Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 25, Issue 3, 2025
PRINT ISSN 2284-7995, E-ISSN 2285-3952

STUDY ON THE POSSIBILITY OF USING GIS IN THE MANAGEMENT OF AGROTOURISM CATTLE FARMS

Jenica CĂLINA[*], Aurel CĂLINA[*], Gheorghe Marian VANGU[**]

University of Craiova, *Faculty of Agronomy, **Department of Land Surveying-Management-Mechanization, 19 Libertății Street, Craiova, 200421, Romania; E-mails: jeni_calina@yahoo.com, aurelcalina@yahoo.com, marian_vangu@yahoo.com`

Corresponding author: aurelcalina@yahoo.com, marian_vangu@yahoo.com

Abstract

This article explores the benefits and use of Geographic Information Systems (GIS) in agrotourism cattle farms management, aiming to highlight their impact on operational efficiency and agricultural sustainability. It presents the process of designing, implementing, and operating a GIS system customized for cattle farms, with details on its integration with modern technologies such as the Internet of Things (IoT), artificial intelligence, cloud computing, augmented reality, and remote sensing. The adopted methodology includes an analysis of how GIS can be used for land and pasture management, animal health monitoring, optimizing feeding, farm infrastructure planning, spatial analysis of assets, tracking animal vaccinations, monitoring staff locations, and disease management. The results obtained demonstrate that the use of GIS for agrotourism cattle farms management significantly improves resource management, reducing costs and risks. The GIS system enables the collection and analysis of geospatial data, providing precise information that aids in making informed decisions. The main conclusion of the research is that the use of GIS in cattle farms is essential for optimizing production and enhancing sustainability. The implementation of this system, combined with emerging technologies, will revolutionize agricultural management, contributing to the creation of more efficient, climate-resilient, and environmentally responsible farms.

Key words**:** *GIS, agrotourism cattle farms management, spatial analysis, livestock behaviour, land use planning*

INTRODUCTION

By integrating and using GIS technologies in agrotourism cattle farms management, they can contribute to a circular economy where resources are used more efficiently, and waste is significantly reduced. Thus, technology not only improves productivity but also helps protect the environment by offering innovative solutions for more sustainable agriculture [10]. Information technologies have had a significant impact on how agricultural activities are managed, and one of the most innovative tools in this field is the Geographic Information System (GIS). It enables the collection, storage, analysis, and visualization of geospatial data, providing farmers with essential information for making informed decisions [1, 5, 8, 13].

GIS represent a set of technologies that combine geospatial data and complex analysis to support decision-making across various fields, including agriculture. Over the past few decades, GIS technology has become an essential tool for farmers worldwide, and its application in cattle farms is a clear example of how technological innovations can transform the way agricultural activities are managed [1, 2, 16]. GIS allows the collection, processing, and analysis of data related to the location and distribution of different resources on the farm, making it possible to obtain critical information about land, animals, infrastructure, and other essential resources for agricultural production.

In an era where agriculture faces significant challenges such as climate change, dwindling natural resources, and increasing production demands, GIS becomes an indispensable tool for improving efficiency and sustainability in farm management. In this context, the use of GIS in cattle farms not only allows for better organization and management of resources but also helps optimize production and improve animal welfare. This has a direct impact on the economic growth of farms, reducing operational costs, and increasing the production of quality milk and meat [1, 10, 11].

Another example of modern technology used is digital feed management, through sensors and

automated systems that monitor the nutritional needs of animals, thereby optimizing feed use and reducing waste. Additionally, the use of smart systems for managing manure [7] allows its transformation into compost or biogas, contributing to soil fertilization or energy generation, instead of becoming a polluting waste.

Furthermore, the constant monitoring of animal health through telemetry technologies and the Internet of Things (IoT) helps prevent diseases, thus reducing the need for chemical treatments and interventions that may harm the environment [2, 14, 9]. These solutions allow for more efficient resource management and more sustainable production.

The use of modern technologies in cattle farms plays an essential role in implementing the principles of the circular economy. In this context, the circular economy involves maximizing the use of resources, minimizing waste, and creating a sustainable system where by-products are efficiently reused and recycled. In cattle farms, innovative technologies significantly contribute to these goals.

In this paper, we will explore the most common scenarios of GIS use in cattle farms, highlighting the interaction with other modern technologies and how this technology contributes to the development of more efficient and sustainable agriculture.

