



# Smart Farming Innovation: Empowering Millennial Farmers to Improve Agricultural Productivity in the Society 5.0 Era

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## ABSTRACT

Empowering millennial farmers in Indonesia is key to achieving sustainable food security and social welfare, especially in the era of Society 5.0, which emphasizes the integration of technology into everyday life. This program aims to introduce a modern technology-based smart farming platform to millennial farmers in Salareh Aia Utara, Agam Regency. Through the application of agricultural technologies such as digital sensors for crop monitoring, data-based irrigation management, and crop yield monitoring systems, it is hoped that agricultural productivity and resource use efficiency will increase, and the quality of agricultural products will improve. The program also aims to reduce dependence on inefficient traditional farming methods and expand market access through digital platforms. Training related to modern agricultural technology and business management will be provided to improve farmers' capacity in business management and product marketing. Using the Participatory Action Research (PAR) method, this activity prioritizes the active participation of farmers in every stage, from planning and implementation to evaluation of results. Based on participant feedback, this program has proven successful in improving the knowledge and skills of millennial farmers, with a participant satisfaction rate of 98%. In addition, the use of this technology also has the potential to improve social welfare and open up new business opportunities for rural communities. Through smart farming innovation, it is hoped that Salareh Aia Utara can become a model for the successful empowerment of millennial farmers in other areas, while also contributing to the achievement of Sustainable Development Goals (SDGs) 2 and 8, which focus on food security and inclusive economic growth.

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## Introduction

Agriculture in Indonesia is a sector that dominates the rural economy and plays an important role in supporting the social and economic welfare of the community. Despite its great potential, the agricultural sector faces various challenges, particularly the low level of technology adoption that can increase efficiency and productivity (Solihin, Anggreany, Rais, & Siregar, 2023). One group with great potential to drive this change is millennial farmers. Millennial farmers, who are more open to technological advances, have a key role in changing the face of Indonesian agriculture, especially through the application of "smart farming" technology. This program aims to empower millennial farmers in Salareh Aia Utara, Agam Regency, through the use of Internet of Things (IoT)-based agricultural technology, crop monitoring systems, and data-based irrigation management. In the



context of the Society 5.0 era, the integration of digital technology in every aspect of life, including agriculture, is a key factor in creating sustainability and efficiency in this sector (Berliana et al., 2025)

This millennial farmer empowerment program not only aims to increase agricultural productivity but also to improve their overall quality of life. The training provided covers various aspects of social entrepreneurship, including health, business management, and digital skills, which are increasingly important in an increasingly connected world. This training is expected to reduce dependence on inefficient traditional farming methods and improve farmers' understanding of data-based business management to strengthen their competitiveness in an increasingly global market (Pasandaran, 2020).

In implementing this program, various experts from different disciplines will collaborate to provide training that is beneficial to millennial farmers. The program will begin with a presentation on the importance of social awareness and the role of millennial farmers in sustainable development by Prof. Dr. Suryanef, M.Si. Next, Cici Nur Azizah, S.Pd., M.Pd. will focus on the importance of building strong community networks for millennial farmers to support modern agriculture. Kiki Amelia, SP., MP, will provide training on smart fertilization for oil palm, which is one of the main commodities in this region. In addition, Halmawati, S.E., M.Si., will discuss online marketing strategies to expand the market reach of agricultural products, and Rahmi Melfa Widodo, S.ST., M.Kes., will emphasize the importance of physical and mental health in agriculture-based entrepreneurship. This program aims to reduce the gap between existing knowledge and practice, as well as prepare millennial farmers to face global challenges in the agricultural sector (Rahmat, 2023)

Initial data obtained through pre-tests shows that although participants have a good basic understanding of social entrepreneurship and digitalization, there are several aspects that need to be further clarified. Most participants understand social entrepreneurship as a business that aims to solve social problems, although the gap between understanding social and economic aspects still needs to be addressed. In addition, understanding of the importance of health in the context of social entrepreneurship is still limited, indicating an opportunity to deepen their knowledge about the relationship between health and entrepreneurship. This program is expected to bridge these gaps by providing comprehensive and interactive training. Through a technology-based and social entrepreneurship approach, this program aims not only to increase agricultural productivity in North Salareh Aia, but also to improve the social and economic welfare of millennial farmers. (Hamzah, Rahmawati, & Nugraha, 2025)(Bachtiar, Tapi, Saputra, Budicahyono, & Konyep, 2025).

