# EXPLORING USE CASES FOR AGRICULTURAL APPLICATIONS: PROPOSALS AND POTENTIAL IMPLEMENTATIONS

**Ana BALAN[1], Geanina PODARIU[1], Andrei BOBU[2], Eduard BOGHIȚĂ[2]**

e-mail: ediboghita@uaiasi.ro

**Abstract**

This scientific paper explores the evolving landscape of the agriculture industry in Romania and the increasing need for software applications to assist farmers in various aspects of their work. By streamlining operations and increasing productivity, these applications can help farmers reduce waste and remain competitive in the industry. Additionally, the paper highlights the potential of integrating advanced technologies such as decentralized platforms and artificial intelligence chat to revolutionize the way farming is practiced in Romania. Through an in-depth analysis of existing applications and proposals for potential implementations, this paper aims to provide insights into the future of the agricultural industry in Romania and the role that technology will play in its continued growth and success.

**Keywords**: decentralized agriculture, smart farms, value chain, digital farming, phone-enabled agriculture

The agriculture industry in Romania is constantly evolving, and farmers require efficient and effective software applications to assist them in various aspects of their work. Several existing applications available in the Romanian market promise to help farmers streamline their operations, increase productivity, reduce waste, and stay competitive.

The purpose of this article is to propose new ideas and potential implementations for agricultural applications in Romania. By analyzing the existing market and identifying areas of improvement, we hope to provide insights and suggestions for developers and farmers alike. Our goal is to create a more efficient and effective ecosystem for all those involved in the agriculture industry in Romania. Through the integration of advanced technologies such as artificial intelligence (Hao, 2019) and decentralized platforms, we believe that there is immense potential for innovation and growth in this sector. We hope that this article will serve as a catalyst for change and inspire others to join us in our mission to transform the future of agriculture in Romania.

## MATERIAL AND METHOD

This study was conducted by combining qualitative research on existing applications, identifying the problems encountered in the literature, and determining the reasons for the relatively low adoption rates of proposed solutions with quantitative research on the functionalities proposed by current software products. By combining these two research methods, we were able to gain a more comprehensive understanding of the current state of agricultural applications in Romania and identify areas for improvement. Through our research, we hope to provide valuable insights into the current landscape of agricultural software solutions and contribute to the development of more effective and efficient applications for farmers in Romania.

## RESULTS AND DISCUSSIONS

There is a significant interest in digitizing the agricultural sector in Romania, with a wide range of software products attempting to streamline the work of Romanian farmers. The majority of these applications have a primary goal of farm management, including costs, resources, and personnel. This classical approach is an attempt to move management from the physical realm (See Figure 1) to the digital realm (See Figure 2), which does not involve all participants in the farm practices. Responsibility is shifted to a digital database administrator, who must record everything and produce reports without allowing others to be involved or have a responsibility in day-to-day operations.

After analyzing the existing applications and observing the growing interest in increasing

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[1] AXIOLOGIC SAAS, Iași, Romania

[2.] Iași University of Life Sciences, Romania

digitalization and app usage, while at the same time noting the low adoption of the proposed solutions, it becomes clear that a change is necessary. The current approach of moving traditional management practices into the digital space, without involving all participants in daily farm practices (See Figure 2), may not be enough to fully support the needs of farmers. There is a need to develop new products based on innovative technologies such as communication, artificial intelligence, machine learning, and decentralization that can replace complicated menus and cumbersome databases. Ideally, each participant in farm activities should be involved in their work through the applications, allowing farmers to have a clear and quick overview of ongoing activities (Kenny, 2021), resources, progress, and problems within the farm (See Figure 3).
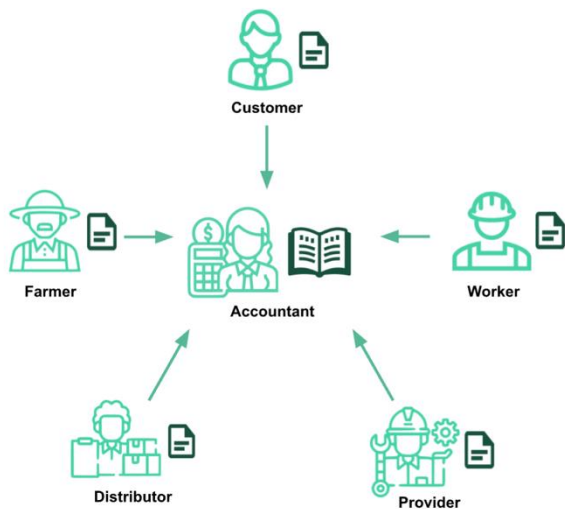


Figure 1 **Agriculture industry in the past: paper-based registry for centralized management of the agricultural sector**