According to [5], "an information system includes technical, organizational, and personnel components, computing techniques, regulations, and imposed methodologies, with the goal of proper and efficient data management, from collection to CRUD operations (create-read-update-delete) and the presentation of final results." Therefore, it must be understood that the implementation and use of a GIS is a process that requires the allocation of financial and human resources both during development and implementation, as well as throughout its operational lifespan and usage.

In the context of modern and sustainable agriculture, any GIS must perform at least four basic functions, which are also applicable in cattle farms: monitoring, control, prediction, and logistics (Fig. 1).

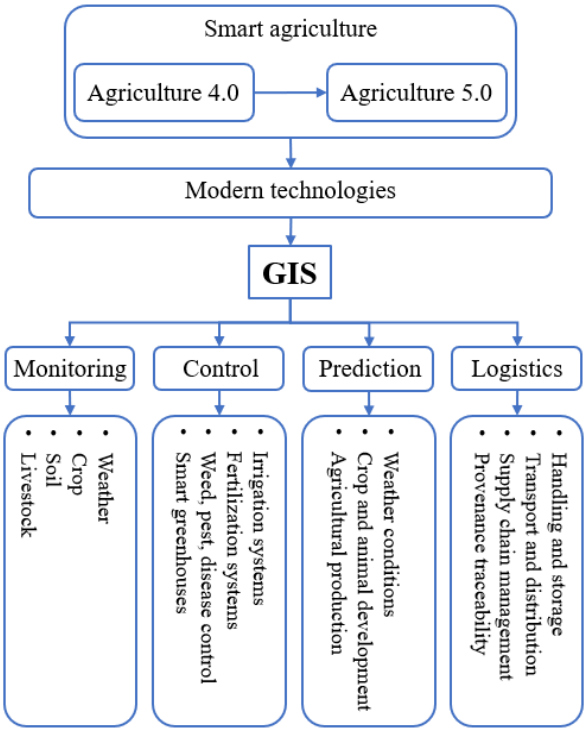

Fig. 1. The use of modern technologies in smart agriculture.
Source: Own elaboration, adapted from [9].

The methodology for designing and implementing a GIS (Fig. 2) involves several essential stages to ensure the effective integration of geospatial technologies into a project [14].

The first stage is the requirements analysis, which involves identifying user needs and defining the objectives of the GIS system. Next, the system architecture is designed, including the selection of the software platform, necessary hardware, and the definition of the data structure. After the design phase, the actual implementation follows, which consists of collecting and processing geographical data and integrating it into a GIS database. After implementation, system testing is crucial to verify its functionality and performance. Finally, user training is carried out, and a plan for system operation, results presentation [13], and system maintenance is established to ensure the long-term update and accuracy of the data.

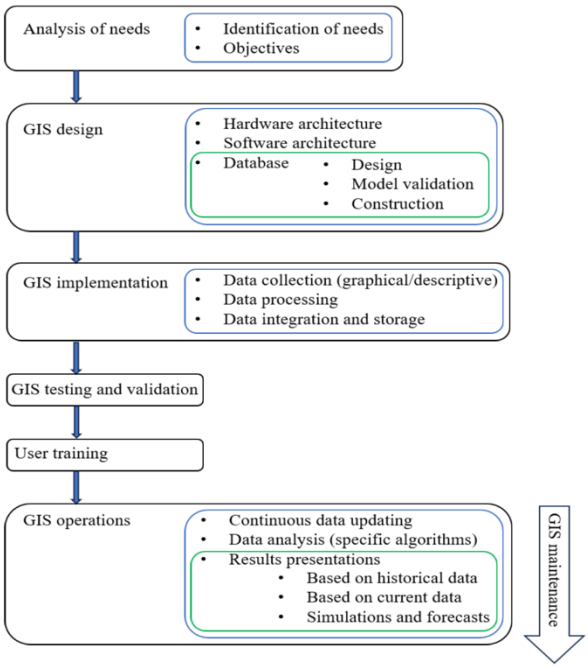

Fig.2. The methodology for designing, implementing, and operating a GIS.
Source: Own elaboration, based on literature review.

In this paper, we aim to analyze the possibility of integrating GIS with innovative technologies and identify the most common scenarios for applying GIS in livestock farm management.

MATERIALS AND METHODS

In this study, we aim to explore the feasibility, utility, and benefits of implementing and using GIS in cattle farm management. GIS provides a data-driven approach for monitoring and optimizing resources, enhancing decision-making in the livestock sector. The study focuses on identifying and analyzing how GIS integrates with advanced technologies. Additionally, it seeks to identify the most applicable scenarios for GIS implementation in cattle farms.

