THE ROLE OF SMART FARMING 5.0 IN CREATING FOOD SOVEIREGNTY IN INDONESIA

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Abstract

As we know, Indonesia is an agricultural country whose main income comes from the agricultural sector. Indonesia's position in the equatorial region and tropical climate makes Indonesia a country with megabiodiversity. Indonesia has a variety of regional conditions with agricultural management techniques according to the needs of farmers in the region. Smart farming 5.0 which utilizes artificial intelligence has become a mainstay for the Indonesian Government in the current digital era. Smart farming 5.0 can encourage farmers' work so that agricultural cultivation becomes measurable and integrated. Farmers can cultivate without depending on the season but through mechanization. The planting to harvesting process can be carried out accurately starting from labor, planting time and the harvesting process. Several smart farming technologies such as blockchain which can make it easier to track the supply of agricultural products for modern off-farm farming, agri drone sprayer (drone spraying pesticides and liquid fertilizer), drone surveillance (drones for mapping land), soil and weather sensors (soil and weather sensors) , smart irrigation system (smart irrigation), Agriculture War Room (AWR), Siscrop (information system) which have been implemented in several areas. The varying levels of education of farmers, the phenomenon of aging farmers, the high cost of Smart Farming technology tools are the biggest obstacles for farmers in implementing Smart Farming. This article aims to analyze the magnitude of the role of Smart Farming 5.0 to utilize the potential of millennial farmers as actors and analyze various government policies to support the implementation of Smart Farming 5.0 as an effort to create Indonesian food sovereignty.

Keywords: Smart Farming 5.0., Food Sovereignty, Agriculture

1. INTRODUCTION

The agricultural sector in Indonesia is experiencing very rapid progress. This is due to adequate natural resources and the very adequate and the number of workers employed in the agricultural sector. The development of the agricultural sector also receives support from the government to actively achieve agricultural development in the agricultural sector (Sayifullah, *et. al.,* 2018). We are currently entering the Era of Society 5.0 which has become an era that is centered on the role of humans through aligning technological progress with its use and utilization, balancing economic progress, and solving social problems by integrating digital space with real space (Hendarsyah, 2019). Moreover, the phenomenon of economic recession requires appropriate responses to meet future challenges (Alwi, 2023).

Indonesia is an agricultural country whose main income comes from the agricultural sector. Indonesia's position in the equatorial region and tropical climate makes Indonesia a country with megabiodiversity. Indonesia has a variety of regional conditions with agricultural management techniques according to the needs of farmers in the region. Agricultural technology is the key to agricultural transformation, marking changes in every era, including the current era

of society. Agriculture in the Era of Society 5.0 will combine technology with automation, where technology can play a role in replacing and complementing agricultural activities (Yunindanova, 2022).

According to Ngatindriatun (2024), Indonesia managed to record a trade surplus in agricultural products in 2022 of 275.15 trillion. In the period January-June 2023, the export value of agricultural products reached IDR 258.46 trillion with a surplus of IDR 74.35 trillion. However, increasing Indonesian agricultural productivity is still not based on added value. Indonesian agriculture is currently facing a number of problems such as limited access to modern technology, low productivity, lack of infrastructure, climate change which disrupts cropping patterns, and inequality in market access. FAO (Food Agriculture Organization) also predicts that by 2050 the world population will increase to 9.6 billion. This can cause agricultural production to increase by 70% to be able to meet the needs of a population of that size (Budiharto 2019). If it is not fulfilled, the world will be threatened with a food crisis. To build a national to global food system that can continue to meet people's food needs, changes to the food supply chain are needed. Technology integration is one of the core business strategies in the agricultural sector for the effectiveness of the Smart Farming program (Rachmawati, 2021).