## **Methods**

This Community Service program uses the Participatory Action Research (PAR) approach, which enables the active involvement of millennial farmers in every stage of the empowerment program in North Salareh Aia. This approach is designed to encourage understanding, involvement, and active participation by farmers in creating solutions to problems faced in the agricultural sector. PAR allows



farmers to not only receive knowledge, but also participate in the process of change, contribute to solutions, and ensure the sustainability of the program (Dwinarko, 2023). In this program, farmer participation is expected to accelerate the adoption of modern agricultural technology and encourage the development of agriculture-based social entrepreneurship.

In the initial stage, a situation diagnosis was conducted to understand the conditions of farmers in North Salareh Aia. This process involved the dissemination of information about the program by the community service team together with Wali Nagari Zulkifli and farmer group facilitator Riko Thomas. The dissemination aimed to introduce the program and build a basic understanding of the objectives and benefits of smart farming technology. A needs survey and pre-test were conducted to identify farmers' initial knowledge of social entrepreneurship, health, and digitization in agriculture, as well as to identify knowledge gaps that needed to be addressed during the training (Rahmayani et al., 2023). After the situation diagnosis, training focused on developing technical and managerial skills for millennial farmers. The training will cover three main modules (1) Farmers will be trained to use smart farming devices such as soil moisture sensors and IoT-based automatic irrigation systems, which aim to improve agricultural efficiency and productivity (Tapi & Makabori, 2024) (2) Agricultural Business Management: This training aims to introduce the concept of efficient agricultural business management, including financial planning, risk management, and data-driven marketing (Ilham, 2023). (3) Health and Health-Based Entrepreneurship: This training will educate farmers on the importance of maintaining physical and mental health in entrepreneurship (Putri, Rozaki, Wulandari, & Suryani, 2024). After the training, the technology will be applied directly in the fields. Ongoing assistance is provided by a community service team and local mentors to ensure that farmers can integrate the technologies they have learned into their agricultural practices. This assistance includes the installation of humidity sensors and data-based irrigation systems, as well as guidance in the implementation of digital marketing strategies (Faried, Sos, Sp, Sri Rahayu, & Siregar, n.d.).

Evaluation is conducted by comparing pre-tests and post-tests to assess improvements in farmers' knowledge of social entrepreneurship, agricultural digitization, and health. Monitoring of technology implementation results was carried out through field visits to evaluate the impact on productivity and marketing of agricultural products. Feedback from participants was also collected to assess the effectiveness of the training and its impact on their businesses (Waluyo, 2023)(Fathurahman, Hariyadi, Setianto, Wulan, & Sari, 2025).

## Results

The millennial farmer empowerment program through the smart farming platform in Salareh Aia Utara, Agam Regency, shows clear evidence that technology-based empowerment can bring significant changes in increasing agricultural productivity, business management, and the social welfare of farmers. The results of the pre-test and post-test conducted at the beginning and end of the program show a substantial increase in understanding of social entrepreneurship, digitalization in agriculture, and the importance of entrepreneurial skills in the future. This improvement reflects the effectiveness



of the training provided and the farmers' readiness to implement the knowledge they have gained in their lives.

#### 1. Application of Smart Farming Technology

The application of smart farming technology, which includes the use of soil moisture sensors, automated irrigation systems, and data-based crop monitoring, has shown significant results in improving agricultural efficiency. For example, farmers who use soil moisture sensors report water savings of 25% and a reduction in fertilizer waste of up to 15%. This technology also helps farmers monitor soil and crop conditions in real-time, enabling them to make faster and more accurate decisions regarding crop care. This is in line with the findings of Simarmata (2019), who states that the use of IoT technology in agriculture increases productivity by minimizing resource waste and optimizing agricultural yields.

#### 2. Improvement in Managerial Skills and Business Management

Training in agricultural business management has a significant positive impact on farmers' ability to manage their businesses. This training covers financial management, business planning, and the use of digital platforms for marketing agricultural products. 85% of farmers who participated in the training reported that they now have a better understanding of how to manage their agricultural businesses in a more structured manner. They are able to create simple business plans and keep more efficient financial records. In addition, some farmers have also started to utilize digital platforms to market their products, although the use of social media and e-commerce platforms is still limited to some participants. This shows that there is a need to continue training in digital marketing, as suggested by (Sugito et al., 2025), who emphasizes the importance of digitalization in expanding markets and increasing the competitiveness of agricultural products.

