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DIGITALIZATION OF AGRICULTURAL LAND UTILIZATION FOR FOOD AND ENERGY SECURITY AS A DRIVER OF THE SHARIA ECONOMY

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ABSTRACT
The development of digital technology has opened up new opportunities for more effective and sustainable agricultural land use, thus addressing the challenges of food and energy security in Indonesia. This study aims to explore a model for implementing digitalization in the agricultural sector that not only focuses on increasing productivity but also integrates renewable energy management as part of the sharia economic ecosystem. The research method used is a qualitative approach with literature studies and descriptive analysis of digital technology implementation models, such as the Internet of Things (IoT), big data analytics, and digital-based sharia financing platforms, in agricultural land use. The results of the study indicate that technology can increase the efficiency of agricultural production and strengthen the position of farmers in the sharia economic value chain. To support national food security, BNI implements agricultural digitalization through various services, such as the Farmer Card for fertilizer, empowerment of Fertilizer Kiosks, and digital People's Business Credit (KUR) facilities, which aim to increase farmer productivity. With the right strategy, state revenue can be increased without sacrificing long-term social and economic stability, and support sustainable digitalization in the agricultural sector. The implications of this study indicate that agricultural digitalization, when integrated with the sharia economic ecosystem, can be a key driver in creating an inclusive and sustainable food system.

Keywords: Agricultural Digitalization, Food Security, Energy Security, Sharia Economy

INTRODUCTION

Indonesia is an agricultural country with abundant natural resources, extensive agricultural land, and the livelihood of most of its population is in the agricultural sector (Khansya, 2024). Indonesia is known as an agricultural country, meaning a country that relies on the agricultural sector, both as a source of livelihood and as a support for development (Kuncoro, 2010). Based on data from the Central Statistics Agency (BPS) in February 2024, agriculture remains the dominant employment sector, employing 40.72 million people, or 28.64% of the population, compared to the trade sector at 27.09% and the manufacturing industry at 18.88% (Ajeng Dwita Ayuningtyas, 2024). This shows that agriculture is a crucial sector in supporting needs, maintaining price stability, and ensuring food security.

Agriculture is a key sector in the Indonesian economy. Acting Head of BPS Amalia Widyasanti stated that the agricultural sector contributed positively to economic growth, contributing 63.61 percent to GDP (Husen Miftahudin, 2024). However, over the past two decades, the agricultural sector has faced serious challenges in the form of a decline in productive land area due to conversion to industrial and residential areas. Many large-scale projects have displaced community agricultural land. Statistics Indonesia (BPS) data shows that the average conversion of rice fields reaches 60,000–80,000 hectares per year, threatening national food security if not balanced with management innovations (Central Statistics Agency, 2021).

Food security is one of the key issues facing the world in this era of globalization. As the world's population grows, the challenge of providing sufficient, nutritious, and affordable food becomes increasingly significant. Meanwhile, unpredictable climate change and limited natural resources threaten sustainable food production. However, technological advances offer new hope in addressing these challenges. Modern technology has

opened up numerous opportunities to improve food security in more efficient, sustainable, and environmentally friendly ways (Ardi, 2025).

Agriculture is a strategic sector that plays a vital role in maintaining food security and supporting energy sustainability in Indonesia. In the era of the Fourth Industrial Revolution, digitalization is one solution that can increase agricultural productivity and efficiency. Through the use of digital technologies such as the Internet of Things (IoT), big data, artificial intelligence (AI), and app-based information systems, farmers can monitor soil conditions, weather, and irrigation, and manage crop distribution more effectively (BINUS, 2021). Digitalization not only strengthens the food sector but also supports the development of agricultural biomass-based renewable energy, creating synergies between food and energy security.

