Strategies for Developing Millennial Farmers to Support Food Security

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Abstract
Purpose: This study aims to identify key factors affecting millennial farmer's human resource development and to formulate a strategic development approach using SWOT and Grand Strategy analyses to support food security in Ogan Komering Ulu Regency.

Research Methodology: This study employs a mixed methods approach with an explanatory sequential design. Quantitative data were collected through a survey of 94 millennial farmers aged 19–39 years, while qualitative data were obtained through in-depth interviews supported by a SWOT analysis. Quantitative analysis was conducted using multiple linear regression, while strategy formulation applied the Internal Factor Evaluation (IFE), External Factor Evaluation (EFE), SWOT Matrix, and Grand Strategy Matrix.

Results: The findings show that formal education, age, access to financing, agricultural extension services, and family support significantly influence millennial farmers' human resource development, with an explanatory power of 86%. The SWOT and Grand Strategy analyses place the development strategy in Quadrant I (S-O), indicating a progressive and growth-oriented approach emphasizing digital agriculture training, agripreneurship development, digital markets, and institutional collaboration.

Conclusions: Millennial farmers in the OKU Regency have good potential to support food security but require stronger digital skills and technology adoption. An aggressive strategy focusing on digital agriculture, financing access, and institutional collaboration is recommended for the future.

Limitations: The study is limited by its regional scope and relatively small sample size, which may limit the generalizability of the findings.

Contributions: This study provides strategic and empirical insights for policymakers, extension services, and research on developing millennial farmers to strengthen regional food security.

Keywords: *Digital Agriculture, Food Security, Human Resource Development, Millennial Farmers*

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1. Introduction

Indonesia is a developing country rich in agricultural resources (Apriyani, Jayanti, & Nearti, 2025). Agricultural development is a strategic pillar in maintaining national food security (Safitri, Agustin, Syahroni, & Kurniati, 2025; Wibowo, 2020). Agriculture is a form of food security that meets the food needs of the community in a region. (Tiwu, Ballo, Molidya, & Tomosowa, 2025). Amid global challenges such as climate change, food price volatility, population growth, economic digitalization, and pressure for land conversion, Indonesia's agricultural sector requires human resources that are adaptive, innovative, and competitive (Atube et al., 2021). In this context, the existence of millennial farmers is very important as a driving force for change towards a modern, efficient, and sustainable food system (Hutapea et al., 2025; Maasi, 2025).

The issue of farmer regeneration in Indonesia is serious. The 2023 Agricultural Census noted that more than 61% of farmers are over the age of 45, while the involvement of young people aged 19–39 is still limited, at only approximately 29%. This phenomenon *of aging farmers* is also occurring in Ogan Komering Ulu (OKU) Regency, one of the main food barns in the South Sumatra Province. The decline in interest among the younger generation to enter the agricultural sector is accompanied by limited access to capital, a lack of technological support, and the perception that agriculture is an unprofitable and unglamorous sector (Roidah, Laily, & Prasekti, 2024). OKU has enormous agricultural potential.

According to the 2023 OKU Statistics Agency (BPS), subdistricts such as Lubuk Raja, Pengandonan, East Baturaja, West Baturaja, Kedaton Peninjauan Raya (KPR), and Sinar Peninjauan are centers of rice and corn production in South Sumatra. In 2023, rice production in OKU reached approximately 143,512 tons, whereas corn production exceeded 36,000 tons. Additionally, the OKU region is a horticultural center for vegetable and fruit commodities, such as chili peppers, eggplants, cucumbers, and bananas. With this enormous potential, the quality of farmers' human resources is a determining factor in the sustainability of regional food security.

Agricultural human resources that are adaptive to the use of technology, have managerial skills, and are capable of developing modern agribusiness will increase the productivity, efficiency, and competitiveness of the food sector (Purba et al., 2025; Qorri, Pergéné Szabó, Felföldi, & Kovács, 2024). The Indonesian government, through the Ministry of Agriculture, has rolled out various strategic programs, such as Youth Entrepreneurship and Employment Support Services (YESS), Farmer Cards, Smart Farming 4.0, and capacity building for agricultural extension workers, to support the emergence of a generation of qualified millennial farmers. OKU Regency has been one of the target areas of the YESS Program since 2021, providing an opportunity to accelerate the growth of millennial farmers based on agribusiness competence.

However, several challenges still hinder the process of developing millennial farmers' human resources in OKU.
1. Limited access to agricultural capital, both conventional and modern agricultural technology.
2. Limited access to formal financing, inadequate human resource capabilities, and poor management practices (Surjanti, Mulyantomo, Triyani, & Kurniawati, 2025).
3. There is a lack of training and mentoring oriented towards innovation, digitization, and agricultural entrepreneurship.
4. Lack of access to modern markets, food value chains, and digital marketing platforms.
5. Limited agricultural mechanization, especially in rural subdistricts such as Ulu Ogan and Semidang Aji, is a challenge.
6. Climate change reduces productivity and increases the risk of crop failure.
7. Negative perceptions of the farming profession among the public have resulted in low interest among the younger generation in pursuing agriculture.

Millennial farmers play a strategic role in food security (Arvianti, Setyabudi, & Novita, 2025). Millennial farmers are a generation that is familiar with digital technology, open to innovation, and tends to have stronger social capital in building agribusiness networks than older farmers. Strong human resources can drive productivity improvements through the use of technology, efficient food production and distribution, strengthening agripreneurship systems, implementing *sustainable agriculture*, and reducing harmful harvesting and post-harvest practices (Farida, 2023; Roy & Medhekar, 2025). Therefore, the development of millennial farmers' human resources is not only beneficial for increasing farmers' income, but also a fundamental element in strengthening local food security in OKU, particularly in terms of food availability, access, utilization, and stability (Pramudia et al., 2025).

