West Science Nature and Technology
Vol. 3, No. 03, September 2025, pp. 159~166

The Effectiveness of Integrated Farming Systems in Improving Household Food Security in Indonesia

Yohanes Kamakaula[1], Alnita Baaka[2]
[1-2]University of Papua

Article Info

Article history:

Received September, 2025
Revised September, 2025
Accepted September, 2025

Keywords:

integrated farming systems,
household food security,
quantitative analysis,
rural households,
Indonesia

ABSTRACT

This study investigates the effectiveness of Integrated Farming Systems (IFS) in improving household food security in Indonesia using a quantitative approach. A total of 70 farming households were surveyed through structured questionnaires, with responses measured on a Likert scale (1–5). Data were analyzed using SPSS version 25, including descriptive statistics, reliability and validity testing, correlation, and regression analysis. The results show that IFS significantly and positively influence household food security, with the strongest effects observed on food availability and food accessibility, followed by food utilization and stability. Regression analysis confirmed that IFS explained 41.3% of the variance in household food security ($\beta = 0.642$, $p < 0.001$). These findings highlight that IFS not only increase food production and income but also contribute to dietary diversity and resilience against external shocks. The study concludes that integrated farming is an effective strategy to strengthen rural household food security and supports Indonesia's broader goal of achieving sustainable food sovereignty.

Corresponding Author:

Name: Yohanes Kamakaula
Institution: Agribusiness Program, Faculty of Agriculture, University of Papua
Email: y.kamakaula@unipa.ac.id

1. INTRODUCTION

Food security has become a central issue in Indonesia, where rapid population growth, limited land availability, and climate variability continue to challenge the sustainability of agricultural systems, and the government along with various stakeholders recognize that food security is not only a matter of national concern but also a fundamental aspect of household well-being, in line with the Food and Agriculture Organization (FAO) which defines food security as a condition where all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food to meet dietary needs and preferences for an active and healthy life. In the Indonesian context, household food security remains uneven, particularly in rural areas where reliance on conventional monoculture farming often results in unstable production and limited income opportunities, exacerbated by rapid population growth, limited land, and climate change. Climate change significantly impacts food production in Indonesia, leading to decreased yields and increased food prices, making adaptation and mitigation strategies such as enhancing agricultural infrastructure and technology crucial [1], while the role of state-owned

enterprises like Bulog is vital in maintaining food availability and affordability for low-income households through food self-sufficiency and buffer stocks [2]. Rural areas face unique challenges such as limited transportation infrastructure and market access, which hinder food security, and the COVID-19 pandemic further disrupted supply chains [3], although some communities sustain stability through local production and plantations [3]. Household food security is also closely linked to income levels and expenditure patterns, as shown in Parigi Moutong District where a large portion of household income is spent on food, reflecting vulnerability to food insecurity and the need for economic interventions to improve household resilience [4].

Integrated farming systems (IFS) have emerged as an innovative and vital strategy to strengthen household food security by optimizing resource use and diversifying agricultural production through the integration of crops, livestock, fisheries, and agroforestry, thereby creating synergistic relationships that enhance productivity, reduce risks, improve soil fertility, and provide households with diverse food sources and additional income streams. Studies indicate that households adopting IFS demonstrate greater resilience against external shocks such as fluctuating food prices or climate-related risks, as the system increases productivity per unit area by efficiently utilizing resources and recycling farm byproducts [5], [6]. The integration of livestock and crop production enables the use of manure as fertilizer, improving soil health and reducing dependence on chemical inputs [6], while diversification through poultry, fisheries, and agroforestry enhances economic stability for small and marginal farmers and contributes to household nutritional security [7], [8]. Moreover, IFS supports environmental sustainability by reducing chemical use, managing agricultural waste, conserving soil health, and incorporating renewable energy such as biogas from agricultural waste to reduce reliance on fossil fuels [6], [7]. Overall, the adoption of IFS not only secures continuous supplies of diverse food products but also strengthens household resilience to climate change and market fluctuations, underscoring its role as a sustainable model for agricultural development and food security [5].