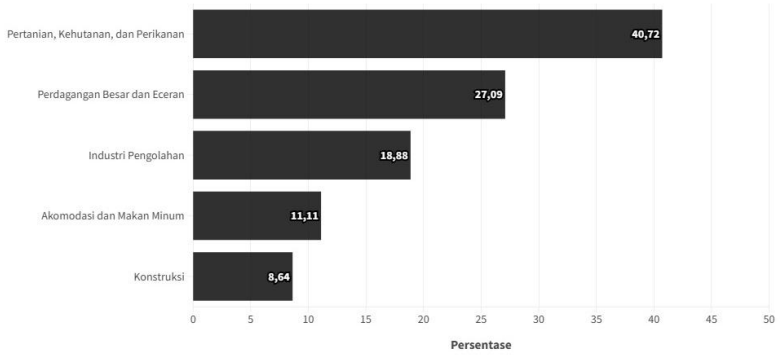

Figure 1. Business Sectors Absorbing the Most Workers in 2024
Source: Kementerian Ketenagakerjaan RI (2024)

In addition to food challenges, Indonesia is also facing energy security issues. High dependence on fossil fuels makes it vulnerable to fluctuations in global oil prices and exacerbates its carbon footprint, contributing to the climate crisis. The government has issued bioenergy-based renewable energy policies, including the mandatory B35 biodiesel program and plans to move towards B40, with projected biodiesel demand reaching 12–13 million kL per year (Ministry of Energy and Mineral Resources (KESDM, 2024). This shows that agricultural land is now positioned not only as a pillar of food security, but also as a sustainable alternative energy source.

Digitalization is increasingly relevant as internet penetration in Indonesia reaches 79.5% of the total population (±221.6 million users by 2024).(Indonesian Internet Service Providers Association (APJII, 2024). This opens up significant opportunities for agricultural digitalization to reach farmers in various regions, especially if supported by digital literacy and adequate infrastructure access. Pramono and Santoso's research, "Digitalization of Agriculture through IoT and Drones in Supporting Food Security," also shows that the application of drone technology, sensors, and digital applications can increase productivity by 15–20% and significantly reduce the use of chemical inputs (Pramono, B. & Santoso, D, 2022)In other words, digitalization plays a role not only in increasing efficiency but also in supporting sustainable agriculture. With digitalization, farmers can manage their land precisely, including monitoring soil moisture, detecting pests in real time, optimizing fertilizer and water use, and accessing digital markets to sell their crops. The Ministry of Agriculture has even launched programs such as the Agriculture War Room (AWR), the Integrated Planting Calendar (KATAM), and the KostraTani network to support the implementation of smart farming 4.0 (Ministry of Agriculture of the Republic of Indonesia, 2023).

Efficient and sustainable land use is not only profit-oriented, but also social and ecological sustainability. From a sharia economic perspective, the digitalization of agricultural land use can be viewed as part of implementing the values of maslahah

(benefit), isti'mar al-ardh (prosperity of the earth), and hifdz al-bi'ah (environmental preservation) (Kamali, 2011). The concept of maslahah emphasizes the importance of creating benefits and avoiding harm, while isti'mar al-ardh teaches the just and sustainable prosperity of the earth. Meanwhile, hifdz al-bi'ah is directed at reducing environmental damage, maintaining ecosystem balance, and providing sustainable benefits. Furthermore, digitalization opens up opportunities for integration with the halal ecosystem, including access to Islamic financing for smallholder farmers, a transparent digital trading system, and a more equitable distribution of agricultural products. Thus, the digitalization of agricultural land use not only contributes to food and energy security but also becomes a key driver of an inclusive and equitable Islamic economy (Huda & Martanti, 2020).

LITERATURE REVIEW

Digitalization of Agriculture (Smart Farming)

The Industrial Revolution 4.0 era is the fourth revolution to hit the world. All changes occurring, particularly during the Industrial Revolution 4.0 era, will benefit global life due to easier access to continuously updated discoveries. The Industrial Revolution 4.0 era can transform people's work for the better because people can expand their mobility. One aspect of the Industrial Revolution 4.0 is the development of the Internet or Internet of Things (IoT). This progress is achieved through the discovery of new technologies in the fields of science, robotics, and engineering. The technologies referred to in this context are nanotechnology, 3D, and artificial intelligence (Febrianti et al., 2021).

