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Prospects and repercussions of digital agriculture to achieve Sustainable Development Goal 2: A thematic literature review

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ABSTRACT

The concept of digital agriculture is currently accepted as a radical approach to reducing hunger on Earth and promoting the goals of Sustainable Development Goal 2 (SDG 2). The current paper examines the contribution of agricultural digitalization to achieve SDG 2, the key success factors, the readiness of Bangladesh, the evaluation of the relevant tools and technologies and challenges of implementation. The study is based on review of research articles, reports, and case studies from 2013 to 2025, collected from Scopus and Google Scholar using keywords related to digital agriculture and productivity The findings indicate that digital agriculture can improve productivity and income, cost reduction, sustainable supply chains, and nutrition but also requires the special approach to address the lack of skills and barriers to investments. Technologies such as mobile applications, Internet of Things (IoT), artificial intelligence (AI), and precision farming help farmers work efficiently and access markets, though they may reduce demand for low-skilled labor. Digital farming has both benefits and drawbacks in achieving SDG 2 as revealed in case studies conducted in Bangladesh, India, and China among other countries. Digital agriculture can greatly improve food security and rural life, but high costs, poor infrastructure, and lack of training are still significant problems. Effective adoption requires strong government support, proper training, and strategic planning to ensure inclusive and sustainable outcomes.

KEYWORDS: Digital Agriculture, Sustainable Development Goal 2 (SDG 2), Rural Development, Internet of Things (IoT), Labor Cost and Employment.

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1. Introduction

The concept of digitalization has been extensively studied in various sectors, such as business processes, supply chain management, and accounting practices (Deichmann et al., 2016; Mia & Islam, 2014; Quraishi et al., 2025). Studies show that digital agriculture is directly connected to SDG2, and digital technologies can help achieve this goal and provide guidance for better outcomes (Mondejar et al.,2021).

SDG goals and targets aim to bring peace and prosperity to the world (Verma & Nema, 2019). The Sustainable Development Goals are the goals set by the United Nations in 2015 to create a better world, support sustainable development, and address all important social needs in society (Mondejar et al., 2021). Sustainable development goals constitute 17 goals and 169 targets to be achieved by 2030 in all countries, whether rich or poor, and they need to work together to achieve these sustainability goals (Verma & Nema, 2019).

Particularly, the significance of digital agriculture in achieving Sustainable Development Goal 2 has been of interest to a broad and diverse group of stakeholders such academics, business owners, policymakers, government agencies and other non-government organizations. In addition to environmental and economic issues, the concept of SDG 2 encompasses a range of aspects of farmers' productivity aimed at eliminating hunger and malnutrition (Sobir, 2019; Verma & Nema, 2019). From an economic perspective, modern farming practices utilize digital technology to transform traditional agriculture into digital agriculture to ensure productivity (Andreev, 2023; Griffith et al., 2013; Gupta et al., 2021; Hamed et al., 2024; Kitole et al., 2024; Kljajić et al., 2024; Kumar & Sivanantha, 2022; Luo et al., 2023; Sarkar et al., 2019; Umarov et al., 2022).

Digital agriculture was proposed initially in 2015, which is consistent with SDG 2 and focuses on enhancing the quality of food, reducing hunger, and improving nutrition. Current literature also reflects the relationship between SDG 2 and digital agricultural productivity (Basso & Antle, 2020; Deichmann et al., 2016; Fleming et al., 2024; Hamed et al., 2024; Mondejar et al., 2021; Sarkar et al., 2019; Sridhar et al., 2023; Verma & Nema, 2019). Some studies have shown that the digital economy significantly helps a country grow and increase the productivity of various industries (Griffith et al., 2013). In addition to achieving SDG2, our study has also explored diverse outcomes, significantly rural development (Deichmann et al., 2016; Griffith et al., 2013; Yeasmin et al., 2024), efficient food supply chains (Balasundram et al., 2023; Khoruzhy et al., 2023; Priya & Sudha, 2021; Sridhar, 2023) and increased skills (Hilbeck et al., 2022; Rotz et al., 2019). The results suggest that the results of digital agriculture are interdependent and complementary; nevertheless, not all of them are favorable. Among negative impacts, there would be unfair competition thus worsening inequality, redundancy, resistance and unemployment in labor (Acemoglu and Pascual, 2019). This paper examines the role of digital agriculture in fostering the achievement of SDG 2 and outlines the key factors in the digitalization of agriculture. It also explores Bangladesh's readiness to adopt digital agriculture, considering potential productivity gains and the risk of unemployment.

In this scenario, the Research Question has centered on

RQ1: What are the critical factors for digital agriculture to achieve SDG 2?

RQ2: As an emerging country, is Bangladesh ready to capture the prospects and repercussions of digital agriculture?