One of the efforts to improve Indonesian food sovereignty is currently the Smart Farming method. Smart farming is an agricultural concept that uses digital and information technology to increase efficiency, productivity and sustainability in crop and livestock production (Sari, 2023). Smart Farming 5.0, which accelerates advanced technology, can optimize resources and reduce environmental impacts, revolutionize food production and encourage sustainability in the face of growing urban populations. Smart Farming usually utilizes digital technology, such as IoT, cloud computing, robotics, sensors, artificial intelligence in agriculture, and the metaverse. Smart Farming 5.0 technology can change the paradigm of progressive agriculture to increase efficiency, productivity and sustainability. The existence of Smart Farming has many impacts on the environment, social and economic aspects. This is in line with the Sustainable Development Goals (SDGs) defined by the UN as a comprehensive and inclusive global development agenda, which aims to end poverty, reduce inequality and protect the earth for future generations (Atin, 2024). In sustainable agricultural development, the implementation of policies, programs and activities always pays attention to harmony between social, economic and environmental aspects.

2. METHODS

The Researchers believe that the role of Smart Farming 5.0 can create Indonesian food sovereignty. Therefore, this research aims to analyze the role of Smart Farming 5.0 in creating Indonesian food sovereignty. This research is qualitative research with a descriptive approach, namely the data used in this research is secondary data that researchers obtained from books, credible websites, scientific articles, books, and other things that are usually used as data references from researchers (Sugiono, 2011). The data sources were analyzed using the stages of data collection, data selection, data reduction, and drawing conclusions (Maksum, 2020).

3. DISCUSSION
The Role Of Smart Farming 5.0 In Creating Indonesian Food Sovereignty

The change from the era of Society 4.0 to Society 5.0 is marked by a significant transition in the way society utilizes technology to meet social needs and challenges. The Society 4.0 era, which is often associated with the Fourth Industrial Revolution, focuses on digitalization and process automation to increase production and operational efficiency. In this context, technologies such as artificial intelligence (AI), Internet of Things (IoT), and big data are starting to be integrated into everyday life, changing the way we work, communicate, and interact. However, the primary focus remains on increasing productivity and technological innovation,

often without considering wider social impacts or individual needs as a whole. The change from Society 4.0 to 5.0 is not only a technological evolution, but also a paradigm shift towards a more inclusive and sustainable future, where technology serves to improve humanity and the quality of life for all (Tapi, *et. al.*, 2024).

Smart farming 5.0 is an urgent need to increase production and achieve Indonesian agricultural food sovereignty. By using mathematical models to analyze data on previous harvests, weather, chemical content, leaf condition and biomass, a farmer can predict agricultural results and with the help of an expert system can obtain information on what efforts should be made next. The role of Machine Learning can be involved here in searching for insight and making decisions. Meanwhile, IoT sensors placed on agricultural land will make it easier for us to collect data and will also increase data accuracy. With this kind of prediction, farmers will know what to plant, where, and when to achieve maximum yields. Agricultural yield predictions like this can increase agricultural production in areas with high population growth rates such as in Indonesia (Budiharto, 2019).

Smart Farming 5.0 is a technology-based smart farming method. The technology used in Smart Farming includes drones spraying pesticides and liquid fertilizer, Surveillance Drones (Drones for land mapping) and Soil and Weather Sensors (Soil and weather sensors). Precision Agriculture or precision farming is something that makes farming practices more accurate and controlled in terms of planting crops and raising livestock. A key component of this farm management approach is the use of information technology and a variety of items such as GPS guidance, control systems, sensors, robotics, drones, autonomous vehicles, GPS-based soil sampling and software. Furthermore, we are entering the era of Society 5.0 where devices and devices such as drones will make our lives easier (Murdaningsih, 2018).

According to Sari (2023) Smart Farming 5.0 has an important role for agriculture because it can increase efficiency, productivity and sustainability in crop and livestock production. There are several reasons why smart farming is important in agriculture:

1. Increase Efficiency

Smart Farming 5.0 can help farmers optimize the use of resources such as water, fertilizer and pesticides by monitoring and predicting crop conditions in real-time. This can increase production efficiency and reduce production costs.

