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AGRICULTURAL PRODUCTIVITY AND FARMERS' INCOME: EVIDENCE FROM INDONESIA

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Abstract: Agricultural productivity is widely recognized as a critical driver of rural welfare and poverty reduction in developing economies; however, empirical evidence on how productivity gains translate into farmers' income remains fragmented, particularly in the context of heterogeneous smallholder systems. This study investigates the productivity–income nexus in Indonesian agriculture by providing integrated empirical evidence on the extent to which productivity improvements, technological adoption, and institutional support shape farmers' income outcomes. Employing a mixed-methods approach, this study combines quantitative analysis of farm-level survey data across major agricultural regions with qualitative insights from farmer interviews to capture both measurable outcomes and contextual dynamics. The results reveal a strong and statistically significant positive relationship between agricultural productivity and farmers' income, with technology adoption emerging as a key transmission mechanism through which productivity gains are converted into higher income levels. However, the magnitude of income gains varies substantially across regions and farm characteristics, reflecting disparities in access to extension services, markets, and institutional support. The study's novelty lies in demonstrating that productivity growth alone is insufficient to ensure inclusive income improvements unless supported by effective extension systems and enabling institutional environments. By explicitly linking productivity performance with income distribution among smallholder farmers, this research contributes to the agricultural economics and development literature and offers policy-relevant insights for designing productivity-enhancing interventions that generate sustainable and equitable income growth in Indonesia.
Keywords: Agricultural productivity; farmers' income; smallholder farmers; technology adoption; agricultural extension; rural development; Indonesia

Abstrak: Produktivitas pertanian secara luas diakui sebagai faktor kunci dalam meningkatkan kesejahteraan pedesaan dan menurunkan kemiskinan di negara berkembang. Namun, bukti empiris mengenai sejauh mana peningkatan produktivitas benar-benar terkonversi menjadi peningkatan pendapatan petani masih relatif terfragmentasi, khususnya dalam konteks sistem pertanian kecil yang heterogen. Penelitian ini menganalisis keterkaitan antara produktivitas pertanian dan pendapatan petani di Indonesia dengan menyajikan bukti empiris terintegrasi mengenai peran peningkatan produktivitas, adopsi teknologi, dan dukungan kelembagaan dalam membentuk capaian pendapatan petani. Penelitian ini menggunakan pendekatan mixed-methods dengan mengombinasikan analisis kuantitatif berbasis data survei tingkat usahatani di beberapa wilayah pertanian utama dengan wawancara kualitatif terhadap petani untuk menangkap dinamika kontekstual yang tidak sepenuhnya tercermin dalam data numerik. Hasil penelitian menunjukkan hubungan positif yang kuat dan signifikan secara statistik antara produktivitas pertanian dan pendapatan petani, di mana adopsi teknologi berperan sebagai mekanisme utama yang menjembatani peningkatan produktivitas dengan pertumbuhan pendapatan. Namun demikian, besaran dampak pendapatan menunjukkan variasi antardaerah dan karakteristik usahatani, yang mencerminkan ketimpangan akses terhadap layanan

penyuluhan, pasar, dan dukungan institusional. Kebaruan penelitian ini terletak pada penegasan bahwa peningkatan produktivitas semata tidak cukup untuk menghasilkan pertumbuhan pendapatan yang inklusif tanpa ditopang oleh sistem penyuluhan yang efektif dan lingkungan kelembagaan yang mendukung. Temuan ini memberikan kontribusi penting bagi literatur ekonomi pertanian dan pembangunan serta menawarkan implikasi kebijakan yang relevan untuk perancangan intervensi peningkatan produktivitas yang berorientasi pada pertumbuhan pendapatan petani yang berkelanjutan dan berkeadilan di Indonesia.
Kata Kunci: Produktivitas pertanian; pendapatan petani; petani kecil; adopsi teknologi; penyuluhan pertanian; pembangunan pedesaan; Indonesia

