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# EFFECT OF PRECISE SYSTEM FOR NUTRITION MANAGEMENT IMPLEMENTED IN DAIRY FARM

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**Abstract:** The aim of the present study was to evaluate the effect of implementing precision system for nutrition monitoring and management in a dairy farm. The study was carried out in dairy farm with 200 cows, located in North Bulgaria. It has been established that after the introduction of precise technology for monitoring and managing nutrition in the dairy cattle farm, an increase in milk productivity was observed, as well as a decrease in the amount of bulky and concentrated feed used, and fuel consumed on the farm. Evidence shows that the integration of digital technologies in dairy farming can lead to more efficient use of resources, increase productivity and reduce some negative environmental impacts. Although the optimization process is likely to be slow, the data demonstrate the potential of digital technologies to transform modern dairy farming and its role in achieving sustainable development in the sector.

**Key words:** precision dairy farming, nutrition management, dairy farm, dairy cows

## Introduction

Dairy farming provides a daily source of raw materials for the dairy industry and income, creating employment opportunities not only on farms but also in the transport, milk processing and agricultural supply and service sectors. Due to the increasingly high requirements for the production of quality milk, decision-making in modern dairy farming is becoming more and more complex and difficult (Mourits, 2000). Slavova et al. (2022), noted the ever-increasing demands of society to mitigate the negative effects on the environment, as a result of the breeding of dairy cows. The crises of various nature in recent years have also had a serious negative impact, leading to a significant increase in production costs - fodder, electricity, energy carriers, etc. According to many authors, the introduction of systems for precision dairy farming (PDF) contributes to increasing production results and recently they are increasingly used (Borchers and Bewley, 2015; Rutten et al., 2018; Halachmi et al., 2019).

Precision animal husbandry involves the use of digital technologies and aims to improve production and reproduction, animal welfare and facilitate the targeted use of resources to reduce the impact on the environment and human health through the precise control of processes (Popova et al., 2024). It contributes to the proper management of large groups of animals, improving profitability, farm efficiency and minimizing environmental impact (Kaur et al., 2024). The efficiency of a dairy cow farm is related to many factors. The desire of every owner is to simultaneously improve them and increase profitability exponentially, which is difficult to achieve. A number of researchers (Dijkhuizen et al., 1995; Tauer and Mishra, 2006; Stankov, 2020) conclude that, for complex reasons, determining the financial value of the technical effects of one or more changes in input factors that occur simultaneously is a very complex task. Sova et al. (2014) and Souza et al. (2022) specify that in order to feed animals more efficiently and increase their profitability, the use of a precise ration formulation and tracking system for accurate and mixing is necessary. According to Bach et al. (2020), in order to optimize the economic return by increasing the average daily milk yield on the farm, even small variations in the amount of feed used in the preparation of the complete ration mixture should be avoided. In long term, this leads to the provision of excess nutrients and their inefficient utilization. Rossow and Aly (2013) found that a change in the ratio of  bulk and concentrate forages led to an increase or decrease in the amount of lignin in the complete ration mixture, which affected milk yield.

Hristov and Martins (2022) describe precision feeding as practices that aim to deliver nutrients without exceeding or failing to meet animal nutritional requirements. According to them, in feeding dairy cows, precision would be about controlling the uniformity of nutrient intake to meet the animal's requirements. Despite the potential benefits, PDF systems are not yet widely implemented (Russell and Bewley, 2013; Chavas and Nauges, 2020). In recent years, part of the country's dairy cattle farms have implemented systems for precission dairy management, which monitor and manage nutrition and track the quantities of input raw materials, errors made and deviations from the set ration, as well as report the amount of complete ration mixture distributed by groups.

The aim of the present study was to evaluate the effect of precise system for nutrition management implemented in dairy farm.

