AGRICULTURAL POWER JOURNAL (APJ)

Vol. 2 No. 3 (2025) 12 – 27 | ISSN: 3062-8563 (Media Online)

Strategic Empowerment of Millennial Farmers for Achieving Sustainable Agriculture in the Digital Era

Amir Lababa [1], Kurnia Hidayatispi [2]*

[1] Institut Pertanian Malang

[2] Universitas Tribhuwana Tungga Dewi

* Correspondence: hidayatikurnia@gmail.com

ABSTRACT

The regeneration crisis, reflected in the declining proportion of young farmers in the 2023 Agricultural Census, poses a serious threat to Indonesia's food security and agricultural innovation capacity. This study aims to examine the causal influence of the 3 Pillar Digital Agripreneurship Empowerment Model—comprising Digitalization, Entrepreneurship, and Institutional Support—on the agricultural sustainability of millennial farmers in three pilot provinces. An explanatory quantitative approach was employed using Structural Equation Modeling–Partial Least Squares (SEM-PLS) with a sample of $N = 350$ respondents, and both the measurement and structural models were rigorously evaluated. The results indicate that the 3-Pillar Model explains 64.5% of the variance in agricultural sustainability ($R^2 = 0.645$). The Entrepreneurship Pillar shows the strongest effect ($\beta = 0.421$, $p < 0.001$), followed by the Digitalization Pillar ($\beta = 0.387$, $p < 0.001$), while Institutional Support remains statistically significant but exhibits the weakest influence ($\beta = 0.155$, $p = 0.044$). These findings demonstrate that technological access alone is insufficient to ensure sustainable agriculture; instead, sustainability requires the strengthening of agripreneurial mindsets, functional digital literacy, and the effective utilization of climate information for climate-resilient decision-making. Policy implications emphasize prioritizing agripreneurship capacity-building and strengthening institutional facilitation rather than merely increasing the number of farmer groups.

Keywords: Millennial farmers; strategic empowerment; digital agripreneurship; agricultural sustainability; PLS-SEM.

Article Information

Received: July 11, 2025
Revised: August 19, 2025
Online: August 23, 2025

PUBLISHED BY : http://doi.org/10.70076/apj.v2i3.122
HEI PUBLISHING https://heijournal.id/index.php/apj

Agricultural Power Journal, August **2025**, Vol 2, No 3

1. Introduction

The aging farmer population has become a structural concern in many agrarian economies, including Indonesia. Data from the 2023 Agricultural Census released by the Central Statistics Agency (BPS) show a declining proportion of farm households led by individuals aged 19–39 years [1]. This regeneration crisis threatens not only the continuity of the national food system but also the country's adaptive capacity toward technological transformation and climate-related challenges. From a theoretical perspective, this condition reflects the limitations of conventional agricultural development models that have failed to attract younger generations who are generally more adaptive to innovation and environmental change. At the same time, global agricultural systems are facing increasingly complex sustainability pressures, particularly those related to climate variability, resource efficiency, and environmental degradation [2].

Strategic empowerment of millennial farmers is therefore increasingly viewed as a critical pathway toward sustainable agricultural transformation. However, empowerment must extend beyond technical production skills to include agripreneurship capacity and digital value-chain integration in order to enhance the economic attractiveness and market relevance of agriculture for digitally oriented youth [3]. Although rural smartphone penetration in Indonesia has increased substantially, functional digital literacy for agricultural applications remains limited, thus constraining the effective use of digital platforms and smart farming services [4].