To achieve these objectives, we followed a structured methodology based on documentation, analysis, and direct interaction with industry specialists. The applied methodology is presented in Figure 3.

In the first stage, we established the study objectives. These aimed to identify the most common uses of GIS in cattle farms, its integration with modern technologies, and the evaluation of its impact on farm efficiency and sustainability.

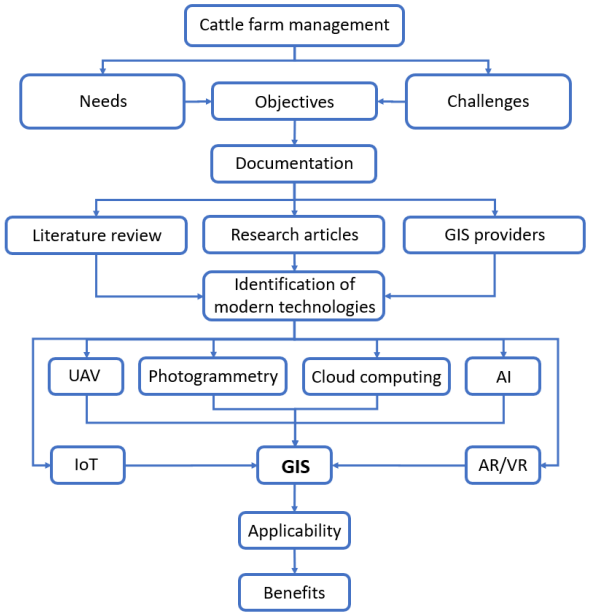

Fig. 3. The research methodology.
Source: Own elaboration, based on literature review.

The second stage involved in-depth documentation through a review of specialized literature and relevant scientific articles (academic databases such as Web of Science and Science Direct). We analyzed case studies and recent research exploring the implementation of GIS in agriculture and animal husbandry, focusing on resource management, feed optimization, animal health monitoring, and pasture management.

In addition to theoretical documentation, direct interaction with industry stakeholders was considered essential. Thus, we conducted discussions with companies that develop and implement GIS solutions for cattle farms. These interactions provided valuable insights into practical challenges, existing solutions, and future perspectives on the use of these technologies.

Based on the collected information, we proceeded to identify modern technologies that work alongside GIS to improve farm management.

The final stage of the study was determining the applicability and benefits of GIS in cattle farm management. Based on the conducted analyses, we determined that GIS contributes to resource optimization, operational cost reduction, productivity improvement, and increased sustainability. We also highlighted

existing challenges, such as high initial costs and the need for user training.

Through this methodological approach, the study provides a clear perspective on how GIS and complementary technologies can transform cattle farm management, supporting data-driven decision-making and optimizing agricultural processes.

RESULTS AND DISCUSSIONS

Definition of GIS and its importance in agriculture

By analyzing the basic characteristics, we can say that GIS is an information system designed to capture, store, analyze, and visualize data that has a geographic component (location) [2, 8, 11]. Through the integration of digital maps with information collected from various sources (such as satellites, soil sensors, mobile devices, and drones), GIS helps users better understand and manage the distribution and dynamics of available resources. In agriculture, this technology is used to track and analyze various aspects such as land use, water management, weather conditions, plant and animal health, and much more [7, 14, 13, 16].

In cattle farms, GIS plays a crucial role in supporting the management of natural resources and infrastructure, helping farmers make informed decisions in real-time [1, 8, 12, 13]. By integrating data on soil and pasture quality, farmers can plan grazing routes more efficiently for their cows, reducing land waste and maximizing production. Similarly, GIS data can be used to track the flow of resources and identify potential problems or inefficiencies in the farm's internal processes.

Integration of GIS with other technologies

GIS have become an essential tool in managing and analyzing geospatial data, widely used in fields such as urban planning, natural resource management, environmental protection, and public safety. These systems allow for the collection, processing, and visualization of geographic data, and their continuous evolution has been closely linked to technological progress. Today, the integration of GIS with other emerging and traditional technologies has opened new horizons in geospatial data analysis, bringing significant benefits to many fields of activity [4, 9, 17].