Smart farming technology is currently not only developing in developed countries, amidst the rapid flow of information and technology (such as the use of mobile phones and the use of the internet), several developing countries are already using smart farming methods (Halawa, 2024). Smart Farming or digital farming is a smart solution in the agricultural sector that utilizes an Internet of Things (IoT)-based network system to automatically monitor and control agricultural areas (Arta, 2023). The results of smart agricultural technologies need to be shared and understood in order to better grasp the idea that smart agricultural technologies can produce positive change (Halawa, 2024). The benefits of smart agricultural technology will bring changes to farmers' incomes and productivity, as well as improve the socio-economic structure, especially for farming communities.

This technology not only helps farmers in cultivation activities, but also transforming the entire agricultural supply chain. Some of the technologies that are the main pillars of smart farming include (Rachmawati, 2024): 1) Internet of Things (IoT) to monitor soil conditions, humidity, and weather in real-time; 2) Artificial Intelligence (AI) & big data to predict productivity, anticipate pests, and provide fertilizer recommendations; 3) Agricultural drones and robots for land mapping, spraying, and harvesting; 4) Blockchain to create transparency in the agricultural distribution chain.

In Indonesia, the implementation of Smart Farming has begun with various strategic programs: Agriculture War Room (AWR), Siscrop 1.0, pilot projects in pilot villages (Garut, Brebes, Situbondo, East Lombok), and digital applications such as E-Tani, TaniHub, and Sayurbox. This demonstrates that digitalization is not just about technology, but also about building a new digital agriculture ecosystem (Halawa, 2024). However, the challenges faced are quite large. Besides The high cost of implementing technology and the low digital literacy of farmers are also major obstacles. According to Munawaroh (2024), citizen participation in agricultural digitalization programs is crucial to ensuring sustainability. Through outreach, workshops, and training, village communities can adapt to new technologies and actively participate in decision-making (Munawaroh, 2024).

The use of IoT in agriculture enables the collection of real-time data on soil moisture, weather conditions, temperature, and ph. This data can be used to support farmers' decisions regarding irrigation management, fertilizer application, and crop protection. Plant (Mansoor, 2025). AI and big data play a crucial role in analyzing the vast amounts of information collected by sensors, satellite imagery, and UAVs to generate productivity predictions, early diagnosis of pest and disease attacks, and evidence-based technical recommendations for cultivation (Sharma, 2024).

UAVs, or drones, are used for land mapping, crop growth monitoring, and precision pesticide and fertilizer spraying. This technology has been proven to reduce input use by up to 40% and increase water efficiency by up to 30% (Maddikunta, 2020). Robotics and automation, such as driverless tractors, automated harvesting systems, and smart irrigation, have also been widely adopted in various developed countries to overcome labor constraints and increase production effectiveness (Raj & Prahadeeswaran, 2025).

Blockchain plays a strategic role in ensuring the traceability of agricultural products from the farm to the end consumer. This is becoming increasingly important in the context of global trade, food safety, and halal and organic certification. Blockchain can build consumer trust in products through transparent and unmanipulated transaction recording (Pranto, 2025). However, the literature also notes various challenges in implementing smart farming, particularly in developing countries. These obstacles include high initial investment costs, limited access to digital technology, low digital literacy among smallholder farmers, and internet infrastructure issues in rural areas (Alreshidi, 2019).

Recent studies suggest the need for an inclusive business model that combines support from the government, cooperatives, and Islamic financial institutions to expand farmers' access to digital agricultural technologies. Therefore, smart farming is not just a matter of technology adoption, but also institutional transformation, financing, and digital literacy. If implemented inclusively, agricultural digitalization has the potential to be key to achieving food security, energy efficiency, and sustainable economic development. Globally, developed countries have integrated digital technology into agriculture. For example: 1) The Netherlands uses IoT-based smart greenhouses to become one of the world's largest food exporters despite its limited land area; 2) Japan develop agricultural robots to overcome the labor crisis due to the decreasing number of farmers; 3)South Korea adopt smart green house with an AI-based control system that increases production efficiency by up to 40%.

