



UDC 619:636

DOI: 10.48077/scihor6.2024.177

## Electronic tracking and identification of animals in agriculture for monitoring herd development and health

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### Article's History:

Received: 10.02.2024

Revised: 08.05.2024

Accepted: 29.05.2024

**Abstract.** Agricultural business methods are no longer possible without computer technology, which helps to identify animals, record productivity and monitor their health. Therefore, the study aims to conduct a comparative analysis of the functionality of the main dairy farm management software for their objective assessment from the point of view of milk producers. For this purpose, information from the official websites of software products was analysed and scientific articles analysing this software were collected. As a result, all software products were divided into 3 categories: software for

### Suggested Citation:

Shergaziev, U., Nurgaziev, R., Baitemir, M., Karybekov, A., & Sultangaziev, E. (2024). Electronic tracking and identification of animals in agriculture for monitoring herd development and health. *Scientific Horizons*, 27(6), 177-187. doi: 10.48077/scihor6.2024.177.



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controlling dairy productivity and managing processes on a dairy farm from dairy equipment manufacturers; such software products include DairyPlan C21 (GEA), DATAFLOW II (Milkline), AfiFarm (Afimilk), DelPro (DeLaval) and FARMSOFT (Farmtec a. s.); dairy farm management software DairyComp 305 and UNIFORM-Agri, as well as farm software from post-Soviet developers – MilkCentre (CIAB Expert). Programmes from dairy equipment manufacturers were almost at the same level and had virtually all the necessary blocks for identifying, controlling and managing animals on a dairy farm. The software developed for dairy farm management is more effective in tandem with one of the milking parlour programmes. This class of software expands the possibilities for managing reproductive and veterinary work on the farm, as well as reduces the workload on staff by generating automatic reports for regulatory authorities and management. The third class of programs is the least developed compared to the above, but it compensates for this shortcoming by constant improvement due to the continuous contact of developers with the manufacturer. Thus, there is a significant number of software products on the software market that can provide dairy management for farms of various sizes

**Keywords:** software; peripherals; production management; reproduction; digitalisation of the industry

## INTRODUCTION

Agricultural business practices are designed to reduce production costs and increase profitability. Such problems are most pressing in livestock farming, as this sector of agriculture employs a significant portion of human resources daily. Reducing labour and financial costs can be achieved by implementing advanced methods of monitoring the productivity and health of animals during their productive use. This will reduce the number of staff on the farm and, at the same time, increase the efficiency of herd management and control over the processes taking place on the farm. This can be achieved by using specific software products that can automatically collect the necessary information about animals and generate tasks and reports for specialists and managers aimed at improving the efficiency of animal use. The introduction of such automated information systems in Kyrgyzstan's livestock industry will not only increase the productive longevity of animals in the country but also improve their genetic potential, which is a promising area of Kyrgyz agricultural science.

According to the National Statistical Committee of the Kyrgyz Republic, as of the end of 2023, the number of animals was cattle – 1.8 million head, including 902,000 cows (Livestock and poultry..., 2024). About 50% of the cow population is kept in collective farms, and the rest in individual households. The number of small cattle was 6.2 million, of which 57% were in farm herds. Poultry had an even larger population – almost 7 million heads. The bulk of the livestock, just like other animals, was concentrated in collective and private farms – 61%. The number of pigs in the country was small and amounted to only 29.6 thousand. Information from the Statistical Committee indicates that in Kyrgyzstan, the bulk of cattle and small ruminants are in herds that can be used to apply information technology to increase their profitability.

The study of the prospects for the introduction of digitalisation in Kyrgyzstan is being carried out as part of the implementation of the United Nations Development Programme “Digital Kyrgyzstan” (Sanarip

Kyrgyzstan), designed for 2019-2023 (Advancing Digital Transformation..., 2023). The report points out that digital technologies are a key factor not only in economic growth but also in achieving the Sustainable Development Goals, which are directly related to the well-being of people and society.