2. Increase Productivity

By utilizing technology such as sensors and robotics, Smart Farming 5.0 can help farmers increase productivity and crop quality. For example, robots for spraying pesticides can reach hard-to-reach areas and increase effectiveness in controlling pests and plant diseases.
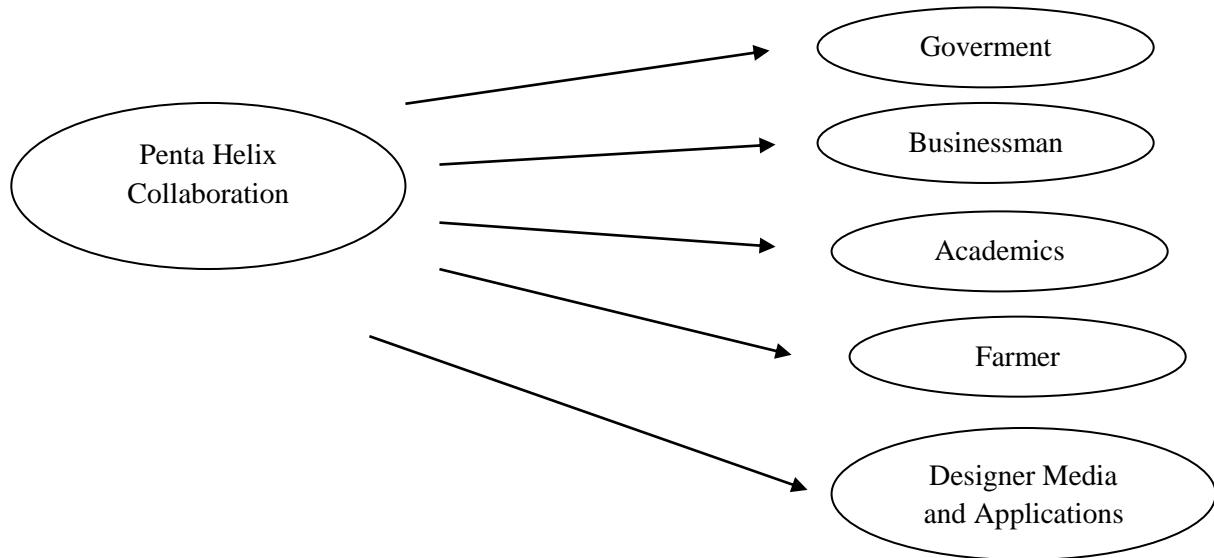
3. Increase Sustainability

Smart Farming 5.0 can help farmers reduce negative impacts on the environment by optimizing the use of resources such as water, fertilizer and pesticides, as well as reducing greenhouse gas emissions. Thus, Smart Farming can help create a more sustainable agricultural system in the future.

4. Improve Product Quality

By monitoring and predicting plant conditions in real-time, farmers can respond quickly to problems that arise in plants. This can improve product quality and reduce the risk of losses due to pest attacks or plant diseases.

Smart Farming 5.0 can change progressive agriculture in increasing sustainable productivity and efficiency. Improving sustainable agriculture requires Penta Helix collaboration. According to Mukti *et. al.* (2023) In order to apply Smart Farming 5.0 as the development of food self-sufficiency, a Penta Helix collaboration strategy from various related parties is needed to actualize its role. The following are the parties involved:

Table. 1 Parties involved in the Penta Helix Collaboration in increasing Indonesia's Food Self-Sufficiency

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                                                    ┌──────────────┐
                                              ┌────▶│  Goverment   │
                                              │     └──────────────┘
 ┌──────────────┐                             │     ┌──────────────┐
 │              │─────────────────────────────┼────▶│  Businessman │
 │  Penta Helix │                             │     └──────────────┘
 │ Collaboration│─────────────────────────────┼────▶┌──────────────┐
 │              │                             │     │  Academics   │
 └──────────────┘                             │     └──────────────┘
                                              │     ┌──────────────┐
                                              └────▶│    Farmer    │
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                                                    ┌──────────────┐
                                                    │ Designer Media│
                                                    │ and Applications│
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With the advantages of Smart Farming 5.0, the Government is a facilitator and regulator in providing services that can increase the productivity and sustainability of the agricultural sector so as to create food sovereignty in Indonesia. Business people are parties who play a role in financial management in the circulation of harvest buying and selling activities. Businessman are expected to be able to collaborate and cooperate with farmers in providing capital, selling harvests, and making investments in the agricultural sector. Academics at universities can integrate the latest technology and science into the agricultural sector. Higher education tridharma activities in food security, especially the development of Smart Farming 5.0, must unite multidisciplinary knowledge from economic, agricultural and engineering clusters. Furthermore, farmers are the parties whose role is to be the object. Because they will feel the benefits from its implementation to make it easier for farmers to utilize village funds in an appropriate manner. No less important, the media has great potential to increase awareness, educate and motivate stakeholders, especially farmers, in implementing smart agricultural technology. Through media campaigns, farmers can be given a better understanding of how technologies such as sensors, drones and IoT can improve the efficiency, productivity and sustainability of their farms (Atin, 2024).