Our review shows that digital agriculture closely aligns with Sustainable Development Goal 2 (SDG 2). If digitalization is considered an emerging component of the economy, various challenges and issues arise. In addition, this study discusses the current status of digitalization in agriculture and recommends appropriate tools and technologies. The thematic literature review has been performed manually, which has been shown to be more effective in discovering and assessing the interdependence of digital agriculture and SDG 2. The remainder of this paper is structured as follows: the next section describes the methodology used for the literature review, followed by a thematic analysis of the selected literature, and the final section highlights key findings, limitations, and directions for future research.

2. Methodology

The research paper utilizes a traditional literature review approach to analyse the impact of digital agriculture by using Scopus-indexed journals found in the ScienceDirect database and the Google Scholar database. Both Google Scholar and Scopus are reputable databases because they index a wide range of significant publications. The literature review approach focuses on two perspectives: taking either a narrow or a broader view by examining existing research in a particular area. When developing our search strategy, we reviewed various terms, including digital agriculture and labour cost, agricultural productivity and digital tools, and the intersection of digital agriculture and labour cost (Riccardo et al., 2021). Accordingly, our review aims to identify existing knowledge on digital agriculture, examine how it contributes to achieving SDG 2, and which areas have been explored or remain under-researched (Snyder, 2019). To identify the relevant studies, we identified publications on ScienceDirect that were indexed on the topics of the following research questions: digital technology and agricultural productivity to SDGs.

Also, a query using the keywords “impact of digital agriculture in achieving SDG 2” was conducted on the Google Scholar database. To narrow the sample of articles and ensure the trustworthiness of the results, we checked a set of inclusion criteria, including the case of studies that utilized the case-analysis study designs and covered the mixed-country settings, such as India, Germany, and the international collaborations (Kumar and Alamgir, 2024; Shamshiri et al., 2024). Our study focuses on publications, research article types, formal reports, reviews, comparative analyses, and syntheses (Andreev, 2023; Deichmann et al., 2016; Gupta et al., 2021; Riccardo et al.,2021; Prakash et al., 2024; Rotz et al., 2019; Sridhar et al., 2023).

2.1 Initial data statistics

To address the modern rise of this field of research, our search includes all articles that have been published since 2013 and thus captures the latest technological breakthroughs and the resulting consequences in the field of digital agriculture. Once the sample was selected, the authors manually reviewed the methodology and themes.

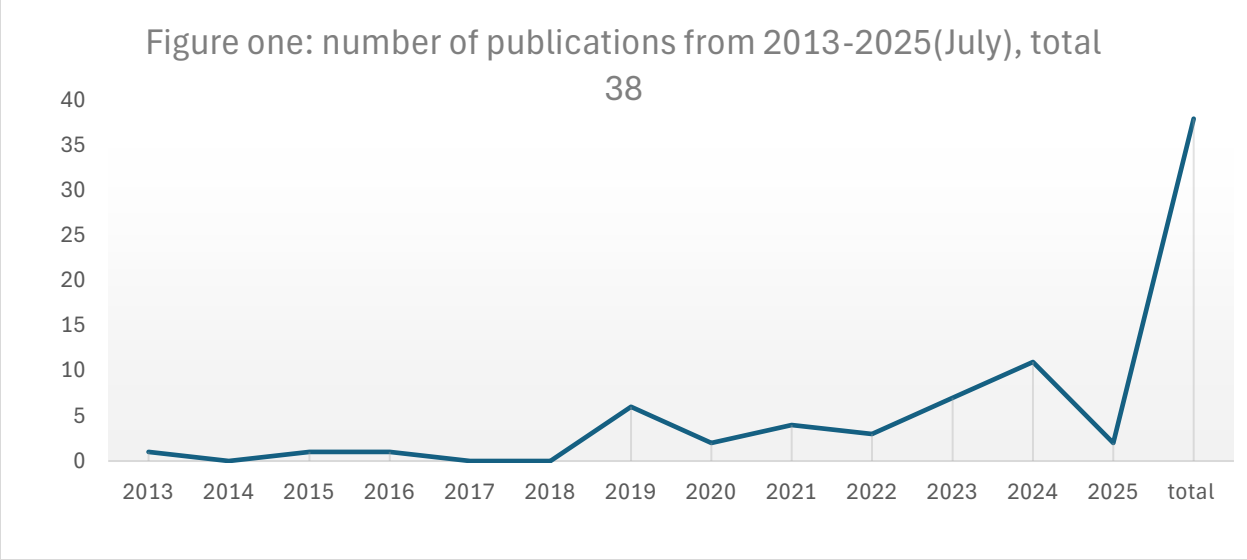

Figure 1: Trend of publications on digital agriculture for achieving SDG 2

In Figure 1, the publication trend on digital agriculture is discussed in relation to Sustainable Development Goal 2 (SDG 2). The graph shows that the literature on digital agriculture has been growing at a high rate compared to the year 2019 and the number of publications will be the highest in the year 2024. This trend can be discussed as an indication of growing academic interest of the field between 2013 and June 2025. Regarding the nature of the literature, among the 42 sources, 38 are research articles, three are reports, and the remaining one is website (see the reference list).