Recent studies on agricultural digitalization have emphasized the roles of the Internet of Things (IoT), big data, and smart farming technologies in improving productivity and efficiency [5]. While these studies provide important technical insights, most adopt a technocentric perspective and inadequately address the socio-economic, entrepreneurial, and institutional dimensions that strongly influence millennial farmers' decisions to adopt and sustain innovation. Government initiatives, such as the Ministry of Agriculture's Millennial Farmer Program, demonstrate strong political commitment to youth empowerment [6]; however, existing evaluations largely focus on output indicators (e.g., number of trained participants) rather than outcome-based impacts related to long-term sustainability. Furthermore, few studies have simultaneously examined the causal interaction between digitalization, entrepreneurship, and institutional support in shaping

Agricultural Power Journal, August **2025**, Vol 2, No 3

comprehensive sustainability outcomes [8]. Even more limited is the integration of environmental and climate data from official sources such as BMKG and BIG, despite the central role of climate adaptation in sustainable agriculture [2].

Based on these limitations, a clear research gap exists between technology-driven approaches and the need for a multidimensional empowerment framework that integrates economic, social, environmental, and institutional dimensions. The novelty of this study lies in integrating official macro-level data (BPS, the Ministry of Agriculture, Kominfo, and BMKG/BIG) with primary survey data to analyze the adaptive impact of empowerment, particularly in relation to environmental sustainability and climate risk [9]. This approach shifts the analytical perspective from simple technology adoption toward adaptive empowerment that strengthens the resilience of the national food system.

Accordingly, this study aims to examine how the 3-Pillar Digital-Agripreneurship Empowerment Model—comprising Digitalization, Entrepreneurship, and Institutional Support—strategically influences agricultural sustainability (economic, social, and environmental dimensions) among millennial farmers in Indonesia. Specifically, this study seeks to (i) assess the individual and collective impacts of the three pillars, (ii) identify the most dominant determinant of sustainability outcomes, and (iii) provide evidence-based recommendations to support farmer regeneration and sustainable agricultural policymaking.

2. Materials and Method

Research Approach and Design

This study employed an explanatory quantitative research design using a multi-location analytical survey approach, aligned with the World Bank methodological framework for institutional and development studies [4]. The design was intended to empirically test the causal relationships between empowerment constructs and agricultural sustainability indicators among millennial farmers using Structural Equation Modeling–Partial Least Squares (SEM-PLS) [9].

Population, Sample, and Study Locations

The population comprised all Farm Households (RTP) managed by individuals aged 19–39 years, classified as millennial farmers according to the Central Statistics Agency (BPS) [1].

Agricultural Power Journal, August **2025**, Vol 2, No 3

A multistage sampling procedure was applied, beginning with purposive selection of three pilot provinces representing different agro-ecological and digital-infrastructure conditions. This was followed by proportional stratified random sampling at the regency and village levels.

Inclusion criteria were: (i) actively managing a farm business, (ii) age between 19 and 39 years, and (iii) prior participation in digital agriculture, entrepreneurship, or institutional empowerment programs. The minimum sample size followed the 10-times rule for SEM analysis as recommended in the literature [9], resulting in a final valid sample of 350 respondents

Research Instruments

Primary data were collected using a structured questionnaire designed to measure all latent variables through a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Instrument validity and reliability were tested through a pilot survey involving 30 millennial farmers located outside the main study areas. All items met the minimum requirements for construct reliability and validity. The finalized questionnaire instrument and coding scheme will be deposited in a public data repository upon publication.

Variables and Operational Definitions

The study employed two main latent constructs: Strategic Empowerment (exogenous variable) and Agricultural Sustainability (endogenous variable). Strategic Empowerment consisted of three pillars: Digitalization, Entrepreneurship, and Institutional Support. Agricultural Sustainability was measured through economic, social, and environmental dimensions.

