AI-DRIVEN DAIRY FARMING: A CASE STUDY OF TECHNOLOGICAL ADOPTION AND ORGANIZATIONAL ADAPTATION IN A CZECH SME

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A B S T R A C T

This paper analyzes the use of artificial intelligence (AI) and smart technologies in dairy cattle farming through a case study of the Czech SME Agrosoft. The study assesses how AI-based management systems affect operational efficiency, animal welfare, and environmental sustainability, and identifies challenges in their implementation. It focuses on automated milking, thermal imaging for health monitoring, and IoT-supported environmental control. A qualitative approach was applied, combining semi-structured interviews with developers and implementation specialists with an analysis of internal documentation. The findings show that AI enables earlier detection of health issues, more efficient feeding and barn-climate control, and reduced labor demands, contributing to improved herd welfare and lower operating costs. At the same time, the research highlights organizational barriers, especially the need for staff training and gradual workflow adaptation. The paper concludes that AI can significantly advance sustainable, welfare-oriented livestock farming, provided that farms ensure sufficient technological readiness and human-centered change management.

Introduction

Smart technologies and AI play a crucial role in various fields of industry, including agriculture and animal production (e.g. Bhagat et al., 2022; Wang et al., 2023). In today's rapidly evolving technological landscape, the integration of smart technologies

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and AI has according to Gras et al. (2024) become increasingly important for enhancing efficiency, productivity, and sustainability in livestock farming.

The utilization of smart technologies such as IoT (Internet of Things) sensors and data analytics enables real-time monitoring and management of various parameters within livestock production systems. These technologies allow farmers to collect and analyze large volumes of data related to animal health, behaviour, and environmental conditions. By leveraging AI algorithms, this data can be processed to extract valuable insights, optimize decision-making processes, and predict potential issues or anomalies (Dayoub et al., 2024).

One of the key advantages of smart technologies and AI in animal production is their ability to improve animal welfare and health outcomes. Some researches (e.g. Neethirajan, 2017; Dhanaraju et al., 2022) explain that by continuously monitoring parameters such as feeding behavior, activity levels, and environmental conditions, farmers can identify and address potential health issues or stressors in a timely manner, leading to improved animal welfare and productivity

Furthermore, smart technologies and AI contribute to the optimization of resource management and environmental sustainability in livestock farming. By precisely controlling factors such as feed distribution, water usage, and energy consumption, farmers can minimize waste, reduce environmental impact, and enhance resource efficiency (Gras et al., 2024; Dayoub et al., 2024).

In summary, the integration of smart technologies and AI offers immense potential for revolutionizing livestock farming practices. By harnessing the power of data-driven insights and automation, farmers can achieve higher levels of efficiency, productivity, and sustainability, ultimately leading to improved outcomes for both animals and producers (Zhang et al., 2022).

The objective of this study is to evaluate how AI-based farm management systems influence operational efficiency, animal welfare, and environmental sustainability in dairy cattle farming. Using a qualitative case study of the Czech SME company Agrosoft, the research analyses the implementation of automated milking systems, thermal imaging for health monitoring, and IoT-based barn climate control.

Theoretical background

It was recognized by Bao and Xie (2022) that the number of related studies has increased significantly since 2016, and the most intensive studies were focused on animal behaviour detection and recognition, and concentrated mostly on farm animal species of pig (37.95%), cattle (37.44%), and poultry (16.92%). Moreover, most scientific research in animal farming driven by sensors and AI models were focused on data collection, processing, assessment, and analysis in the areas of animal behaviour detection, disease monitoring, growth estimation, and environment monitoring at the experimental stage. Moreover, some technical challenges on AI like the accuracy and cost need to be improved before it could come into use in the commercial animal farming. According to Liu et al. (2021) many of these technologies have been previously used in what is known as Industry 4.0 and are now being applied and adapted to agriculture.

Many authors (for example Gerdan Koc et al., 2024; Rebez et al., 2024; Sindiramutty et al., 2024) have already addressed the utilization of smart technologies and AI in animal production, with several notable mentions among them. In agriculture, smart technologies involve the use of IoT devices, cloud computing, and AI to monitor and manage farm operations, from environmental conditions to livestock health. These technologies enable farmers to automate processes such as irrigation, feeding, and environmental control, making farming more sustainable and efficient (Liakos et al., 2018).