3. Discussion on findings

In the selected papers, thematic analysis identifies the main objectives or themes, key findings, and arguments. Table 1 lists the 12 most essential themes on “digital agriculture to achieve SDG 2” reported by the authors, followed by a detailed discussion as follows:

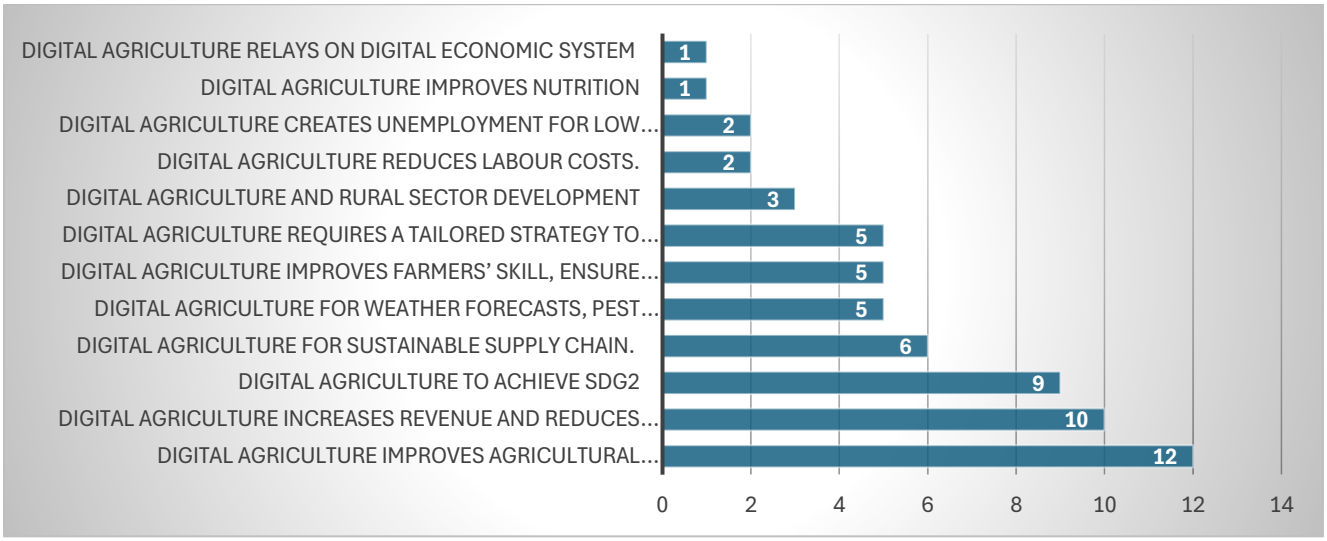

Figure 2: Major themes in Research on Digital Agriculture

Based on the following themes, in the subsequent discussion we have merged several themes to explore the specific impact of digital technology in relation to SDG 2: sustainable food supply and improved nutrition, agricultural productivity, farmers' revenue and expense management, issues of labor cost in digital agriculture, investments and stakeholders' involvement in digital agriculture, tools and technologies for digital agriculture, and the outcomes of implementing digital agriculture in a global context.

3.1 Digital agriculture to achieve SDG 2

The goal of SDG 2 (the second Sustainable Development Goal) is to reduce hunger by ensuring high-quality food security and nutrition, as well as promoting sustainable agriculture. In addition, the initial focus of digitalization in agriculture is indeed related to SDG 2, which is primarily in the agro-food sector, with a major priority of reducing hunger and achieving food security (Sridhar et al., 2023). In 2021, hunger issues affected the global population by nearly 9.8%, but these issues have increased significantly since then, with increases of 8% in 2019 and 9.3% in 2020. Globally, 11.7% of the population faces food insecurity (Sridhar et al., 2023).

The scenario of the global population is more than 7 billion, which is expected to reach around 9.6 billion, and also around 5 billion people will have enough money to buy sufficient food, and on the other hand, 4.5 billion people may also suffer from food insecurity, so to feed the population, agricultural production needs to double as quickly (Sarkar et al., 2019).

The trends suggest that the world remains far from the ultimate target of eliminating hunger and malnutrition-related issues (Sridhar et al., 2023). It is a significant challenge for humanity (Sarkar et al., 2019). Current research suggests a strong relation between digital agriculture and achieving SDG2 goal to combat hunger and malnutrition (Basso & Antle, 2020; Deichmann et al., 2016; Fleming et al., 2024; Hamed et al., 2024; Mondejar et al., 2021; Sarkar et al., 2019; Sridhar et al., 2023; Verma & Nema, 2019).

3.1.1 Digital agriculture for sustainable food supply chain

Research recommended that agro-based MSMEs play a significant role in creating and maintaining a sustainable food supply (Verma & Nema, 2019). Several studies suggest that digital agriculture plays a critical role in the sustainable food supply chain (Balasundram et al., 2023; iFarmer Limited, 2025; Khoruzhy et al., 2023; Priya & Sudha, 2021; Sridhar et al., 2023; Suma, 2024). Where MSMEs comprise the majority of agricultural and food producers, ensuring a sustainable food production system is crucial (Sobir,2019).