Table 1. Variables and Operational Definitions

Variable	Dimension	Key Indicators	Reference Source
Strategic Empowerment (Exogenous Variable)	Digitalization Pillar	Digital literacy, connectivity access (Kominfo/APJII), technology adoption (IoT, agricultural apps)	[3]

Agricultural Power Journal, August **2025**, Vol 2, No 3

	Entrepreneurship Pillar	Agripreneurial mindset, financial management, access to capital (Fintech/OJK/BI)	[7]
	Institutional Pillar	Millennial farmer group participation (Kementan), extension access, supply-chain partnerships	[4]
Agricultural Sustainability (Endogenous Variable)	Economic	Net income ratio, input efficiency, commodity diversification	[2]
	Social	Farm business regeneration, family welfare, community involvement	[7]

Official Secondary Data Collection (Materials)

To strengthen contextual interpretation and measurement rigor, the study incorporated validated official secondary data, including:

1. BPS (Agricultural Census 2023): demographic characteristics, farm household structure, and farmer age distribution [1].
2. Kementan (Agricultural Human Resource Statistics 2024): registration and distribution of millennial farmer groups and related empowerment programs [6].
3. Kominfo/APJII: internet penetration and digital infrastructure mapping for each study province (no formal publication cited; considered institutional source).
4. BMKG and BIG/BPN: geospatial datasets including rainfall indices, climate zones, and land productivity classes used to construct the environmental climate-adaptation indicators (no formal publication cited; institutional source).

Publicly available datasets will be deposited in an open-access data repository with accession numbers provided during the review process. Any restricted-access datasets will be clearly disclosed at the submission stage in compliance with journal policy.

Agricultural Power Journal, August **2025**, Vol 2, No 3

Data Analysis Techniques

Data analysis was conducted in two sequential stages:

1. Descriptive Statistics

   Descriptive analyses were conducted to summarize respondent characteristics and the distribution of indicator scores, including means, standard deviations, and percentages.

2. Structural Equation Modeling - Partial Least Squares (SEM-PLS)

   SEM-PLS was employed due to its suitability for evaluating complex structural models with multiple latent variables and mixed indicator types (formative and reflective), as well as its tolerance for non-normal data distributions [9]. Analyses were performed using SmartPLS and IBM SPSS AMOS.

   - Measurement Model Evaluation (Outer Model): assessment of convergent validity (Average Variance Extracted/AVE), discriminant validity, and composite reliability (CR).
   - Structural Model (Inner Model): hypothesis testing using path coefficients (β), t-statistics, and p-values. Model predictive power was evaluated using R^2 (variance explained) and Q^2 (predictive relevance).
   - Effect Size (f^2): calculated to estimate the relative contribution of each empowerment pillar to agricultural sustainability.

   The structural model is expressed as:

$$Agricutural\ Sustainability = \beta_1\ (Digitalization) + \beta_2\ (Enterpreneurship)$$

$$\text{Effect Size } (f^2) = \frac{R^2_{including\ excluding\ exogenous\ i} - R^2_{excluding\ exogenous\ i}}{1 - R^2_{including\ exogenous\ i}}$$

Ethical Considerations

Ethical approval was obtained from the relevant institutional ethics committee. The approving authority and ethical clearance code will be provided during the review process and prior to publication, in compliance with international journal standards. Informed consent was obtained from all respondents, and anonymity and confidentiality were strictly maintained. The full research protocol, along with datasets and analysis procedures, will be made available according to journal requirements to facilitate reproducibility [2].

Agricultural Power Journal, August **2025**, Vol 2, No 3

3. Result

The research findings are articulated across three principal components: (1) the demographic profile and digital readiness of Millennial Farmers, (2) the evaluation of the 3-Pillar Strategic Empowerment Model using PLS-SEM, and (3) the analysis of agricultural sustainability components.

Millennial Farmers' Demographic Profile and Digital Readiness

1. Demographic Distribution and Farm Classification

   Secondary data from the Central Statistics Agency (BPS, Sensus Pertanian 2023) show that 21.8% of the farmer population in the three study provinces fall within the Millennial Farmer category (aged 19–39 years). This group is further divided into Younger Millennials (19–29 years), accounting for 8.5%, and Older Millennials (30–39 years), representing 13.3%. The majority (62%) operate on land areas of less than 0.5 hectares, indicating the dominance of smallholder farming.