## Material and Methods

The study was conducted in a dairy cattle farm located in North Bulgaria with a capacity of 200 dairy cows. At the end of December 2020 precision system (Intouch, Alltech) for nutrition monitoring and management has been introduced on the farm. The system works by combining a control device, a software platform and a mobile device to provide a holistic system for tracking and managing nutrition in dairy farms. The controller tracks the weighting, mixing of ingredients, and provides real-time feedback. Main software components are represented by software for nutrition management and monitoring, analytical tools for data processing and recommendation generation, mobile and web applications for remote user access. A mobile device allows users to access and interact with the system through a mobile application that enables remote monitoring and control of processes. The feed control and management system has been developed in collaboration with Intel and its purpose is to ensure that optimal efficiency is achieved in the use and management of feeds during their feeding to animals.

For the purposes of this study, the following indicators are taken into account:

- average daily milk yield based on 305 days of lactation, in liters;
- amount of concentrated and roughage per lactating cow per day;
- spent fuel per lactating cow per day;
- number of doses per inseminated cow.

The data for quantitative indicators were obtained from the primary accounting records of the farm for the period 2020-2024. Primary accounting includes the collection and recording of all financial transactions and farm operating data, such as income and expense journals, records of production, material and labor costs, and other related documents. To process this data, standard accounting methods were used, such as systematization of income and expenses by category, compilation of journals and turnover sheet. The data were processed using the software product IBM SPSS Statistics 19, and the MS Excel software package was used to prepare the graphs.

## Results and Discussion

Fig.1 presented the change by year of the quantitative indicators of average daily milk yield, roughage and concentrated feed for the period 2020-2024. The average daily milk yield shows a gradual increase. In 2020 (before the introduction of the precision system) it was 24.48 l, which is a baseline value for the analysis. In the following year, the value of this indicator increases to 26.24 l, which is an increase of 1.76 l or approximately 7.2% compared to 2020. In 2022 values continued to rise, reaching 26.64 l, an increase of 0.40 l or about 1.5% from 2021 In 2023 average daily milk yield reached 26.74 l, which is an increase of another 0.10 l or approximately 0.4% compared to the previous year. For 2024 the value is slightly lower than that of 2023 - 26.69 l, which means a slight decrease of 0.05 l or about 0.2%. Roughage used in 2020 are in the amount of 35.37 kg. In the following years, a continuous decrease was observed: to 32.14 kg in 2021 (down 9.07%), to 30.72 kg in 2022. (by another 4.27%), and up to 29.79 kg in 2023 (by 2.98%).