Figure 3: Impact of Digital technology to achieve Goals of the SDG2

[Adopted from Abiri et. al, 2023; Sobir,2019; Gupta et al., 2021; Hamed et al., 2024; Khoruzhy et al., 2023]

Digitalization enables access to a vast array of previously unexploited data networks, which can help society closely monitor the environment. Additionally, MSMEs can take potential steps to implement immediate actions in their business practices to help achieve this goal (Sobir, 2019). Kumar & Sivanantha (2022) have focused on a comparative framework-based study analyzing the transition from non-digitalization to digitalization in agriculture. MSMEs can be encouraged to support small farmers by buying products from local sources, promoting small-scale agriculture, and maintaining

a transparent supply chain so that people know where their food and materials originate. This approach also encourages local entities and sustainable farming practices (Sobir, 2019).

3.1.2 Digital agriculture improves nutrition

Currently, malnutrition costs the global economy up to 5% of GDP in lost productivity and direct healthcare spending (Sobir, 2019). In particular, MSMEs can improve nutrition through digital agriculture (Sobir, 2019). Considering that MSMEs tend to be labor-intensive, improved nutritional status can help produce a healthier workforce and contribute to increased productivity (Sobir, 2019).

3.2 Digital agriculture Improves agricultural productivity

Digital agriculture increases agricultural productivity (Andreev, 2023; Griffith et al., 2013; Gupta et al., 2021; Hamed et al., 2024; Kitole et al., 2024; Kljajić et al., 2024; Kumar & Sivanantha, 2022; Luo et al., 2023; Umarov et al., 2022; World Union of Small and Medium Enterprises [WUSME], 2023; WUSME, 2025). Digitalization makes farming highly efficient, improving food security and nutrition by using information systems for predictive weather forecasting, pest management, and reducing farming risks (Gupta et al., 2021; Hamed et al., 2024; Khoruzhy et al., 2023; Kumar & Sivanantha, 2022; Priya & Sudha, 2021; Suma, 2024). Software applications also enhance poultry farming in Bangladesh, assisting smallholders with better solutions that simplify their work through digital support (Suma, 2024). On the other hand, digitalization firms are more profitable and productive. Still, they face challenges, including the high cost of tools, a lack of training, and inadequate data privacy and security (Prakash et al., 2024).

3.3 Digital agriculture increases farmers' revenue and reduces expenses

Research suggests that digital agriculture increases Farmers' revenue and reduces expenses improves skills, ensures access to loan (Basso & Antle, 2020; Deichmann et al., 2016; Hilbeck et al., 2022; Khoruzhy et al., 2023; Lei & Yang, 2024; Luo, 2023; Priya & Sudha, 2021; Shamshiri et al., 2024; Suma, 2024; Umarov et al., 2022; iFarmer Limited, 2025; Kitole et al., 2024; Kumar & Alamgir, 2024; Prakash et al., 2024; Yeasmin et al., 2024). In the Tanzania context, it focuses on small farmers and shows how digital tools can make farming easier, more productive, and more profitable. Proper adoption requires training and a minimum level of digital literacy so that farmers can use technology at all production phases, both planting and marketing. This facilitates higher revenues, time savings, reduced food insecurity, and increased sustainability. Moreover, digital agriculture has helped to enhance the transparency of the supply chain, allow access to the direct market, and reduce income gaps between small and large-scale farmers (Lei and Yang, 2024).

Financial support also mitigates risk associated with bad weather and price changes and hence allows production to remain constant, outputs to be higher and income to remain stable (Yeasmin et al., 2024). Nevertheless, the availability of loans is usually limited in terms of the size of the farm, income, experience, high-interest rates and complicated procedures. Banks can also set restrictive eligibility rules or restrict help because of bad loans or because of the threat of natural disasters (Yeasmin et al., 2024).

Lastly, with the help of digital technologies, marketing and crop diversification, as well as supply chain management are enhanced, supporting agricultural productivity and sustainability (Deichmann et al., 2016).

3.3.1 Digital agriculture reduces labor costs

Ultimately, studies suggest that digital agriculture causes a decrease in the labor expenses (Basso & Antle, 2020; Rotz et al., 2019), which can contribute to the unemployment of low-skilled workers (Hilbeck et al., 2022; Rotz et al., 2019). Digitalization has also revealed the most important trends and tensions in the agricultural production, the use of technology, and the labor relations (Rotz et al., 2019; Acemoglu and Pascual, 2019). In the United States, the implementation of machine and digital technologies enables farms to yield more profitability at equal costs, using fewer inputs like water and fertilizers, and increasing environmental benefits (Basso & Antle, 2020).