   Primary survey data (N = 350) revealed an average respondent age of 31.4 years (SD = 4.2). The sample demonstrates relatively higher educational attainment, averaging 11.5 years of formal education. However, only 45% were formally registered as members of Millennial Farmer Groups (Kementan, 2024).

Table 1. Basic Characteristics of Sample Millennial Farmers (N=350)

Characteristic
Average Age (SD)
Average Years of Formal Education
Access to Stable Internet (4G/5G)
Membership in Millennial Farmer Groups (Kementan data)
Land Ownership < 0.5 ha

2. Technology Adoption Indicators

   Kominfo/APJII data report that 4G internet coverage in the study regions averages 78%. However, the functional use of digital technology in agriculture remains low. The Digital Adoption Index (DAI), which measures the use of

Agricultural Power Journal, August **2025**, Vol 2, No 3

agritech applications for farm planning, monitoring, and marketing, reached only 38% among respondents.

Although smartphone penetration is high, most millennial farmers primarily use their devices for communication and social-media-based marketing rather than for precision agriculture or real-time farm monitoring (Miftahul & Aini, 2024). This highlights a persistent gap between digital access and effective digital utilization.

$$\text{Digital Adoption Index} = \frac{\text{133 Farmers Using Agricultural Apps}}{\text{350 Millennial Farmers}} \times 100\% = 38.0\%$$

Testing the 3-Pillar Empowerment Model using PLS-SEM

The Structural Equation Modeling – Partial Least Squares (SEM-PLS) technique was employed to assess the hypothesized causal relationships between the three Strategic Empowerment Pillars—Digitalization, Entrepreneurship, and Institutional Support—and Agricultural Sustainability.

1. Measurement Model Evaluation (Outer Model)

   The measurement model demonstrated satisfactory reliability and validity. All indicators achieved loading values > 0.70, confirming convergent validity. Average Variance Extracted (AVE) values ranged from 0.58 to 0.71, surpassing the minimum threshold of 0.50. Composite Reliability (CR) values ranged from 0.88 to 0.93, exceeding the standard 0.70 benchmark (Hair et al., 2024). These results confirm the robustness of the measurement model.
2. Structural Model Evaluation (Inner Model)

   The structural model demonstrated strong explanatory strength, with the three empowerment pillars jointly explaining 64.5% of the variance in Agricultural Sustainability (R^2 = 0.645). The predictive relevance value (Q^2 = 0.402) also exceeded zero, confirming the model's predictive adequacy.

Agricultural Power Journal, August **2025**, Vol 2, No 3

Table 2. The results of the hypothesis testing (path coefficients β):

Path Relationship	Path Coefficient (β)	T-Statistic	P-Value	Finding
Digitalization →Sustainability	0.387	5.923	<0.001	Significant
Entrepreneurship →Sustainability	0.421	6.541	<0.001	Significant
Institutional Support → Sustainability	0.155	2.011	0.044	Significant

Key Findings:

1. Entrepreneurship (β = 0.421) exerted the strongest and most significant effect on Agricultural Sustainability. This suggests that agripreneurial mindset development and improved capital access (OJK/BI data) are particularly influential drivers.
2. Digitalization (β = 0.387) also contributed substantially, indicating the necessity of digital literacy and technology adoption for enhancing farm productivity and efficiency.
3. Institutional Support (β = 0.155), while statistically significant, exhibited the weakest influence. This implies that although farmer-group participation (Kementan data) is beneficial, existing institutional mechanisms may require enhancement to increase their impact.

The total influence of empowerment elements is expressed as:

$$\text{Total Influence of Pillar i} = \sum_{j=1}^{3} \text{Path Coefficient}_{ij} \times \text{Path Coefficient}_{j-Sustainability}$$

4. Discussion

This section provides an in-depth interpretation of the empirical findings obtained from testing the 3-Pillar Digital-Agripreneurship Empowerment Model on Agricultural Sustainability outcomes among Millennial Farmers.