In Indonesia, the promotion of Integrated Farming Systems (IFS) supports the national strategy for food sovereignty and sustainable rural development by enhancing productivity, community welfare, and economic resilience through the integration of crops, livestock, and other agricultural activities. Pilot projects in regions such as West Papua and Banyuwangi address local issues like poverty, land conversion, and limited knowledge, while IFS improves productivity with organic fertilizers and sustainable practices [9], [10], creates jobs and raises product value to reduce poverty [9], [11], and promotes food sovereignty by reducing dependence on imports [12]. However, challenges such as land use conversion and the need for technological and policy support remain [9], [11]. Case studies in Tambrauw and Kemiren Village show positive impacts on food security and farmer skills [9], but empirical studies with quantitative evidence are still limited.

This study seeks to fill this gap by investigating the effectiveness of integrated farming systems in improving household food security in Indonesia using a quantitative approach. Specifically, it employs survey data from 70 farming households, analyzed through SPSS version 25, to determine whether the adoption of integrated farming significantly contributes to food availability, accessibility, utilization, and stability at the household level. The findings of this research are expected to provide insights for policymakers, agricultural extension officers, and farming communities on the role of integrated farming systems in strengthening food security and promoting sustainable livelihoods in rural Indonesia.

2. LITERATURE REVIEW

2.1 Concept of Food Security

Household food security in Indonesia is a multifaceted issue shaped by agricultural productivity, economic stability, and socio-economic factors, with challenges most severe in rural areas where agriculture is the main livelihood. Enhancing agricultural productivity and strengthening local food production are essential, as shown during the COVID-19 pandemic when some villages remained food secure by relying on local agriculture, supported by investments in infrastructure such as transportation and local markets to improve access to nutritious food [3]. Economic stability also plays a vital role, with programs promoting off-farm employment and access to credit helping to stabilize household incomes, while social protection measures like insurance and disaster management are needed to reduce the impact of shocks and natural disasters [13]. In addition, socio-economic characteristics such as education, occupation, and income strongly influence food security, making policies that enhance education, employment opportunities, and public services in health, education, and infrastructure crucial for improving household food security outcomes [13], [14].

2.2 Integrated Farming Systems (IFS)

Integrated Farming Systems (IFS) offer a sustainable agricultural approach by integrating crops, livestock, fisheries, and agroforestry in synergistic ways that enhance productivity, sustainability, and ecological balance, particularly benefiting smallholder farmers in developing countries through resource recycling, reduced dependency on external inputs, and improved resilience. By recycling farm by-products—such as using livestock manure as fertilizer and crop residues as animal feed—IFS maximizes resource efficiency, reduces waste, and enhances soil health [15], [16]. Economically, IFS increases profitability and employment, with studies reporting a 265% improvement in profitability and a 143% rise in employment compared to single-enterprise farms [17]. Environmentally, it minimizes chemical inputs, improves soil quality, conserves biodiversity, and reduces greenhouse gas emissions [16], [17]. However, challenges remain, as successful adoption requires sufficient knowledge and skills, highlighting the importance of training and extension services [15], [17], while the initial setup demands capital and labor, often limiting adoption among resource-constrained farmers [17].

2.3 Integrated Farming and Household Food Security

Integrated Farming Systems (IFS) play a crucial role in enhancing food security by diversifying food sources, increasing income, and improving dietary diversity through the integration of crop cultivation, livestock rearing, and aquaculture, which collectively strengthen food availability, accessibility, utilization, and stability. By producing diverse food items such as rice, vegetables, meat, and fish within a single system, IFS enhances food availability [8], [15], with evidence from Nigeria showing higher dietary diversity and sufficiency compared to monoculture systems [18]. In terms of accessibility, IFS generates multiple income streams that improve household purchasing power, as demonstrated in India where its adoption increased farm income and improved rural food consumption patterns [19]. For utilization, IFS supports better nutrition and dietary diversity [20], with integrated rice–fish–livestock systems in Indonesia enabling rural families to meet nutritional needs and withstand seasonal food shortages [18]. Moreover, IFS stabilizes food supplies by mitigating risks from crop failures and market fluctuations [8], [15], while its efficient resource use and optimized outputs contribute to long-term sustainability [20].