In this regard, digitalization could be approached from two perspectives that need to be simultaneously addressed. The first perspective involves the development of new functionalities that can ease the work of those involved in agricultural practices, a perspective that is already addressed by most of the existing solutions on the market. The second perspective is the utilization of innovative technologies to improve the existing functionalities and activities related to recording and monitoring agricultural activities (Agyekumhene, 2020). Therefore, a holistic approach to digitalization in agriculture is needed, one that combines the development of new functionalities and the utilization of innovative technologies to enhance the overall efficiency and effectiveness of the agricultural sector. Only by addressing both of these perspectives can the full potential of digitalization in agriculture be realized.
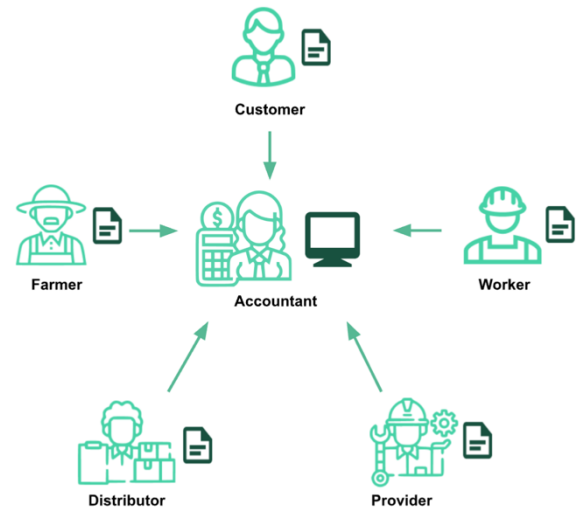


Figure 2 **Agriculture industry in the digital age: Computer-based registry for centralized management of the agricultural sector**

### Functional-driven use cases

Farm management software is essential for farmers to manage their operations efficiently. These applications can assist farmers in optimizing their productivity and provide real-time data on crop yields, weather conditions, and soil quality, among other metrics. Farmers can also monitor their resources such as labor and equipment, ensuring that they are being used optimally.

Livestock Management Software can help farmers to benefit from software applications and manage their herds. These applications can track animal health, reproduction, and weight gain, among other metrics. Livestock management software can provide farmers with real-time data on their animals, enabling them to detect potential problems early and take necessary actions to prevent them. This can help farmers improve the health and well-being of their livestock while also increasing their productivity.

Crop management software can assist farmers in monitoring and managing their crops. These applications can provide farmers with real-time data on soil quality, moisture levels, and weather conditions, among other metrics. This information can help farmers optimize their crop yields, reduce waste, and ensure that their crops are healthy and pest-free. Crop management software can also assist farmers in identifying potential problems early, such as pest infestations or nutrient deficiencies.

Weather forecasting software is an essential tool for farmers as it can help them plan their operations and protect their crops from adverse weather conditions. These applications can provide farmers with real-time weather updates, long-term forecasts, and even alerts for severe weather conditions. This information can help farmers plan

their planting and harvesting schedules, reduce crop losses due to weather-related damage, and make informed decisions about irrigation and fertilization.

Farm accounting software can help farmers manage their finances and keep track of their expenses and income. These applications can provide farmers with real-time data on their cash flow, inventory, and profits, among other metrics. Farm accounting software can also assist farmers in filing their taxes and complying with local regulations, ensuring that they stay compliant with the law and avoid any penalties.

**Technology-driven use cases**

In today's world, technology has revolutionized the way businesses operate, and the agricultural industry is no exception (Higgins, 2020). The introduction of new technologies in agriculture has paved the way for better yields, reduced wastage, and improved sustainability (Emeana, 2020). In this article, we will dive deep into the various technologies that are being implemented in agriculture and the potential impact they can have on the industry, and second on innovative technologies that proved their potential in other industries but their adoption in agriculture could make a huge difference.

Water is a scarce resource, and with climate change, water scarcity is only going to increase. To tackle this problem, *smart irrigation systems* have been introduced in agriculture. Smart irrigation systems use sensors to measure soil moisture levels, weather conditions, and crop water requirements. The data is then analyzed, and the irrigation system is programmed to deliver the right amount of water at the right time. This ensures that water is used efficiently, and crops are not overwatered or underwatered, leading to better yields and reduced water wastage.

*Precision agriculture* is a farming management concept that uses technology to optimize crop yields and reduce waste. Precision agriculture uses tools like drones (Ayamga, 2021), GPS, and satellite imagery to gather data about soil, crops, and weather conditions. This data is then analyzed to make informed decisions about when to plant when to fertilize, and when to harvest. By using precision agriculture techniques, farmers can reduce their input costs and increase their yields (Clapp, 2020).