Model Consolidation: Contributions of the Three Empowerment Pillars

The Structural Equation Modeling (SEM-PLS) results confirm that the three Strategic Empowerment Pillars—Digitalization, Entrepreneurship, and Institutional

Agricultural Power Journal, August **2025**, Vol 2, No 3

Support—jointly explain 64.5% of the variance in Agricultural Sustainability (R^2 = 0.645). This substantial explanatory power provides strong support for the study's central hypothesis and demonstrates that strategically integrated empowerment is a decisive predictor of successful millennial-led agricultural enterprises. Importantly, the results highlight that empowerment must go beyond technological availability and encompass business competencies and institutional facilitation.

1. The Dominance of the Entrepreneurship Pillar

   Entrepreneurship exerted the strongest and most significant influence on Agricultural Sustainability ($\beta = 0.421$). This aligns with findings from Wang & Li (2024), who contend that institutional and technological support yield limited progress without a robust agripreneurial orientation. For Millennial Farmers, financial literacy, market responsiveness, and access to capital (OJK/BI data) proved more pivotal than traditional agronomic competencies.

   This reflects a broader structural shift from the conventional "producer" identity to a more holistic "agripreneur" role capable of navigating market volatility, supply chains, and financial risks. Economic sustainability—widely recognized as the key determinant driving youth engagement and retention in agriculture—is therefore strongly dependent on this entrepreneurial mindset.

2. Digitalization as a Prerequisite for Efficiency and Adaptation

   The Digitalization Pillar demonstrated a strong and significant effect on sustainability outcomes ($\beta = 0.387$). Its greatest influence emerged within the Economic (input efficiency) and Environmental (climate-smart practices) dimensions. These findings reinforce Tey & Arumugam [3] arguments that digital transformation constitutes the foundation of next-generation farm management.

   Despite high regional internet coverage (Kominfo/APJII data), the Digital Adoption Index (DAI = 38%) remains low, indicating that the primary bottleneck is not infrastructure availability but rather functional literacy—the ability of farmers to utilize agritech applications for real-time decision-making [5]. Tools integrated with BMKG/BIG geospatial and rainfall datasets illustrate untapped potential for climate-adaptive farming.

Agricultural Power Journal, August **2025**, Vol 2, No 3

3. Institutional Pillar: Importance of Quality Over Quantity

Although the Institutional Pillar showed a significant positive impact (β = 0.155), it was the weakest among the three empowerment components. Kementan [6] data indicate that only 45% of millennial farmers actively participate in formal farmer groups, suggesting underlying issues in institutional effectiveness.

Common weaknesses include:

- limited facilitation of financing access;
- uneven distribution of supply chain partnerships [4];
- insufficiently modern or technology-oriented extension services.

These findings imply an urgent need to enhance not merely the number (quantity) but the quality of institutional interventions—especially in areas of market linkages, technology advisory services, and integrated capacity building.

Implications for the Three Dimensions of Sustainability

The findings also offer nuanced insights into the three sustainability dimensions, consistent with the framework of Kumar et al. [2]:

1. Economic Sustainability: Entrepreneurship emerged as the principal driver. Millennial farmers who adopt business-oriented practices demonstrate stronger capabilities in commodity diversification, income optimization, and improving the Net Income Ratio.
2. Social Sustainability: Entrepreneurship and Digitalization both contribute indirectly to social sustainability by enhancing farm business regeneration. Profitable and technologically modern farming enterprises are more likely to attract younger individuals (Muda), strengthening intergenerational continuity in agriculture.
3. Environmental Sustainability: The strong linkage between Digitalization and environmentally sustainable practices shows that access to geospatial intelligence (BMKG/BIG data) supports climate adaptation. Digital tools enhance decision-making on planting schedules, input efficiency, and risk mitigation, reinforcing climate-smart agriculture as the cornerstone of long-term sustainability [2].