Following A. Karbekova and A. Abdykalykova (2023), the level of development of digital technologies in Kyrgyzstan is still at an early stage, although some livestock enterprises are already using some components of such a system – computerised ration balancing, herd management software, an electronic livestock identification and tracking system, and a breeding programme. These are mainly farms that specialise in milk production. Following A.O. Okenova (2019), Kyrgyzstan is ahead of such post-Soviet countries as Uzbekistan, Tajikistan and Turkmenistan in terms of the dynamics of digitalisation among neighbouring countries but lags far behind neighbouring Kazakhstan. Therefore, K.K. Toktorov *et al.* (2020) suggest that the introduction of automated information systems in dairy farming will improve breeding work with animals and thereby increase milk yields by 2-2.5 times and reach the level of Kazakhstan. This can be achieved by optimising and adjusting the ration and targeted breeding. C.A. Timashev (2020) points to the need to introduce digital technologies in Kyrgyzstan's agriculture. His main theses point to the focus on smart livestock technologies in the dairy cluster and sheep breeding.

However, according to T. Bekov (2022), the main constraint to the introduction of digital technologies in livestock production in the Kyrgyz Republic is the high price of such innovative products and the small size of farms that keep animals. According to his information, 95% of all farms are represented by small farms with small land plots. According to C. Timashev (2020), an information system for animal identification has already been developed in partnership with the French IT company SENOE, which consists of four modules: registration of the farmer and animal housing, identification

of animals, herd management and distribution of tags, registration of animal movements.

Thus, given that the most promising livestock sector in Kyrgyzstan, where it is possible to introduce an automatic information system, is dairy farming, due to the high rate of payback and partial development of computer technologies in this sector of livestock, the purpose of this work was to conduct a comparative characterisation of existing software products for managing, monitoring the productivity and health of animals on a dairy farm. One of the tasks was to group software products according to various criteria and identify the advantages and disadvantages of such software.

Based on Internet search results on request: “Modern methods of control over the identification, productivity and health of farm animals”, 8 software products for dairy farms from leading international and several European companies were selected for comparison, which can provide a full range of electronic animal identification works to control and manage all works in the maintenance of the dairy herd. The comparative analysis included integrated products DairyPlan C21 (from GEA), DATAFLOW (Milkline), DairyComp 305 (DigiFarm Software), AfiFarm (AfiMilk), UNIFORM-Agri and DelPro (DeLaval), MilkCentre (Ciab Expret (Ukraine)), FARMSOFT (Farmtec a.s. (Czech Republic)).

To conduct an objective comparison, information from the official website of the software product on the main features and limitations of the program, and conducted a literature review of articles with a high impact factor for the last 3-5 years with information on the functioning of a particular system in an operating farm. When selecting scientific articles for the review, first, sources with a high citation level and published in Web of Science, Scopus, and Google Academy databases were selected. All the software was evaluated according to the same criteria – veterinary unit, reproductive technologies, feeding control, remote access and availability of a mobile version.

### THE STATE OF DIGITALISATION IN DAIRY FARMING

Recently, digital information systems have been actively introduced into the livestock industry to manage the farm and conduct business more efficiently, which is made possible by combining a system of innovative technological solutions with mobile applications (Schulze Schwering & Lemken, 2020). This approach reduces decision-making time and cuts costs at the same time. This is made possible, according to T. Groher *et al.* (2020), through the introduction of electronic measuring instruments and specialised sensors, electronic controls and electronic databases that are integrated into one system. An analysis of the information available on the Internet shows that there are a huge number of software products to simplify the work of livestock farmers (Neethirajan & Kemp, 2021). Given that the term “smart agriculture” has emerged recently,

it is worth noting at this stage that there are already a significant number of commercial solutions and platforms for different types of animals (Buka *et al.*, 2023), which indicates the urgency of the problem.