*Livestock* is an essential part of the agricultural industry, and *monitoring* their health and well-being is critical. The introduction of IoT (Internet of Things) sensors (Jayaraman, 2015) has made it possible to monitor livestock in real time. These sensors can monitor the animal's temperature, heart rate, and movement. This data is then analyzed to detect any abnormalities in the animal's health,

and the farmer can take appropriate action. This not only ensures that the animals are healthy but also helps to prevent disease outbreaks, leading to better yields.

*Vertical farming* is a relatively new concept in agriculture, and it involves growing crops in vertically stacked layers using artificial lighting. Vertical farming has several advantages over traditional farming methods. Firstly, it uses significantly less water than traditional farming, as the water is recycled within the system. Secondly, it can be done in urban areas, reducing transportation costs and increasing access to fresh produce in cities. Lastly, it allows for year-round production, increasing yields and reducing food waste.

*Robotics and automation* have the potential to revolutionize the way crops are planted, maintained, and harvested. Robotics and automation can perform tasks like planting, weeding, and harvesting, reducing the need for manual labor. This not only reduces labor costs but also ensures that crops are harvested at the right time, leading to better yields and reduced waste.

*Blockchain technology* has the potential to transform the agricultural industry by increasing transparency and traceability. Blockchain technology can be used to track the origin of produce, from the farm to the consumer. This ensures that consumers can be confident about the quality and safety of the food they are consuming. Additionally, blockchain technology can be used to improve the efficiency of supply chain management, reducing waste and improving yields (Balan, 2022).

The integration of *artificial intelligence (AI)* in agriculture offers numerous advantages, one of which is the ability to communicate easily and receive real-time reports. With AI-powered applications, farmers can easily share information with each other and receive reports on the status of their crops or livestock. This enables them to make informed decisions quickly, which can ultimately lead to increased productivity and profitability. Additionally, AI can help farmers detect and diagnose crop diseases or pests early, allowing them to take corrective measures before significant damage is done. The real-time communication and reporting capabilities of AI-powered applications offer a significant advantage to farmers, helping them to stay connected and informed in an industry that requires constant monitoring and quick decision-making.

*Machine learning* prediction has become increasingly important in agriculture due to its potential to improve crop yields and optimize resource usage. By analyzing large datasets and identifying patterns, machine learning algorithms

can predict crop growth, detect diseases, and optimize irrigation and fertilization schedules. This technology allows farmers to make data-driven decisions in real time, leading to increased efficiency and profitability. Additionally, machine learning algorithms can be used to analyze weather patterns and predict climate changes, helping farmers to adapt to changing environmental conditions. With the use of machine learning, agriculture can become more sustainable and productive, ensuring food security for the growing population.

*Decentralized platforms* have the potential to revolutionize the way we approach agriculture by providing a more transparent, secure, and efficient way to manage and exchange data. In traditional agriculture systems, data is often siloed and controlled by a few large entities, leading to limited access and control for farmers. Decentralized platforms offer a more democratic approach, allowing farmers to retain ownership and control over their data and facilitating secure and efficient sharing with other stakeholders. This can lead to better decision-making, improved collaboration, and increased innovation in the agriculture industry (Berthet, 2018).
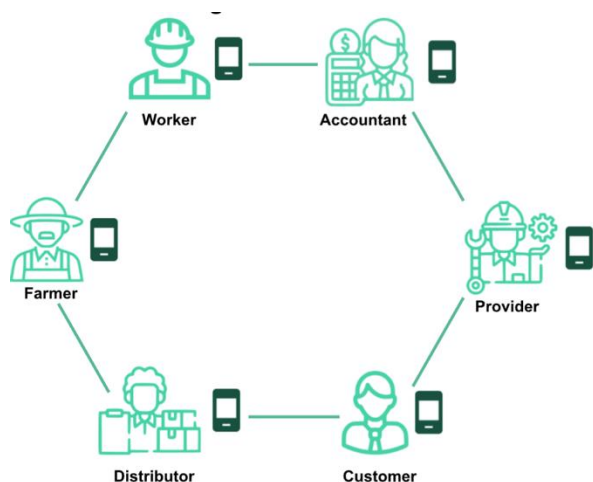


Figure 3 **Agriculture industry in the future: Self-sovereign applications and decentralized platforms for decentralized management of the agricultural sector**

Decentralized platforms have the potential to revolutionize the way people participate in agricultural activities by providing a transparent and secure environment for collaboration and decision-making. By leveraging blockchain technology, decentralized platforms can facilitate the engagement and responsibilities of all participants in the agricultural ecosystem, from farmers and producers to distributors and consumers. These platforms can provide a shared database of information, enabling real-time tracking of products and processes, as well as enabling participants to

validate each other's actions and contributions. This approach can create a culture of trust, collaboration, and transparency, where everyone involved can have a greater sense of responsibility and ownership, leading to improved performance and greater success for the agricultural sector as a whole.

