generated at hydroelectric power plants.

The problem of the sustainability of the functioning of the agricultural sector is the problem of the number of people employed in it.

Artificial intelligence can reverse the effects of aging agricultural workers and reduce the number of workers who will be provided with less physically demanding work, which requires the use of unmanned agricultural equipment and autonomous drones, and as a result, farmers will be able to achieve more sustainable yields, introduce advanced technologies in agriculture and receive significant profits.

When this idea is implemented, data mining, including large data analysis and predictive analytics will spread. All of the above will not only make it easier for farmers to work, but will also enable them to make more informed decisions, maximize the use of existing resources and optimize crop yields. Farms are becoming high-tech and are able to produce more marketable products at a lower cost.

Robots and machine learning are helping to introduce new, more resilient farming practices, minimize chemicals and shorten time-to-market, saving resources, reducing the employment of farm workers and increasing their efficiency. With more innovative opportunities realized by greenhouse and vertical farms producers, the population should have more affordable and cleaner products (Гончаров, Истранин и др., 2017).

To enable robots to perform physical work in complex and real environments, artificial intelligence technology based on, the latest advances in algorithms (especially computer vision software for finding individual objects in complex environments), combined with cloud communications and machine learning

The development of renewable energy sources, such as wind or solar power plants, as well as supplementing them with energy storage and storage systems is a promising and important area for the development of modern electric power industry, since water and energy problems in Uzbekistan are now very urgent. Artificial Intelligence is driving the development of renewable energy sources.

Russia is one of the ten countries in which the most intensive research in the field of artificial Intelligence is conducted. As part of the development, the "Credit Factory" was created at Sberbank of Russia - an automated system for making decisions on granting loans, analyzing data on the borrower. This is one of the first systems in Russia with AI features, applied in practice. As of the end of 2019, Credit Factory issued a total of 41.7 million loans worth 12.3 trillion rubles.

At present time large Russian companies are using and developing various intelligent systems. For example, Gazprom, together with Rostec, creates intelligent field management systems, systems for interpreting geological data, intelligent control of oil transportation, and so on. These are all highly specialized intelligent systems with some artificial Intelligence traits, but they provide good economic returns.

There are dozens of similar examples among Russian companies. For example, the Russian technical committee "Artificial Intelligence" was created in 2019, where work on standardization in the field of artificial Intelligence in key sectors of the economy is carried out in accordance with the National Strategy for the Development of artificial Intelligence for the period up to 2030. It provides for the creation of unified systems for standardization and conformity assessment of technological solutions developed on the basis of artificial Intelligence, the development of international cooperation on standardization issues and the provision of the possibility of certification of products created on the basis of artificial Intelligence.

Agency Gartner (Qaror, 2022) has published research results showing how much money companies in the world have made thanks to the use of artificial Intelligence technologies. Using artificial Intelligence in the company, he brought these companies $ 700 billion (figure 1).