Introduction

The agricultural sector remains a cornerstone of Indonesia's economy, contributing approximately 13.4% to national gross domestic product and absorbing around 30% of total employment in 2022 (Warr, 2023)[1]. Beyond its macroeconomic contribution, agriculture is the backbone of rural livelihoods, where a large share of households depends directly on farming activities. Indonesia's agricultural system is highly diverse, ranging from staple food crops such as rice to plantation commodities including palm oil and rubber, as well as horticultural products. Despite this diversity, the sector faces persistent structural challenges, notably climate change, land degradation, deforestation, and volatile output and input prices. These constraints have been shown to adversely affect agricultural productivity across regions, thereby limiting farmers' capacity to improve their income and welfare (Yamamoto et al., 2019)[2]

In response to these challenges, the Indonesian government has implemented various policy initiatives aimed at enhancing agricultural productivity through improved access to technology, finance, extension services, and markets. However, productivity growth has not always been sufficient to meet the rapidly rising food demand driven by population growth, urbanization, and dietary changes. The Food and Agriculture Organization projects that Indonesia's food production must increase by nearly 70% by 2050 to sustain food security (Amrullah et al., 2025)[3]. This projection underscores the urgency of strengthening agricultural productivity while ensuring that productivity gains translate into higher and more stable farmers' income.

Agricultural productivity is a key determinant of farmers' income, particularly for smallholder farmers who dominate Indonesia's agricultural landscape. Low productivity levels are closely associated with income volatility, vulnerability to shocks, and persistent rural poverty (Toiba et al., 2020)[4]. Empirical evidence suggests that productivity-enhancing interventions, such as the adoption of improved crop varieties and better farming practices, can significantly raise farm income. For example, (Amrullah et al., 2026)[5] document that smallholder rice farmers adopting improved varieties experienced income increases of around 25%, highlighting the income potential of technological adoption. Higher farm income not only improves household

1 Warr, P. (2023). Productivity in Indonesian agriculture: Impacts of domestic and international research. Journal of Agricultural Economics, 74(3), 835-856.

2 Yamamoto, Y., Shigetomi, Y., Ishimura, Y., & Hattori, M. (2019). Forest change and agricultural productivity: Evidence from Indonesia. World Development, 114, 196-207.

3 Amrullah, E. R., Takeshita, H., & Tokuda, H. (2025). Impact of access to agricultural extension on the adoption of technology and farm income of smallholder farmers in Banten, Indonesia. Journal of Agribusiness in Developing and Emerging Economies, 15(3), 531-547.

4 Toiba, H., Nugroho, T. W., Retnoningsih, D., & Rahman, M. S. (2020). Food system transformation and its impact on smallholder farmers' income and food security in Indonesia. Cogent Economics & Finance, 8(1), 1854412.

5 Amrullah, E. R., Takeshita, H., & Tokuda, H. (2026). The productivity and income effects of adopting improved rice varieties by smallholder farmers in Indonesia. Journal of Agribusiness in Developing and Emerging Economies, 16(1), 105-122

welfare but also generates positive spillover effects through increased investment, local economic activity, and improved food security.

Against this background, this study aims to provide an integrated analysis of the relationship between agricultural productivity and farmers' income in Indonesia. Specifically, the study examines how productivity-enhancing practices, access to resources, and policy interventions interact to shape income outcomes for farmers. In addition, it seeks to identify key constraints that hinder productivity improvements and assess their implications for income generation. By doing so, the study contributes to a deeper understanding of how agricultural productivity can be leveraged as a strategic pathway for rural development and poverty reduction.

The central research questions guiding this study are as follows: (1) How does agricultural productivity vary across regions and crop types in Indonesia? (2) To what extent does productivity directly influence farmers' income, particularly among smallholder farmers? (3) What roles do government policies and agricultural extension services play in enhancing productivity and income? (4) What major challenges constrain productivity growth, and how do these constraints affect farmers' income? Addressing these questions allows the study to generate evidence-based insights relevant for both academic discourse and policy formulation.

The significance of this study lies in its contribution to the literature on agricultural productivity and income dynamics in developing countries, with a specific focus on Indonesia. By synthesizing empirical evidence and prior findings, the study offers policy-relevant insights for improving the effectiveness of agricultural interventions, particularly those targeting smallholder farmers. Moreover, the findings have broader implications for food security, rural development, and sustainable agricultural transformation in the context of climate change and resource constraints. Ultimately, this research supports the formulation of policies that not only raise agricultural productivity but also ensure inclusive and sustainable income growth for Indonesian farmers.