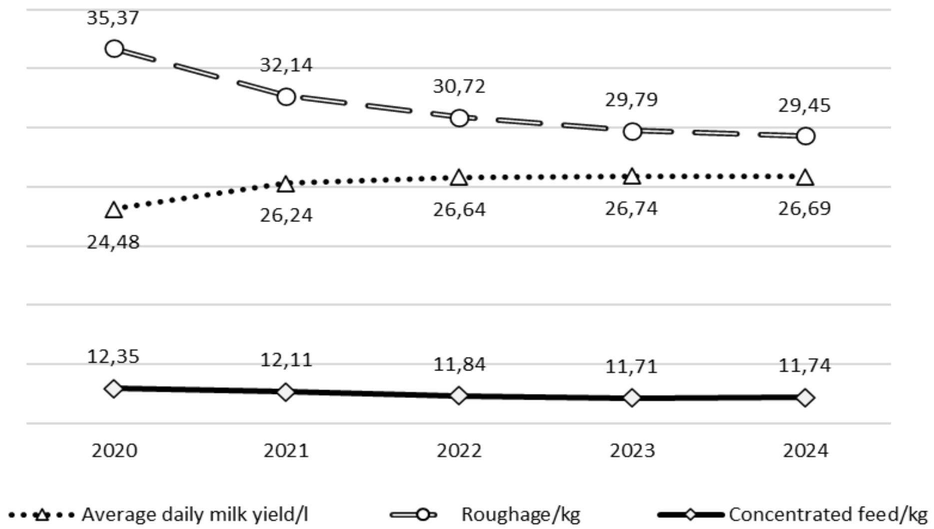


**Figure 1.** Changes in average daily milk yield and amounts of roughage and concentrated feed during the study period.

In 2024 the volume of feed reaches 29.45 kg, the decrease compared to 2023 is another 1.18%. Concentrated feed also follows a gradual decreasing trend, from 12.35 kg in 2020 to 11.71 kg in 2023, as in 2024 the value slightly increases to 11.74 kg. The percentage change for the period is as follows: from 2020 to 2021 there is a decrease of 1.83%, from 2021 to 2022. – by 2.07%, from 2022 to 2023. – by 0.33%. In 2024 value increases by 0.26% compared to 2023. The graph shows that in the period 2020–2023 an increase in the average daily milk yield was observed, accompanied by a decrease in the amount of roughage and concentrated feeds. This corresponds to innovative approaches in the feeding of dairy cattle breeding, among which precision feeding systems occupy an increasingly important place. According to Boscoa et al. (2021), these systems have the potential to significantly improve milk yield by optimizing nutrient intake and increasing feed utilization efficiency. van Empel et al. (2016) point out that precision nutrition allows to precisely meet the needs of animals, thereby increasing their productivity and reducing environmental pollution. Hunt (2024) adds that precision feeding involves accurately measuring and delivering the required amount of feed, minimizing residues and increases milk yield. On the other hand, according to Fischer et al. (2020), precise feed restriction is an effective strategy to reduce inter-cow variation in feed efficiency. This does not disturb the lactation or the growth of the animals, on the contrary, it leads to a more efficient use of resources and improves profitability in dairy farming. As a result, farmers achieve lower feed costs, increased productivity and increased income. This integrated strategy for nutrition optimization and resource management offers prospects for sustainable development of the sector.

Fig. 2 shows the change by year of the consumed fuel (l/cow/day) and the average daily milk yield (l/cow/day), in the period before and after the implementation of the system.

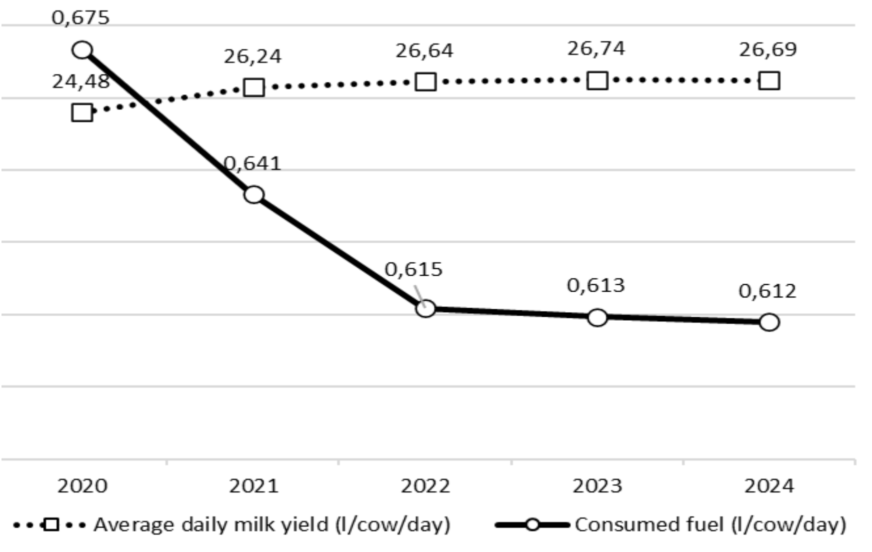


**Figure 2.** Changes in fuel used (l/cow/day) and average daily milk yield (l/cow/day)

When considering the data for the period 2020-2024 for the fuel consumed, a stable tendency to decrease the values of the indicator measured in liters per cow (l/cow/day) is observed. The values of this indicator decrease from 0.675 l/cow/day in 2020 to 0.612 l/cow/day in 2024, which represents a total decrease of 9.33% for the considered period. In the period 2020 and 2021, the most significant decrease is reported - by about 5.19%. From 2022 to 2024, the values stabilize with a minimal change, and the final decrease in this period is about 0.16%. This trend corresponds with the introduction of precision technology in 2020, which is aimed at optimizing animal feeding processes, which leads to more efficient use of energy carriers.