Lessons from these countries show that digital technology must be accompanied by policy support, education, and community participation. This is in line with research by Munawaroh (2024) which emphasizes the need for strengthening citizen engagement To ensure agricultural digitalization is truly effective, agricultural digitalization is not only relevant for increasing productivity but also holds significant potential for climate change and environmental sustainability. For example, the use of sensors and AI can help reduce the excessive use of chemical fertilizers, which can lead to soil and water pollution (Munawaroh, 2024)

Food and Energy Security

Food security is a global strategic agenda. The FAO (2020) predicts that food production must increase drastically to meet the needs of the global population. Indonesia, as an agricultural country, plays a key role in maintaining food security, both for domestic consumption and international contributions (FAO, 2023). Munawaroh, in her research entitled "Strengthening Citizen Involvement in Sustainable Development through Agricultural Digitalization Programs," explains that digitalization of agriculture at the village level plays a role in increasing farmer knowledge, accelerating access to information, and reducing the risk of crop failure. This also encourage young generation to return to seeing agriculture as a promising sector, not just a traditional job (Munawaroh, 2024). Energy security encompasses a country's ability to ensure the

availability of sustainable energy at affordable and environmentally friendly prices (Yergin, 2020). Energy is closely related to agriculture, both as an input in production (for example the use of fertilizers, tractors, and electricity-based irrigation), and as an output in the form of renewable energy from agricultural waste such as bioethanol, biogas, and biomass (IEA, 2020). Thus, strengthening food security also contributes to energy security, and vice versa.

Food and energy security are two interrelated strategic issues in sustainable development. Food security is defined by the FAO as a condition when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food to meet their nutritional needs and food preferences for a healthy and active life (FAO, 2021). Meanwhile, energy security includes the availability of sustainable, affordable, and environmentally friendly energy resources to support economic activities and people's lives (IEA, 2022).

In a global context, rapid population growth requires an increase in food production of up to 70% by 2050 to meet world consumption needs (Alexandratos & Bruinsma, 2012). On the other hand, the agricultural sector itself is a significant energy consumer, from electricity for irrigation pumps to fossil fuels for tractors and distribution transportation. Therefore, the relationship between food and energy is often referred to as the food-energy nexus, emphasizing the importance of policy and technology integration in maintaining the sustainability of both sectors (Mansoor, 2025).

Digitalization in agriculture (smart farming) plays a significant role in increasing the efficiency of food production and supporting energy diversification. IoT and AI, for example, can precisely monitor crop water and nutrient needs, thereby reduce resource waste and increasing crop yields (Basso & Antle, 2020). In addition, technology-based waste management systems also enable the use of agricultural residues as an alternative energy source (Sarkar et al., 2012). From a policy perspective, Indonesia has enacted Food Law No. 18/2012 and the National Energy General Plan (RUEN) which targets a renewable energy mix of 23% by 2025 (Kementerian ESDM RI, 2017). However, implementation in the field still faces obstacles, including limited infrastructure, low digital literacy among farmers, and weak cross-sector integration between agriculture, energy, and technology (Purwanto & Afifah, 2020). Therefore, it emphasizes the need for regulatory support, green infrastructure investment, and synergy between the food and energy sectors to create long-term resilience. Therefore, food and energy security cannot be viewed in isolation. Both form a mutually influencing ecosystem and require an integrative approach through the adoption of smart technology, the use of renewable energy, and the support of inclusive policies.

Sharia Economics in Agriculture

Agriculture holds a strategic position in the Islamic economic system because it directly relates to meeting people's basic needs. Integrating smart farming with Islamic economic principles can create a more equitable, transparent, and socially just agricultural ecosystem (Rachmawati, 2024). Munawaroh's research confirms that agricultural digitalization can serve as a means of civic education that fosters the knowledge, skills, and character of citizens. This aligns with the principles of Islamic economics, namely justice, togetherness, and sustainability (Munawaroh, 2024).

Sharia economics in the agricultural sector emphasizes the principles of justice, sustainability, and blessings in the management of natural resources. The primary foundation of Sharia economic practices is the Qur'an and Hadith, which emphasize that the earth and all its contents are a trust from God that must be managed fairly and without harm (Chapra, 1992). In the context of agriculture, Islamic economics demands practices that prioritize not only financial gain, but also ecological sustainability, farmer welfare, and meeting the community's need for halal and thayyib food (Haneef, 2015).