Agricultural Power Journal, August **2025**, Vol 2, No 3

Scientific Contribution (Novelty)

This research delivers significant contributions to the existing literature by:

1. Holistic Integration of the Three Strategic Pillars
   The study is among the first to empirically test and validate the 3-Pillar Digital-Agripreneurship Empowerment Model within the Indonesian agricultural context using SEM-PLS, addressing a gap in existing empowerment and sustainability literature.
2. Incorporation of Macro-Environmental Adaptive Indicators
   By integrating official secondary datasets (BMKG/BIG) into the environmental sustainability construct, this research moves beyond technocentric analyses. It demonstrates that digital empowerment acts as a catalyst for climate resilience, not merely operational efficiency.
3. Policy-Relevant Prioritization of Empowerment Components
   The empirical hierarchy—Entrepreneurship > Digitalization > Institutional Support—provides a clear foundation for policy redesign. The findings encourage resource allocation toward agripreneurship development and digital capacity building, instead of focusing solely on expanding the administrative number of farmer groups.

5. Conclusions

This section synthesizes the key research findings, articulates practical recommendations, and outlines the study's limitations to demonstrate how the research advances scientific understanding of agricultural empowerment and sustainability.

Conclusion of the Study

This study rigorously examined the strategic influence of the 3-Pillar Digital-Agripreneurship Empowerment Model on the Agricultural Sustainability of Millennial Farmers in Indonesia using Structural Equation Modeling – Partial Least Squares (SEM-PLS). The results clearly demonstrate that the integrated empowerment framework—encompassing Digitalization, Entrepreneurship, and Institutional Support—serves as a strong and statistically significant predictor of

Agricultural Power Journal, August **2025**, Vol 2, No 3

multidimensional agricultural sustainability, jointly explaining 64.5% of its variance ($R^2 = 0.645$).

Among the three pillars, the Entrepreneurship Pillar exerted the strongest and most significant effect ($\beta = 0.421$, $p < 0.001$). This indicates that fostering an agripreneurial mindset, strengthening financial literacy, and improving access to financial capital (OJK/BI data) are essential for the long-term viability and competitiveness of millennial-led agricultural enterprises. These findings highlight a paradigm shift from subsistence-oriented production to a market- and business-oriented agricultural model [7].

The Digitalization Pillar also demonstrated a substantial and significant effect ($\beta = 0.387$, $p < 0.001$). Digital technologies enhanced economic efficiency and environmental adaptability, particularly through the use of data-driven decision-making tools aligned with climatic and geospatial information [3]. This underscores the critical role of functional digital literacy—not just infrastructure availability—in improving sustainability outcomes [5].

The Institutional Pillar, while significant, exerted the weakest influence ($\beta = 0.155$, $p = 0.044$). The relatively low level of active participation in formal farmer groups [6] and gaps in institutional service quality suggest that existing institutional arrangements require substantial qualitative improvements to effectively support sustainability transitions [4].

Overall, this study advances the scientific literature by empirically validating a holistic empowerment model in a developing agrarian context. It moves beyond technocentric frameworks by demonstrating that technological access alone is insufficient without entrepreneurial capability and effective institutional mediation. Additionally, the incorporation of macro-environmental datasets (BMKG/BIG) as part of the sustainability indicators provides a novel contribution to the measurement of climate adaptation, reinforcing the importance of digital empowerment for enhancing climate resilience [2]. The findings suggest that nurturing digital capabilities alongside entrepreneurial acumen constitutes the most effective approach to fostering farmer regeneration and strengthening sustainable food systems.