Based on the above description, research on *the Development of Millennial Farmers' Human Resources in OKU Regency in Supporting Food Security* is important to be carried out in order to describe the real conditions of millennial farmers, the factors that influence them, and the strategies that can be formulated in developing millennial farmers' human resources to strengthen regional food security in a sustainable

manner. Research on millennial farmers has been conducted by several researchers (Arvianti et al., 2025; Haryanto, Effendy, & Yunandar, 2021). This study is novel in that it integrates a quantitative analysis of millennial farmers' human resource development factors with strategic management tools, including SWOT and the Grand Strategy Matrix, in a regional agricultural context. Unlike previous studies that focus mainly on descriptive or policy perspectives, this research combines explanatory modelling with strategic formulation to support food security.

2. Literature Review

2.1 The Concept of Human Resources (HR) in the Agricultural Sector

Human resources (HR) in agriculture refer to the abilities, skills, knowledge, motivation, and productivity of the workforce involved in the cultivation, post-harvest, distribution, and marketing of agricultural products (Supatminingsih, 2022). Agricultural HRM not only covers direct labor in agricultural fields but also agribusiness actors, agricultural extension workers, young farmers, and food *value chain* actors. In the context of modern agricultural development, the quality of human resources is a strategic factor that determines the success of food system transformation. Excellent human resources can apply innovation, digital technology, and mechanization and build a wider market network to increase agricultural competitiveness.

Agricultural human resource development consists of several key dimensions (Nainggolan et al., 2025), namely 1) increasing knowledge through education, training, and technology transfer; 2) improving skills such as technical cultivation skills, farm management, marketing, and digital literacy; 3) *attitude* and motivation, including work ethic, entrepreneurial mindset, creativity, and willingness to innovate; 4) access to production factors, such as land, capital, technology, and information; and 5) organizational capacity through farmer groups, cooperatives, and market networks. Ideal human resource development requires synergy among the government, educational institutions, extension workers, and farmer organizations.

Millennial farmers are young farmers aged 19–39 who use modern thinking, are able to utilize digital technology, and have an innovative and adaptive orientation towards change in farming. In various studies, millennial farmers are described as a generation characterized by being tech-savvy, adaptive to *smart farming*, involved in *agripreneurship*, having entrepreneurial insight, and being open to mechanization and digitalization in agriculture. Millennial farmers are important agents in facing challenges in the agricultural sector, such as land conversion, climate change, and low productivity. Furthermore, according to Haryanto et al. (2021), the characteristics of millennial farmers include being more educated than previous generations, business-oriented, not merely subsistence-oriented, using digital technologies such as agricultural applications, *e-commerce*, and *drones, and* being involved in online social networks for marketing and community-building.

Millennials are characterized by their responsiveness to technology, active participation in communities, and great potential as agents of change in household food security (Pramudia et al., 2025). They can access global information on modern agricultural trends and tend to choose businesses with added value, such as *processing*, *packaging*, and *branding*. From a strategic perspective, millennial farmers play an important role in accelerating the transformation of agriculture towards Agriculture 4.0. In fact, the role of millennial farmers is very strategic, namely to increase productivity and efficiency, build a competitive food value chain, reduce dependence on food imports, support local and national food security, and maintain environmental sustainability *(sustainable agriculture)*.

Human resource development is a systematic process to improve individuals' knowledge, skills, abilities, and motivation to achieve development goals (Bariqi, 2018). The level of understanding and knowledge of farmers greatly influences their way of thinking and insight into farming activities (Reniati, Zukhri, Hamsani, Pronika, & Setiawan, 2025). In agriculture, human resource development includes agricultural training and education (formal and non-formal), farming assistance (extension services), the application of modern agricultural technology, agricultural entrepreneurship (*agri*), improving agricultural digital literacy, and access to capital, markets and information.

According to Nurida and Sitorus (2024), the development of young farmers' human resources is influenced by education and training, access to land and capital, the role of agricultural extension workers, government policy support, access to technology and digitalization, the motivation and interests of the younger generation, the social and cultural environment, and the networks and communities of young farmers. Meanwhile, the human resource development model for millennial farmers includes the Capacity Building Model (CBM), which emphasizes the improvement of technical and managerial skills; *the Agripreneurship Development Model*, which emphasizes the business orientation of farming; *the Technological Adoption Model*, which encourages the application of *smart farming*; and *the Value Chain Integration Model*, which connects farmers with markets, industries, and distributors. Based on the research objectives, this study formulates the following research questions:

1. What factors significantly influence the development of millennial farmers' human resources in the Ogan Komering Ulu Regency?
2. Does access to financing positively affect millennial farmers' human resource development?
3. How do agricultural extension services and family support contribute to millennial farmers development?
4. What development strategies can be formulated based on SWOT and Grand Strategy analyses to strengthen millennial farmers in supporting food security?

3. Research Methodology

3.1 Sampling Method
This study applied a survey sampling method, involving 94 millennial famers aged 19-39 years in the Ogan Komering Ulu Regency. The respondents were selected based on their active involvement in agricultural activities and classification as millennial farmers. This sampling approach was considered appropriate to represent the characteristics of millennial farmers in the study area.

3.2 Data Analysis
This study employed a mixed-method approach with an explanatory sequential design. Quantitative data were analyzed using multiple linear regression analysis to examine the influence of formal education level, age, access to financing, the role of agricultural extension service, and family support on the human resource development of millennial farmers. The regression model was evaluated using a t-test for partial effects, an F-test for simultaneous effects, and the coefficient of determination (R^2) to assess the model's explanatory power. For strategic formulation, this study utilized SWOT analysis, supported by Internal Factor Evaluation (IFE) and External Factor Evaluation (EFE) matrices. The strategic position was further determined using the Grand Strategy Matrix to formulate development strategies for millennial farmers to support food security.