Artificial intelligence (AI) refers to the ability of a digital computer or computer-controlled robot to perform reasoning tasks commonly associated with intelligent beings. (De Vries et al., 2023). Al-Ahmed and Ahamed (2024) or Kawagoe et al. (2023) explain that in the context of agriculture, AI involves the use of machine learning and advanced data processing algorithms to make predictive analyses, automate processes, and enhance decision-making. AI enables real-time monitoring of livestock health, crop conditions, and environmental factors, leading to increased efficiency and productivity in farming. AI in animal health is specifically used for monitoring physiological parameters, early disease detection, and automating treatments, all based on data collected from sensors or diagnostic devices. This helps in the timely management of health issues in livestock (Dayoub et al., 2023; Melfsen et al., 2023).

Smart technologies, also known as Intelligent Systems, correspond to technologies used for sensing, decision-making, and actuation in systems that can work autonomously and act and modify the world (Verschae, 2023). An intelligent system senses the environment, makes decisions, and acts in the environment. Applications of these smart technologies in agriculture can be grouped into four domains (Araujo et al. 2021): Monitoring, Control, Prediction, and Logistics.

Table 1. Main application domains of smart technologies in agriculture. (Araujo et al. 2021)

Monitoring:	Control:
Weather monitoring	Smart greenhouses
Crop monitoring	Irrigation systems
Soil monitoring	Fertilization and fertigation
Water monitoring	Weed, pest, and disease control
Animal monitoring	Harvesting systems
Prediction:	Logistics:
Forecasting weather conditions	Handling
Crop development	Storage
Yield estimation	Transport and distribution
Animal development	Supply chain management
Forecasting market demand	Provenance traceability

Source: Araujo et al. 2021

According to Verschae (2023) these technologies can help optimize the use of resources (such as water, fertilizer, and energy), help increase production quantity and quality, support postharvest operations, and make agroecosystems more sustainable.

Smart technologies in agriculture can play an essential role in promoting sustainable agriculture in various ways, including (Verschae, 2023):

- It can support farmers to optimize the use of resources such as water, fertilizer, and energy.
- It can help farmers to monitor their crops and livestock more effectively, allowing them to detect and respond to problems early on.
- It can allow to increase in the transparency and traceability of food products by providing accurate and detailed information about the origin, quality, and sustainability of food products.
- It can also help to connect farmers with buyers and marketplaces, allowing them to sell their products directly to consumers or other businesses.

Charfeddine and Jemai (2018) examine recent methods for forecasting electricity consumption, with potential applications in optimizing energy usage in livestock farming operations. Similarly Ahmadi et al. (2018) investigate the application of machine learning techniques in predicting energy usage in social housing, suggesting potential applications in optimizing energy consumption in livestock farming facilities.

The review paper by Hruska et al. (2019) offers a comprehensive analysis of how artificial intelligence (AI) is reshaping precision agriculture. It explores AI's impact across various farming practices, from enhancing crop monitoring to optimizing resource management and refining decision-making processes. Overall, the article provides a succinct yet comprehensive overview of AI's pivotal role in advancing efficiency, sustainability, and productivity in agriculture. The study by Garcia et al. (2018) offers a comprehensive review of the application of artificial intelligence in the livestock sector, highlighting its potential to improve animal health, optimize breeding programs, and enhance overall productivity in livestock farming operations. Carabaňo et al. (2020) explores the applications and perspectives of precision livestock farming tools in promoting sustainable cattle production, emphasizing their role in optimizing resource utilization, improving animal welfare, and reducing environmental impact.

From the other side, Bannink and France (2016) investigate nutritional approaches to mitigate enteric methane emissions in ruminants, highlighting the importance of dietary manipulation in reducing greenhouse gas emissions from livestock production. A research by Hu et al. (2005) presents artificial neural network models for predicting ruminal fermentation in continuous culture, demonstrating their potential utility in optimizing feed formulations for dairy cattle. Or Massel et al. (2020) discuss the use of chemical repellents and deterrents in vertebrate management, highlighting their potential role in protecting livestock from predation and minimizing wildlife-related conflicts on farms.