The figures show that the introduction of the precision management technology resulted in a significant reduction in fuel costs by 9.33% and an improvement in milk productivity by around 9% over the period. Precision feeding systems on dairy farms play an important role in reducing fuel costs by improving feed efficiency. A similar conclusion was reached by Buckmaster (2009) that by optimizing the performance of the mixer, the fuel used is reduced due to the accurate and efficient observance of the order of mixing the ingredients. In addition, precision systems contribute to the reduction of feed waste and reduce the negative impact on the environment (Pavlova et al., 2025). This is achieved by providing optimal nutrients to the cows, which increases the overall profitability and sustainability of the farm. As a result, less fuel and feed is used to produce the same amount of milk (Lawrence et al., 2015). According to research by Chase and Fortina (2023), the optimization of the feed management contribute to a significant reduction in the carbon footprint of dairy farms, making them more environmentally friendly and sustainable in the long term.

Fig. 3 presents data on the average number of doses per insemination and average daily milk yield. During the reporting period, a gradual decrease was observed in the number of doses of seed material required for the fertilization of one animal.

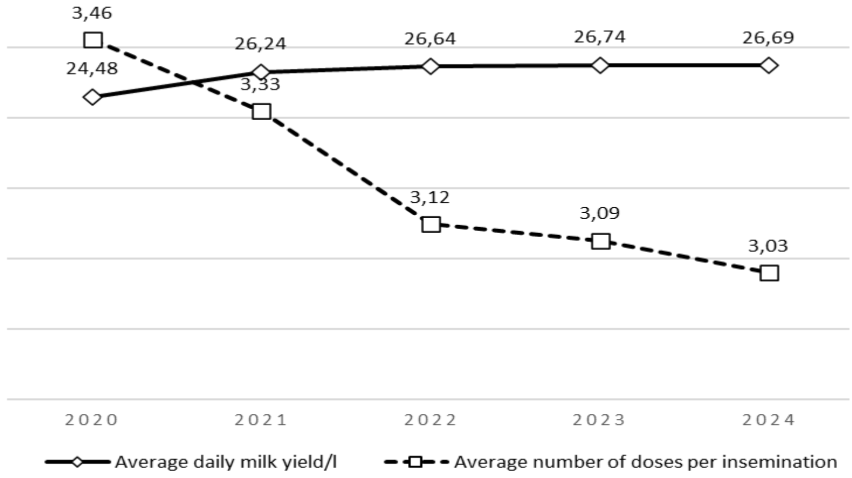


**Figure 3.** Changes in average number of doses per insemination and average daily milk yield

In 2020, this indicator was 3.46 doses, which in the following years decreased to 3.33 in 2021, 3.12 in 2022, 3.09 in 2023 and 3.03 in 2024. In numerical terms, this represents a decrease of about 0.43 doses or approximately 12.4% compared to 2020. On the basis of the data provided, it can be concluded that precise feeding of animals optimizes metabolic processes and reproductive function, which leads to a reduction in the required number of doses per insemination and an increase in milk productivity. Several studies have found a negative relationship between milk yield and fertility (Grimard et al., 2006; Cutullic et al., 2012). This is partly explained by a negative genetic correlation between milk yield and fertility (Pryce et al., 2004). The positive relationship between high productive and reproductive performance, according to Lucy (2001), can be related to more precise feeding of the animals. Precision nutrition also has a significant impact on body condition assessment and energy balance (Maltz, 2013) and is a major factor associated with improving reproductive performance (López-Gatius et al., 2003; Santos et al., 2004; Grimard et al., 2006). Schmidt (2022) specifies that precision nutrition plays an important role in improving fertility by providing the necessary amount of energy, proteins, vitamins and minerals that are included in the ration.