3.3 Validity Testing
Instrument validity was tested using item-total correlation analysis, in which each questionnaire item was correlated with the total score of its respective variable. Items with correlation coefficients exceeding the critical value were considered valid and suitable for further analyses.

3.4 Reliability Testing
Reliability testing was conducted using Cronbach's alpha, with a minimum acceptable value of 0.70. The results indicated that all the research variables met the reliability criteria, confirming the internal consistency of the measurement instruments.

4. Results and Discussions

4.1 Characteristics of Farmers
4.1.1 Age of Millennial Farmer Respondents
Based on the survey results of 94 millennial farmers, the age structure of respondents was as follows: 24% were aged 19–25 years, 33% were aged 26–30 years, 29% were aged 31–35 years, and the remaining 14% were aged 36–39 years. This distribution pattern shows that the majority of millennial farmers (62%) are in the 26–35 age group, which is a productive age phase with a capacity for technological adaptation, high energy levels, and a greater tendency to accept change than other age groups.

Table 1. Age of respondents, 2025

No	Age Group	Percentage
1	19–25 years	24
2	26–30 years old	33
3	31–35 years old	29
4	36–39 years old	14

Table 1 shows age group is highly relevant in the context of modern agricultural development in India. Young people play an important role in the adoption of new technologies because they have broader access to information, faster learning abilities, and a more open view of digital agricultural innovations, such as *the Internet of Things* (IoT), precision farming, smart farming, and the use of mobile-based agricultural applications. These findings are consistent with previous studies showing that youth is an important factor in driving agricultural transformation.

Farmers aged 25–35 are quicker to adopt digital technology because they have relatively high digital literacy, making them more adaptable to agricultural modernization. Furthermore, Hariri, Amar, Alfian, and Renika (2025) found that the younger age group (20–35 years old) is more responsive to agricultural training, uses social media for marketing, and is more innovative in diversifying farming businesses. According to the Agency for Agricultural Extension and Human Resource Development, the success of the Millennial Farmer Program in various provinces is influenced by the dominance of participants aged 20–35 years, who have a strong interest in technology and agricultural entrepreneurship.

Meanwhile, the FAO Study also states that young people in rural areas are the driving force behind the modernization of agricultural production systems, especially in the context of precision agriculture and the use of digital-based agricultural data. Thus, the age composition of the respondents in this study reflects the great potential for driving agricultural transformation in OKU Regency. The dominance of the 26–35 age group strengthens the opportunities for implementing millennial farmer development programs that are oriented towards technology, innovation, and entrepreneurship. This becomes strategic social and demographic capital in accelerating the adoption of modern agricultural systems and increasing the competitiveness of the regional agricultural sector in the long run.

4.1.2 Education Level
Based on the results of the study, the percentage of respondents' education levels is shown in Table 2.

Table 2. Educational level of millennial farmer respondents in OKU Regency, 2025

No	Education	Percentage
1	High School/Vocational School Diploma	53
2	Bachelor	14
3	Postgraduate	33

Table 2 shows survey results from 94 millennial farmers show that 52% of respondents have a high school/vocational school education, 14% have a diploma, 33% have a bachelor's degree, and 1% have a postgraduate degree. This composition shows that most millennial farmers have secondary to higher education, which is an important asset in increasing the capacity and competence of modern farming businesses. A relatively high level of education is a strategic factor in agricultural decision-making, especially in the digital agriculture era. Many high school/vocational school graduates today are equipped with a basic understanding of technology and entrepreneurship, while diploma and bachelor's degree graduates have more mature analytical and technological literacy skills.

This encourages young farmers to adopt precision agriculture, agricultural management applications, the Internet of Things (IoT) for land monitoring, digital marketing through marketplaces or social media, and modern post-harvest technology more quickly. The results of this study are consistent with those of previous studies. Education level has a significant effect on young farmers' ability to access digital-based

agricultural information and their ability to manage data for decision making (Mokhtar, Izhar, Zaini, & Hussin, 2022; Oli, Gyawali, Acharya, & Oshikoya, 2025). Farmers with a medium to high level of education have a greater chance of adopting modern agricultural innovations, including the use of agricultural tools and machinery, as well as ICT-based applications.

Education plays an important role in increasing agricultural productivity because educated workers adapt more quickly to new technologies and more efficient farming practices. This is in line with Dwinarko and Muhamad (2023), who noted that successful participants in the Millennial Farmer Program are those who have at least a high school/vocational school education and actively participate in training on technology, agribusiness, and farm management. Thus, the high proportion of millennial farmers with secondary and higher education in this study provides a strong indication that they have the capacity to accelerate the transformation of agriculture towards *smart agriculture* and more competitive agribusiness.

4.1.3 Commodities Managed

The results of the study show that the main commodities managed by millennial farmers are paddy rice (61%), followed by corn (16%), horticulture (13%), and livestock and mixed farming (10%). The dominance of paddy rice shows that the food crop subsector is still the main choice for millennial farmers in the study area, mainly due to the high and stable demand for rice, a relatively secure market, government support (input subsidies, agricultural machinery, and guidance), and the availability of suitable land (irrigation and agro-climate).

Table 3. Main commodities managed by the sample of millennial farmers, 2025

No	Commodity	Percentage
1	Paddy rice	61
2	Corn	16
3	Horticulture	13
4	Livestock and mixed farming	10

Table 3 shows corn ranks second, in line with the increasing demand from the animal feed industry and food diversification. Meanwhile, the involvement of millennial farmers in horticulture (fruits and vegetables) shows a trend towards high-value agribusiness, although it is still limited. Groups that manage livestock and mixed farming show business diversification, which can increase household income resilience. These findings are consistent with previous studies, namely BPS (2023), which noted that rice and corn are the two dominant commodities managed by young farmers owing to clearer market access and relatively complete supporting infrastructure.

