
APPLICATION AND PREVALENCE OF INFORMATION TECHNOLOGY (IT) IN AGRICULTURE

Vojin Cvijanović

Institute for Science Application in Agriculture, Serbia, vcvijanovic@ipn.bg.ac.rs

Marija Bajagić

Faculty of Agriculture, University of Bijeljina, Bosnia and Herzegovina, marijabajagic@yahoo.com

Gorica Cvijanović

Faculty of Agriculture, University of Bijeljina, Bosnia and Herzegovina, cvijagor@yahoo.com

Abstract: Smart agriculture can be defined as a combination of modern technologies and traditional farming methods. This industry primarily relies on the use of the internet as a tool to access essential information. Smart agriculture enables significant efficiency in production processes, both in agriculture and other economic sectors. By introducing new technologies into traditional farming, it transforms it into modern farming, thanks to innovations such as artificial intelligence, robotics, and more. Smart agriculture provides solutions for agricultural automation and intelligence. In developed countries, both the agricultural and industrial sectors still face challenges such as increasing productivity, food production, and creating employment opportunities, especially for people from poor and rural areas. Economic trends and rapid changes have a significant impact on the agricultural sector, and IT technologies play a key role in solving problems, improving and increasing productivity, and promoting agriculture. Although there is interest in the use of IT in agriculture, its full potential has not yet been realized. The digitalization of agriculture progresses slowly compared to other sectors, where IT technologies are adopted more quickly. In developed countries, IT technologies have had a significant impact on agriculture, leading to improvements and broader use of new devices and technologies. The use of personal digital assistants (PDAs) and handheld computers, which have recently transformed into various mobile devices, is expected to expand further. One of the main priorities of the European Union in the field of Information Society Technologies (IST) is improving internet access, especially for people in rural areas (e-Rural). Although these technologies have been quickly adopted and used across various sectors of the economy, they are expected to have an even wider application in the future. In low- and middle-income countries, smart agriculture, such as IT, can have a positive impact on agricultural production. The United Nations Food and Agriculture Organization (FAO) reports that global food production needs to increase by 70% by 2050 to feed the growing world population, which is expected to reach between 9.4 and 10.2 billion people. To achieve this increase, it is necessary to introduce new technologies to address challenges such as food production. These issues are particularly evident in less developed countries (LMICs), where the highest population growth is expected, leading to increased food demand. In these countries, most of the population lives in rural areas, and many farmers are small-scale producers (SSP). While there are positive advancements in developed countries, developing nations must improve their agricultural production to enhance living standards and meet growing needs. Agricultural transformation is essential for these countries to adapt to the growing population and achieve better economic development, which is a challenging task with many obstacles.

Keywords: agriculture, information technology, IT, smart agriculture

1. INTRODUCTION

Agriculture is a key sector vital to the further development of modern society. It is the primary source of food production and plays a crucial role in economic development, especially in developing countries (Praburaj, 2018). Agriculture is a field that requires the support of all other disciplines to function fully and progress. The agricultural industry plays an important role in increasing food availability and ensuring enough food for the population. There is uncertainty about the global agricultural sector's ability to meet the challenge of increasing food supply, despite universal consensus that global food demand will rise in the coming period (Pavlak & Kołodziejczak, 2020). Today, modern technologies are used in agriculture, such as robots, temperature and humidity sensors, aerial imagery, and GPS technology. These advanced devices enable businesses and farmers to be more profitable, efficient, safer, and environmentally friendly. Information technology (IT) in agriculture encompasses networks, mobile devices, equipment, services, and applications that facilitate the comprehensive operations necessary in agriculture. In developing countries, agricultural enterprises are involved in issues related to food security, human health, and food quality improvement (Milovanović, 2014). The implementation of new technologies, such as the internet, can positively impact smart agriculture by influencing the quality, quantity, profitability, and sustainability of agricultural production (Roukh et al., 2020). Smart agriculture and modern technologies can improve most agricultural processes and, through optimization, lead to greater productivity with reduced use of natural resources

(Zanella et al., 2020). Information technology (IT) is defined as tools, such as software and hardware solutions, needed to support management, operations, and strategies, aiming to increase organizational productivity (Thong & Iap, 1995). The purpose of IT is to transfer information from one point to another. When discussing modern agricultural technology, the role of IT as a decision-support system for farmers should be recognized. With the help of IT, farmers can stay up-to-date with the latest information. This includes data about weather, agriculture, and advanced methods to improve crop quality and production. The majority of the global population has access to the internet, and mobile internet is now the most widespread tool for internet access worldwide. Information technologies have helped the global agricultural sector advance and transform the ways producers cultivate, harvest, and distribute agricultural products. The introduction of such technologies aims to accelerate agricultural development by adopting innovative methods to improve existing information and communication processes. This revolution has particularly impacted small-scale farmers and has also helped address several challenges associated with traditional forms of agriculture. Agriculture has existed for centuries, whereas IT is a relatively young discipline, discovered only a few decades ago. However, IT plays a significant role in the agricultural sector. Technology and innovation are closely linked concepts, also associated with science, engineering, or knowledge, which focus on using knowledge and science to improve or do something better.