Because the study was based on the number of doses used per insemination and did not account for the multiple factors responsible for reproductive performance, the results should not be used as definitive proof of any particular theory. Instead, these results can be used as a rationale for further studies on the critical topic of the effects of nutrition on reproduction in lactating dairy cows.

# Conclusions

Based on the obtained results, it can be concluded that after the introduction of the precise technology for monitoring and management of nutrition in the dairy cattle farm, an increase in milk productivity is observed, as well as a decrease in the amount of used roughage and concentrated feed, fuel consumed in the farm. Evidence shows that the integration of digital technologies in dairy farming can lead to more efficient use of resources, increased productivity and reduced some negative environmental impacts. Although the optimization process is likely to be slow, the data demonstrate the potential of digital technologies to transform modern dairy farming and its role in achieving sustainable development in the sector.

## References

Bach A., Terré M., Vida M. 2020. Decomposing efficiency of milk production and maximizing profit. *Journal of Dairy Science*, 103:5709–5725.

Boscoa S., Volpia I., Cappuccia., Mantinoa A., Ragaglinia G., Bonaria E., Mele M. 2021. Innovating feeding strategies in dairy sheep farming can reduce environmental impact of ewe milk. *Italian Journal of Animal Science*, 20(1), 2147–2164.

Brito L.F., Bedere N., Douhard F., Oliveira H.R., Arnal M., Peñagaricano F., Schinckel A.P., Baes C.F., Miglior F. 2021. Genetic selection of high-yielding dairy cattle toward sustainable farming systems in a rapidly changing world. *Animal*, 15:100292.

Buckmaster D. 2009. Optimizing Performance of TMR Mixers. Tri-State Dairy Nutrition Conference. https://www.researchgate.net/publication/228388352_Optimizing_Performance_of_TMR_Mixers

Chavas J.P., Nauges C. 2020. Uncertainty, learning, and technology adoption in agriculture. *Applied Economic Perspectives and Policy*, 42:42– 53.

Cutullic E., Delaby L., Gallard Y., Disenhaus C. 2012. Towards a better understanding of the respective effects of milk yield and body condition dynamics on reproduction in Holstein dairy cows. *Animal*, 6 (3), 476-487.

van Empel J.M.M., Makkar J., Dijkstra P., Lund. 2016. Nutritional, technological and managerial parameters for precision feeding to enhance feed nutrient utilization and productivity in different dairy cattle production systems. CAB International, 1749-8848

Fischer N., Edouard P., Faverdin. 2020. Precision feed restriction improves feed and milk efficiencies and reduces methane emissions of less efficient lactating Holstein cows without impairing their performance. *Journal of Dairy Science*, 103 (5), 4408-4422.

Gengler N. 2019. Symposium review: challenges and opportunities for revaluating and using the genetic potential of dairy cattle in the new era of sensor data from automation. *Journal of Dairy Science*, 102, 5756–5763.

Grimard B., Freret S., Chevallier A., Pinto A., Ponsart C., Humblot P. 2006. Genetic and environmental factors influencing first service conception rate and late embryonic/foetal mortality in low fertility dairy herds. *Animal Reproduction Science* 91, 31-44.

Hristov N.A., Martins L. 2022. Precision Feeding in Dairy Cows: Increasing Efficiency and Profitability. https://extension.psu.edu/precision-feeding-in-dairy-cows-increasing-efficiency-and-profitability

Hunt A. 2024. Precision Feeding Strategies Every Dairy Farmer Needs to Know: https://www.thebullvine.com/management/nutrition/unlock-dairy-profits-precision-feeding-strategies-every-farmer-needs-to-know/#:~:text=Reduction%20in%20Feed%20Waste:%20Regular,and%20quality%2C%20thus%20increasing%20revenue.