Haryanto et al. (2021) in a study on millennial farmers in West Java found that most young farmers still choose rice as their main commodity because of low market risk and high government support. Young farmers tend to choose staple crops, such as rice and corn, because they provide a stable market guarantee before switching to higher value-added commodities, such as horticulture or livestock. Furthermore, Asmaga, Sari, and Efrianti (2025) found that the adoption of horticulture by young farmers is increasing in areas with access to large urban markets, but in semi-rural areas such as OKU Regency, the dominance of food crops is still very strong.

Mixed *farming* practices are being widely adopted by millennial farmers as a strategy to increase income and mitigate the risks of climate change (Shaffril et al., 2024). The composition of these commodities indicates that millennial farmers in OKU Regency are still focused on traditional commodities but are beginning to explore opportunities in the horticulture and livestock sectors. This development is highly relevant for promoting local food diversification while increasing farmers' economic resilience.

4.1.4 Human Resource Capacity Level

The results of the study indicate that the human resource capacity of millennial farmers in OKU Regency is in the good category, but with variations between dimensions (Table 4).

Table 4. Dimensions of human resource capacity levels of millennial farmers in OKU Regency, 2025

No	Dimension	Average Score	Category
1	Cultural knowledge	3.87	Good
2	Digital literacy	3.42	Fair
3	Skills in farm management	3.68	Good
4	Agricultural technology skills	3.11	Fair
5	Motivation and innovative attitude	4.02	Very good

Table 4 shows the results, which indicate that the dimensions of motivation and innovative attitude were high, with a score of 4.02. This shows that millennial farmers have a strong desire to change and adopt technology, which is an important asset for agricultural modernization. The results of the study show that the knowledge and management skills of the respondents are quite good. The cultivation knowledge score (3.87) and management skills score (3.68) indicate that the respondents already have basic technical mastery of farm management.

Meanwhile, digital literacy and agricultural technology are still weak, with digital literacy at 3.42 (sufficient) and agricultural technology skills at 3.11 (sufficient). This shows a gap between innovative attitudes and technological capacity, which requires training and mentoring. The situation consistent with research emphasizing digital transformation is often hampered by gaps in human skills and limited technical capacity, despite a relatively high attitude toward innovation (Akbar, Abdurahman, Nursanto, & Hartati, 2025). Similar findings indicate that limited digital skills and literacy remain major barriers to effective digital transformation, emphasizing the importance of education, training, and continuous mentoring (Lisa et al., 2025).

These results are in line with Rogers' Theory/Study Zondo and Ndoro (2023) on *the Diffusion of Innovation*, where the adoption of innovation is greatly influenced by perceived benefits, technological capabilities, and social network support. A high level of innovative attitude is an important driving factor, but adoption will not be optimal without technical skills. Digital literacy is a key competency for modern farmers, especially in the use of digital markets, weather information systems, and cultivation applications.

4.1.5 Level of Digital Agriculture Technology Utilization by Millennial Human Resources
Digital agriculture (smart farming) is the use of information and communication technology (ICT) throughout the entire agricultural value chain, from production planning, cultivation, harvesting, and post-harvesting to marketing. The results of a study in Ogan Komering Ulu Regency show that the level of utilization of digital agriculture technology by millennial human resources is shown in Table 5.

Table 5. Level of utilization of digital agricultural technology by millennial human resources, 2025

No	Type of Technology	Level of Utilization (%)
1	Agricultural marketplace	48
2	Social media marketing	78
3	Automatic irrigation system	1
4	Drone monitoring	2
5	Crop cultivation & farming records application IoT	52
6	Institutional Sensors	2

Table 5 shows the results of the study show that the highest utilization of digital agricultural technology by millennial human resources is in the type of social media marketing technology, at 78%. Millennial farmers utilize platforms such as Facebook, Instagram, and WhatsApp to promote and sell agricultural products. This is in line with the digital marketing trends. The type of agricultural *marketplace* technology utilized by millennials is 48%, which shows that the use of this technology is not yet dominant but is already quite high. Some farmers are already connected to agricultural *e-commerce platforms*, but not all.

Meanwhile, the use of advanced production technology is still very low: drones at 2% and IoT at 2%. Based on these results, this actually shows that there is a gap in the mastery of modern production technology at the millennial farmer level, which is caused by limited capital, low technical skills, and a lack of assistance.

4.1.6 Participation of Millennial Farmers in Farmer Groups
The results of the study show that the level of participation of millennial farmers in farmer groups is very high, with 82% of respondents actively participating in farmer group activities, while the remaining 18% are inactive. This high level of participation indicates that local agricultural institutions in the study area have developed well and can attract the younger generation to actively engage in agricultural institutional activities. The active participation of millennial farmers in farmer groups plays a strategic role in supporting the development of modern farming.

Farmers' groups function as administrative forums, a medium for technology and innovation transfer, a channel for agricultural information distribution, and a means of strengthening farmers' social and economic networks. Through farmers' groups, millennial farmers gain broader access to information on cultivation technology, agricultural mechanization, use of production inputs, financing, and business partnership opportunities. In addition, farmer groups play an important role in the collective purchase of inputs, which can reduce production costs and increase farming efficiency. The existence of farmer groups also strengthens the bargaining position of millennial farmers, both in the procurement of production facilities and marketing of agricultural products.

By joining a group, farmers no longer deal with the market, financial institutions, or other parties individually but instead have greater collective power. This finding is in line with the views of Khairunnisa, Saleh, and Anwas (2019), who state that farmer groups are key actors in strengthening farmer institutions and play a significant role in increasing the adoption of agricultural innovations. Although this study is classical in nature, its relevance remains strong in the context of modern agriculture and the development of millennial farmers. The results of this study are supported by various recent empirical studies.

