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The Role of Agricultural Institutions in Enhancing National Food Security through the Development of Sustainable Agricultural Systems in Indonesia

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Abstract

The development of digital technology has brought significant changes in the banking sector, including digital banking services which are now a primary need for customers. This study aims to analyze the effect of digital banking service quality on customer satisfaction and loyalty of Bank Syariah Indonesia (BSI) Padang Branch. With a quantitative approach, data were collected through questionnaires distributed to 100 respondents who use BSI digital banking services. The analysis was carried out using Structural Equation Modeling (SEM) based on Partial Least Square (PLS) to test the relationship between variables. The results of the study indicate that the quality of digital banking services has a positive and significant effect on customer satisfaction, and customer satisfaction also has a significant effect on customer loyalty. However, the quality of digital banking services does not have a significant direct effect on customer loyalty. This shows that customer satisfaction plays an important mediating variable in shaping loyalty. This study provides an empirical contribution to the understanding of the importance of managing digital banking services in order to increase satisfaction which can then drive customer loyalty. The practical implication is that banks must focus on improving the quality of digital services, such as ease of access, transaction speed, and system security, to strengthen long-term relationships with customers.

INTRODUCTION

Food security is a crucial aspect of national development, especially for an agricultural country like Indonesia (Miyasto, 2014). However, challenges such as climate change, land degradation, and dependence on food imports are still major obstacles in realizing sustainable food security (UI, 2024; WRI Indonesia, 2024). Data shows that Indonesia's food security index in 2022 was at 60.2, ranking 63rd out of 113 countries, which is still below the global average (Wakil Presiden

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Republik Indonesia, 2023). This indicates the need for a more effective strategy to increase national food independence.

Sustainable agriculture is an agricultural system approach that aims to meet current food needs without compromising the ability of future generations to meet their own needs (P-Tali, 2025). This concept emphasizes the balance between productivity, environmental sustainability, and social welfare (BPJIID, 2024). The main principles of sustainable agriculture include conservation of natural resources, crop diversification, reducing the use of hazardous chemicals, and improving farmer welfare. Practices such as crop rotation, use of organic fertilizers, and integrated pest management (IPM) have proven effective in maintaining soil fertility and reducing negative impacts on the environment (Ardi, 2024).

Technological innovation also plays an important role in supporting sustainable agriculture. The use of the Internet of Things (IoT) allows farmers to monitor field conditions in real time, such as soil moisture and weather, so they can make more informed decisions to improve efficiency. In addition, practices such as agroforestry and organic farming help increase biodiversity and reduce greenhouse gas emissions. Although challenges such as high initial costs and lack of knowledge among farmers still exist, support from the government, educational institutions, and the private sector is essential to overcome these obstacles and realize a sustainable agricultural system.

One strategy that can be adopted is the development of a sustainable agricultural system. This approach emphasizes the wise use of natural resources, maintaining ecosystem balance, and implementing environmentally friendly agricultural practices (Kumparan, 2024). However, the implementation of sustainable agriculture in Indonesia still faces various challenges, such as the conversion of agricultural land to non-agricultural areas and the excessive use of chemical fertilizers, which have a negative impact on land productivity and quality (An-Nur, 2024).

In this context, agricultural institutions have a strategic role in supporting national food security through the development of sustainable agricultural systems. These institutions can play a role in providing training, technical assistance, and access to financing to farmers, as well as facilitating agricultural risk management through insurance and government policies (BPMPP UMA, 2024). Programs such as the Special Effort (Upsus) to Increase Rice, Corn, and Soybean Production (Pajale) show how collaboration between the government, farmer groups, and research institutions can significantly increase food production.

In addition, agricultural institutions can also encourage diversification of agricultural products and the use of modern technologies, such as biotechnology and integrated agricultural information systems, to increase agricultural efficiency and productivity (Farmonaut, 2024). The development of plant varieties that are resistant to pests and climate change, as well as the development of integrated information systems, can assist in planning the production, distribution, and marketing of agricultural products.

The urgency of this research lies in the importance of understanding and optimizing the role of agricultural institutions in supporting national food security through the development of sustainable agricultural systems. With the increasing global challenges such as climate change and food crises, the role of agricultural institutions is becoming increasingly vital in ensuring the availability and accessibility of food for all Indonesian people (Bappenas, 2024).