In Canada, the research shows that innovative technology, such as sensors and artificial intelligence, is changing the agricultural practices and labor, but this is not the focus of the research on the topic of revenue management (Rotz et al., 2019). The final outcomes highlight the relevance of investigating the social implications of the existing technology in the field of agriculture in terms of labor equity and possible exploitation (Rotz et al., 2019). Digitalization is modernizing the labor market in a differentiation between high-skilled employees and low-skilled migrant labor, with farmers becoming the so-called digital workers, which in the interests of data management companies (Rotz et al., 2019). Such trends show how necessary policies are to reduce inequalities and avoid the exploitation that can be the result of adoption of digital technologies in agriculture (Rotz et al., 2019).

3.3.2 Costing and valuation

The authors found that the cost and economic perspectives are valuable and essential for improving sustainability outcomes (Fleming et al., 2024). Research showcased the necessity for 1) the growth

of dependable and rational valuation techniques that oppose any kind of manipulation, 2) finding ways to make natural capital accounting affordable and deliver value to users, and 3) supporting farmers in applying at the same time reporting these systems for diverse purposes and contexts. (Fleming et al., 2024).

The current study explores the economic impact of digitalization within the Serbian context with a specific emphasis on how it affected the revenue management of the agrarian sector (Kljajić et al., 2024). The analysis shows that farmers are slowly-moving towards digital solutions. Still, they do it with caution and shows that there is indeed a lot of potential in improving the revenue through better resource management and increased productivity (Kljajić et al., 2024). More than half of farmers (56.6%) are planning to increase their investment in digital, viewing this investment as a channel to increase their revenues (Kljajić et al., 2024). The main advantages identified are time savings, high productivity, and cost savings, but significant disadvantages are the high initial expenses and insufficient funding (Kljajić et al., 2024). A high percentage of farmers also state that they are not met with the degree of digitalization, which means that they create the need to continue advancement and improvement of digital projects in the agriculture sector (Kljajić et al., 2024).

3.4 Strategies for Managing Stakeholder Challenges in Digital Agriculture

Farmers face challenges such as small landholdings, lack of training, unreliable power supply, and high costs, which hinder the adoption of digital agriculture (Kumar & Alamgir, 2024). The implementation of digital agriculture effectively requires a modified and widely adapted strategy to address stakeholder complexities, including investment and skill gaps (Abiri et al., 2023; Andreev, 2023; Fleming et al., 2024; Kumar & Alamgir, 2024; Prakash et al., 2024). These achievements also depends on rural sector development (Deichmann et al., 2016; Griffith et al., 2013; Yeasmin et al., 2024) and the broader digital economic system (Griffith et al., 2013).

Strategic planning, particularly in digital marketing, can increase revenue by targeting the right audience, improving sales, and enhancing connections with potential buyers. It also provides insights into consumer behavior, reduces costs, and enables measurable performance improvements, thereby strengthening overall business outcomes (Umarov et al., 2022).

3.5 Digital Tools and Technologies for Agriculture

Digital agriculture provides evidence for the monitoring and control of crops, aquaculture, soil, livestock, and cross-cultural farm management needs, enhancing innovative and more efficient

agricultural activities (Sarkar et al., 2019). The digitalization tools reduce human labour, waste, and costs and also increase the yields of crops, which is accompanied by real-time monitoring (Shamshiri et al., 2024; Guebsi et al. 2024). In addition to that, these technologies can make the world more sustainable due to the improvement of soil health and a decrease in environmental impact (Hamed et al., 2024).

This study reviews how these advanced technologies of digital agriculture including smartphones, software and internet-based tools optimize agricultural productivity and make the market accessible for small-scale farmers (Basso & Antle, 2020; Deichmann et al., 2016; Griffith et al., 2013; Rotz et al., 2019; Sarkar et al., 2019). These technologies help address information barriers and improve supply chain management, which is essential for increasing revenue in agriculture (Deichmann et al., 2016).

Such tools of digitalization as drones, sensors and the Internet of Things can optimize the productivity of agriculture and thus allow farmers to lower the cost and maximize resources use to get more crop output and a higher profit margin (Shamshiri et al., 2024). Besides, these tools will help to predict and detect any kind of uncertainty early and manage water more efficiently, which will not only result in an additional source of income but also will reduce waste (Shamshiri et al., 2024). Digital agriculture, primarily through the Internet of Things (IoT), also faces fundamental issues on the food water energy nexus, the support of Industry 4.0, the reinforcement of collaboration and the reduction of global warming (Mondejar et al., 2021). Artificial Intelligence (AI) also leads to productivity by optimizing crop management, improving precision, and efficiently allocates the use of resources (Hamed et al., 2024). Integration of AI and IoT offers strategic opportunities in solving the problems of agriculture and assist to achieve the United Nations Sustainable Development Goals (SDGs) creating a fair, sustainable, and robust society (Mondejar et al., 2021). Empirical research claims that IoT enhances operational efficiency and returns by automating operations, reducing the use of pesticides, and combining the native agricultural knowledge with technological innovation, making the overall agricultural performance better (Priya & Sudha, 2021).