The findings by Berckamans (2017) underscore the pivotal role of precision livestock farming (PLF) technologies in improving welfare management within intensive livestock systems. Through advanced monitoring and management systems, PLF enables proactive interventions to address welfare issues, optimize conditions, and enhance animal well-being and productivity. Additionally, PLF contributes to more efficient resource utilization, reduced environmental impact, and improved economic sustainability in intensive livestock operations. The article by Venkatesan and Thirunavukkarasu (2019) delves into the realm of real-time data analytics in agriculture, focusing on the utilization of Internet of Things (IoT) and big data technologies. It provides a comprehensive overview of how these advanced technologies can revolutionize livestock farming operations by enabling real-time monitoring and management. Through the integration of IoT sensors and big data analytics, farmers gain valuable insights into various aspects of livestock farming, including health monitoring, environmental conditions, and resource management. This article sheds light on the potential applications of real-time data analytics in enhancing efficiency, productivity, and sustainability in agricultural practices.

AI has become an integral part of modern agriculture, with a significant focus on animal health. AI's ability to process vast amounts of data and predict potential health issues in livestock has revolutionized the way farmers monitor their herds (Monteiro et al., 2021). For instance, sensors integrated with AI systems can continuously track physiological parameters such as body temperature, heart rate, and movement patterns. These data points are analysed in real-time, allowing early detection of diseases before symptoms are visible, thus reducing the spread of illness and improving overall animal welfare.

Moreover, AI is also instrumental in disease control and prevention. By analysing environmental factors such as temperature and humidity in combination with animal behaviour, AI systems can identify conditions that may lead to disease outbreaks. Early identification allows farmers to take proactive measures, thus limiting the impact of potential diseases on the livestock population (Arsevska et al., 2018). For instance, AI-driven monitoring of respiratory diseases in cattle has been particularly successful, as it enables farmers to isolate affected animals and administer treatment promptly (Charlier et al., 2024).

In addition to health monitoring, AI plays a key role in feeding optimization. Automated feeding systems use AI algorithms to analyse data on individual animals' consumption habits and energy needs. This ensures that each animal receives the correct amount of nutrients, enhancing growth and productivity while minimizing feed waste. Such precision feeding reduces the environmental footprint of farms and contributes to more sustainable agricultural practices (Bök and Micucci, 2024). The integration of AI with other technologies, such as the Internet of Things (IoT), has further enhanced its applications in agriculture. AIoT systems are used not only to monitor animal health but also to manage environmental conditions within farming facilities. For example, IoT sensors measure air quality, temperature, and humidity, while AI systems adjust these conditions in real time to maintain an optimal environment for livestock. This holistic approach helps prevent stress-related illnesses and promotes better growth and reproductive outcomes in animals (Ezanno et al., 2021).

In summary, AI in agriculture has significantly improved animal health management by enabling early disease detection, optimizing feeding, and creating healthier living conditions. These advancements not only boost farm productivity but also contribute to more sustainable and ethical farming practices.

Methods and Data

The authors have chosen Agrosoft as the subject of the study, considering its significance in the utilization of smart technologies and artificial intelligence in animal production. Interviews were conducted with key members of the company's team, including software developers, technical specialists, and project managers, to gain an in-depth insight into the application of smart technologies and artificial intelligence within the company. Documentation of Agrosoft, including technical specifications, strategic plans, and internal reports, will be analysed to understand the implementation and development of technological systems. Specific smart technologies and applications of artificial intelligence utilized by the company will be identified, such as sensors for monitoring animal health and behaviour, algorithms for optimizing feeding regimes, and software platforms for automation of farming. Based on the collected data, the benefits and limitations of applying these technologies in relation to the company's goals and strategy were evaluated.

The research aims to assess the impact of AI-driven technological solutions on three core areas of dairy cattle farming: (1) operational efficiency, (2) animal health and welfare, and (3) environmental resource management. To achieve this, we conducted a qualitative case study of Agrosoft, involving semi-structured interviews with software developers and system implementation specialists, and an analysis of internal documentation. The methodological goal is to understand not only the technical performance of these systems, but also the practical challenges, organizational adjustments, and human factors influencing their successful adoption.

In this study on the application of smart technologies and artificial intelligence (AI) in livestock farming, we adhered to the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist to ensure methodological transparency and rigor. Compliance with the COREQ guidelines entailed detailed documentation of researcher roles, participant recruitment processes, and the contextual environment of the interviews. This comprehensive approach facilitated in-depth exploration of AI integration within Agrosoft, providing a robust framework for assessing its implications on productivity, animal welfare, and sustainability in livestock farming.