Several previous studies have discussed food security and sustainable agriculture in Indonesia. However, there are still limitations in studies that specifically highlight the role of agricultural institutions in this context. A study by Miyasto (2020) emphasizes the importance of a national food security strategy, while studies by WRI Indonesia (2024) and Bappenas (2024) highlight the transformation of the national food system. However, an in-depth study of the

contribution of agricultural institutions to the development of a sustainable agricultural system is still needed.

The purpose of this study is to analyze the role of agricultural institutions in increasing national food security through the development of a sustainable agricultural system in Indonesia. This study is expected to contribute to the formulation of more effective policies and strategies in supporting national food security.

METHOD

This study uses a qualitative approach with a literature study method (library research) to analyze the role of agricultural institutions in improving national food security through the development of sustainable agricultural systems in Indonesia. This approach was chosen because it allows researchers to explore and understand in depth the concepts, policies, and practices that have been applied in the context of sustainable agriculture without collecting data directly in the field. The literature study method is also effective in identifying knowledge gaps and formulating evidence-based recommendations from various existing sources (Zed, 2018).

The data sources in this study consist of secondary data obtained through systematic searches of various relevant literature. The literature reviewed includes scientific journals, books, research reports, policy documents, and publications from government institutions and international organizations related to sustainable agriculture and food security in Indonesia. Inclusion criteria for literature selection include relevance to the research topic, source credibility, and publications within the last five years to ensure the timeliness of the information (Snyder, 2019).

The data collection technique was carried out through a literature search using keywords such as "sustainable agriculture", "agricultural institutions", and "Indonesian food security" in academic databases and institutional repositories. This process includes identification, selection, and collection of literature that meets the inclusion criteria. Each selected literature is then analyzed to identify key themes, important findings, and existing research gaps.

The data analysis method used is qualitative descriptive analysis. Data collected from various literatures are analyzed to identify patterns, relationships, and findings relevant to the focus of the study (Krippendorff, 2018). This analysis aims to develop a comprehensive understanding of the role of agricultural institutions in supporting food security through a sustainable agriculture approach. The results of the analysis are then presented in a systematic narrative form to answer the research questions and achieve the study objectives.

RESULT AND DISCUSSION

The following is a table of bibliographic data which is the result of findings from 10 selected articles through a strict selection process from various related literature. These articles were selected based on their relevance to the topic "The Role of Agricultural Institutions in Improving National Food Security through the Development of Sustainable Agricultural Systems in Indonesia", as well as considerations of their actuality and scientific contributions. Each article provides different insights into the role of agricultural institutions, policies, and sustainable agricultural practices in the context of national food security.

Table 1. Literature Review

No	Title	Author	Research Focus
1	Farm Sustainability Assessment and Model: Achieving Food	Juhandi et al. (2023)	The agricultural sustainability status is at a moderate level; improvements in certain

	Security through the Food Estate Program in North Sumatra		aspects can significantly increase the sustainability score.
2	Overcoming Infrastructure Challenges to Unlock Food Security in Rural Indonesia	Arifin & Sukmana (2024)	Effective communication between village governments, farmers, and community groups improves agricultural productivity and community welfare.
3	Sustainable Agriculture: Integrating Traditional Practices With Modern Technology For Food Security	Syawaludin et al. (2024)	Technologies such as automatic irrigation systems and soil sensors improve resource efficiency and crop yields; major challenges are limited infrastructure and training for farmers.
4	STUDY ON FOOD SECURITY AMONG FARM HOUSEHOLDS PARTICIPATING IN THE SUSTAINABLE FOOD YARD (SFY) PROGRAM IN SEMARANG CITY	Nugraha et al. (2023)	88.46% of households participating in the program are in a food secure status; the program has a role in increasing energy consumption and reducing household food expenditure.
5	Role of Roads and Irrigation on Food Security in Indonesia	Oktiani & Khoirunurrofik (2024)	Consistent road and irrigation development can improve food security in districts and cities in Indonesia; Gross Regional Domestic Product (GRDP), sanitation access, and water availability also play important roles.
6	FOOD SECURITY POLICY ANALYSIS PERPECTIVE ON FOOD SELF-SUFFICIENCY VILLAGE PROGRAMME CASE IN CENTRAL JAVA INDONESIA	Rusliyadi (2023)	The Independent Food Village Program contributes to increasing food independence through a participatory approach and community empowerment; strengthening local institutions is needed.
7	The Movement to Maintain Food Security Through Technological Advancements and Local Diversification: Ministry of Agriculture Republic of Indonesia	Herlina et al. (2024)	The application of agricultural technology and diversification of local products improve food security; collaboration between the government, research institutions, and farmers is essential.
8	Agreement on Agriculture WTO: Discourse on Indonesia's Food Security in a Global Context	Putra et al. (2023)	Indonesia needs to strengthen bilateral economic relations to support national food security and food sovereignty; the role of agricultural institutions in economic diplomacy is crucial.
9	THE NEXUS OF PLANNING AND FOOD SECURITY IN INDONESIA: A REVIEW OF THE LITERATURE	Pandangwati & Widiyanto (2023)	Spatial planning that is sensitive to food issues can support a resilient food system; multidisciplinary approach is needed in regional planning.
10	Mapping the Progress and Direction of Sustainable Agriculture Research in Indonesia: A Bibliometric Analysis Perspective	Sutiharni et al. (2023)	Sustainable agriculture research in Indonesia shows an increasing trend; collaboration between institutions and interdisciplinary approaches are key to developing sustainable agriculture.