The Agri-technologies have become entire systems, which incorporate information science, environmental science, Geographic Information Systems (GIS), Global Positioning Systems (GPS), remote sensing, and virtual satellite imagery, making the agricultural activities aligned with the soil, climatic and environmental conditions (Sarkar et al., 2019). The use of emerging technology

including blockchain, personalization of food, big data analysis, cloud computing, and Online Analytical Processing (OLAP) systems further simplify planning, risk, and financial decision making, and improve efficiency and profitability (Khoruzhy et al., 2023; Prakash et al., 2024; Sridhar et al., 2023). Mobile applications provide meteorological predictions, market rates, and pest-control advice, which improve the quality of informed decision-making, yet adoption is still low, which explains why education and marketing efforts are required (Gupta et al., 2021).

The use of smartphones in the rural world has become a necessity for the smallholder farmers, boosting their productivity and access to the market (Luo et al., 2023; Deichmann et al., 2016). However, many innovations struggle to scale due to market fragmentation and unsustainable business models (Deichmann et al., 2016). Successful implementation requires complementary investments in infrastructure, education, and governance to address the broader challenges farmers face (Deichmann et al., 2016). The availability of satellite-based statistics and information was a significant drivers for smart farming, which is basically precision agriculture (Griffith et al., 2013). The implementation of the Global Positioning System (GPS) has been playing a notable role in improving the utilization of agricultural machinery in cultivation industries (Griffith et al., 2013). In contrast, the use of satellite imagery statistics, the improvement of soil and vegetation conditions knowledge has become possible in a wide range (Griffith et al., 2013). New scopes are being created for the rural area to enhance efficiency level and expand new markets (Griffith et al., 2013). The tech-based framework in the countryside for farming needs to be fully utilized to drive the wave of advanced technology (Luo et al.,2023).

Digitalized firms save costs, improve quality, and boost productivity (Kumar & Alamgir, 2024). Farmers do not use digitalization tools because they cannot afford to maintain them, which is primarily due to the low power supply and internet, the high cost of these tools, and a scarcity of skills and awareness about the advantages of digitalization for the agricultural sector (Kumar & Alamgir, 2024). That is why they face a slowdown in digital growth for revenue, suitability, and productivity (Kumar & Alamgir, 2024). Many existing technologies are custom-designed for specific tasks, making them expensive for commercial use; throughout the time, the rest remained in the initial phases of development, limiting their widespread adoption by farmers (Shamshiri et al., 2024).

Although these challenges are faced, digitalized farms are characterized by cost reduction, improved quality, and production. The government should assist and offer scalable solutions to maximize automation, sustainability, transparency with blockchain, and also the long-term

development of communities (Kumar and Alamgir, 2024; Mondejar et al., 2021; Shamshiri et al., 2024).

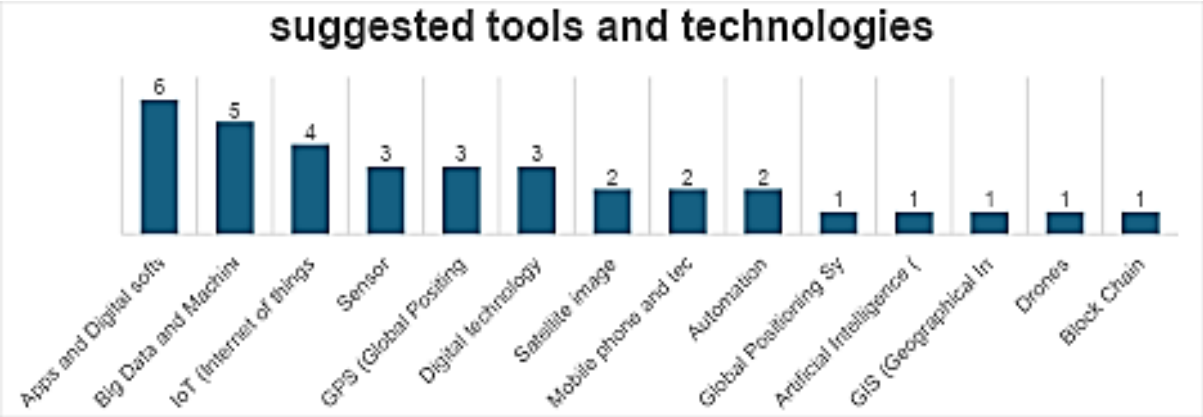

Figure 4: Most recommended digital agriculture tools and technologies

The figure shows that there is a strong tendency towards applications, digital software, big data, and the Internet of Things, and GPS, satellite imaging, mobile technologies, and general digital tools are moderately cited, followed by blockchain, drones, GIS and artificial intelligence. This trend suggests that stakeholders are more interested in accessible, data-driven solutions and software, rather than highly specialized or innovative solutions, thus pointing to a more general inclination towards more practical, scalable and technologically integrated solutions in the area.