The research team comprised four academic scholars, three of whom were female Ph.D. holders with over a decade of expertise in the domain. Participants from Agrosoft were introduced to the objectives of the project and study prior to their involvement. Researchers disclosed their motivations and interests in the topic to enhance rapport and understanding. Importantly, no theoretical framework was imposed during the interviews to ensure that responses were authentic and unbiased.

Data collection was conducted within the company's office environment, ensuring confidentiality and minimizing external influences. No individuals other than the interviewees and researchers were present during the sessions. The interview protocol, developed by the authors, was pilot tested prior to implementation to refine its effectiveness. Each interview session lasted approximately 60 minutes, and transcripts were subsequently shared with participants for validation and feedback. The findings were presented to Agrosoft following the analysis phase, ensuring alignment with the study's objectives and fostering transparency in communicating the results. The data collection involved semi-structured interviews with key members of Agrosoft. These interviews were recorded and transcribed verbatim, and a thematic analysis was conducted to identify patterns related to the benefits and challenges of implementing AI systems in animal farming.

Table 2: Questions for the interviews.

Questions	**Area/Topic**
Opening Questions	
What specific factors motivated your company to adopt AI?	Value
Which specific areas of your marketing/sales/export activities benefit the most from AI technologies?	Value
Has the introduction of AI changed the workflows within your marketing, sales and export team?	Technology, Management
Who was or is involved in AI projects focusing on Marketing, Sales and Export? How are they involved (what are their roles)?	Management
AI Strategy Formulation and Results	
Can you outline your company's overarching AI strategy for implementation?	Technology, Management, Ethics
Which performance metrics were used to measure the success of AI implementation in your company?	Value
How do you assess the overall impact of AI on your business?	Value
How do you communicate the benefits of AI to external stakeholders, such as customers, investors and partners?	Ethics
Talent and Culture	
What qualifications are required to hire employees skilled in AI?	Technology, Management, Ethics/legal
What kind of AI trainings do you offer for your employees?	Technology, Management, Ethics/legal
What corporate cultural changes (continuous learning, shift in decision making process, curiosity over fear) have been initiated to support AI integration?	Management
How does the company manage AI-related apprehensions among staff?	Ethics
How does the AI strategy of your company correspond to the company's value and culture?	Value

Challenges and Solutions	
Did you encounter any problems during the AI implementation?	Technology, Management, Value, Ethics
What organizational challenges have been encountered, and what strategies were used to address them?	Management
What technical obstacles have you faced during AI implementation and how were they resolved?	Technology
Have you noticed any ethical or legal issues during and after the AI application? If yes, can you describe those issues a little bit more?	Ethics/legal
How do you think does the AI system relate to power relations between the management and employees?	Ethics
Future Outlook	
How does your company envision the long-term impact of AI on your operations and the wider industry?	Value
How do you think will the AI Act impact your company?	Ethics/legal
Lessons Learned and Recommendations	
What insights have you gained through the AI adoption process?	Value
What recommendations would you give to companies which are planning to implement AI?	Value

Source: Authors

Case study (Results)

Agrosoft is a purely Czech company with a tradition dating back to 1985. Their products are utilized in hundreds of operations, ranging from family farms to multi-level large-scale breeding facilities. In addition to the Czech Republic and Slovakia, they also operate in the Russian Federation, Belarus, Poland, Kazakhstan, and Tajikistan.

Their core program focuses on software and barn-related electronically controlled technologies. The traditional Agrosoft SKOT program holds a significant position in the market. Agrosoft have expanded product portfolio to include a system for monitoring and controlling the microclimate in the barn. Thermal cameras are utilized for monitoring the health status of hooves. For other company - Farmtec, they have developed a complete system for managing barn technologies and supporting cattle farming – Farmsoft. This system includes electronic identification of dairy cows, data collection from the milking parlor, selection gates, automatic concentrate feeder (ACF), and monitoring of locomotor activity. The Vitalimetr 5P not only monitors the movement of the dairy cow but also tracks feeding and rumination time. The Farmsoft system is offered to users as a complete assembly or its individual technological components (e.g., concentrate dosing via ACF).