The active participation of young farmers in agricultural institutions has a positive effect on the adoption of modern agricultural technology and increased agricultural productivity. Strengthening farmer groups that are adaptive to the characteristics of millennial farmers—such as the use of digital technology and more flexible management systems—can increase the sustainability of agricultural businesses and the interest of the younger generation in remaining in the agricultural sector. Thus, the high level of participation of millennial farmers in farmer groups in this study shows that agricultural institutions have a strategic role in supporting the development of millennial farmers' human resources, expanding access to financing, and encouraging the realization of productive, modern, and sustainable agriculture.

4.1.7 Access to Credit for Millennial Farmers
The results of the study show that People's Business Credit (KUR) is the main source of financing for millennial farmers in the Ogan Komering Ulu (OKU) Regency, with a percentage of 41%. This finding indicates that the KUR program is still the most dominant formal financing instrument used by millennial farmers, especially in supporting the development of small-to medium-scale farming businesses. The characteristics of millennial farmers, who are relatively more adaptive to technology and information, should be an important asset in accessing formal financing for their enterprises. However, the results of the study show that millennial farmers in OKU Regency still face various obstacles in utilizing KUR, particularly related to administrative requirements that are considered complicated, the requirement to provide collateral, and limited understanding of bank loan application procedures.

Table 6. Millennial farmers' access to business credit, 2025

No	Source of capital	Percentage
1	Agricultural KUR	41
2	Own capital	37

| 3 | Government Assistance | 12 |
| 4 | Cooperation with local investors | 10 |

Table 6 shows these findings are in line with the research by Mustikawati, Priantinah, Sari, and Astuti (2024), which states that although millennials have relatively good digital literacy, financial literacy, and understanding of banking products, they are still major obstacles in accessing agricultural business credit. In addition to KUR, the results of the study show that the use of personal capital by millennial farmers in OKU Regency is still relatively high at 37%. This condition shows that some millennial farmers still rely on internal sources of financing to run their farms. The high use of personal capital indicates a cautious attitude towards credit risk and reflects the suboptimal use of formal financing by millennial farmers.

However, the limited assets that can be used as collateral and unstable income from farming also influence millennial farmers' decisions to use their own capital. These results are supported by research conducted by Alam, Wulandari, and Widadie (2025), who concluded that young farmers tend to avoid formal credit financing because of concerns about their ability to repay loans, especially for agricultural commodities that have high production risks and price fluctuations. Furthermore, Khanal and Omobitan (2020) state that millennial farmers' dependence on personal capital can limit the expansion of farming businesses, thereby impacting the low increase in business scale and productivity in rural areas.

Meanwhile, financing sourced from government assistance (12%) and investors (10%) shows that opportunities for collaboration and diversification of financing sources for millennial farmers in OKU Regency are still available. Government assistance is generally stimulatory and not yet sustainable; therefore, it is not yet able to fully support the transformation of millennial farming businesses. Investor involvement remains relatively limited due to the low institutional readiness of millennial farmers, lack of structured business models, and suboptimal guarantees of business certainty. These findings are in line with the research by Kusmiati (2025), which emphasizes that strengthening partnerships between millennial farmers, local governments, and the private sector is an important strategy for expanding access to capital and improving the sustainability of agricultural businesses.

Additionally, Widarti, Bancin, Youlla, and Sugiardi (2023) assert that the development of millennial farmer institutions, increased transparency in business management, and the use of digital technology are key factors in attracting investors' interest in the agricultural sector. Overall, the results of this study show that access to financing for millennial farmers in OKU Regency is still dominated by KUR and personal capital, while alternative sources of financing, such as government assistance and investors, have not been optimally utilized. Therefore, it is necessary to improve the financial literacy of millennial farmers, simplify KUR financing procedures, and strengthen institutions and partnership networks so that millennial farmers in OKU Regency can access financing in a more inclusive and sustainable manner to support the development of modern farming businesses.

4.2 Factors Affecting the Development of Millennial Farmers' Human Resources in OKU

The results of multiple linear regression analysis show that formal education level, age, access to financing, the role of agricultural extension workers, and family support simultaneously and partially have a significant effect on the human resource development of millennial farmers. The resulting regression equation is as follows.

$$Y = 12.3 + 0.41X_1 + 0.32X_2 + 0.29X_3 + 0.37X_4 + 0.26X_5 \tag{1}$$

- Y = Development of Millennial Farmers' Human Resources
- X_1 (Level of Formal Education)   t = 6.591 α_1 = 0.001
- X_2 (Age)   t = 3.543 α_2 = 0.013
- X_3 (Access to financing)   t = 9.760 α_3 = 0.018
- X_4(Role of Agricultural Extension Workers) t = 1.912 α_4= 0.005
- X_5 (Family support)   t = 12.451 α_5 = 0.020
- Fhit   = 8.467 α = 0.000

- R^2 = 0.86

The F-value of 8.467 with a significance level of 0.000 indicates that all independent variables simultaneously have a significant effect on the development of the human resources of millennial farmers. Meanwhile, the coefficient of determination (R^2) value of 0.86 indicates that 86% of the variation in the development of millennial farmers' human resources can be explained by these five variables, while the remaining 14% is influenced by other factors outside the model, such as access to digital technology, market networks, and local government policies.

4.2.1 The Influence of Formal Education Level (X1)
The formal education level variable has a regression coefficient of 0.41 with a t-value of 6.591 and a significance of 0.001, which means it has a positive and significant effect on the development of human resources of the millennial farmers. This finding shows that the higher the formal education level of millennial farmers, the better their knowledge, skills, and adaptability to modern agricultural practices. These results are in line with Mendrofa et al. (2024), who stated that formal education plays an important role in improving farmers' ability to adopt technology, make farming decisions, and manage market-based agribusiness. In the context of millennial farmers, education is a major asset for understanding digital agriculture and agricultural entrepreneurship.