Agricultural Power Journal, August **2025**, Vol 2, No 3

Recommendations and Limitations

1. Policy Recommendations

   Based on the empirical findings, several policy interventions are proposed:

   - Prioritize Agripreneurship Development

     Ministries (e.g., Ministry of Agriculture), regulatory bodies (OJK/BI), and financial institutions should intensify programs that cultivate agripreneurial mindsets, strengthen financial literacy, and expand access to customized financing solutions—particularly digital financing platforms (fintech)—for millennial farmers [7].
   - Strengthen Functional Digital Literacy

     Digital development efforts by Kominfo and Kementan should shift from expanding infrastructure alone to enhancing functional digital competencies. Training programs must emphasize the effective use of agritech applications for production planning, market intelligence, and climate-smart agriculture utilizing BMKG/BIG datasets [5].
   - Improve the Quality of Institutional Support

     Reinforcement of millennial farmer groups should prioritize quality over quantity. Extension services must be modernized to be more digital- and market-oriented, and partnerships along the supply chain should be strengthened to ensure equitable access and reduce market asymmetries (World Bank, 2020). Capacity-building initiatives should also support stronger peer learning and networking [6].
2. Research Limitations and Suggestions for Future Studies

   Although the study provides robust empirical insights, several limitations should be acknowledged:

   - Cross-Sectional Research Design

     As the study is cross-sectional, it captures only a single time point. Future research should incorporate longitudinal designs to examine how empowerment and sustainability evolve over time.
   - Self-Reported Measures

     Some variables rely on self-reported perceptions. Future studies may incorporate objective indicators such as verified financial performance, agricultural yield records, or digital usage logs to strengthen measurement accuracy.

- Geographical Scope
  The study covers three provinces representing diverse conditions, yet the findings may not generalize to all regions of Indonesia. Expanded sampling across more ecological zones and socio-cultural settings is recommended.
- Limited Qualitative Insight
  While the quantitative approach provides strong statistical evidence, deeper qualitative insights—through interviews, focus group discussions, or participatory rural appraisals—could illuminate contextual nuances, barriers to digital adoption, and factors influencing institutional engagement [10].

References

1. Statistics Indonesia (BPS). Agricultural Census 2023: Preliminary Results of Agricultural Household Statistics; Statistics Indonesia: Jakarta, Indonesia, 2024.
2. Kumar, P.; Singh, S.K.; Sharma, M. Digital Agriculture and Sustainable Development: A Global Perspective; CRC Press: Boca Raton, FL, USA, 2023.
3. Tey, Y.S.; Arumugam, R. Agricultural Digital Transformation and Future Farm Management; CABI Publishing: Wallingford, UK, 2022.
4. World Bank. Indonesia Agro-Value Chain Assessment: Issues and Options in Promoting Digital Agriculture; World Bank Group: Washington, DC, USA, 2020.
5. Miftahul, K.; Aini, N. The Role of IoT in Enhancing Food Security through Smart Farming in Developing Countries. J. Agric. Technol. Innov. 2024, 5, 112–125.
6. Ministry of Agriculture (Kementan). Statistics of Agricultural Human Resources and Farmer Institutions 2024; Center for Agricultural Data and Information Systems, Ministry of Agriculture: Jakarta, Indonesia, 2024.
7. Wang, J.; Li, M. Institutional Support for Youth Agripreneurship in the Digital Era. Sustain. Agric. Syst. 2024, 8, 45–60.
8. Ghozali, I. Multivariate Analysis Applications with IBM SPSS 29, 8th ed.; Diponegoro University Press: Semarang, Indonesia, 2023.

Agricultural Power Journal, August **2025**, Vol 2, No 3

9. Hair, J.F.; Hult, G.T.M.; Ringle, C.M.; Sarstedt, M. Multivariate Data Analysis: Applications Using Structural Equation Modeling (SEM), 5th ed.; Springer: Cham, Switzerland, 2024.
10. Osei, K.; Boateng, D. Mixed-Methods Insights into Youth Agripreneurship and Institutional Support in Sub-Saharan Contexts. Int. J. Agric. Res. Ext. 2023, 18, 98–114.