Most of these digitalisation approaches, according to J. Munz *et al.* (2020), relate to the dairy industry, and M. Goller *et al.* (2021) point out that the maximum number of software products has been developed for this sector of livestock production in the last decade alone. One of the reasons for this “digitalisation” of the industry is the significant involvement of people in the milk production process, and, accordingly, the significant dispersion of information required for herd management (Wrzecińska *et al.*, 2023). In addition, technological approaches to creating comfortable conditions for animals without restricting their freedom of movement, even within the premises for their keeping, according to H. Buller *et al.* (2020), increase their welfare in the production process. However, this approach depersonalises animals and reduces the control of staff over productivity, health, reproduction and other indicators. Therefore, many software vendors offer software solutions specific to a particular subject area. A. Kassahun *et al.* (2022) point out that many enterprises have previously used special software products for a specific type of work in dairy farming – calculation and control of rations, breeding programmes, individual control of cow milk production, etc. These were separate programmes designed for a specific employee – a manager, a zootechnician, a veterinarian. But recently, one vector of work has been identified – the integration of such software products into a single, unified system for monitoring and managing the herd (Deschenko & Lykhach, 2024). In addition, such programmes have undergone some improvements. A visual control of feed intake with its computerised analysis, and automatic measurement of animal weight by body measurements made with digital video cameras were added to feed programmes (Cominotte *et al.*, 2020). Breeding programmes now address and prevent the possibility of inbreeding for several breeds, and conduct breeding modelling based on optimal selection of parental pairs (Bezen *et al.*, 2020). Computer software for veterinary specialists on the farm, now, in addition to registering sick animals and registering medicines used, can conduct visual monitoring of the condition of animals in real time (Tassinari *et al.*, 2021; Issimov *et al.*, 2022), computer detection of lameness in cows and other metabolic diseases (Kang *et al.*, 2021).

This excludes the most intensively developing area of cow milk productivity control, where not only individual control of cow productivity and its milk quality parameters is carried out, but also productivity forecasting (da Rosa Righi *et al.*, 2020), the use of artificial intelligence for modelling milk and predicted productivity (Fuentes *et al.*, 2020; Pogranichniy *et al.*, 2023) and other innovative solutions. This area has been developing most actively since the introduction of milking robots

(Simões Filho *et al.*, 2020; Chikurtev *et al.*, 2024) and the implementation of a voluntary milking strategy (Wildridge *et al.*, 2020) in industrial milk production technology. R. Matson *et al.* (2021) point out that the voluntary milking system was primarily aimed at reducing the need for labour on farms.

Thus, new peripheral equipment for collecting information and methods of processing has recently been introduced and integrated into livestock software. On the other hand, according to E. Maltz (2020), the development of dairy farming management technologies stimulates the search and development of new types of sensors and their integration into a single system or software product to obtain new information about animal productivity or health.

Agriculture is a complex structure, whose profitability depends on many different factors, and according to A. Lytos *et al.* (2020), can only be effectively supported by computerised systems. D. Piwczyński *et al.* (2020) point out that such digital technologies for dairy farming enterprises are based on the human-machine-animal system, and this interaction is based on the analysis of the large amount of data obtained, followed by the construction of an algorithm for organising and managing processes on the farm. At this stage, according to V. Cabrera *et al.* (2020), analysing the data is one of the biggest challenges facing the dairy industry today. This is due to the increased flow of various information from the same animal into a common database, and its integration and analysis is a rather difficult task. Moreover, F. Carillo and F. Abeni (2020) point out that it is necessary to address that dairy farms differ in terms of herd size (production scale), available technology and equipment. Therefore, for the effective management of all processes on a dairy farm, complex software products are preferable, capable not only of collecting information from animals but also of conducting its primary analysis, grouping the data obtained depending on the predictors and building a logical chain to improve milk production technology.

### COMPREHENSIVE SOFTWARE PRODUCTS FOR DAIRY FARM MANAGEMENT

Addressing the significant challenges in creating a unified software product for the identification of animals

in the herd, as well as monitoring their productivity, development and health, which are necessary for making operational decisions, this part of the review analysed the most well-known and used integrated software products on dairy farms in the post-Soviet countries.

Among these well-known and used products, the bulk is software developed by the manufacturers of dairy equipment installed on the dairy farm. This approach to creating a software product has significant advantages due to the full integration of peripheral devices (sensors, measuring instruments and other sources of information) to link dairy equipment with the database and software for analysing the information received. In addition, such companies have recently been allocating significant sums of money to develop new sensors and conduct research to improve and expand the functionality of their software to increase their competitive position. Among them are DairyPlan C21 by GEA, DATAFLOW II by Milkline, AfiFarm by Afimilk, DelPro by DeLaval and FARMSOFT by Czech manufacturer Farmtec a.s. Only a small part of the existing software products from dairy equipment manufacturers was included in the comparison sample.