Analysis of Figure 1 shows that in 2017, companies around the world received $ 692 billion from the use of artificial intelligence. In 2018, revenue grew to $ 1.2 trillion, and by 2022, the profit is projected to be measured at almost $ 4 trillion. First, the main business income from the use of artificial intelligence will come from improving customer service, as companies are already seeing the impact of such technologies to increase and retain customers. In addition, organizations are looking for opportunities to use artificial Intelligence to improve the efficiency of business processes in order to improve decision making and automate more tasks.
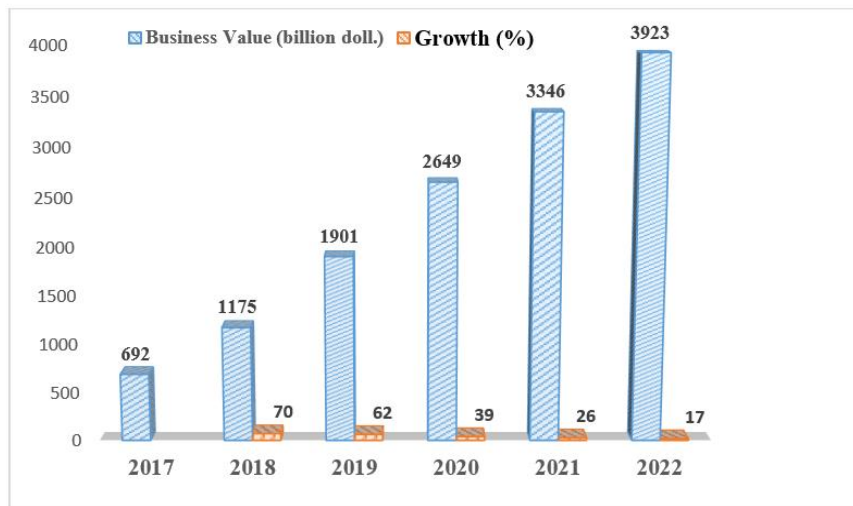
Figure 1. Forecast for the total revenues of companies obtained through artificial intelligence (Qaror, 2022)

According to Teradata research (Гончаров, Истранин, 2017), the analysis of Figure 1 shows that majority of enterprises (80%) invest in artificial intelligence technologies, but one in three CEOs believes their company will have to increase such investments over the next three years to remain competitive.

During the research, it was found that the productivity of milk production in most farms decreases. One of the main reasons for this is that the correct feed ration is not formed and there are not enough conditions for cattle to feel good. It should be noted that as a result of studies, it was found that inconveniences in the process of milking purebred cattle lead to a decrease in milk volume. Therefore, it is suggested to use modern digital remotely controlled robotic milking technologies in the process of milking dairy cows.

Digitalization of animal husbandry complexes should be developed after studying the experience of the world's agriculturally developed countries. In this regard, the experience of the country of Belarus is commendable, because in this country robotic mechanisms for milking dairy cows have been implemented. Automation of the milking process is being actively implemented not only in dairy farms, but also in large complexes in Belarus. The practice of using such equipment makes it possible to fully realize the genetic potential of animals. This is ensured by the fact that all dynamic processes, including milking and feeding with concentrated feed, are carried out with the help of special programs. Such an approach allows not only to optimize the costs of milk production and to obtain an additional volume of products, but also to form a careful treatment of animals (Fig. 1).
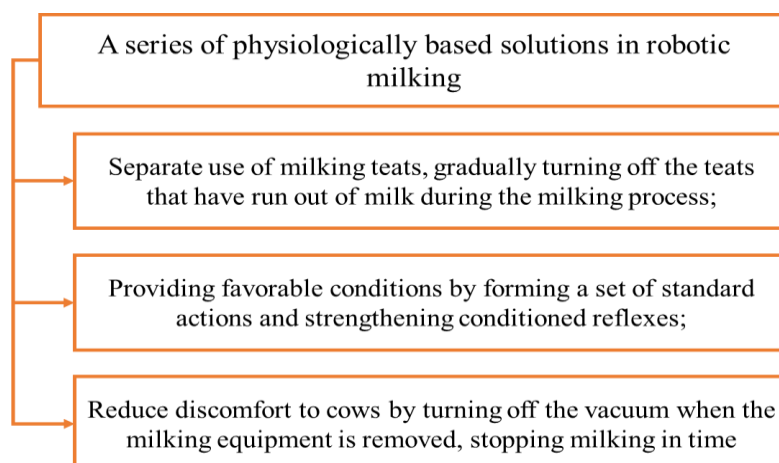

Figure 2. Cow physiological aspects of robotic milking process

In the process of milking robotic cows, the following is required:

1. Increasing milk productivity;

2. The part where the teats are attached to the cow's abdomen should be soft and placed at a height of 45 cm from the ground;

3. The distance between suction cups: rear suction cups should be 6-20 cm, front suction cups 12.5-25 cm, and front and rear suction cups should be at a distance of 6-14 cm;

4. The diameter of teats is 1.5-3.5 cm (depending on the milking time);

5. Increasing the stress and activity of dairy cows;

The robotic milking system implements the following concepts in its work (Fig. 2). The requirements for cows suitable for robotic milking must be much stricter than for conventional automated milking. For example, the wrong position of the suction cups causes the robot to have difficulty connecting individual parts, which requires many attempts.