One of the most obvious examples of GIS integration is its collaboration with *Internet of Things* (IoT) technology [9]. IoT involves the interconnection of devices and sensors that collect real-time data and transmit it to central systems for processing. When this data is integrated into a GIS system, it adds a dynamic dimension to geospatial analysis, enabling decisions to be made more quickly and efficiently. Figure 4 illustrates how IoT interacts with other technological elements and systems.

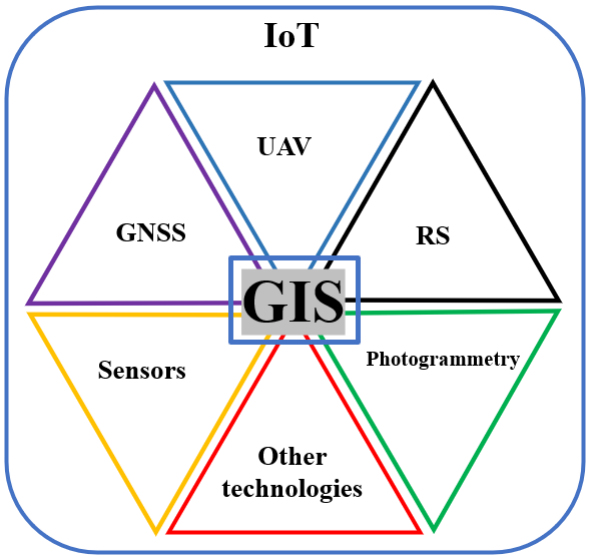

Fig. 4. IoT in the field of agriculture for smart farming.
Source: Own elaboration, based on literature review.

In animal farm management, sensors can be used to monitor soil quality, track weather conditions, place sensors on animals to collect data on their health and behavior, monitor staff locations, etc. Therefore, the integration of IoT with GIS not only improves real-time monitoring but also optimizes the management of stocks and resources.

Another field where GIS has found a natural integration is in *Artificial Intelligence (AI)* [9, 17]. Machine learning algorithms and neural networks, specific to AI, are used to analyze large amounts of data and extract patterns that would be difficult to identify using traditional methods. Within a GIS system, these technologies enable rapid analysis of geospatial data and prediction of long-term events or trends. In the field of natural resource management, AI can analyze geospatial data to

predict high-risk flood areas or assess the effects of climate change on specific ecosystems. AI algorithms can identify hidden patterns in geographic data, helping to make more informed and precise decisions.

Furthermore, *cloud computing technology* has revolutionized the way geospatial data is stored and processed. Instead of relying on local servers, which can be expensive and difficult to maintain, modern GIS platforms can store and process their data on external servers accessible via the internet. This brings significant benefits, especially in the context of large data volumes and collaboration between various organizations or government agencies managing the same geospatial data [3, 9]. For example, in disaster management, government institutions or rescue organizations can share geospatial data in real-time to coordinate interventions. Cloud computing not only reduces infrastructure costs but also enables global data accessibility, facilitating collaboration and information exchange between different entities.

Additionally, the integration of GIS with *augmented reality (AR)* and *virtual reality (VR)* opens up new possibilities for visualizing and interacting with geospatial data [7, 13, 15]. Augmented reality allows digital information to be superimposed on real images (Fig. 5), and in the context of GIS, this can help visualize in real-time how certain projects will impact a geographic area.

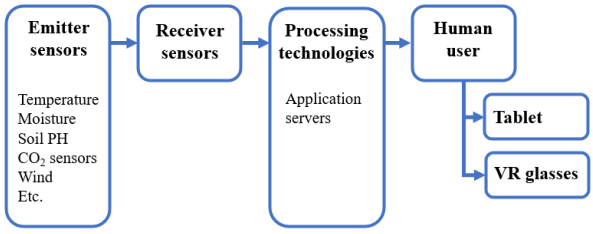

Fig. 5. Workflow for using AR
Source: Own elaboration, based on literature review.

For example, a specialist could use AR to visualize what a warehouse, land, or road would look like in a specific location, thus facilitating the planning, approval, and execution process of projects.

Moreover, virtual reality allows the creation of simulations of the geographic environment, and users can explore areas from a three-dimensional perspective. These technologies offer an interactive way to visualize and understand the complexity of geographic issues, thus contributing to better planning and decision-making.

Photogrammetry, a technology that uses aerial or satellite imagery to measure geospatial objects or phenomena, is another example of effective integration with GIS. It enables the creation of accurate models of terrain and objects within a geographic area and is essential in mapping and monitoring processes [1, 2, 15]. Figure 6 shows a photogrammetric processing model. In practice various processing models can be applied depending on the available data type and desired results.