2. MATERIAL AND METHODS

The purpose of this scientific paper is to explore the questions and challenges related to the use of IT in the agricultural sector through a literature review. The aim of the paper is to present knowledge in a relatively new and specific area of study, including theories, applied methods, phenomena, and practices. To write this paper, data and information on the defined topic were collected and analyzed in line with the subject and research objectives. Secondary research was conducted using expert and scientific papers, information available on the internet, and contemporary literature on the application of information technologies in agriculture. The goal of this work is not only to explore the defined concepts but also to present the practical application of various IT solutions in agriculture.

3. RESULTS AND DISCUSSION

Smart agriculture can be defined as a new sector with the potential to monitor, observe, automate, and analyze operations. Also known as precision agriculture, this approach offers the ability to monitor agricultural activities using sensors and various software solutions. Smart agriculture is becoming increasingly important due to the growing global population, the rising demand for higher crop yields, the need for efficient use of natural resources, and the expanding use and sophistication of information and communication technologies. Historically, farms have not utilized high technologies, but it is planned that by 2025, there will be a significant implementation of this technology in agricultural production cycles. In smart agriculture, the internet serves as a key technology enabling data exchange between sensors and other devices. This enhances the value of information through automated processing, analysis, and access, achieving faster and more efficient farm management (Rechikin et al., 2019). Such management includes control, monitoring, and assessment of agricultural systems through technological support like artificial intelligence to solve problems. Among the adopted solutions are pest control systems, planting and replacing heavy tractors, soil compaction, precision fertilization and irrigation systems, use of drones for early disease detection, field scanning, and crop treatment. The term "precision agriculture" has the potential to use GIS and GPS tools to provide detailed information about the overall crop condition, yield, water absorption, nutrient levels, topography, and soil variability (Adrian et al., 2005). Precision agriculture is an approach that uses modern technology to optimize agricultural production. This technology-based management method is data-driven, allowing for detailed monitoring, measurement, and analysis of the specific needs of individual fields and crops (Perakis et al., 2019). Precision agriculture can also contribute to the broader goal of meeting the growing food demand by ensuring the sustainability of production (Roberts et al., 2021). One of the most common applications of the internet is in monitoring water usage for optimal plant growth, determining soil moisture, and nutrient content (Kurdyumov et al., 2020). The introduction of information technology (IT) into crop production is becoming increasingly important due to the need for more efficient, sustainable, and productive cultivation systems. Automation with the help of IT enables precise management and control of key parameters such as climate conditions, soil characteristics, minimizing human involvement, and data management. In this regard, IT helps meet the increased demand for newer approaches. This digital agricultural technology also aids in empowering rural farmers by providing better access to efficient production strategies. Some key trends in digital agriculture, based on current economic technologies and data obtained from drones and satellites, enable farmers to gain more detailed insights and better recommendations for managing production. The development of the digital economy in agriculture allows farmers to improve the quality of their products and increase production volumes, which is essential in the face of

growing market competition. Digitization in agriculture not only enhances the competitiveness of producers but also contributes to the expansion of markets for agricultural products, enabling them to reach a wider consumer base and conquer new markets (Khasanovna et al., 2020).

There are several issues in agriculture that hinder the faster and more efficient spread of information technologies in this sector. For instance, problems such as uneven quality of mobile communication in agricultural areas make data exchange more difficult. Additionally, there is a lack of funds for investing in farm digitalization. Of course, the lack of funding for agricultural modernization through digitalization is the most pressing challenge. One possible solution could be to create a unified platform and mechanisms to attract investors and strengthen public-private partnerships in the agricultural sector. For digitalization processes to be effective, systematic and quality monitoring is needed, which is currently challenging at the city and regional levels. An important systemic problem is the unwillingness of businesses and managers to adopt digital processes due to a lack of human resources, skilled personnel, digital skills among leaders, and a vision for a digital future. These issues reflect the qualitative state of the institutional environment for the application of digital technologies in agriculture.