Auxiliary results of milking automation include: stimulation of milk production, reduction of mastitis diseases, reduction of the possibility of stress in cows. At the same time, many manual operations will be automated, significantly changing the nature of the milking operator's work. The focus is more on monitoring the cows, reacting to changes in physiological state in time and providing all the needs of the animals.
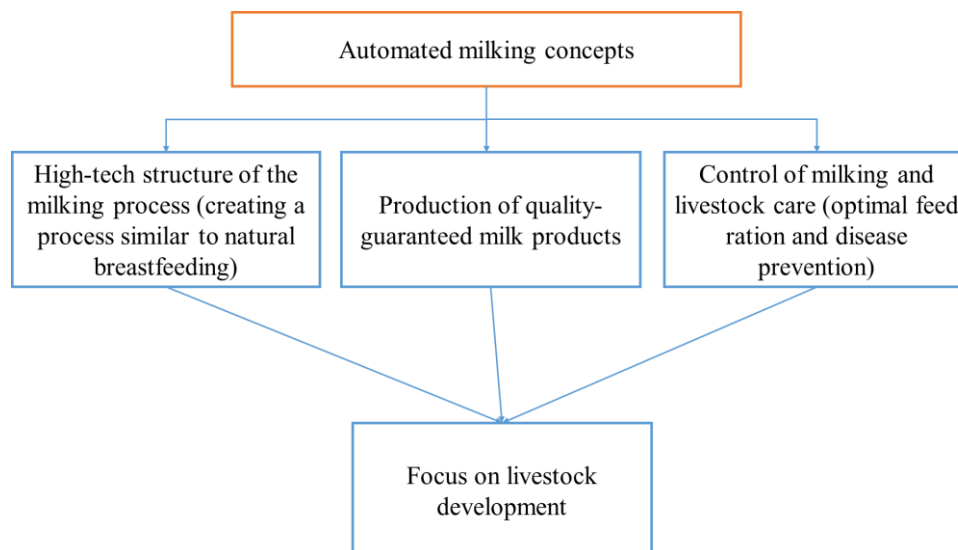

Figure 3. The concept of robotic cow milking and its effects

Robotic cow milking tools and the process of their application to farms are shown in the following pictures.

Figure 4. MR-S2 Boumatic Milking Robot

Figure 4. CR-1 teat management technology during milking

Conclusion.

The growth indicators of the population of the Republic of Uzbekistan lead to a further increase in the population's demand for quality food products. According to the forecast developed on the basis of the proposed econometric model, the population of our country is expected to reach 40595.46 thousand people by 2030. It is expected that the population's demand for meat products will increase by 19.2% and dairy products by 16.3% compared to 2023. The issue of meeting this expected demand of the population is urgent. The water shortage and environmental problems in the lower Amudarya and some regions of the republic have a significant negative impact on the development of the livestock industry. Therefore, it is necessary to use the available resources wisely and create conditions for them based on the characteristics of livestock. During the study, the following propositions were developed:

1. Digitization of livestock farms;

2. Proper feeding of cows and creation of sufficient conditions for them. That is, the development of automatic farm management mechanisms based on digital technologies;

3. Analyzes on increasing the milk productivity of dairy cows show that the cows feel free and comfortable during the milking process, which allows the milking process to be carried out 3-4 times a day. In this case, it has been proven that milk yield can be increased by approximately 10-14% during the first milking, and by 9-12% during the second milking. That is, it is necessary to introduce robotic milking technologies in the process of milking cows.

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