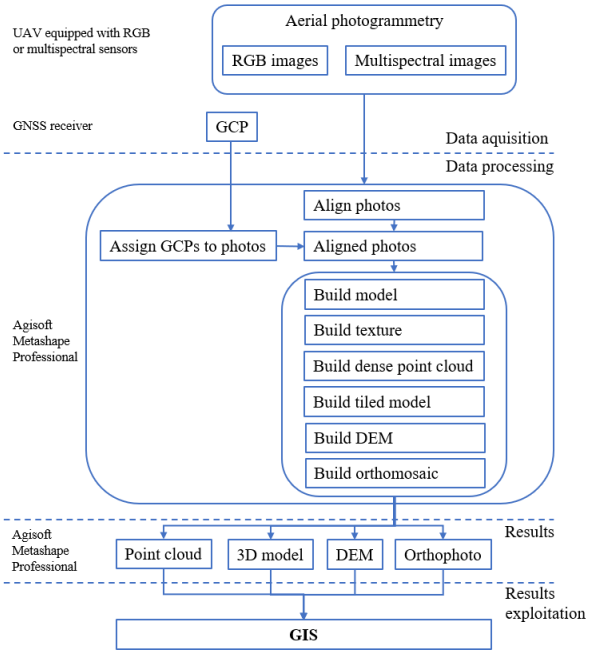

Fig. 6. Flow chart of image processing
Source: Own elaboration, based on literature review.

In combination with a GIS system, photogrammetry can add an extra level of detail to geographic analysis. Photogrammetry can be used to monitor changes in landscapes, such as soil erosion or deforestation, and this information can be processed in a GIS to create detailed maps that help local authorities better manage natural resources. Moreover, advanced photogrammetry techniques allow the creation of three-dimensional models of terrain [1], which contributes to more efficient project planning.

Similarly, remote sensing plays an important role in integrating with GIS [1, 2, 4, 9], allowing data collection from large

geographical areas using satellites or aircraft equipped with specialized sensors. Remote sensing can provide detailed information about the surrounding environment, including data on vegetation, water, soils, or urbanization. By integrating this data into a GIS system, complex analyses can be performed, and patterns that would not be easily observed from traditional sources can be identified. Through the use of satellite data and images, changes in the vegetation of a region can be detected, and this information can be used to assess the impact of climate change or human activities on ecosystems. Remote sensing and GIS enable continuous environmental monitoring and are essential in fields such as environmental protection, precision agriculture, and natural disaster management.

Another significant integration example is the use of GNSS measurements within GIS. These technologies provide precise coordinates of a geographical object or phenomenon, essential for creating accurate maps and collecting precise geospatial data [4, 6, 14, 17]. In fields like topography, cartography, and infrastructure management, GNSS measurements are crucial for obtaining accurate information about the positions of objects on the ground. A technician can use a GNSS receiver to measure the exact coordinates of a new construction or geographical feature, and this data can be integrated into a GIS system to create detailed maps or monitor the evolution of land over time.

Thus, we can appreciate that the integration of GIS systems with emerging and traditional technologies, such as IoT, AI, cloud computing, AR/VR, photogrammetry, remote sensing, and GNSS measurements, brings numerous benefits to the analysis and use of geospatial data. These technologies not only improve the ability to collect and process information but also contribute to making more informed [1, 8, 13] and faster decisions in essential fields such as natural resource management, urban development, environmental protection, and public safety. Their integration makes it possible to create more efficient and sustainable solutions to the challenges faced by contemporary society, and the future of GIS is undoubtedly closely linked to these technological advancements.

Benefits of using GIS in agrotourism cattle farms management

One of the main benefits of using GIS in cattle farms is the improvement of resource planning and management. Farmers can use maps and geospatial analyses to better assess land use and make informed decisions about how to utilize it. This includes determining the best areas for grazing, planting forage crops, or establishing irrigation zones. Additionally, the use of GIS can assist in efficiently monitoring water resources and managing irrigation systems, which are essential in farms facing droughts or extreme weather conditions [10, 6, 13, 16].

At the same time, GIS can help reduce costs by optimizing workflows and resource distribution. By analyzing animal flows and their movements within the farm [12, 14, 17], farmers can identify the most efficient routes for animal transportation, reducing energy consumption and saving time. This is a crucial application in large farms where effective management of animal transport can significantly reduce operational costs.