The software products that were originally developed for dairy farm management and later on, at the software level, were connected to modules that could integrate various peripheral devices into these programmes – DairyComp 305, and UNIFORM-Agri. Separately, for the sake of completeness, MilkCentre software product from the Ukrainian company Cib Expert was analysed. This system is included in the review since most dairy farms in the post-Soviet space use low-cost milking parlours and animal and feeding control systems produced by local manufacturers that cannot provide the necessary integration to get a complete picture of the herd. According to the producers, MilkCentre will be able to solve such problems by actively cooperating with the customer directly on their farm. Thus, this analysis collected software products from different categories of vendors, but primarily those that are more common in post-Soviet countries. A comparative description of the different programmes based on the same criteria is provided in Tables 1-3.

**Table 1.** Comparative characteristics of dairy farm management software

Indicator	Software		
	DairyPlan C21	DataFlow II	Dairy Comp 305
Productivity	Individual and overall assessment of milk production, Mastitis control, animal sorting	Collecting information from the milking parlour about the milk yield per cow. Auto-detection of mastitis	Information on monitoring the milking parlour; lactation curves; analysis of control dairy cows (somatic cells, production analysis, fat/protein ratio)

Table 1. Continued

Indicator	Software		
	DairyPlan C21	DataFlow II	Dairy Comp 305
Veterinary module	Determining the need for treatment of sick animals. Prescribing, conducting and reviewing treatment	Rumination control, graphs and playback tables. Control of the rumination department.	Treatment regimens; a list for the veterinarian; control of treatment; forming vaccination lists; dynamics of morbidity; lists for hoof trimming
Reproduction	Determining hunting by motor activity	Hunting by motor activity + rumination + body temperature	Control of the ceiling check; insemination analysis; launch control; analysis of the litter; analysis of artificial insemination schemes.
Feeding	Concentrate control	Rumination-based feeding control	Module is missing
Analytics	Calf forecast, dry cows, list for the vet	Graphical and tabular information on productivity and reproduction	Graphical and tabular information on productivity and reproduction
Mobile application	DPMobil 2	DataFlow II Milking	-
Additional options	Determination of weight in motion. The quality of cleaning of dairy equipment. Monitoring the temperature of the milk in the tank. Control of calf feeding when using special feeders. Identification system with conveyors	Two types of sensors: tracker and rumination. Rumination control to determine the functional state of animals. Real-time updates, and email notifications of events. Heat stress control	Growth and weight of young animals, safety monitoring, and analytics of the reasons for culling. Analysing the timeliness of technological transfers from group to group. Remote access extends the application's functionality through the VAS Pulse Platform – mobility,

Source: compiled by the authors.

Table 2. Comparative characteristics of dairy farm management software

Indicator	Software		
	Milk Centre	FarmSoft	Uniform-Agri
Productivity	By importing information from milking parlour software or manually entering milk yield information	Automatic entry of milking data for animals using the identification system.	Work with all groups of cattle (main herd, bulls, young animals, work with history). Daily monitoring of milk production. A unique Dutch method for calculating peak performance – SPP Analysys
Veterinary module	Accounting for veterinary drugs	Accounting for medicines and procedures (diagnoses, treatment plans)	Monitoring of animal health (somatic cell count, use of medicines, registration of diseases and preventive measures)
Reproduction	Information is entered by the operator for further analysis and grouping	Motor activity – to determine rumination to monitor postpartum complications.	Keeping a stock of semen by bull. Monitor playback performance through reports and analyses.
Feeding	A mechanism for the production and distribution of feed according to recipes and rations has been implemented	Control of feed distribution (correct distribution and ration)	Connecting to the feed computer
Analytics	Moving animals in groups and between farms. Special reports compare the plan with the actual work performed or materials used.	Economic report on drug consumption suggested and custom report templates	Productivity. Reproduction. Health. Veterinarian's list. Economics.