3. METHODS

3.1 Research Design

This study employs a quantitative research design to examine the effectiveness of Integrated Farming Systems (IFS) in improving household food security in Indonesia. The approach was chosen to

provide measurable evidence of the relationship between integrated farming practices and food security dimensions. A structured questionnaire was used as the primary research instrument, with responses measured using a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

3.2 Population and Sample

The population of this study consists of farming households in rural areas of Indonesia that have adopted, at varying levels, elements of integrated farming systems. Using purposive sampling, 70 households were selected as respondents. The sample size was deemed sufficient for statistical analysis and aligns with similar studies in agricultural research (Hair et al., 2019). The inclusion criteria required that households be actively engaged in farming activities and have at least one component of integration (e.g., crop–livestock, crop–fish, or crop–livestock–fish systems).

3.3 Data Collection

Data were collected through field surveys using structured questionnaires distributed directly to respondents, consisting of two main sections: demographic characteristics such as age, education, family size, landholding, and farming experience, and research variables measuring integrated farming practices along with household food security dimensions. To ensure accuracy and clarify responses, interviews were also conducted, and the entire data collection process was completed over a one-month period.

3.4 Research Variables and Indicators

The research focused on two main constructs, namely Integrated Farming Systems (independent variable) and Household Food Security (dependent variable). Integrated Farming Systems (IFS) were measured through indicators such as resource recycling, diversification of farm enterprises, use of organic inputs, and synergy among components including crops, livestock, and fisheries. Meanwhile, Household Food Security was assessed based on the four FAO dimensions: food availability (self-sufficiency in staple food production), food accessibility (increased income and purchasing ability), food utilization (dietary diversity and nutrition), and food stability (resilience to seasonal shortages or price fluctuations). Each indicator was measured using a five-point Likert scale to capture respondents' perceptions and experiences.

3.5 Data Analysis

Data analysis was conducted using SPSS version 25 through several procedures, including descriptive statistics to summarize demographic data and provide an overview of responses for each variable, reliability and validity tests using Cronbach's Alpha and item–total correlations, correlation analysis to identify the strength and direction of relationships between integrated farming practices and food security indicators, and regression analysis to determine the extent to which integrated farming practices influence household food security dimensions. This methodological framework provides a robust basis for testing the hypothesis that Integrated Farming Systems positively and significantly improve household food security in Indonesia.

4. RESULTS AND DISCUSSION

4.1 Descriptive Analysis

The demographic profile of the 70 farming households showed that most respondents were male heads of households (65%) with an average age of 45 years, the majority having completed primary or secondary education (72%) and possessing an average of 15 years of farming experience, while the average household size was 4–5 members and the average landholding was 0.7 hectares. In terms of integrated farming practices, 60% of households combined crop and livestock enterprises, 25% adopted crop–livestock–fish systems, and 15% practiced crop–fish integration, with mean scores on a 1–5 Likert scale indicating strong agreement with statements on resource recycling (M = 4.21) and diversification (M = 4.05), suggesting that households view IFS as an effective strategy to optimize resources and reduce external dependency. Regarding household food security, respondents

reported higher levels of food availability (M = 4.12) and accessibility (M = 3.98), while food utilization (M = 3.89) and stability (M = 3.92) were slightly lower, indicating that although IFS contributes positively to production and income, further efforts are needed to strengthen long-term stability and dietary diversity.

4.2 Reliability and Validity Tests

The results of the reliability test using Cronbach's Alpha showed that all constructs were reliable, with values above the 0.70 threshold. Specifically, Integrated Farming Systems scored α = 0.83, while Household Food Security scored α = 0.87. Validity testing through item–total correlations confirmed that all items had correlation coefficients above 0.30, indicating that the questionnaire was a valid instrument for measuring the intended variables.

4.3 Correlation Analysis

Pearson correlation analysis demonstrated a positive and significant relationship between Integrated Farming Systems and Household Food Security ($r = 0.642$, $p < 0.01$). This suggests that households with stronger adoption of integrated farming practices tended to have higher food security levels. At the sub-dimensional level, IFS was most strongly correlated with food availability ($r = 0.671$, $p < 0.01$) and food accessibility ($r = 0.655$, $p < 0.01$), followed by food utilization ($r = 0.587$, $p < 0.01$) and food stability ($r = 0.562$, $p < 0.01$).