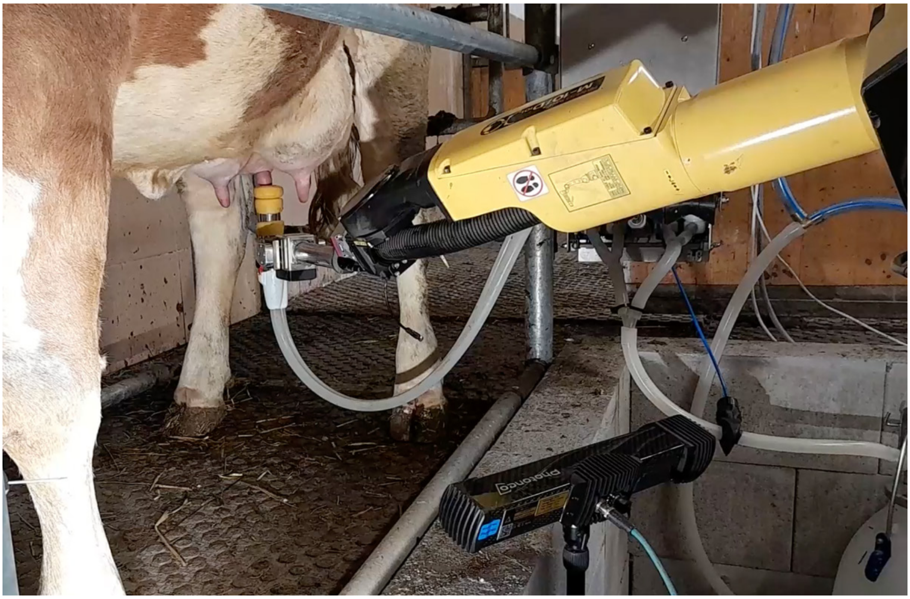
In collaboration with the University of South Bohemia in Ceske Budejovice and other Czech companies, they have successfully completed research project QJ1210144 “Development of a New Information System and Applied Technological-Organizational Innovations of Control Systems in Dairy Cattle Farming to Strengthen the Competitiveness of Breeders and Animal Welfare.” Outputs from this project –

microclimate parameters, new ACF design, pass-through weighing system, locomotor activity monitoring function, control software algorithms – were utilized in the development of the Farmsoft system. They continue to collaborate with the University of South Bohemia on projects related to milk quality monitoring, automated system for monitoring barn indices, and animal identification through image analysis. The most extensive project is the development of a robotic arm for conventional milking parlors.

In addition to software, hardware development, and identification, Agrosoft has have a quality team for implementing the aforementioned systems, including zootechnical and operational consultancy services. Another team handles assembly, servicing, and repairs of mainly technologically-driven systems controlled by electronic systems (milking robot, milk vending machine, milking parlor and milking system, etc.), both of domestic and foreign origin.

The findings reveal significant improvements in both animal welfare and operational efficiency due to AI adoption. For example, the AI-powered milking robots have reduced human labor dependency and provided a more consistent milking routine for cows. The robotic arms detect and adapt to the size, shape, and position of cow teats, ensuring precise milking while minimizing animal discomfort.

Figure 1. Robotic arm for milking of the cow (internal documents of the company).



AI in health monitoring has also proven effective. A body condition monitoring system installed at the exit of the milking robot or milking parlor determines whether any of the cows is rapidly losing condition, i.e., losing weight. If such a case is detected, the farmer receives a notification and reviews the animal's vital data (milk yield, activity, body temperature). Using the positioning system, the farmer can locate the animal within the barn and then mark it with a visual (light) signal. This allows the cow to be examined within minutes of the alert, enabling timely administration of a nutritional drench to support its vitality.

Some of the cows are diverted by the sorting gate into a separation pen equipped with a restraint option. The farmer confirms these animals based on the list that he reviewed on his mobile phone early in the morning. He examined the information reported for each animal and, based on current data on milk yield, milk quality, body condition, locomotor activity, feed intake, rumination, thermal camera imagery, and body temperature, issued a command in the system to separate the respective cows. The relevant data are also available from the morning on the smart devices of service providers—namely the veterinarian, the insemination technician, and the hoof trimmer. In addition to conditions inside the barn, the situation on the pasture can also be monitored via the application. Here, a drone flying over the grazing area provides significant assistance. The primary focus is on animal behavior and the functionality of the electric fencing. Thanks to the localization feature and the illuminated LED indicator, the breeding cow can be easily located.