Sharia-compliant financial instruments play a crucial role in supporting the agricultural sector. Sharia-compliant financing schemes such as mudharabah, musyarakah, and murabahah can provide access to capital for smallholder farmers who often struggle to obtain financing from conventional systems (Ascarya, 2020). In addition, the Islamic microfinance model has proven effective in increasing farmer productivity while simultaneously suppressing the practice of usury, which is prohibited in Islam (Obaidullah & Khan 2008).

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Sharia economics also encourages the application of Islamic ethical principles in agricultural supply chains. The halal value chain concept, for example, emphasizes traceability from production to distribution, ensuring consumers receive assurance of product quality and halal certification (Talib & Hamid, 2014). With the increasing digitalization of the agricultural sector, this principle can be strengthened through blockchain technology to maintain transparency and accountability for halal products. However, significant challenges remain. Several studies have shown that the level of Islamic financial literacy among Indonesian farmers remains low, hampering the optimal use of Islamic financial instruments (Firmansyah & Anwar, 2019). Furthermore, limited government policies to promote the integration of Islamic finance with the agricultural sector have resulted in uneven adoption. Therefore, a collaborative strategy is needed between the government, Islamic financial institutions, and agricultural businesses to strengthen the contribution of the Islamic economy to the food and energy sectors (Firmansyah & Anwar, 2019). Thus, Islamic economics in agriculture is not just a matter of financing, but also encompasses aspects of governance, production ethics, and environmental sustainability in accordance with Islamic values. This integration is expected to be a driving force in realizing food security, energy security, and equitable social welfare

METHODS

The research in this journal uses a theoretical study approach or literature review. This method was chosen because the research objective is to analyze the concepts, models, and implementation of digitalization of agricultural land use to support food and energy security as a driver of the Islamic economy. The literature review allows researchers to examine various previous research findings, including national and international journals, books, annual reports, and official government publications related to digital agriculture and the Islamic economy.

This research data is sourced from secondary data obtained through a literature search. The sources used include: 1) Scientific journals discussing agricultural digitalization, food security, renewable energy, and Islamic economics. 2) Reference books relevant to the concepts of smart farming, Islamic financing, and sustainable development. 3) Official government reports.such as the Ministry of Agriculture, the Financial Services Authority (OJK), and the Ministry of Cooperatives and SMEs. 4) International scientific articles published through the Scopus, Google Scholar, and ScienceDirect databases.

Data collection was conducted through library research, which involved searching, selecting, and compiling references relevant to the research topic. The data obtained were analyzed using qualitative descriptive analysis, with steps including data reduction, data presentation, and conclusion drawing. This method was chosen to provide a comprehensive understanding of the relationship between agricultural digitalization and sharia principles in sustainable economic development.

RESULTS

Potential and Barriers to Implementing Agricultural Digitalization

Agricultural digitalization has significant potential to increase productivity and efficiency in the agricultural sector. Globally, digitalization in agriculture is not just a trend, but an unavoidable necessity, given the world's accelerating population growth.(Basso & Antle, 2020). Over the past decade, digital technology has entered the agricultural sector through the concepts of smart farming and precision agriculture, which enable farmers to manage their land using IoT (Internet of Things) sensors, drones, big data analytics, artificial intelligence (AI), and blockchain (Nugroho, 2022).

The UN predicts that the world population will reach over 9.7 billion people by 2050, meaning that food demand will increase drastically, while agricultural land will not increase significantly. Therefore, the use of digital technology is a strategic solution to overcome land limitations by increasing productivity per hectare. Technologies such as IoT sensors for soil moisture, drone mapping for plant health, big data systems for weather prediction, and blockchain for supply chain transparency are believed to be able to address classic problems in the agricultural sector, such as production inefficiencies, high distribution costs, and fluctuating food prices (Basso & Antle, 2020).

Digitalization offers several benefits, including increased productivity and social and economic benefits for farmers. With digital agricultural applications, farmers can access real-time market information, monitor commodity price trends, and sell their crops directly without the help of middlemen. This creates more transparent market conditions, increases farmers' bargaining power, and provides fairer financial returns. For the government, digitalization enables more accurate agricultural data collection, allowing for more effective policies related to subsidies, food imports, and logistics distribution (Qureshi, 2021).