Table 2. Continued

Indicator	Software		
	Milk Centre	FarmSoft	Uniform-Agri
Mobile application	-	FarmSoft	Uniform App
Additional options	Control of young stock rearing, automatic generation of documents for accounting and veterinary services, standard weight values, feed consumption rates, and animal treatment protocols. Possibility of remote connection.	Animal accounting (general information, individual animal card, registration of changes), animal weighing.	Comparison of farms. Cloud synchronisation. Communication with trackers. Work with several herds. Networking. Generate personalised reports on any required indicators. Diary – the programme reminds what actions to take and with which groups of animals
Peculiarities	Ability to work with conveyors at the development stage		

Source: compiled by the authors.

Table 3. Comparative characteristics of software products for monitoring and analysing animal performance

Indicator	Software	
	DelPro	AfiFarm
Productivity	Detailed information on animal, group and herd productivity. Real-time information on milk yields	Monitors the condition and performance of the herd and individual animals,
Veterinary module	Diagnosis of mastitis, ketosis. Vaccination. Automatic generation of a list for the vet	Early diagnosis and treatment of mastitis, ketosis and metabolic disorders, as well as cow nutrition and acidosis. Warning of prolonged calving.
Reproduction	Definition of hunting Ceiling control. Tracking of reproductive disorders	Monitoring of cows and heifers, accurate and timely detection of animals in heat, improvement of calving periods
Feeding	Quality control of the diet	Accurate data on rumination and feed intake
Analytics	Plan for the future	Graphical and tabular information on productivity and reproduction
Mobile application	DelPro Companion	Afi2Go Pro + option to work with a mobile gadget
Additional options	Microclimate control. Visual inspection	Quality of milk from each cow, AfiCollar monitors animal behaviour (rumination, feed intake and motor activity)

Source: compiled by the authors.

The analysis of the functionality of software products from dairy equipment manufacturers shows that most of these programs are at the same level. This is also confirmed by similar functionality in other programmes not included in this comparison, such as HerdMetrix or BouMatic, Lely Horizon or Lely, FULLEXPERT® from Lemmer Fullwood GmbH and other similar companies, but less well known in the post-Soviet countries.

Such software products contain significant functionality for managing a dairy farm. This is determined by the companies themselves being manufacturers of sensors for identifying animals and recording their activity, which allows them to constantly expand and improve animal control methods (Post *et al.*, 2020; Lee & Seo, 2021). The main function of such software is to control the milk production of cows, regardless of the type of dairy equipment used. The dairy productivity accounting unit is implemented at a high level in all programmes

from manufacturers of equipment for dairy farms. All programmes in this category can record individual cow milk production, determining milk yield, milk conductivity and other indicators, thereby controlling animal performance at the programme level and signalling possible udder diseases, including mastitis. This is the functionality of most dairy farm management software, as pointed out by M. Bausewein *et al.* (2022). In their research, they showed high reliability ( $p < 0.05$ ) of the results obtained during the diagnosis of milk in software products from DeLaval and GEA and the actual results on the number of somatic cells in raw milk. This can be extrapolated to software from other companies, even lesser-known ones, such as the Czech company Farmtec a.s. (FarmSoft software). Following R. Codl *et al.* (2021), using the Vitalimeter 5P sensor from this manufacturer, it was also possible to easily identify animals with early signs of disease. The biggest differences between the

programmes presented were in the use of different approaches to obtaining additional information about the animal. In such programmes as DelPro and DairyPlan C21, the algorithm for collecting information is based on tracking the movement of animals. The number of steps made by the animal was used to determine the physiological state of the cow, the presence of sexual desire or other symptoms of diseases that have a high correlation with motor activity. Another way to collect information about the animal was to determine the number of chewing movements (rumination) – Afimilk or both methods were implemented in the software and are used, depending on the type of sensor used – DATAFLOW II and FARMSOFT (Leso *et al.*, 2021). As a result of the information received from the sensors, the software sorts the animals into different lists, which are then passed on to the artificial insemination technician and veterinarian for work. Such information is displayed both directly on the main computer monitor screen and, on the employee's, mobile phone. It should be noted that almost all herd management software products for dairy farms have implemented the ability to connect to the program remotely and have mobile applications (Khmelovskiy *et al.*, 2019). This approach can be used to obtain information about a problem animal, such as prolonged labour or other emergencies, more quickly. Thus, the software can automatically monitor the physiological state of animals and distribute animals based on software algorithms. Following A. Janocha *et al.* (2023), the DelPro software product can improve reproductive performance in a group of highly productive cows due to more efficient control of the animal population. Similar positive results from the use of software algorithms from other manufacturers were reported by X. Zhou *et al.* (2022) for the early detection of various diseases in the DATAFLOW II programme and N. Najm *et al.* (2020) for the early detection of ketosis symptoms with DairyPlan C21.