The strategy that can be implemented by the government for smart farming 5.0 as food security is to shape the mindset of farmers regarding the importance of using artificial intelligence (AI) and digitalization of technology. The thinking of farmers who object because they feel smart farming is something that is difficult to do, requires a large budget and takes a long time must be changed immediately. Conveying facts about the successful achievements of farmers who have previously implemented smart farming is very important to accelerate the implementation of smart farming. Farmers must understand that in the future everything is constantly changing and increasingly uncertain. For this reason, the government must prepare itself to face various conditions with intelligent and adaptive artificial intelligence technology (Rachmawati, 2021).

Increasing Human Resources capabilities for farmers by implementing capacity building so they are able to use artificial intelligence and other advanced digital technologies, such as blockchain and the Internet of things (IoT) well. In reality, people are reluctant to use

digitalization because it will eliminate the role of human labor. However, this can be overcome by increasing the knowledge capacity of farmers so that farmers can work in tandem with AI and intelligent robots without feeling marginalized (Arkeman 2021).

Implementing smart farming in a country as big as Indonesia cannot be done instantly, but must be done gradually with clear targets and determining priority areas. Smart farming is often considered to require high costs that threaten the profits received by farmers. This view is not correct, because smart farming can be done in stages according to the farmer's financial capabilities. The government also needs to make it easier for farmers to access various smart farming technologies. When the implementation of smart farming is successful in one particular section or stage, then it can be continued to other priority sections afterwards. All costs arising from the implementation of smart farming are actually part of the investment to increase agricultural productivity and efficient use of labor. Technology investment will provide economic benefits. Farmers can feel efficiency by reducing labor, controlling plant nutrient requirements can be carried out accurately every day, reducing costs for using fertilizers or pesticides and improving the quality of the products produced (Moysiadis *et. al.,* 2021).

With smart farming, the farmers can increase agricultural input efficiency by up to 30% and increase production by up to 20%. Farmers will get the best quality agricultural products with minimal chemical residue (Zambon *et. al.,* 2019). Experts predict that by 2050, by using smart farming farmers can increase agricultural production by 70% (Nayyar *et. al.,* 2017). The implementation of smart farming must be built by utilizing human resources and technology from within the country itself, such as technology created by the Agricultural Research and Development Agency, or various universities and private consultants. Competent use of domestic human resources and technology will make the costs of implementing smart farming cheaper and more affordable. Giving trust to domestic experts will provide positive energy that can increase the self-confidence of IT experts in the agricultural sector.

The government must remain committed to playing an active role in supporting smart farming through various positive policies such as coaching, providing convenience or opening access to domestic and export markets so that farmers can easily market their agricultural products, providing incentives for farmers who have implemented smart farming, involvement in human resource development , research incentives for technological development, legal protection or certainty, ensuring cyber security and development of digital infrastructure. Indonesia is still facing problems in terms of internet because not all regions in Indonesia have internet access. This has the potential to hamper data and information integration. Collaboration with relevant stakeholders or internet providers is one solution to overcome this (Arkeman 2021).

4. CONCLUSION

Based on the research results, the role of Smart Farming 5.0 for Indonesian Food Sovereignty can be concluded in several points as follows:

1. Smart Farming 5.0 technology can play a role in changing the advanced agricultural paradigm in increasing efficiency, productivity and sustainability.
2. The presence of Smart Farming 5.0 has a multifaceted environmental, social and economic impact which aims to end poverty, reduce inequality and protect the earth for the future generations.
3. The government plays an important role as a facilitator and regulator in providing Smart Farming 5.0 services which can increase the productivity and sustainability of the agricultural sector so as to create food sovereignty in Indonesia.

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