### Contextual influence

For any software solution to be efficient and widely adopted, it must take into account both functional and technological use cases to fully realize its potential. This means that the application should not only provide the necessary functions to address specific problems but also be built on a reliable technological foundation. However, even with the best functional and technological approach, there will always be external factors that have to be considered before choosing the right approach. These factors could be related to market dynamics, regulatory requirements, or other contextual factors that could impact the success of the solution. Therefore, it is important for software developers and other stakeholders to carefully assess and consider these factors to create an efficient and effective solution that maximizes its adoption and impact.

The adoption of different software solutions in agriculture is influenced by various factors, including policy priorities at the national and European levels. At the European level, several key priorities related to agriculture and rural development have been identified. These include climate change mitigation and adaptation, biodiversity conservation, digitalization of agriculture, rural development, and social inclusion, and trade and international cooperation. These priorities are expected to advance the adoption of software solutions that promote sustainable farming practices, reduce waste, and improve the quality and safety of food. However, the adoption of these solutions could be delayed by factors such as limited access to digital infrastructure, insufficient funding for research and development, and resistance to change among farmers. Policymakers need to address these challenges (McCampbell, 2021) and provide support to ensure that the adoption of software solutions in agriculture is successful and sustainable.

### CONCLUSIONS

The agricultural industry is constantly evolving, and the introduction of new technologies has paved the way for better yields, reduced waste, and improved sustainability. In this article, we have explored various use cases for agricultural applications, starting with exploring farmer needs

and existing software applications, we identified a series of functional use case proposals, on the one hand, and potential implementations of technological use cases following the adoption of new technologies in complement industries. From smart irrigation systems to precision agriculture, livestock monitoring to vertical farming, and robotics and automation to blockchain technology, the potential impact of these technologies on the agricultural industry is immense.

In the realm of agriculture, each use case requires a tailored approach based on the specific needs of the farmers, access to technology, current regulations, and existing infrastructure. By breaking down each use case into different functionalities, various possibilities for implementation can generate personalized solutions that address the problem from a direct perspective. It is important to take into consideration all of these factors when designing and implementing a solution to ensure that it is both functional and technologically sound. A thorough analysis of each use case is necessary to determine the best approach and ensure that the solution is optimized for adoption and maximum potential.

When considering the development or adoption of a software solution, it's important to carefully evaluate the benefits that the solution provides and how these benefits can be maximized by choosing the right technology. It's essential to identify the use case that best fits the needs of your business, and then choose the most appropriate software solution that can address these needs effectively. By doing so, you can ensure that the solution you choose provides the maximum possible benefits to your business. It's also important to choose a technology that is suitable for your organization's existing infrastructure and can seamlessly integrate with your current systems. By carefully evaluating your options, you can select a software solution that not only provides the desired benefits but also complements your organization's long-term goals and objectives.

The digitalization of the agricultural sector offers numerous advantages that can help farmers achieve more efficient and profitable farming practices. With the help of agricultural software, farmers can automate many processes such as crop monitoring, data storage, and analysis, which reduces the need for manual intervention and saves time and resources. This software can also provide farmers with valuable insights into their crops and help them make better decisions about fertilizer application, irrigation, and other farming practices, leading to improved productivity and reduced losses.

Moreover, agricultural software can monitor costs accurately and identify opportunities to save money by optimizing the use of fertilizers, pesticides, and other inputs. By using satellite imagery, farmers can identify areas with pollution problems and use water more efficiently, reducing the environmental impact of farming. Agricultural software can also help monitor crops, identify problems earlier, and take action before they affect product quality, thus reducing the risk of financial losses.

Efficient inventory management is another benefit of agricultural software, as farmers can monitor stock levels and make informed decisions about when and how much to order to prevent surpluses or input shortages. Furthermore, precise irrigation control helps prevent water loss and ensures water is used efficiently. By identifying risks to crops and taking timely action, farmers can reduce the risk of losses. Improved communication through mobile apps and other software tools can help the farming team work better together, leading to better coordination and greater efficiency in farming efforts. Finally, farming software can customize farming practices to the specific needs of each crop and each land, making farming more efficient and profitable.

Software applications for agriculture in Romania can assist farmers in streamlining their operations, improving their productivity, and reducing waste. By leveraging these tools, farmers can stay ahead of the competition and succeed in today's rapidly evolving agriculture industry.

## ACKNOWLEDGMENTS

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