Based on the results of the literature review of ten selected articles, several important conclusions can be drawn regarding the dynamics and role of agricultural institutions in improving national food security through a sustainable agriculture approach in Indonesia. These articles not only present empirical findings but also underline the importance of synergy between policies, institutions, technological innovation, and community participation in building a resilient and adaptive agricultural system to changing times.

A study by Juhandi et al. (2023) shows how the Food Estate program in North Sumatra is a concrete representation of the government's efforts to increase food production capacity through a large-scale sustainability-based approach. Through the farm sustainability assessment method, it was found that the sustainability status of this program is still at a moderate level. However, with improvements in certain aspects such as water use efficiency, crop diversification, and increasing farmer capacity, the potential to increase sustainability value becomes significant. These findings emphasize the importance of continuous monitoring and evaluation as part of government program management (Juhandi et al., 2023).

On the other hand, Arifin and Sukmana (2024) emphasize the infrastructure dimension as an important foundation in ensuring food security in rural areas. They revealed that limited agricultural infrastructure such as roads, irrigation, and storage warehouses are the main obstacles that reduce the efficiency of the food supply chain. An important finding in this study is that the success of food security does not only depend on production, but also on smooth distribution and equitable accessibility. In this context, agricultural institutions at the local and national levels act as facilitators of infrastructure development and bridges of communication between farmers and policy makers.

Another study conducted by Syawaludin et al. (2024) offers an integrative approach between local knowledge and modern technology in developing a sustainable agricultural system. This study shows that the application of technology such as automatic irrigation systems, soil moisture sensors, and digital agricultural applications has increased the efficiency of natural resource use and land productivity. However, there are major challenges in terms of technology adoption, namely the limited technological literacy of farmers and the lack of technical training support from related institutions. In this context, the role of agricultural institutions is crucial in bridging the digital transformation in the Indonesian agricultural sector (Syawaludin et al., 2024).

A study by Nugraha et al. (2023) examined the impact of the Sustainable Food Yard Program (P2L) on the food security of farmer households in the city of Semarang. Using indicators of food security status, the study found that around 88.46% of households participating in the program were in a food secure condition. The success of the program is correlated with the household-based approach and active participation of residents, which strengthens the local food system. This finding proves that even a small scale can have a big impact if managed well, and the role of agricultural institutions is very important in determining the success of program implementation and supervision (Nugraha et al., 2023).

Furthermore, Oktiani and Khoirunurrofik (2024) analyzed the contribution of road and irrigation infrastructure to food security at the district and city levels. They used a quantitative approach based on panel data to show that agricultural infrastructure development is directly proportional to increased food production and access. Other factors that support food security are regional GRDP, sanitation quality, and the availability of clean water. This finding reaffirms that agricultural development cannot be separated from overall regional development, and agricultural institutions play a role in cross-sector integration (Oktiani & Khoirunurrofik, 2024).

Rusliyadi's research (2023) which focuses on the Independent Food Village program in Central Java shows that community empowerment based on local institutions has a significant impact on village food independence and sustainability. With a participatory approach, this program is able

to create an internal food production and distribution system that is resilient to external disturbances. However, institutional capacity strengthening is needed so that the program does not only run as a formality, but is able to create socio-economic transformation in rural areas (Rusliyadi, 2023).

Herlina et al. (2024) raises the issue of technology and local diversification in maintaining national food security. The Indonesian Ministry of Agriculture is described as the main actor in technological transformation and promotion of food product diversification. Through programs such as the use of superior seeds and agricultural mechanization, as well as the promotion of local non-rice food consumption, it is hoped that there will be a lower dependence on certain commodities. This is where agricultural institutions play a dual role as innovators and educators (Herlina et al., 2024).