In addition, all software products have a veterinary unit that keeps records of used veterinary drugs and compiles lists of animals for vaccination or pregnancy checks. Some programmes, such as AfiFarm and FarmSoft, also provide treatment plans for several diseases and monitor their progress. The biggest difference in software products from dairy equipment manufacturers is the various additional options that are less implemented in competing products. For instance, according to the official websites of each of the products under comparison, GEO has included in its DairyPlan C21 programme the ability to determine the weight of an animal in motion, as well as a whole block of subroutines that control the washing of dairy equipment and the temperature of milk in the tank (control of its cooling). Other software products have the following unique features: DATAFLOW II – control of heat stress in animals; FarmSoft – integration of scales into the system to monitor the condition of cows and track postpartum

complications; DelPro – monitoring the microclimate in animal premises, as well as integrated visual control; AfiFarm – determining the quality of milk individually from each cow, warning of prolonged lactation.

Thus, by and large, all software products sold with the manufacturer's dairy equipment have significant functionality that is sufficient to manage and monitor the condition of the dairy herd, and they do not require the purchase of additional software. Software products such as DairyComp 305 and UNIFORM-Agri have more advanced functionality than those from dairy equipment manufacturers. They are more focused on management and process control in the dairy herd. As a standalone software, they are rarely used on the farm, as they have limited functionality for working with trackers and other peripheral devices. Therefore, in most cases, these programmes function in tandem with one of the above milkshake programmes. However, their main difference from the programmes supplied with dairy equipment is that they expand the opportunities for specialists to monitor not only dairy cows but also to track the growth and development of young animals, the timely transfer of animals to groups, analysis of young animal deaths and other processes not related to dairy livestock. In addition, this software also provides an opportunity to compare the performance of a farm with others where this system is installed and operating. Following M. Capel (2020), more advanced functionality of such programmes became possible due to the implementation of the ability to manually enter additional information into the programme database about certain events, such as vaccination, testing of animals for latent forms of mastitis and other events. In contrast to the programmes presented in the first part of the review, these software products provide much more information for veterinarians and artificial insemination technicians and improve their work efficiency by monitoring planned activities daily. The software algorithms monitor the main reproductive parameters for cows, as indicated by V. Schweinzer *et al.* (2020) and thereby monitor the effectiveness of cow synchronisation programmes for heat and insemination efficiency. Given the features of these programmes, D. Gonzalez (2023) recommends using them to control animal reproduction on small farms where there is a lack of specialists.

An important component of these two programmes is their significant integration with other software products installed on farms. They can import a range of animal data into their database, and in turn, export information on farm performance for reporting, tracking breeding information, and linking to the feed programme. For instance, the UNIFORM-Agri software product guidelines indicate that it is possible to automatically pull information into the programme database from local producers' milking machines, generate and transfer the necessary information to the 1C program: Accounting, automatic generation and sending

of reports to the Animal Identification Agency, which reduces the number of routine tasks for farm workers (Opportunities when using..., 2011). The wide network of offices and representative offices of these companies in post-Soviet countries should also be considered. Thus, of the countries closest to the Kyrgyz Republic, DairyComp 305 is in Russia and UNIFORM-Agri in Kazakhstan.

Milk Centre should be mentioned separately, not to compare it with the previous software, but to distinguish it as a whole class of programmes created in post-Soviet countries to improve the efficiency of dairy farms. Such programs include software products such as: "M-Complex, Coral Cattle Farm: Herd Management", "Dairy Farm" and other similar projects. The advantage of such developments is the continuous improvement of the software based on regular interaction between developers and farm staff and the customisation of the programme to the needs of each farm, which is paying off. In addition, it should be noted that the price of these products is much lower.