In addition to economic benefits, GIS helps ensure a safer and more sustainable working environment for farm employees and the animals they manage [14]. Geospatial analysis can help identify and prevent accident risks on the farm, such as areas with heavy traffic or high potential for soil erosion. Moreover, using GIS to monitor animal health can aid in preventing the spread of diseases and improving cattle welfare [8, 11].

Challenges and future perspectives of using GIS in agrotourism cattle farms management

Although GIS technology has enormous potential in modern agriculture, there are challenges associated with its implementation. One of the main difficulties is access to accurate and up-to-date data, which is essential for GIS analysis to be useful and efficient. Additionally, integrating GIS technologies with other farm management systems may require significant investments in IT infrastructure and staff training.

Despite these challenges, the use of GIS in agrotourism cattle farms management continues to grow, and emerging technologies such as drones and precision sensors are expected to deepen the impact of GIS in this field. In the future, GIS is expected to become a core tool in farm management, contributing to the development of more efficient, sustainable, and resilient agriculture in the face of global challenges [8, 11].

GIS application scenarios for agrotourism cattle farms management

Various GIS system use scenarios can be applied in a farm setting. Following a study of the specialized literature, the most applicable scenarios for cattle farms are presented below.

GIS in land and pasture management

One of the most important aspects of cattle farms is land management, especially pasture management. GIS can help farmers map and monitor vegetation distribution, analyze soil quality, and identify areas that require specific interventions [10, 14, 16, 17]. Using GIS can help determine the most fertile grazing areas that should be used for feeding cattle [13], as well as identify places at risk of erosion or drought. GIS enables monitoring vegetation changes over different seasons and adjusting grazing strategies accordingly.

Land cover analysis is essential in cattle farming to maximize the use of available land [10,16], ensuring a constant supply of grass and reducing the risks associated with improper land management. GIS can be used to create detailed maps of the farm showing grazing areas, access roads, animal shelters, and irrigation infrastructure.

Monitoring animal health and well-being

Another important application of GIS in cattle farms is monitoring animal health and well-being. By integrating data from sensors placed on animals (bracelets or collars that measure vital parameters such as body temperature, heart rate, or physical activity) [4,12,17], farmers can create detailed maps of animal behavior and health status [8, 12, 11, 17]. This allows them to quickly identify cows that may show signs of disease or stress and intervene promptly to prevent the spread of diseases or avoid significant economic losses.

GIS can also be used to track cattle movement within the farm, identifying areas where animals spend the most time, preferred shelter locations, and abnormal behaviors [12,17]. This information is crucial for maintaining a healthy environment for the cattle, which can contribute to increased milk and meat production of superior quality.

Optimizing animal nutrition and feed management

Animal feed management is another important GIS application in cattle farming. Feed distribution maps can be created with GIS [14] to track which areas of the farm require more attention regarding available food for the cattle. Additionally, data from other farms can be used to anticipate the animals' feed needs at different times of the year [8]. This helps farmers reduce feed waste, improve feeding efficiency, and increase production.

GIS can integrate information about available feed types in different areas of the farm and how they affect cow performance. As a result, farmers can make better-informed decisions regarding the addition of dietary supplements or diet adjustments to improve animal health and productivity.

Farm infrastructure planning and management

GIS also plays an important role in managing farm infrastructure [14]. Creating digital maps of the farm can help in optimal planning of access roads, animal shelters, feed storage areas, and other facilities. This information can be used to avoid conflict zones, reduce accident risks, and improve the efficiency of daily operations.

GIS can also be used to analyze transport routes for products from the farm to processors or markets, identifying the most efficient routes, saving time and fuel. These infrastructure plans can contribute to reducing operational costs and creating a safer and more efficient working environment.

Spatial analysis and asset mapping

Spatial analysis and asset mapping in an agrotourism cattle farms are essential tools for efficient resource management [4,14] and improving farm performance. Using modern technologies such as GPS and GIS, farmers can create detailed maps of land, infrastructure,

and available resources (water, feed, shelters, equipment, etc.). These maps enable monitoring of resource distribution and usage, optimizing the spatial management of the farm. Asset mapping contributes to efficient land management, risk prevention, and long-term sustainability of the farm. In this way, farmers can make informed decisions that support both productivity and environmental protection.