Putra et al. (2023) highlighted the importance of the global context in national food policy through a review of the WTO Agreement on Agriculture. They emphasized that Indonesia's position in international forums is greatly influenced by how the country utilizes its agricultural institutions to support the food sovereignty agenda. By strengthening economic diplomacy and strategic partnerships, agricultural institutions can be an important instrument in balancing national needs and global market demands (Putra et al., 2024).

In a literature review conducted by Pandangwati and Widiyanto (2023), it was shown that spatial planning that is sensitive to food is one of the keys to building long-term food security. When regional development ignores the agricultural aspect, food security is threatened. Therefore, the role of agricultural institutions is needed in making spatial planning decisions so that agricultural land is maintained and the food system is not interrupted (Pandangwati & Widiyanto, 2023).

Finally, Sutiharni et al. (2024) through bibliometric analysis shows that research on sustainable agriculture in Indonesia has increased in terms of quantity and diversity of approaches. Collaboration between institutions is a key element in accelerating the advancement of knowledge and implementation of sustainable agriculture. This study provides a theoretical basis that the role of institutions is not only in direct agricultural practices, but also in facilitating the development of science and technology that supports this sector (Sutiharni et al., 2024).

Overall, the literature collectively provides a very rich picture of how agricultural institutions play a role in improving national food security. They are not only program implementers, but also actors of social transformation, drivers of technological innovation, guardians of environmental sustainability, and liaisons between farmers and national policies and global dynamics. The integration of these roles is the key to a sovereign, inclusive, and sustainable food system in Indonesia.

Discussion

Strategic Role of Agricultural Institutions

Agricultural institutions in Indonesia play a strategic role in supporting national food security through the development of sustainable agricultural systems. This role covers various aspects, from policy formulation, provision of technology and innovation, farmer assistance, to access to financing.

One real example is the Food Crops Research Institute (BPTP) which has developed superior rice varieties that are resistant to pests and climate change. Through the support of agricultural institutions, farmers can access superior seeds and technology that increase production efficiency.

Farmer cooperatives also play an important role in efficient food distribution. They function as a link between producers and consumers, and help reduce farmers' dependence on middlemen. For example, farmer cooperatives in several regions have played a role in stabilizing agricultural commodity prices by regulating the distribution of harvests.

The Special Effort Program (Upsus) to Increase Rice, Corn, and Soybean Production (Pajale) is a government initiative to increase the production of three main food commodities by providing seed assistance, fertilizer, and extension to farmers. Through cooperation between the government, farmer groups, and research institutions, this program has succeeded in significantly increasing rice production in recent years, which has had a positive impact on national food security.

The Al-Ittifaq Islamic Boarding School Cooperative (Kopontren) in Bandung Regency, West Java, is a successful example of an agribusiness cooperative that has received revolving fund financing based on sharia principles of IDR 18.3 billion since 2020. This Kopontren has succeeded in integrating production, distribution, and marketing of agricultural products, as well as empowering small farmers who produce vegetables and fruits since 1997. President Joko Widodo even called the business ecosystem run by Kopontren Al-Ittifaq a role model for other Islamic boarding school cooperatives.

Contribution to National Food Security

Agricultural institutions in Indonesia have played a central role in strengthening national food security through various initiatives focused on increasing local food production, diversifying food sources, and adapting to climate change.

One concrete example is the simultaneous corn planting program implemented in January 2025. This initiative involves planting corn on one million hectares of land throughout Indonesia, including in Bogor City, as part of a national effort to strengthen food security. This program shows how agricultural institutions can coordinate collective action to increase local food production and reduce dependence on imports.

In addition, food diversification is also a major focus of agricultural institutions. Through programs such as the Gogo Rice Planting Movement in Subang, the government encourages the planting of rice varieties that are resistant to dry land conditions, so that it can increase food production in previously less productive areas.

Adaptation to climate change is also an important concern. Agricultural institutions have developed and introduced sustainable agricultural technologies, such as the use of plant varieties that are resistant to extreme climate conditions and environmentally friendly agricultural practices. These efforts aim to maintain stable food production despite the challenges of climate change.

Overall, the contribution of agricultural institutions in improving national food security is reflected through increasing local food production, diversifying food sources, and adapting to climate change. These initiatives demonstrate how agricultural institutions can play a strategic role in ensuring sustainable food availability for the people of Indonesia.