3.6 Global Impact of Digital Agriculture

This paper discusses the role of digital agriculture in the world to promote a sustainable food supply. In Russia, digital solutions are mostly used to improve efficiency and productivity in agriculture (Andreev, 2023). Smartphone oriented applications have been developed, and China is using those apps to raise farm incomes by availing of modern farming equipment, but the poor farmers are unable to enjoy such gains to the fullest (Luo et al., 2023). The direct accomplishment of the Internet of Things (IoT) in agriculture has been highlighted to ensure cost-efficiency and maximize the earnings from crop through process automation and minimize the use of pesticide, which enhances sustainability (Priya and Sudha, 2021).

The implementation of information and communication technologies (ICT) and well-developed smartphone-based software in India facilitates farmers to manage revenue margins, procure information on time, and carry out business in the market (Gupta et al., 2021). Mobile commerce has high chances in rural places where there is high mobile penetration. Other government initiatives

like Kisan Sampada Yojana also encourage cost-effective food production and processing among the MSMEs (Verma and Nema, 2019). The post-epidemic crisis, in turn, highlighted the gaps in the supply chain of the agro-industry (Sridhar et al., 2023). Entirely, it is noticeable that the low percentage of productivity and excessive loss of crops accompany the effects of digitalization in non-digitalized farms, while the productivity of digitalized farms is greater, and their losses are reduced (Kumar & Sivanantha, 2022). The IoT integration enables the use of data to make informed decisions, which maximize the revenue management (Priya & Sudha, 2021).

Agriculture is one of the important foundations for Bangladesh economy with a contribution of about 12.50 -25 percent of the GDP and around 40 percent of the population was employed in the agriculture sector at 2020 (Yeasmin et al., 2024). The farmers play a crucial role in the food security process but the industry experiences issues, among them poor infrastructure, fragmentation of land, low productivity, lack of access to digital technologies, natural disasters and market insecurities. These problems further weaken the vulnerability and increase the dependence on agricultural credit, which mostly depends on the socioeconomic status of farmers (Yeasmin et al., 2024).

According to a case study conducted in Bangladeshi poultry industry, temperature monitoring becomes fundamental to prevent diseases, productivity and sustainability. The IoT-based monitoring systems enhance the results through the regulation of farm conditions and allowing routine consultations with veterinarians, optimization of feed supply, and direct communication with the market, all of which increase profitability (Suma, 2024). Another application like Sofol and Kri -shop also contributes to helping farmers to get credit, match with investors, and sell crops (iFarmer Limited, 2025). Smallholders have increased productivity by 15-20 through digital tools and have been able to do soil health diagnosis and better fertilizer recommendations due to satellite images and weather forecasts (Arshi, 2025). The innovations also empower women and reduce inequalities by increasing women access to agricultural services (iFarmer Limited, 2025).

Other than these advantages, automation can lead to the low demand of labour, which can ultimately raise the unemployment rate in highly crowded nations like Bangladesh (iFarmer Limited, 2025).

Figure 5: Global and country-wise research trends in digital agriculture

The figure represents the worldwide and country-wise circumstantial research trend on digital agriculture. Findings suggest a real disparity in the research impact of digital technology across locations. Among all these, the global context has received most of the concern, where emerging countries excluding India, whose economies are mostly dependent on the agricultural sector received marginal attention. Study findings also suggest that collaborative and continuous efforts are necessary to integrate digital technology into the agricultural industry to achieve SDG 2. Particularly, how digital agriculture can reduce labor costs and cause the risk of unemployment remains a limited area of study.

4. Conclusion

This paper identifies the role of digital agriculture in aiding Sustainable Development Goal 2 (SDG 2). It shows how digital agriculture relates to SDG 2, the key drivers of the digitalization of agriculture, and how prepared Bangladesh is, based on the potential opportunities of digital agriculture but also considering the risk of unemployment. There is no doubt that digital agriculture technologies can significantly increase agricultural productivity by ensuring maximization farming practices and resource management (Abiri et al., 2023). The coordination of these technologies empowers in better decision-making, resulting in increased yields and reduced costs (Abiri et al., 2023). Our study also highlights the difficulties farmers faces in implementing digital agriculture in their daily work activities and discusses future perspectives for its application in traditional farming practices (Abiri et al., 2023).

4.1 Challenges and policy recommendations

Tools of digitalization like drones, sensors and the Internet of Things can help to maximize the productivity of agriculture, and these things will allow farmers to lower the cost and optimize resources use to get more crop output and a higher profit margin (Shamshiri et al., 2024; Guebsi et al. 2024). Moreover, these tools will help to detect diseases early and manage water efficiently, which will not only result in an additional source of income but also reduce wastes (Shamshiri et al., 2024).