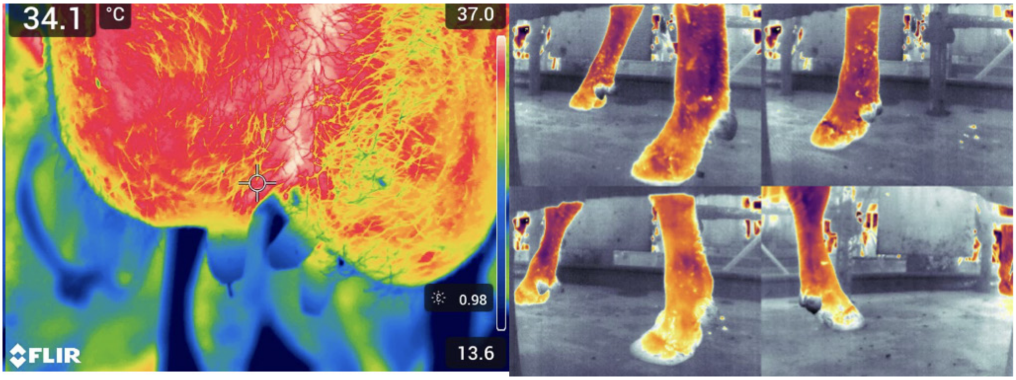
The behavior of dairy cows in the barn is continuously monitored using a camera system with integrated image analysis. This system contributes to the assessment of animal welfare, automatically calculates barn performance indices, and sends an SMS notification to the farmer in the event of atypical behavior.

Animal monitoring components and management software systems, which provide appropriate reporting based on the collected data, have a significant impact on animal welfare. In practice, this mainly involves sensors that record the animal's locomotor and feeding activities, physiological parameters, spatial location, and interactions with other individuals. Monitoring of animals and their living conditions is also supported by integrated camera systems equipped with dedicated analytical software.

Thermal imaging allows for continuous, non-invasive monitoring of cow hooves, which helps detect inflammation at an early stage. Diagnosis of disease using AI is usually significantly ahead of human-observable symptoms. The cows are experiencing hoof problems because their nutrition is not sufficiently balanced. Five degrees of lesion severity (inflammation development) are distinguished. At levels 1–2, the cow can still be milked and treatment is relatively simple; at levels 4–5, the cows must be removed from the production process. When the cows enter the milking parlor, a thermal camera scans each hoof. The collected data are then processed using AI, which identifies the cows exhibiting inflammatory lesions. As a result, veterinary interventions can focus on nutritional changes rather than costly medical treatments like antibiotics. Moreover, it is also possible to monitor the cow's reaction to the applied treatment. This proactive approach reduces treatment costs while improving overall herd health.

AI's ability to process large datasets generated by IoT sensors has improved the barn environment by controlling microclimate conditions. Sensors continuously monitor both the internal barn environment (methane emissions, temperature, and humidity) and the external meteorological conditions. A modern criterion used to evaluate the quality of the barn microclimate is the kata-value, a physical parameter that reflects the thermal comfort of the animals. This value is determined using a kata-thermometer, which illustrates the development from a mechanical measuring device to an electronic one. Based on the collected data, the software sends control commands to the barn technology systems, such as fans, ventilation openings in the building envelope, heating, misting systems, and lighting. This helps meet EU environmental standards for reducing greenhouse gases while lowering operational costs related to energy consumption.

Figure 2. Thermal cameras (internal documents of the company).



Furthermore, AI has a notable impact on resource management. By analysing data from feeding patterns, AI-driven systems adjust the distribution of feed, ensuring that no food is wasted while each cow receives optimal nutrition. This precision in feeding management has led to a measurable reduction in feed waste, contributing to both economic savings and environmental sustainability.

To summarise, the key AI technologies used at Agrosoft include:

- Robotic arms for milking, equipped with AI-powered vision systems that recognize and analyse the geometry of each cow's udder
- IoT-based systems for monitoring barn environments, integrating sensor networks that control air quality, temperature, and humidity
- Thermal cameras used for hoof health monitoring, which detect issues such as inflammation early, allowing non-invasive interventions
- AI-driven feeding systems that adjust feed distribution based on animal behaviour and environmental data, ensuring optimal nutrition and reducing waste

These technologies are part of Agrosoft's broader effort to bring Agriculture 4.0 into livestock farming, where AI plays a critical role in predicting health issues, optimizing resource use, and improving operational efficiency. Managers would particularly recommend "taking it slow, step by step, and thoughtfully, preparing employees for changes, and accounting for their conservative approach" when implementing AI.