Kaur U., Victor M.R., Malacco., Bai H., Price T.P., Datta A., Xin L., Sen S., Nawrocki A.R., Chiu G., Sundaram S., Min B., Daniels K.M., White R.R., Donkin S.S., Brito L.F., Voyles R.M. 2023. Integration of technologies and systems for precision animal agriculture a case study on precision dairy farming. *Journal of Animal Science*, 101, 1–23.

Larry E.C. and Fortina R. 2023. Environmental and Economic Responses to Precision Feed Management in Dairy Cattle Diets. *Agriculture*, 13(5), 1032.

Lawrence D.C., O'Donovan M., Boland T.M., Lewis E., Kennedy E. 2015. The effect of concentrate feeding amount and feeding strategy on milk production, dry matter intake, and energy partitioning of autumn-calving Holstein-Friesian cows. *Journal of Dairy Science* 98 (1), 338-348.

Lucy M.C. 2001. Reproductive Loss in High-Producing Dairy Cattle: Where Will It End. *Journal of Dairy Science* 84 (6), 1277-1293.

Maltz E., Barbosa L.F., Bueno P., Scagion L., Kaniyamattam K., Greco L.F., De Vries A., Santos J.E.P. 2013. Effect of feeding according to energy balance on performance,nutrient excretion, and feeding behavior of early lactation dairy cow. *Journal of Dairy Science*, 96, 5249–5266.

Mourits M.C.M. 2000. Economic modelling to optimize dairy heifer management decisions. PhD-thesis Wageningen University, ISBN 90-5808-155-9.

Pavlova K., Trichkova-Kashamova E. 2025. Using Precision Feeding to Improve Livestock Health and Profit Margins: A Nutritional Risk Management Strategy. *Journal of Information Systems Engineering and Management,* 10(45), 2468-4376.

Popova Y., Laleva S., Oblakova M., Ivanov N., Slavov I., Dimova N. 2024. Precision livestock farming: essence and application in large and small ruminants. *Bulgarian Journal of Animal Husbandry*, 61(2), 54-63.

Pryce J.E., Royal M.D., Garnsworthy P.C., Mao I.L. 2004. Fertility in the high-producing dairy cow. *Livestock Production Science*, 86 (1–3), 125-135.

Rossow H. A., Aly S. S. 2013. Variation in nutrients formulated and nutrients supplied on 5 California dairies. *Journal of Dairy Science*, 96:7371–7381.

Royal M.D., Smith R.F., Friggens N.C. 2008. Fertility in dairy cows: bridging the gaps. *Animal*, 2(8), 1101-1103.

Russell R., Bewley J. 2013. Characterization of Kentucky dairy producer decision-making behavior. *Journal of Dairy Science*, 96:4751–4758.

Santos E. D. G., Paulin, M. F., Valadares Filho S. de C., Lana R. de P., Queiroz, D. S., Fonseca, D. M. 2004. Intake, digestibility and ruminal parameters in young bulls Limousin-Nelore, supplemented during dry season in Brachiaria decumbens Stapf postponed pasture. *Revista Brasileira de Zootecnia*, 33 (3), 704-713.

Schmidt J. 2022. 4 steps to improve dairy cow fertility through feeding. https://ew-nutrition.com/4-steps-to-improve-dairy-cow-fertility-through-feeding/#:~:text=Feeding%20plays%20a%20major%20role,as%20healthy%20and%20fertile%20animals.

Slavova S., Angelova T., Krastanov J. 2022. Bio-economic models for deriving economic values for cattle: a review, *Agricultural Science and Technology,* 14(2), 3-11.

Souza V.C., Liebe D.M., Price T.P., Ellett M.D., Davis T.C., Gleason C.B., Daniels K.M., White R.R. 2022. Algorithm development for individualized precision feeding of supplemental top dresses to influence feed efficiency of dairy cattle. *Journal of Dairy Science*, 105:4048–4063.

Sova A.D., LeBlanc S.J., McBride B.W., DeVries T.J. 2014. Accuracy and precision of total mixed rations fed on commercial dairy farms. *Journal of Dairy Science*, 97, 562–571.