4.2.2 Effect of Age (X2)
The age variable has a regression coefficient of 0.32, with a t-value of 3.543 and a significance of 0.013, indicating a positive and significant effect on the development of the human resources of the farmers. This finding indicates that in the productive age range, millennial farmers tend to have high energy, motivation, and adaptability to technological change and agricultural innovation. The results of this study support the findings of Winarno and Lestari (2025), who state that the productive age of farmers contributes greatly to the success of modern agricultural transformation, especially in the use of digital technology, business management, and market networks.

4.2.3 The Influence of Access to Financing (X3)
The financing access variable shows a regression coefficient of 0.29 with a t-value of 9.760 and significance of 0.018, indicating that it has a positive and significant effect on the development of millennial farmers' human resources. Adequate financing access enables millennial farmers to increase the scale of their businesses, adopt new technologies and participate in agricultural training and innovation. These findings are in line with those of Wahab (2023) and Kurniawan, Suharto, and Andari (2023), who concluded that capital constraints are one of the main obstacles to developing the capacity of farmers, especially young farmers. Financing schemes such as the People's Business Credit (KUR) are considered strategic in encouraging improvements in the quality of human resources among millennial farmers.

4.2.4 The Effect of the Role of Agricultural Extension Workers (X4)
The agricultural extension worker role variable has a regression coefficient of 0.37, with a t-value of 1.912 and a significance of 0.005, indicating a positive and significant effect. This confirms that agricultural extension workers still play an important role as facilitators, educators, and mentors in increasing the capacity of millennial farmers. These results support the studies by Nurida and Sitorus (2024) and Ahmad, Mokoginta, Indrianti, and Djibran (2025), which state that the effectiveness of extension has a direct effect on improving competence, innovative attitudes, and the sustainability of farming businesses, especially among young farmers who need continuous assistance.

4.2.5 The Influence of Family Support (X5)
The family support variable had a regression coefficient of 0.26, with a t-value of 12.451 and a significance of 0.020, indicating the strongest positive and significant influence among the other variables. Family support, whether in the form of moral support, labor, or social capital, plays an important role in increasing the motivation and sustainability of millennial farmers' businesses. This finding is in line with the research by Tengapoe, Baddianaah, and Yaradua (2024) and Nurumami, Kriska, and Wastutiningsih (2023), which confirms that family support is a key factor in the success of farmer

regeneration and agricultural human resource development, especially in the context of small- and medium-scale farming in rural areas.

4.3 Millennial Farmer Human Resource Development Strategies Analysis of External and Internal Factors in the Input Stage

The input stage is the first stage in strategy formulation. This stage consists of an Internal Factor Evaluation (IFE) matrix and an External Factor Evaluation (EFE) matrix. Both matrices were the result of identifying internal and external factors. Based on the results of identification and field observations, data were obtained on the conditions of Human Resource Development for Millennial Farmers in Ogan Komering Ulu Regency. The identified internal and external factors were then evaluated using the *Internal Factor Evaluation* (IFE) and *External Factor Evaluation* (EFE) *matrices*. The IFE matrix was used to evaluate the strengths and weaknesses of the Millennial Farmer HR Development strategy in Ogan Komering Ulu Regency. The EFE matrix is used to evaluate the opportunities and threats of the Millennial Farmer HR Development strategy in Ogan Komering Ulu Regency.

4.3.1 IFE Matrix

The IFE *(Internal Factor Evaluation)* Matrix is a matrix that contains internal company factors in the form of weaknesses and strengths. The IFE matrix assessment is based on questionnaire interviews with the respondents. The IFE matrix questionnaire also includes weight, ranking, and weighted values. By entering the results of the identification of strengths and weaknesses as internal factors of the company and assigning weights and rankings, the results shown in Table 7 are obtained.

Table 7. IFE (*internal factor evaluation*) for the development of millennial farmers in Oku Regency, 2025

No.	Internal Strategic Factor	Weight	Rating	Score
A	**Strengths (S)**			
1	The majority of millennial farmers are of productive age and are adaptable to innovation.	4	0.09	0.36
2	Basic technology literacy (smartphones, social media) is relatively good quality.	4	0.09	0.36
3	The participation of millennial farmers in farmer groups is quite high.	2	0.05	0.10
4	Motivation for agricultural entrepreneurship and Market orientation is beginning to develop in the country	3	0.07	0.21
5	Availability of strategic agricultural land in OKU Regency.	3	0.07	0.21
	Total	16		1.24
B	**Weaknesses (W)**			
1	Modern agricultural and managerial technical skills are still limited.	4	0.09	0.36
2	Access to technology-based agricultural training is uneven.	3	0.07	0.21
3	Limited business capital and dependence on informal financing.	3	0.07	0.21
4	Low capacity for processing and adding value to products.	4	0.09	0.36
5	Agricultural extension assistance is not yet optimal and sustainable.	3	0.07	0.2
	Total	17		1.35
	Total A + B			**2.59**

4.3.2 EFE Matrix

External strategic factors consist of opportunities and threats. The results of the EFE Matrix calculation are presented in Table 8.