The application of agricultural digitalization has various great potentials cannot be separated from the existence of a number of serious obstacles. The first is the obstacle of digital literacy, where most farmers, especiallyIn developing countries, farmers still lack the knowledge and skills to use digital technology. The majority of farmers in developing countries, including Indonesia, still rely on traditional methods and are unfamiliar with using digital devices. This obstacle is exacerbated by limited internet infrastructure in rural areas, making it difficult to implement digital agricultural technology comprehensively (Sari, 2023). Rotz et al. (2019) explain that the digital divide in the agricultural sector can create new inequalities between farmers who can afford technology and those who cannot. The digital divide in the agricultural sector not only creates gaps in technology access but also increases the inequity in the distribution of benefits among farmer groups (Rotz, 2019).

The second obstacle is the limited internet and electricity network infrastructure in rural areas, which remains a classic problem in many countries, including Indonesia. Third, the relatively high initial capital often discourages farmers from investing in new technologies. This limited capital makes it difficult for most farmers to access relatively expensive digital technologies in the early stages of implementation. Digital devices such as soil sensors, drones, or irrigation automation devices require high initial investment costs. For smallholder farmers, this presents an additional burden that is difficult to meet without

financial support. Furthermore, cultural factors also play a role in hindering the adoption of digitalization. Many farmers are comfortable with traditional methods passed down through generations, making resistance to innovation a challenge (Sari, 2023).

The potential for agricultural digitalization to strengthen food and energy security is enormous, but its success depends on overcoming barriers such as limited literacy, infrastructure, capital, and cultural barriers. If these barriers can be addressed through government policies, multi-stakeholder collaboration, and inclusive Islamic financing, agricultural digitalization has the potential to become a key pillar of sustainable development in the food and energy sectors. Without policy intervention, subsidies, or Islamic financing support, the adoption of agricultural digitalization risks remaining limited to a select group (Sari, 2023). Qureshi (2021) emphasized that the digital divide between urban and rural areas has the potential to widen the economic gap, because farmers who do not have access to technology will be left further behind (Qureshi, 2021).

Integration of Agricultural Digitalization into the Sharia Economy

The integration of agricultural digitalization with Islamic economics plays a crucial role in creating a sustainable, inclusive, and Islamically sound agricultural system. Agricultural digitalization goes beyond simply introducing modern technology to increase productivity, but also builds a more equitable, transparent system that prioritizes social and environmental sustainability (Ascarya, 2022). In the context of Islamic economics, this integration aims to create fair distribution of agricultural products, strengthen access to Islamic-based financing, and develop a halal supply chain that is in accordance with the principles of maqashid sharia (Chapra, 1992).

First, agricultural digitalization supports the principle of distributive justice in the Islamic economy. Through a digital platform based on agribusiness e-commerce, farmers can sell their products directly to consumers, bypassing the long distribution chain. This eliminates the intermediary practices that disadvantage farmers and ensures more affordable prices for consumers (Hidayat, 2021). From a sharia perspective, this practice is in line with the prohibition of exploitation (gharar and ikhtikar) and upholds the principle of fair trade (al-'adl),

Second, agricultural digitalization expands access to sharia-compliant financing for farmers. Sharia-compliant fintech technology enables farmers, especially small-scale farmers, to obtain business capital through sharia-compliant mechanisms such as mudharabah (profit sharing), musyarakah (capital partnership), and murabahah (buying and selling with a profit margin). With digital systems, the financing process becomes faster, more transparent, and more accountable. This is crucial considering that one of the classic obstacles faced by farmers is limited access to conventional financial institutions, which often do not comply with sharia principles (Mubarok, 2022).

Third, digital integration also strengthens the halal supply chain. With blockchain technology, the entire production, distribution, and halal certification process can be recorded transparently and cannot be manipulated. This is particularly relevant for export-oriented agriculture, particularly halal food products, which are increasingly in demand in the global market (Fauzi, 2023). In the context of maqashid sharia, the existence of a halal supply chain supports the protection of life (hifdz al-nafs), property (hifdz al-mal), and religion (hifdz al-din) by ensuring that the food consumed by Muslims is in accordance with sharia.