Digital agriculture, especially through the Internet of Things (IoT), also faces fundamental issues on the food water energy nexus, the support of Industry 4.0, the reinforcement of collaboration and the reduction of global warming (Mondejar et al., 2021). Artificial Intelligence (AI) also contributes to productivity by optimizing crop management, improving precision, and lessening the use of resources (Hamed et al., 2024). Combination of AI and IoT offers strategic opportunities in solving the problems of agriculture and helps to achieve the United Nations Sustainable Development Goals (SDGs) creating a fair, sustainable, and resilient society (Mondejar et al., 2021). According to empirical research, IoT involves operational efficiency and returns by automating operations, reducing the use of pesticides, and combining the native agricultural knowledge with technological innovation, making the overall agricultural performance better (Priya & Sudha, 2021).

Agri-technology has now become a comprehensive system that integrates the knowledge of information science, environmental science, computer and software engineering, systems science, geographic information systems (GIS), global positioning system (GPS) technology, remote sensing and virtual satellite imagery, thus matching the agricultural activities with the soil characteristics, climatic factors and environmental factors (Sarkar et al., 2019). Recent technologies such as blockchain and food personalization are becoming more and more popular as their value propositions are potentially valuable (Sridhar et al., 2023). There are empirical indications including IoT, big data analytics, and blockchain integration would help advance the profitability of the agricultural industry (Prakash et al., 2024). Additionally, the cloud-based technologies and online analytical processing (OLAP) systems can alleviate the costs and risks by enhancing the planning, expenditure management, and risk evaluation (Khoruzhy et al., 2023). These kinds of cloud-based services also assist the process of financial decision-making, but only if it is suitable (Khoruzhy et al., 2023). As a result, the main benefits of these types of digital tools includes cost management

through waste reduction, better risk management, and better decision-making, which leads to greater efficiency and flexibility in the work of the agricultural industry (Khoruzhy et al., 2023).

The mobile applications provide vital and operative information, including meteorological predictions, market prices, and pest-controlling advice, and as a result it helps to improve decision-making (Gupta et al., 2021). However, the relatively low level of their usage indicates the need to beef up marketing and educational efforts. The integration of cultural factors into the mobile commerce planning is critical to enhancing adoption and usage (Gupta et al., 2021).

The key to sustainable outcomes is based on the all-inclusive concept of energy production, conversion, and consumption in the agricultural systems and the overall economy (Basso and Antle, 2020). Based on this, governments should focus more on investment in rural digital technologies, which will ultimately lead to the development of the necessary infrastructures and supply chains, encourage modernization across the rural areas, and reduce the financial cost of technology adoption by providing more acceptable solutions (Lei and Yang, 2024).

The strategic efforts guide in making agricultural commodities perform better commercially, exploiting the opportunities that digital technology presents, finding various channel partners, and developing new and long-term sales models (Lei and Yang, 2024). The purpose of digitalization on the agricultural sector is to overcome the problem of managerial and decision-making issues (Andreev, 2023). However, the adoption rate is not consistent when it is being compared to geographic areas and large and small businesses, which hinders aggregate development (Andreev, 2023). The concern regarding data privacy and significant costs to maintain and ensure security of data continue to limit the adoption of digital technologies (Hamed et al., 2024). Future efforts should focus on integrating AI with other technologies and overcoming these barriers. Successful implementation also requires strategies that take into account the needs of all stakeholders (Andreev, 2023). In Bangladesh, for sustainable development, there is a need for a targeted, data-driven, and strategic approach to implement digital agricultural tools for farmers and rural areas (Husain and Rahmat 2025).

4.2 Limitations and prospects for future study

Our study has suffered from multiple limitations, as it is based on existing literature that lacks primary empirical evidence. We produce our argument by analyzing only the publicly available data. We do accept due to the unaffordability, limited access to the database also affects the analysis and

findings. In the future, more case-based studies should be conducted to address the following issues.

To achieve SDG 2, more applied and verifiable studies are needed to assess the effectiveness of digital agriculture technologies in reducing greenhouse gas emissions and enhancing food security, particularly in developing countries (Balasundram et al., 2023). Future research should also examine the potential of digital agriculture to mitigate climate change while addressing the gaps and limitations of previous studies. Additionally, there is a lack of research on labor costs and employment impacts. Holistic research efforts are needed to explore these areas and support the achievement of SDG 2.

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Conflict of Interest

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Appendix-1: Major Themes in Research on Digital Agriculture and Their Frequency of Publication

Sequence of the themes	Major themes	Number of articles
1	Digital agriculture Improves agricultural productivity	12
2	Digital agriculture increases revenue and reduces expenses	10
3	Digital agriculture to achieve SDG2	9
4	Digital agriculture for sustainable supply chain.	6
5	Digital agriculture for weather forecasts, pest control and risk reduction	5
6	Digital agriculture improves Farmers' skill, ensure access on loan	5
7	Digital agriculture requires a tailored strategy to address stakeholder complexities - investment, skill gap	5
8	Digital agriculture and Rural sector development	3
9	Digital agriculture reduces labor costs	2
10	Digital agriculture creates unemployment for low-skilled labor	2
11	Digital agriculture Improves nutrition	1
12	Digital agriculture relies on Digital economic system	1