Table 8. EFE (*External Factor Evaluation*) Development of Millennial Farmers in OKU Regency OKU, 2025

No	External Strategic Factors	Weight	Rating	Score
C	**Opportunities (O)**			
1	Government program support (KUR, millennial farmers and agricultural digitization).	4	0.09	0.36
2	Agricultural technology development (smart farming and digital marketing).	4	0.09	0.36
3	Market demand for local and sustainable food products is increasing.	4	0.09	0.36
4	Collaboration with universities, agricultural startups, and the private sector	2	0.05	0.10
5	Access to information and business networks through digital platforms	3	0.07	0.21
	Total	16		**1.39**
D	**Threats (T)**			
1	Conversion of agricultural land to other uses.	3	0.07	0.21
2	Fluctuations in agricultural product prices and production inputs.	3	0.07	0.21
3	Climate change and crop failure risks.	3	0.07	0.21
4	Low interest among the younger generation in conventional agriculture (Table	4	0.09	0.36
5	Competition from agricultural products from other regions.	4	0.09	0.36
	Total	17		**1.35**
	Total C + D			**2.74**

4.3.3 SWOT Strategy Matrix

The SWOT matrix is a tool used to determine strategic alternatives formed by four types of strategies: SO, ST, WO, and WT. The SO strategy maximizes internal strengths and external opportunities to form an offensive strategy. The WO strategy focuses on improving internal weaknesses to take advantage of various opportunities in external factors. The ST strategy focuses on maximizing internal strengths and minimizing potential threats. The WT strategy focuses on defensive actions to improve internal weaknesses and avoid external threats.

The SWOT Matrix is created by first determining *the Internal Factor Evaluation* (IFE) and *External Factor Evaluation* (EFE). The internal and external factors in Tables 2 and 3 are used to determine strategic alternatives using the SWOT Matrix. The results of the SWOT Matrix are presented in Table 9.

Table 9. SWOT strategy matrix

IFAS / EFAS	STRENGTHS (S)	WEAKNESSES (W)
	1. Most millennial farme are of productive age an adaptable to innovation. 2. Basic technology literac (smartphones, soci media) was relative good. 3. Millennial farmer participation in farm groups is high. 4. Motivation for agricultur entrepreneurship an market orientation developing. 5. Availability of strateg food agricultural land the OKU Regency.	1. Modern agricultur technical and manageri skills remain limited. 2. Access to technolog based agricultural trainin is limited. 3. Limited business capit and dependence informal financing a also common issues. 4. Low capacity fe processing and addir value to products: **5.** Agricultural extensic services are neith optimal nor sustainable.
OPPORTUNITIES (O) 1. Government program suppo (KUR, millennial farmer agricultural digitization). 2. Advancements in agricultur technology (smart farming ar digital marketing). 3. There is an increasing mark demand for local ar sustainable food products. 4. Collaboration with universitie agricultural startups, and th private sector. 5. Access to information ar business networks throug digital platforms.	**STRATEGIES SO** 1. Developing digital agricultu training and entrepreneurship progran based on millennial farm groups. 2. Encouraging millennial farme to become *agripreneu* through technology integratic and digital market access essential. 3. Strengthening collaboratic between millennial farmers ar universities and agricultur *startups*	**WO STRATEGIES** 1. Enhancing human resour capacity through technica managerial, and financial training based on th government programs. 2. Optimizing KUR and inclusiv financing are accompanied t business assistance. 3. Strengthening the role c agricultural extension worke and business mentors usir technology.
THREATS (T) – THREATS 1. Land use conversion. 2. Fluctuations in agricultur product prices and productic inputs are also observed. 3. Climate change and crop failu risks are also important factor 4. Low interest among young generations in convention agriculture. 5. Competition from agricultur products from other regions	**STRATEGIES ST** 1. Adapting technology to addre climate change and productic risks is crucial. 2. Strengthening millennial farm institutions to improve the bargaining power. 3. Product innovation ar agricultural busine diversification can redu market risks.	**WT STRATEGIES** 1. Strengthening human resour capacity for agricultural ris management. 2. Developing a sustainab mentoring system to prevent th failure of millennial farmer businesses. 3. Encouraging farm regeneration through mode and attractive agricultur business models.

4.3.4 Grand Strategy Analysis

The scores obtained from Tables 2 (IFE) and 3 (EFE) are used to determine the quadrant position using the *Grand Strategy* Matrix analysis, which will then be used to determine strategic alternatives for Karanganyar Regency using the SWOT Matrix. IFE scores were used for the horizontal coordinate (X), and EFE scores were used for the vertical coordinate (Y). The value at the horizontal axis coordinate point (X) is calculated by subtracting the internal strength and weakness factors, namely (2.65-0.61) = 2.04. Meanwhile, the value at the vertical axis coordinate point (Y) is calculated by subtracting the external opportunity factor from the threat factor, namely (2.14-1.63) = 0.51. Based on the IFE and EFE score calculations, the position is in quadrant I (2.04, 0.51), which is a strategic position for S-O.

Table 10. Strategic coordinates

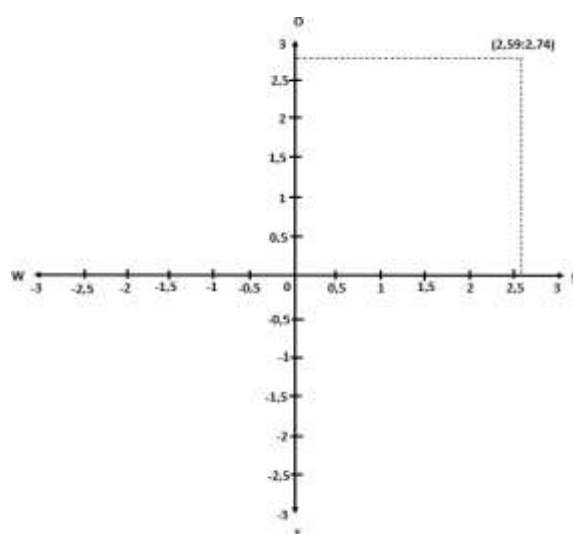| Internal Factors	X Coordinate	External Factors	Y Coordinate
Strength = 1.24		Probability = 1.39	
	2.59		2.74
Weakness = 1.35		Threats = 1.35	

Figure 1. *Grand Strategy* Matrix

The results of the study show a position in quadrant I, namely the S-O strategy. The position in quadrant I (S-O) is strategic (*excellent*). Several strategies are appropriate for quadrant I S-O, namely by concentrating on the market and products owned. Strategies that focus on the market and products that can be applied according to the expert respondents in the SWOT Matrix results are: 1) developing digital agriculture training and entrepreneurship based on millennial farmer groups, 2) encouraging millennial farmers to become *agripreneurs* through technology integration and digital market access, and 3) strengthening collaboration between millennial farmers and universities and agricultural *startups*.