Fourth, agricultural digitalization also supports environmental sustainability, which is part of Islamic moral responsibility. Precision farming technology minimizes the use of water, fertilizers, and pesticides, thereby reducing environmental pollution. This aligns with Sharia principles, which prohibit the destruction of the earth (fasad fi al-ardh) and encourage the wise use of natural resources (isti'mar al-ardh) (Syahriza, 2021).

Thus, the integration of agricultural digitalization into the Islamic economy is not merely a matter of technological modernization, but rather a systemic transformation toward a

more equitable, transparent, halal, and sustainable agriculture. This integration is a strategic solution to address food and energy security challenges and strengthens Indonesia's position as a future global Islamic economic hub.

Forms of Cooperation in Implementing Agricultural Digitalization

The implementation of agricultural digitalization cannot be optimal without multi-stakeholder collaboration. Agricultural digitalization is not only about the application of advanced technology, but also concerns accessibility, funding, literacy, and the sustainability of the digital agricultural ecosystem. Therefore, integrated collaboration is needed between the government, Islamic financial institutions, technology companies, universities, farming communities, and civil society organizations (Ascarya, 2022).

First, government-private sector collaboration is crucial in providing digital agricultural infrastructure. The government plays a role in formulating regulations, developing rural internet networks, and providing fiscal incentives for agricultural technology (agritech) companies. Meanwhile, the private sector is delivering innovations in the form of smart farming applications, IoT sensors, and agricultural product e-commerce platforms. An example of this collaboration is the e-farming program initiated by the Ministry of Agriculture in collaboration with various agritech startups in Indonesia (Ministry of Agriculture of the Republic of Indonesia, Center for Agricultural Data and Information Systems).

Second, collaboration between Islamic financial institutions and farmers is a key element in strengthening access to digital financing. Through Islamic fintech, farmers can obtain capital based on Islamic contracts, such as mudharabah and musyarakah, which are managed through digital applications. This collaboration not only supports capital but also ensures transparency in the use of funds and profit distribution. This model has been widely developed by Islamic peer-to-peer lenders focused on the agricultural sector (Mubarok, 2022).

Third, the role of universities and research institutions is crucial in providing agricultural technology research and digital literacy training for farmers. Universities can collaborate with local governments to conduct capacity building, introduce precision agriculture technology, and provide digital-based farm management training. This aims to ensure that farmers are not only technology users but also able to adapt to changing agricultural production and marketing patterns (Hidayat, 2021).

Fourth, collaboration between farming communities and cooperatives is also a crucial pillar in implementing digitalization. Through Sharia-compliant cooperatives managed through digital applications, farmers can access market price information, conduct collective transactions, and streamline supply chains. These Sharia-compliant digital cooperatives can also act as intermediaries between farmers and financing institutions and distributors, thereby reducing price monopolies by middlemen (Fauzi, 2023). Through synergistic collaboration, the implementation of agricultural digitalization not only increases productivity but also creates an agricultural system that is equitable, sustainable, and in line with sharia values.

CONCLUSION

Digitizing agricultural land use is a strategic step in addressing the challenges of food and energy security in Indonesia while simultaneously supporting the strengthening of the Islamic economy. Research shows that the application of digital technologies such as the Internet of Things (IoT), big data, drones, and digital platforms can increase productivity, efficiency, and sustainability in the agricultural sector. This significant potential can strengthen farmers' position in the supply chain while opening broader access to markets and capital. However, several obstacles must be overcome, including limited digital literacy among farmers, unequal internet infrastructure, and relatively high initial

investment costs. These obstacles require an active role from the government, private sector, academics, Islamic financial institutions, and farming communities in building an inclusive digital agricultural ecosystem. The integration of agricultural digitalization with the Islamic economy provides added value in the form of transparency, fairness, and sustainability. Digital-based Islamic financial platforms can provide capital solutions for smallholder farmers through Islamic contracts, thereby avoiding usury and exploitation. Furthermore, digitalization also supports the principles of maqasid al-sharia, namely maintaining benefits, environmental sustainability, and social welfare. With synergistic cross-sector collaboration, agricultural digitalization has the potential to become a key driver of sustainable agricultural development in Indonesia. It will not only address food and energy security challenges but also foster inclusive, equitable, and socially just Islamic economic growth.

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