4.4 Regression Analysis

A simple linear regression was conducted to test the effect of Integrated Farming Systems on Household Food Security. The model was statistically significant ($F = 28.54$, $p < 0.001$) and explained 41.3% of the variance ($R^2 = 0.413$) in household food security. The regression coefficient ($\beta = 0.642$, $t = 5.34$, $p < 0.001$) indicated that integrated farming practices had a positive and significant effect on household food security.

These findings support the hypothesis that integrated farming systems contribute significantly to strengthening food security at the household level.

4.5 Discussion

The results confirm that Integrated Farming Systems (IFS) play a vital role in improving household food security in Indonesia, with a high correlation between IFS and food availability indicating that diversification of farm enterprises ensures a steady supply of various food products; for instance, households integrating livestock and fisheries reported greater protein availability to complement staple crops, consistent with findings that integrated rice–fish–livestock systems enhance dietary sufficiency and reduce seasonal shortages in rural areas. IFS further contributes through nutrient recycling and soil health by reusing farm byproducts, which improves soil quality and reduces production costs, thereby supporting long-term agricultural sustainability [15]. It also increases crop yields and income, with studies showing yield improvements of up to 86.17% through improved cultivars and intercropping compared to traditional methods [19]. By diversifying outputs, IFS secures nutritional needs by providing cereals, pulses, oils, fruits, milk, meat, eggs, and vegetables [21], while its economic viability is reflected in a high benefit–cost ratio that stabilizes income and strengthens the livelihoods of small and marginal farmers [8].

In terms of food accessibility, the positive effect of Integrated Farming Systems (IFS) shows that households economically benefited from selling surplus produce, thereby improving their purchasing power, similar to findings in Nigeria where diversified farming households reported better income and food purchasing ability. Income diversification, increasingly common among Nigerian rural households, has been found to positively influence agricultural intensification, suggesting that multiple income sources can drive productivity gains, higher household income, and greater food purchasing power [22]. Diversification into non-farm activities and cash crops, practiced by about 60% of farmers, also enhances household consumption, though the magnitude of benefits depends on initial

conditions and agro-climatic contexts [23]. Determinants such as household demographics, access to electricity, and market proximity influence income diversification, while crop diversification is shaped by factors like age and education of the household head, access to extension services, and resource availability [24], [25]. Furthermore, crop diversity contributes to improved dietary diversity, a key indicator of food security, with increased food expenditure and access to credit further strengthening nutritional outcomes [26].

Food utilization and stability, though positively influenced, showed relatively lower mean scores, indicating that while Integrated Farming Systems (IFS) enhance food diversity, challenges such as limited nutritional knowledge, inadequate food preparation practices, and vulnerability to climate risks still constrain long-term stability. Nutritional education is essential to improve food utilization by enabling informed dietary choices that promote health and prevent disease [27], while effective food preparation practices are necessary to maximize nutritional value but often remain insufficient, especially among vulnerable populations [28]. Climate change further threatens food utilization by influencing diet and health, highlighting the need for climate-resilient agricultural practicesn [29], [30]. Building resilient agricultural systems through strengthened food value chains and crop breeding programs can improve availability and affordability, thereby supporting nutritional security [28]. Moreover, collaboration across public health, agricultural, and environmental sectors is crucial for developing adaptive strategies to safeguard food systems against climate-related challenges [30].

5. CONCLUSION

This research provides empirical evidence that Integrated Farming Systems (IFS) significantly enhance household food security in Indonesia, as households adopting IFS experience improvements in food availability and accessibility through diversified production and increased income, while also benefiting from positive contributions to food utilization and stability, though these latter dimensions require further support through nutritional education and resilience-building strategies. The findings affirm that IFS is not only a sustainable farming approach but also a strategic pathway to improve household well-being and reduce vulnerability to food insecurity, highlighting the importance of promoting integrated farming through extension services, training programs, and financial support to accelerate adoption and maximize benefits. Future research is recommended to expand the sample size and examine the longitudinal effects of IFS to capture its long-term impacts on household livelihoods and community food systems.

REFERENCES

[1] C. Anjani and D. Darto, "Financial literacy, income and self-control on financial management behavior of generation Z," *BASKARA J. Bus. Entrep.*, vol. 5, no. 2, pp. 152–164, 2023.