The results of the study show that the coordinates in quadrant I (one) have strengths, namely that the majority of millennial farmers are of productive age and adaptable to innovation, their basic technological literacy (smartphones, social media) is relatively good, the participation of millennial farmers in farmer groups is quite high, motivation for agricultural entrepreneurship and market orientation is beginning to develop, and there is availability of strategic agricultural land in OKU Regency. In addition, in quadrant I, the strategy for developing the human resources of millennial farmers in OKU Regency has opportunities in the form of government program support (KUR, millennial farmers, agricultural digitization), agricultural technology development (smart farming, digital marketing), increasing market demand for local and sustainable food products, collaboration with universities, agricultural startups, and the private sector, and access to information and business networks through digital platforms.

4.3.5 Determination of Alternative Strategies

a. Development of Digital Agriculture Training and Entrepreneurship Based on Millennial Farmer Groups

This strategy focuses on improving the capacity of millennial farmers through education and training relevant to market needs and technology trends. Digital agriculture training covers literacy in the use of agricultural applications, digital marketing, and modern agribusiness management, which can improve farming efficiency while broadening the entrepreneurial horizons. Previous findings indicate that training in digital agricultural marketing can provide direct access to consumers and strengthen the competitiveness of agricultural products, which has a positive impact on income and millennial engagement in the agricultural sector. In addition, the literature also emphasizes that strategies to strengthen digital marketing must be integrated with mentoring and communities so that the effectiveness of training is not only technical but also institutional.

b. Encouraging Millennial Farmers to Become Agripreneurs through Technology Integration and Digital Market Access.

The second strategy emphasizes the importance of developing the character of agripreneurs among millennial farmers through optimal use of digital technology. Agricultural digitization encompasses not only production aspects but also marketing and business development. Access to digital markets through e-commerce platforms, social media, and marketplace systems is an important instrument that enables millennial farmers to market their products directly to a wider range of consumers. Previous studies have also found that the integration of digital marketing can overcome the limitations of conventional distribution channels, shorten the supply chain, and increase the value of agricultural products. The concept of digital-based agripreneurship is in line with the transformation of modern agriculture, which encourages product diversification, service innovation, and the development of an agricultural business ecosystem that is responsive to market dynamics.

c. Strengthening Collaboration between Millennial Farmers, Universities, and Agricultural Startups

Collaboration between millennial farmers, universities, and agricultural startups is a key strategy for accelerating the adoption of agricultural technology and innovation. Universities play a role in providing knowledge resources, applied research, and agritech business incubation centers that can facilitate millennial farmers in developing their businesses. This collaborative approach aligns with the *triple helix* concept, which involves academia, industry, and the community as the drivers of innovation acceleration.

In addition, collaboration with agricultural startups enables technology transfer and new market opportunities through digital solutions relevant to the needs of millennial farmers, such as marketing applications, smart land management, and production analytics. This is in line with the findings that cross-institutional synergies can significantly improve digital literacy and product marketing capabilities. Overall, the SWOT analysis results show that the SO strategy is the top priority in developing the human resources of millennial farmers in Ogan Komering Ulu Regency, with an emphasis on increasing human resource capacity, utilizing technology, and strengthening agribusiness institutions as the foundation for sustainable food security.

5. Conclusions

5.1. Conclusion

This study reveals that millennial farmers in OKU Regency possess strong potential, with most being of productive age (26–35 years) and having secondary to higher education. They manage major food crops like rice and corn, which strengthens agricultural transformation and regional food security. While they demonstrate good human resource capacity, including motivation and innovation, the use of digital technology in agriculture is still limited, focusing mainly on marketing rather than production. Access to financing remains a key challenge, despite KUR being the largest formal funding source.

The study finds that factors like education, age, financing access, agricultural extension support, and family backing significantly impact the development of millennial farmers' human resources, with 86% of the variation explained. The SWOT analysis places human resource development in Quadrant I (S–O),

suggesting a strategic position. Key strategies for development include enhancing digital agriculture training, fostering agripreneurship, and collaborating with universities and agricultural startups.

5.2. Research Limitations

This study had several limitations. First, the research was conducted only in Ogan Komering Ulu Regency, which may limit the generalizability of the findings to other regions with different socioeconomic and agroecological conditions. Second, the sample size was relatively limited and relied on self-reported data, which may have introduced response bias. Future studies should involve larger samples, comparative regional analyses, and longitudinal approaches to capture dynamic changes in millennial farmer development over time.

5.3. Suggestions and Directions for Future Research

This study contributes to the field of agricultural development and food security both theoretically and practically. From an academic perspective, this study enriches the literature on millennial farmers by integrating human resource development analysis with strategic management tools such as SWOT, IFE, EFE, and the Grand Strategy Matrix. Practically, the findings provide valuable insights for local governments, agricultural extension institutions, and policymakers in designing targeted programs to strengthen millennial farmers' capacity through education, digital technology adoption, and financing access.

Furthermore, this study can serve as a reference for researchers and development practitioners in similar rural and agricultural contexts, particularly in developing regions facing challenges related to generational renewal in agriculture and sustainable food security issues. For future research, scholars should examine the role of digital literacy in enhancing the productivity and competitiveness of millennial farmers, especially in relation to the adoption of smart farming technologies and digital marketing platforms.

Acknowledgement

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