Discussion

The findings of our case study on Agrosoft align with several key themes identified in the literature regarding the integration of AI and smart technologies in livestock farming. For instance, Berckmans (2017) emphasizes the role of precision livestock farming (PLF) technologies in improving animal welfare through advanced monitoring systems. Similarly, our study found that Agrosoft's AI-driven milking robots and health monitoring systems, particularly through thermal imaging of cow hooves, contributed to enhanced animal well-being by enabling early detection of health issues and reducing the need for invasive treatments. This is consistent with the literature, which highlights AI's potential in improving both operational efficiency and animal welfare in intensive livestock systems (Carabaño et al., 2020).

In livestock production, AI is used to diagnose health problems in livestock (Contla Hernández et al., 2021), analyze poultry behavior (Li et al., 2020), and automatically monitor cattle ethology (Pavlovic et al., 2021). The greatest benefit is in the milking process. Currently, about 400 milking robots are working in the Czech Republic. It is estimated that in 2025 there will be 43,000 milking robots in the world (Bumbalek et al., 2022). In plant production we find applications in the identification of fruits, their metric properties and count (Gai et al., 2021; Parico and Ahmed, 2021) or the detection of plant diseases (Alguliyev et al., 2021).

Kumar et al. (2018) identify dairy cows by processing muzzle images using deep neural networks. The central premise of their approach lies in the uniqueness of the pattern and texture of the muzzle surface, which can be compared to a human fingerprint. The first phase of their study involved the creation of a relatively small yet high-quality dataset consisting of 500 photographs of an equal number of individual animals. During the preprocessing stage, the acquired images are first converted to grayscale and then enhanced through histogram equalization using the CLAHE method. Subsequently, the images are processed using two deep learning approaches—Convolutional Neural Networks (CNN) and Deep Belief Networks (DBN)—which perform feature extraction and analysis for classification. In the reported results, the DBN method achieved the highest performance, reaching an identification accuracy of nearly 96% (Bumbalek et al., 2021).

Moreover, the literature reviewed by Hruska et al. (2019) and García et al. (2018) suggests that AI enhances decision-making and optimizes resource management by analyzing large datasets in real time. Our case study supports this claim, as Agrosoft's IoT-based systems for environmental control and AI-driven feed distribution systems demonstrated significant reductions in resource wastage, particularly in feed and energy consumption. This not only improved the economic sustainability of operations but also aligned with the broader environmental goals mentioned in the studies by Bannink and France (2016) and Venkatesan and Thirunavukkarasu (2019), who stress the importance of AI in reducing the environmental footprint of farming practices.

Conclusions

This study demonstrates that the integration of artificial intelligence and smart technologies in livestock farming has the potential to significantly improve operational efficiency, animal welfare, and environmental sustainability. The case of Agrosoft illustrates how automated milking systems, sensor-based health monitoring, and AI-supported environmental control can reduce labor demands, enable earlier interventions, and optimize resource use. These findings are consistent with broader trends in precision livestock farming, where data-driven decision-making is increasingly replacing manual observation and routine procedures.

However, the successful adoption of AI in agricultural settings requires more than the implementation of advanced technologies. It depends on organizational readiness, staff training, and the gradual adjustment of workflows and responsibilities. Farmers and managers must understand the capabilities and limitations of AI systems and remain actively involved in decision-making to ensure that technology complements, rather than replaces, human expertise.

More generally, AI should be viewed as a tool supporting the transition toward more sustainable and animal-centered farming practices. As the technology continues to evolve, future research should focus on evaluating long-term impacts, developing user-friendly training programs, and ensuring ethical and regulatory frameworks that maintain trust among farmers, consumers, and animal welfare advocates. The broader implication is that while AI can transform livestock production, its effectiveness ultimately depends on a balanced integration of technological innovation and human judgment.

Declaration of competing interest

There are no financial and personal relationships with other people or organizations that could inappropriately influence (bias) our work.

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Conflict of interests

The authors declare no conflict of interest.

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