Moreover, GIS can include and utilize resources from external environments, such as veterinary clinics, artificial insemination centers, semen storage facilities, biological or feed analysis laboratories, feed depots, nearby farms, markets, fairs, and public institutions regulating cattle farming.

Feed production or cultivation

Feed production refers to the activities of cultivating and improving resources for animal feed, an indispensable resource in livestock management. Feed production involves the cultivation and proper management of various grass, legume, or other plant species used to feed animals.

GIS systems allow the integration of multiple datasets (soil types, pedological data, land topography, climatic data, water resources) [13], enabling the identification of the most suitable land for cultivating feed and efficient crop management (by integrating data on environmental conditions, treatments, and applied fertilizers, standard crop growth models) [1,14,17]. Additionally, GIS can include data for multispectral analyses or for managing equipment and staff, with direct benefits on productivity and staff safety.

Monitoring animal vaccination levels

Vaccinating animals is a critical aspect of managing their health. Administering appropriate vaccines at the right times protects animal health and prevents the spread of infectious agents. GIS systems allow the integration of vaccination data for livestock [11,14], including who, where, when, and to whom, providing an overview of vaccination levels and coverage. This dataset can be correlated with data from individual monitoring sensors [4, 17], allowing for the evaluation of vaccination effectiveness. Generally, integrating GIS into animal vaccination monitoring improves the efficiency and effectiveness of vaccination programs by ensuring accurate data capture, informed decision-making, and improved coverage rates.

Tracking personnel locations

GIS systems include tracking and real-time monitoring features for personnel [14] and equipment, allowing for activity optimization and increased productivity. By integrating location sensors, the position of personnel (veterinarians, caretakers, vaccination staff, other workers) within the farm can always be known, enabling optimal allocation of activities and guiding them to the location of interest.

Moreover, the integration and use of personnel and equipment location sensors allow the implementation of alert mechanisms, with direct benefits for the safety and protection of the staff.

GIS for disease management

Using GIS for managing epidemics in cattle farms can significantly improve disease control and prevention [9,11,14]. By collecting and analyzing geospatial data, farmers can identify disease outbreaks, track their spread, and anticipate risks. GIS allows integration of data regarding animal locations [4,12,17], disease types, climatic conditions, and animal movements, helping to identify high-risk areas. Additionally, it facilitates the creation of detailed maps that support quick decisions, such as isolation, vaccination, or treatment. Continuous monitoring and real-time data updates ensure a prompt and efficient response, reducing the impact of epidemics on animal health and production [11].

CONCLUSIONS

The use of GIS in cattle farms represents a revolution in managing and optimizing various agricultural activities, offering significant benefits in terms of both operational efficiency and long-term sustainability. The implementation and utilization of a well-designed GIS can transform the way farms are managed, enabling more precise planning and detailed monitoring of resources. Integrating this system with other modern technologies, such as IoT, artificial intelligence, cloud

computing, virtual reality, augmented reality, photogrammetry, and remote sensing, greatly enhances the ability to collect, analyze, and utilize complex data for making informed and quick decisions.

The benefits of GIS in cattle farms are diverse and extremely valuable. From land and pasture management, optimizing animal feed and forage, to monitoring animal health and farm infrastructure, GIS offers solutions that support more efficient and sustainable resource management. Spatial analysis of assets, monitoring vaccination levels, and tracking staff locations are just a few examples of applications that contribute to increased productivity and reduced risks. Additionally, GIS can be used for disease management, helping to prevent and combat outbreaks by quickly identifying hotspots and high-risk areas.

Therefore, the use of GIS in cattle farms not only improves their economic performance but also contributes to creating a healthier environment for animals, better land and resource utilization, and greater adaptability to climate and environmental challenges. As technologies evolve, the continuous integration of GIS with innovative solutions will open new opportunities for farmers who wish to adopt a more efficient and responsible business model. However, it should be noted that there are also challenges in implementing and using GIS in livestock farms. Among these, we mention: the need for financial resources (both for implementation and during operation), the staff must be continuously trained to use the system, and the GIS must be constantly adapted to the farm's activities and its development pace.

REFERENCES

[1]Agatsiva, J., Oroda, A., 2002, Remote Sensing and GIS in the Development of a Decision Support System for Sustainable Management of the Drylands of Eastern Africa: A Case of the Kenyan Drylands, The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Vol. XXXIV, Part 6/W6.