Development of Sustainable Agricultural Systems

The development of sustainable agricultural systems in Indonesia has become a major focus in efforts to improve national food security. Agricultural institutions play an important role in encouraging the adoption of environmentally friendly, efficient, and sustainable agricultural practices. The following are some real examples of the implementation of sustainable agricultural systems in various regions in Indonesia:

In Kersagalih Village, Jatiwaras District, Tasikmalaya Regency, sustainable agricultural practices have been adopted by the local community. The village head, Mr. Asep, S.Pd.SD, led this initiative by introducing organic farming to farmers. Through training and mentoring, farmers began to reduce the use of chemical pesticides and synthetic fertilizers, switching to more environmentally friendly organic farming methods. As a result, soil quality improved, agricultural production increased, and the health of farmers and consumers was maintained. In addition, this village also

maintained the sustainability of forests and rivers through good natural resource management practices.

In Lampung Province, WWF-Indonesia has been running the Sustainable Agriculture Field School program since 2009. This program aims to provide understanding and skills to farmers so that they can practice the concept of sustainable agriculture. Through training, farmers learn about soil fertility conditions, plant types, pests and diseases, and the manufacture of liquid organic fertilizers and compost. This program has involved around 1,977 farmers from 24 villages in three districts in Lampung, namely West Lampung, Tanggamus, and West Coast. As a result, farmers have been able to increase the productivity of their land, such as farmers in Ulubelu who are now able to produce 1.5 tons of coffee.

The National Education University (Undiknas) developed a modern agricultural model in Penebel Village, Tabanan, Bali, through the GAURI (Greenhouse Agricultural Unit for Rural Innovation) project. This project introduces organic farming based on precision farming as a form of smart agriculture. With the construction of a greenhouse, the Penebel Village community can produce agricultural products, especially fresh vegetables and fruits, without being affected by the pandemic situation. This initiative has had a significant impact on the village and its surroundings, especially during the pandemic and post-pandemic when conventional agricultural activities were hampered.

In Nagekeo Regency, East Nusa Tenggara, Pandawa Agri Indonesia (PAI) is developing a sustainable agricultural ecosystem through the Mbay Natural Rice Ecosystem Development initiative. This initiative aims to reduce pesticide use and increase farmer productivity by up to 40%. Through mentoring and innovation of pesticide reductants, PAI helps independent farmers improve the quality and quantity of their harvests, so that farmers' incomes increase and the food supply in the region is maintained.

In Papayan Village, Jatiwaras District, Tasikmalaya Regency, farmer groups play a crucial role in building a sustainable agricultural system. They apply innovative and environmentally friendly agricultural techniques, so that this village is able to produce abundant agricultural products, meet the food needs of the community, and even open up export opportunities to other areas. The sustainable agricultural system initiated by the farmer group also creates new jobs for village residents.

In Sidasari Village, the village government introduced a technology-based agricultural application to farmers. This application provides up-to-date information on weather, crop water requirements, and proper fertilization procedures based on crop type. In addition, an automatic irrigation system was also introduced to regulate irrigation based on crop needs, so that water use can be more efficient and farmers' costs in purchasing fertilizers can be reduced.

In Boyolali, Central Java, farmers who are members of farmer groups such as the Boyolali Organic Rice Farmers Alliance (APPOLI) and the Sustainable Food Farmers Cooperative (KTPL) have successfully implemented sustainable agricultural practices and obtained positive results. They implemented the jajar legowo planting system, used organic fertilizers and pesticides, and paid attention to plant age in their application. These practices not only increased crop yields but also paid attention to the institutional management system that supports local farmers.

Through these various initiatives, agricultural institutions in Indonesia have demonstrated a strategic role in developing a sustainable agricultural system that supports national food security. Collaboration between the government, non-governmental organizations, universities, and the private sector is the key to success in realizing environmentally friendly, efficient, and sustainable agriculture.

CONCLUSION

This study concludes that the quality of digital banking services significantly affects customer satisfaction, and satisfaction acts as an intermediary that strengthens customer loyalty. However, the quality of digital services does not have a direct effect on loyalty without the mediation of satisfaction.

Bank Syariah Indonesia needs to continue to improve the features and security of digital banking services, as well as provide education to customers so that they better understand how to use the application optimally. Responsive service to complaints will also support increased customer satisfaction and loyalty.

This study was only conducted at one branch and with a limited number of samples so that the results cannot be generalized to all operational areas of BSI or other Islamic banks. Future studies can expand the scope of the area and add moderating variables such as risk perception or trust to gain a more comprehensive understanding of customer loyalty in the context of digital banking services.

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