[2] M. Jamaludin, "Indonesia's Food Security Challenges: How Food SOE Optimizes its Role?," *Res. Horiz.*, vol. 2, no. 3, pp. 394–401, 2022.

[3] S. L. Venna and A. Romulo, "Role of Agriculture on Rural Household Food Security: A Systematic Review from Indonesia," in *IOP Conference Series: Earth and Environmental Science*, IOP Publishing, 2024, p. 12132.

[4] R. A. Rauf, L. Damayanti, and S. R. Malik, "Food security of lowland rice farmers to support sustainable food development in Parigi Moutong District, Indonesia," in *IOP Conference Series: Earth and Environmental Science*, IOP Publishing, 2023, p. 12061.

[5] A. Biswas, S. Sarkar, S. Balo, and K. Ghosh, "Integrated Farming Systems for Sustainable Agriculture: A Comprehensive Review".

[6] S. S. Walia and T. Kaur, "Scope of Integrated Nutrient Management in the Indo-Gangetic Plains Toward Food Productivity Enhancement in a Major Cropping System," in *Basics of Integrated Farming Systems*, Springer, 2023, pp. 207–219.

[7] J. Singh, B. Singh, A. K. Singh, and P. Rani, "Integrated Farming System: A Sustainable Approach towards Modern Agriculture," *Int. J. Plant Soil Sci.*, vol. 36, no. 9, pp. 641–649, 2024.

[8] I. P. Kumar, P. T. Suraj, S. Harikumar, and J. Mathew, “INTEGRATED FARMING SYSTEM (IES) FOR SUSTAINABLE AGRICULTURE: A CASE STUDY IN KARAIKAL, UNION TERRITORYOF PUDUCHERRY,” *Indian J. Vet. Anim. Sci. Res.*, vol. 53, no. 5, pp. 116–123, 2025.

[9] H. Wahyudianto *et al.*, “Synergies To Address Stunting In Papua: A Multisectoral Approach And Improving People’s Quality Of Life,” 2020.

[10] M. E. Rita Parmawati SP *et al.*, “Implementation of Integrated Farming System Technology Towards Sustainable Agriculture in the Kemiren Tourist Village, Banyuwangi,” *J. Innov. Appl. Technol.*, vol. 10, no. 1, pp. 85–93, 2024.

[11] M. Nurcholis and G. Supangkat, “Pengembangan integrated farming system untuk pengendalian alih fungsi lahan pertanian,” in *Prosiding Seminar Nasional Budidaya Pertanian, Urgensi dan Strategi Pengendalian Alih Fungsi Lahan Pertanian*, 2011, pp. 71–84.

[12] S. Sadarestuwati, D. R. Suryaningsih, and D. Haryanta, “Strategies to Uphold Food Sovereignty In Indonesia: Strategi Menegakkan Kedaulatan Pangan di Indonesia,” *J. Appl. Plant Technol.*, vol. 2, no. 2, pp. 86–99, 2023.

[13] D. N. Asih and S. Klasen, “Improving food security? Setting indicators and observing change of rural household in Central Sulawesi,” 2017.

[14] M. Malik, V. K. Gahlawat, R. S. Mor, and A. Hosseinian-Far, “Towards white revolution 2.0: challenges and opportunities for the industry 4.0 technologies in Indian dairy industry,” *Oper. Manag. Res.*, vol. 17, no. 3, pp. 811–832, 2024.

[15] R. Bhagat, S. S. Walia, K. Sharma, R. Singh, G. Singh, and A. Hossain, “The integrated farming system is an environmentally friendly and cost-effective approach to the sustainability of agri-food systems in the modern era of the changing climate: A comprehensive review,” *Food Energy Secur.*, vol. 13, no. 1, p. e534, 2024.

[16] A. K. Gupta, D. Yadav, B. G. Dungdung, J. Paudel, A. K. Chaudhary, and R. Arshad, “Integrated farming systems (IFS)–a review paper,” *Int. J. Eng. Appl. Sci. Technol.*, vol. 4, no. 9, pp. 134–137, 2020.

[17] P. Bhati *et al.*, “Integrated farming systems for environment sustainability: a Comprehensive Review,” *J. Sci. Res. Reports*, vol. 30, no. 1, pp. 143–155, 2024.