#### 3. Physical and Mental Health

One interesting finding from this training is the increased understanding of farmers regarding the importance of physical and mental health in running an agricultural business. 90% of participants reported that they felt fitter and ready to face the challenges of entrepreneurship after attending training sessions on health. This is in line with research (Nurdayati, Sudarmanto, Mubarakah, Purwono, & Makmun, 2024) (Solihin et al., 2023) which shows that maintaining physical and mental health plays an important role in increasing work productivity, especially in agriculture-based entrepreneurship.

#### 4. Increased Satisfaction and Confidence in Entrepreneurship

Overall, 95% of participants felt more confident in running their businesses after participating in this program. They felt more prepared to face the challenges of entrepreneurship and better understood the importance of managing agricultural businesses with a more professional approach. This program also succeeded in improving skills that are highly applicable to farmers in their daily lives. 100% of participants felt that the knowledge they gained was helpful, indicating that this training is highly relevant and needed by millennial farmers in North Salareh Aia.



### Discussion

Based on the findings of this millennial farmer empowerment program through the smart farming platform, it can be concluded that empowering farmers with a technology-based approach has a significant impact on agricultural productivity, business management, and social welfare. The application of technology in agriculture not only increases production efficiency but also expands market reach and improves the social welfare of farmers.

The use of smart farming technology, such as soil moisture sensors and automatic irrigation systems, has been proven to save resources and increase agricultural yields, which supports the findings of (Soedarto & Ainiyah, 2022), who state that modern agricultural technology can boost productivity and reduce waste in the production process. The importance of training in business management cannot be overlooked. This program provides farmers with better knowledge about business planning, financial management, and digital-based product marketing. Along with that, training in physical and mental health shows that the success of agriculture-based entrepreneurship is greatly influenced by the health of farmers, which supports the results achieved. However, even though this program has shown encouraging results, challenges remain, especially in program sustainability and technology adoption. Most participants still need more support in implementing digital marketing strategies, particularly in the use of social media and e-commerce platforms. Therefore, efforts to strengthen farmers' capabilities in digital marketing must be a priority in the sustainability of this program.

To ensure the sustainability of the program, continuous assistance is needed, involving the formation of independent farmer groups that can continue to manage their technology and product marketing without dependence on external parties. This is in line with the Sustainable Development Goals (SDGs), especially SDG 2 on food security and SDG 8 on decent work and inclusive economic growth. This program is expected to become a model that can be applied in other areas, especially in rural areas of Indonesia that still face similar challenges in terms of technology and agriculture-based entrepreneurship.

Table of Stages of Implementation of the Millennial Farmer Empowerment Program through the Smart Farming Platform

No.	Activity Stage	Description	Achievement Indicator
1	Socialization and Participant Recruitment	Introduction of the program to the community, village leaders, and farmer groups	100% of participants are involved
2	Smart Farming Technology Training	Training on the use of soil moisture sensors and automatic irrigation systems	80% of participants use the technology
3	Agricultural Business Management Training	Training on business planning and financial management	85% of participants understand business management



4	Technology Implementation in Agricultural Land	Installation of sensors and automatic irrigation systems	25% water savings, 15% reduction in fertilizer waste
5	Digital Marketing Assistance	Training on digital marketing using e-commerce platforms	50% of participants begin marketing products digitally
6	Program Evaluation and Participant Feedback	Evaluation of technology usage and business management	95% of participants are satisfied with the program

With systematic stages and a technology-based approach, this program is expected to not only successfully increase agricultural productivity but also bring sustainable social and economic impacts to millennial farmers in North Salareh Aia.

### Conclusion

The program to empower millennial farmers through the smart farming platform in Salareh Aia Utara, Agam Regency, has achieved many significant accomplishments. Pre-test and post-test results show an increase in farmers' understanding of social entrepreneurship and digitalization in agriculture. The average score of participants increased by 28.5 points, reflecting a better understanding of modern agricultural technology and social entrepreneurship.

More than 80% of farmers have implemented smart farming technologies, including soil moisture sensors and automated irrigation systems, which have improved water use efficiency and crop yields. However, although managerial and digital marketing training has helped farmers manage their businesses more efficiently, the challenge remains that digital marketing is not yet being used to its full potential.

Many farmers have started using social media to market their products, but they still need further training to optimize the use of e-commerce platforms. The Participatory Action Research (PAR) approach has proven to be effective in empowering farmers, as it involves them in every stage of the program, from planning to evaluation. This increases their sense of ownership and ensures that the solutions provided are relevant to their needs. Overall, this program has succeeded in increasing agricultural productivity, reducing operational costs, and improving the social welfare of millennial farmers. Another positive impact is the increased awareness of the importance of physical and mental health in entrepreneurship.

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