Thus, summing up the results of the review of the materials on the presented software products for controlling the quantitative and qualitative indicators of farm animals, using the example of dairy farming, it is possible to conclude that there are different classes of software in this industry for the effective management of all processes on a dairy farm – from animal identification to animal reproduction and health management.

## CONCLUSIONS

The analysis of literature sources and the results of the analytical review of the software used in dairy farming to identify and control the productivity, reproductive capacity and health of productive animals allowed us to draw the following conclusions and suggestions for further work. The maximum number of software products developed to monitor the productivity of farm animals and manage their reproduction and productive health relates to the dairy farming industry. All software for managing processes on a dairy farm can be divided

into: programmes created by dairy equipment manufacturers – DairyPlan C21, DATAFLOW II, AfiFarm, DelPro and FARMSOFT. These software products are characterised by a high integration of measuring and other peripheral devices for high-quality control of individual productivity and the physiological state of animals in the herd. These programmes are self-sufficient and can carry out all the processes of dairy farm management.

For more effective control of all processes on the farm, including the rearing of young animals, deeper monitoring of reproduction problems of high-yield cows and problems with their health, there are DairyComp 305 and UNIFORM-Agri programmes, which were originally developed for dairy farm management. These software products are tightly integrated with other software on the farm and allow for the automatic generation of the necessary information and reports for regulatory authorities. Particular attention should be devoted to livestock control programmes developed by companies in the post-Soviet space. Their distinguishing characteristic is a much smaller functional set of methods for monitoring and managing the productive health of cows. The missing functions are compensated for by constant contact between developers and producers to find the necessary solutions, which also makes these programmes a competitor in farm management.

Given the constant development of modern technologies in the Kyrgyz Republic, it is necessary to introduce the digitalisation of dairy cattle in the field of identification, breeding and monitoring of the physiological condition of animals as soon as possible, as well as the rapid introduction of modern scientific achievements in software for dairy farms, it is necessary to constantly monitor software products for the effective conduct of dairy business.

## ACKNOWLEDGEMENTS

None.

## CONFLICT OF INTEREST

None.

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## Електронні відстеження та ідентифікація тварин у сільському господарстві для контролю за розвитком і здоров'ям стада

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**Анотація.** Методи ведення сільськогосподарського бізнесу вже неможливі без комп'ютерних технологій, що допомагають в ідентифікації тварин, обліку продуктивності та контролі їхнього здоров'я. Тому метою роботи стало проведення порівняльного аналізу функціональності основних програм для управління молочною фермою для їхньої об'єктивної оцінки з точки зору виробників молока. Для цього було проаналізовано інформацію з офіційних сайтів програмних продуктів та зібрано наукові статті, в яких проводився аналіз цього забезпечення. У результаті всі програмні продукти було поділено на 3 категорії: програми для контролю молочної продуктивності та управління процесами на молочній фермі від виробників молочного обладнання; до таких програмних продуктів віднесено DairyPlan C21 (GEA), DATAFLOW II (Milkline), AfFarm (Afimilk), DelPro (DeLaval) та FARMSOFT (Farmtec a. s.); програми для менеджменту молочною фермою DairyComp 305 і UNIFORM-Agri, а також забезпечення для ферм від розробників із пострадянського простору – MilkCentre (Сіаб Expert). Програми від різних виробників молочного обладнання перебували практично на одному рівні та мали практично всі необхідні блоки для ідентифікації, контролю та менеджменту тваринами на молочній фермі. Програмне забезпечення, що розроблялося для менеджменту молочної ферми, є більш ефективним у тандемі з однією з програм для доїльного залу. Цей клас програм дає змогу розширити можливості з управління репродуктивними та ветеринарними роботами на фермі, а також знизити навантаження на обслуговуючий персонал завдяки формуванню автоматичних звітів для контролюючих органів і керівництва. Третій клас програм найменш розвинений порівняно з перерахованими вище, але компенсує цей недолік постійним удосконаленням, за рахунок постійного контакту розробників з виробником. Таким чином, на ринку програмного забезпечення існує значна кількість програмних продуктів, здатних забезпечити управління молочною виробництва для ферм різних розмірів

**Ключові слова:** програмне забезпечення; периферійні пристрої; менеджмент виробництва; репродукція; «цифровізація» галузі