[18] U. Sekaran, L. Lai, D. A. N. Ussiri, S. Kumar, and S. Clay, “Role of integrated crop-livestock systems in improving agriculture production and addressing food security–A review,” *J. Agric. Food Res.*, vol. 5, p. 100190, 2021.

[19] P. Kashyap *et al.*, “Achieving food and livelihood security and enhancing profitability through an integrated farming system approach: a case study from western plains of Uttar Pradesh, India,” *Sustainability*, vol. 14, no. 11, p. 6653, 2022.

[20] S. S. Walia and T. Kaur, “Sustainable Rural Livelihood Security Through IFS,” in *Basics of Integrated Farming Systems*, Springer, 2023, pp. 113–155.

[21] L. R. Meena *et al.*, “Development of a successful IFS model for livelihood sustenance of small households of Uttar Pradesh,” *Indian J. Agric. Sci.*, vol. 92, no. 10, pp. 1175–1180, 2022.

[22] A. O. Iraoya and A. C. Isinika, “Income diversification and agricultural intensification of rural households in Nigeria: Synergies and tradeoffs,” *J. African Dev.*, vol. 23, no. 1, pp. 112–131, 2022.

[23] E. Bertoni, P. A. Corral Rodas, V. Molini, G. Oseni, and G. O. Siwatu, “Heterogeneous returns to income diversification: evidence from Nigeria,” *World Bank Policy Res. Work. Pap.*, no. 7894, 2016.

[24] O. O. Osuafor, “On-Farm Income Diversification Decisions Of Rural Farm Households In Enugu State, Nigeria,” 2015, *M Sc. Dissertation, Dept of Agricultural Economics & Extn, University of ….*

[25] J. A. Tagoe, “Food crop diversification and economic efficiency of smallholder farmers: implications for improving food security in Okere district in the Eastern Region, Ghana. Food crop diversification and economic efficiency of smallholder farmers: implications for improving food security in Okere district in the Eastern Region, Ghana. Jacob Adam TagoeFood crop diversification and economic efficiency of smallholder farmers: implications for improving food security in Okere district in the Eastern Region, Ghana. Jacob Adam TagoeFood crop diversification and economic efficiency of smallholder farmers: implications for improving food security in Okere district in the Eastern Region, Ghana. Jacob Adam TagoeFood crop diversification and economic efficiency of smallholder farmers: implications for improving food security in Okere district in the Eastern Region, Ghana. Jacob Adam TagoeFood crop diversification and economic efficiency of smallholder farmers: implications for improving food security in Okere district in the Eastern Region, Ghana. Jacob Adam TagoeFood crop diversification and economic efficiency of smallholder farmers: implications for improving food security in Okere district in the Eastern Region, Ghana. Jacob Adam TagoeFood crop diversification and economic efficiency of smallholder farmers: implications for improving food security in Okere district in the Eastern Region, Ghana. Jacob Adam TagoeFood crop diversification and economic efficiency of smallholder farmers: implications for improving food security in Okere district in the Eastern Region, Ghana.,” 2022, *University of Cape Coast*.

[26] I. O. Amao, A. I. Ogunniyi, G. Mavrotas, and A. O. Omotayo, “Factors affecting food security among households in Nigeria: the role of crop diversity,” *Sustainability*, vol. 15, no. 11, p. 8534, 2023.

[27] P. Shetty, “From food security to food and nutrition security: role of agriculture and farming systems for nutrition,” *Curr. Sci.*, pp. 456–461, 2015.

[28] K. Vatta, “Reassessing agri-food systems for sustaining nutritional food security: Evidence, imperative and way forward,” *Indian J. Agric. Econ.*, vol. 79, no. 1, pp. 47–59, 2024.

[29] N.-L. Aberman and C. Tirado, “Impacts of climate change on food utilization,” in *Global Environmental Change*, Springer, 2014, pp. 717–724.

[30] S. Saxena and S. Upadhyay, “From Fields to Forks: Navigating the New Climate Reality in Agriculture and Health,” in *The Climate-Health-Sustainability Nexus: Understanding the Interconnected Impact on Populations and the Environment*,

Springer, 2024, pp. 95–125.