[2]Al-Ghanmi, A.K., Al-Jabri, A.H., 2019, The role of remote sensing techniques (RS) and geographic information systems (GIS) in the development of agricultural land uses, Plant Archives 19(1):983-988.

[3]Basnet, B., Apan, A., Raine, S., 2001, Selecting Suitable Sites for Animal Waste Application Using a Raster GIS, Environmental Management 28(4):519–531, https://doi.org/10.1007/s002670010241

[4]Bhabhor, I.N., Vyas, H.U., 2018, Role of geoinformatics in animal husbandry, Gujarat Journal of Extension Education, Special Issue on National Seminar:113-116.

[5]Călina, A., Călina, J., Vangu, G.M., Croitoru, A., Miluț, M., Băbucă, N., Stan, I., Ionică, C., 2024, Geographic Information System. In Book Elements of topography and GIS Used in Forestry, Agritourism and Sustainable Development, 1st ed., Universitaria Publishing House: Craiova, Romania, pp. 235–238.

[6]Gopalakrishnan, B., Sugumaran, M. P., Balaji, K., Thirunavukkarasu, M., Davamani, V., 2021, GIS-based approach for mapping the density and distribution of crossbred cattle, The Indian Journal of Animal Sciences, 91(1):46–50.

[7]Gubert, F., Silvestri, S., Pecile, A., Grandi, L., 2018, A GIS-Based Approach for the Sustainable Management of Livestock Effluents on Alpine Meadows, Frontiers in Sustainable Food System, 2:55, doi: 10.3389/fsufs.2018.00055
https://doi.org/10.56093/ijans.v91i1.113273

[8]Hassanein, M.K., Abdrabbo, M.A., Farag, A.A., Abolmaaty, S.M., Khalil, A.A., 2012, Application of Geographic Information Systems to produce descriptive maps for Poultry Farms in Egypt, Nature and Science, 10(3):43-48.

[9]Mandal, S., Yadav, A., Panme, F.A., Devi, K.M., Kumar, S.M.S, 2024, Adaption of smart applications in agriculture to enhance production, Smart Agricultural Technology, 7:100431, https://doi.org/10.1016/j.atech.2024.100431

[10]Nong, D.H., Nguyen, T.T., Vu, X.T., Ngo, S.T., Vo, C.H., Tran, P.T., 2024, A systematic review of GIS-based and AHP approaches for identifying suitable locations for livestock farms, IOP Conference Series: Earth and Environmental Science, 1345:012003, doi:10.1088/1755-1315/1345/1/012003

[11]Norstrom, M., 2001, Geographical Information System (GIS) as a Tool in Surveillance and Monitoring of Animal Diseases, Acta Veterinaria Scandinavica, 42 (Suppl.1):S79, https://doi.org/10.1186/1751-0147-42-S1-S79

[12]Parlato, M.C.M., Valenti, F., Porto, S.M.C., 2024, GIS-based methodology for tracking the grazing cattle site use, Heliyon, 10(13):e33166, https://doi.org/10.1016/j.heliyon.2024.e33166

[13]Rana, M.M.S.P., Moniruzzaman, M., 2023, Potential application of GIS and remote sensing to evaluate suitable site for livestock production in Northwestern part of Bangladesh, Watershed Ecology and the Environment, 5:161–172, https://doi.org/10.1016/j.wsee.2023.07.001

[14]Scanpoint Geomatix Limited, White Paper: GIS in Animal Husbandry Management, 2023, https://www.sgligis.com/wp-content/uploads/GIS-In-Animal-Husbandry-Management.pdf, Accessed on February 12, 2024.

[15]Stal, C., Covataru, C., Muller, J., Parnic, V., Ignat, T., Hofmann R., Lazăr, C., 2022, Supporting Long-Term Archaeological Research in Southern Romania Chalcolithic Sites Using Multi-Platform UAV Mapping, Drones, 6, 277, https://doi.org/10.3390/drones6100277
[16]Tantuoyir, S.M., Muluneh, A., Danbara, T.T, 2025, Land suitability evaluation using GIS and multicriteria decision analysis for cashew cultivation in the Abaya-Chamo Watershed, Ethiopia, Smart Agricultural Technology, 10:100744, https://doi.org/10.1016/j.atech.2024.100744
[17]Turner, L. W., Udal, M. C., Larson, B. T., Shearer, S. A., 2000, Monitoring cattle behavior and pasture use with GPS and GIS, Canadian Journal of Animal Science, 80:405–413, https://doi.org/10.4141/A99-093