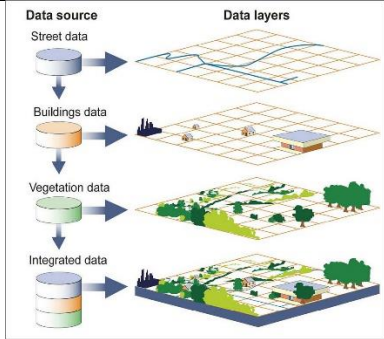
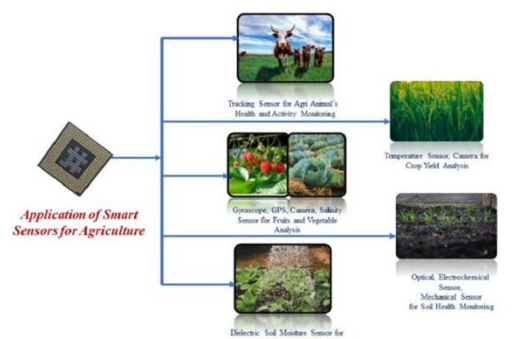
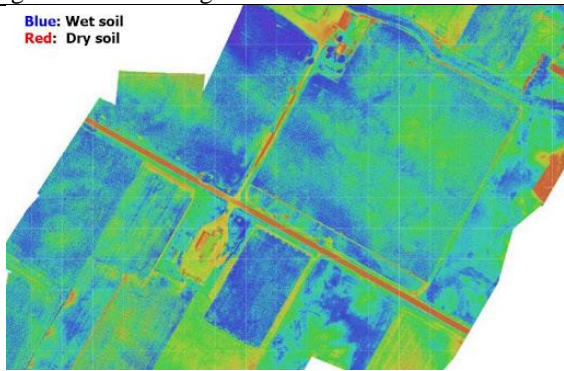

<p>Figure 1. GIS (“Geographic Information System”)</p>  <p>Source: https://education.nationalgeographic.org/resource/geographic-information-system-gis/</p>	<p>Figure 2. Application of smart sensors in agriculture</p>  <p>Source: Ullo et al., 2021</p>
<p>Figure 3. Monitoring of field conditions</p>  <p>Source: https://www.croptracker.com/blog/drone-technology-in-agriculture.html</p>	<p>Figure 4. Presentation of smart agriculture</p>  <p>Source: https://rpsaus.com.au/blog/why-do-we-need-smart-agriculture-here-are-the-benefits/</p>

Table 1. SWOT Analysis of the Food for the Future Sector

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> • Educated and highly qualified staff • Developed agricultural production/raw material inputs • Traditional products, biodiversity, agriculture without GMOs • Examples of successful export-oriented producers • Examples of successful innovations 	<ul style="list-style-type: none"> • The education system lacks modern applied knowledge and practices • Low transfer of technology from research and development to companies • Poor perception of the need to protect intellectual property • Lack of suitable workforce • Poor demography in rural areas

<ul style="list-style-type: none"> • Examples of successful intersectoral cooperation and diversification 	<ul style="list-style-type: none"> • Underdeveloped technological infrastructure • Fragmented farms • Fragmented production capacities and suboptimal industrial clusters and other arrangements of business associations • Inadequate production structure – products with low added value • Underutilized potential for intersectoral cooperation • Investing in insufficiently sustainable, insufficiently productive and uncompetitive industries and technologies • Distrust of producers in domestic innovations
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THREAT	OPPORTUNITIES
<ul style="list-style-type: none"> • Strengthening of intersectoral cooperation and multidisciplinary arrangements • Intensive agricultural production • Greater share of value-added products through innovation • Certification and commercialization of traditional foods • Export to the markets of the most favored countries • Use of technologies and innovative sales and promotion arrangements • Greater efficiency in the use and development of agricultural advisory services 	<ul style="list-style-type: none"> • Emigration abroad and migration of young people from rural areas • Weak technical preparedness for climate change • Greater EU agricultural subsidies • Lack of continuity in the implementation of incentive policies and strategies • Consumer distrust and resistance to innovation

Source:(Smart specialisation strategy of the Republic of Serbia for the period 2020 to 2027.)

4. CONCLUSION

Farmers need information about the latest crop varieties, changing weather conditions, new crop production techniques, and advanced agronomic practices in order to elevate their production to the next level. Information technology is crucial, as it enables farmers to access the necessary information for further development and to track trends. In order to meet the growing food demand caused by the increase in the human population, farmers must demonstrate readiness and the ability to adapt and adopt new technologies. The introduction of information technologies (IT) in agricultural production is a key strategy for efficient IT resource management and addressing challenges in food production. By adopting these technologies in all stages of the production process, better results can be achieved and human resources can be utilized in an optimal manner. To ensure the sustainability of food production at a national level, all key actors in the agricultural sector, including farmers, businesses, decision-makers, and technological innovators, must collaborate and take on their roles in the transformation of agriculture. This requires a collective approach, where all resources and expertise are utilized in the best possible way. The need for a transition to modern agriculture underscores the importance of information technology as an inseparable part of modern farming that should be fully embraced. Moving away from local and traditional methods toward integrated, digital solutions that offer greater efficiency, better resource management, and increased yields is essential. IT-integrated agriculture shows significantly higher yields compared to traditional farming practices, offering solutions tailored to the challenges of today and the needs of the future.

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