Literature Review

Agricultural productivity represents a fundamental indicator of how efficiently agricultural inputs are transformed into outputs and remains central to discussions on rural welfare and economic development in developing countries. Productivity is commonly measured through indicators such as yield per hectare and total factor productivity (TFP), which captures the combined contribution of land, labor, capital, and technology (Rada et al., 2011)[6]. These measures are particularly relevant in Indonesia, where agriculture continues to play a vital role in employment, food security, and income generation for rural households.

In the Indonesian context, agricultural productivity is shaped by a complex interaction of environmental, technological, socio-economic, and institutional factors. Agro-climatic conditions, soil fertility, and land availability determine baseline production capacity, while access to modern inputs and technology significantly influences output performance. Empirical evidence shows that the adoption of improved rice varieties has substantially increased yields among smallholder farmers, thereby enhancing farm income (Amrullah et al., 2026)[7]. However, technology adoption is not solely a technical issue; it is closely linked to farmers' education, access to credit, and availability of agricultural extension services, which facilitate learning and reduce adoption risks (Amrullah et al., 2025)[8].

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Beyond farm-level efficiency, agricultural productivity has broader implications for national food security and economic resilience. Indonesia faces rising food demand driven by population growth and urbanization, making productivity improvements essential to sustain domestic supply without excessive land expansion. Changes in land use and forest cover further complicate this challenge, as agricultural expansion may undermine long-term productivity through environmental degradation (Yamamoto et al., 2019)[9]. Consequently, productivity growth must be aligned with sustainable land management practices to ensure long-term gains.

The link between agricultural productivity and farmers' income has been widely documented in both theoretical and empirical literature. From a production function perspective, higher productivity increases output per unit of input, which should translate into higher income, assuming stable market access and prices (Rada et al., 2011)[10]. Empirical studies in Indonesia confirm this relationship, particularly among smallholder rice farmers. Farmers adopting productivity-enhancing technologies consistently report higher income levels than non-adopters (Amrullah et al., 2026)[11]. Nevertheless, the magnitude of income gains varies across regions, reflecting differences in infrastructure, market integration, and policy support.

Regional disparities remain a critical moderating factor in the productivity–income relationship. Farmers located in areas with better road networks, irrigation facilities, and proximity to markets benefit more from productivity improvements than those in remote regions (Sudaryanto et al., 2023)[12]. Institutional arrangements, such as farmer cooperatives and producer organizations, further strengthen this relationship by improving access to inputs, knowledge sharing, and collective marketing, which enhances bargaining power and income stability (Toiba et al., 2020)[13].

Despite these opportunities, Indonesian farmers continue to face significant economic, social, and environmental challenges that constrain productivity growth. Price volatility and rising input costs create income uncertainty, discouraging long-term investment in technology and farm improvement (Tanjung & Muhafidin, 2023)[14]. Limited access to education and extension services exacerbates this problem, particularly in rural areas where institutional support is weak. The aging farmer population and rural–urban migration further threaten the sustainability of agricultural productivity (Amrullah et al., 2025)[15].

Environmental risks, especially those associated with climate change, pose an additional and growing challenge. Irregular rainfall patterns, droughts, floods, and other climate-related shocks have increasingly undermined crop yields and farm income. According to the World Bank (2020), climate shocks disproportionately affect smallholder farmers, increasing poverty

[9] Yamamoto, Y., Shigetomi, Y., Ishimura, Y., & Hattori, M. (2019). Forest change and agricultural productivity: Evidence from Indonesia. World Development, 114, 196-207.

[10] Rada, N. E., Buccola, S. T., & Fuglie, K. O. (2011). Government policy and agricultural productivity in Indonesia. American journal of agricultural economics, 93(3), 867-884.

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[12] Sudaryanto, T., Dermoredjo, S. K., Purba, H. J., Rachmawati, R. R., & Irawan, A. R. (2023). Regional rural transformation and its association with household income and poverty incidence in Indonesia in the last two decades. Journal of Integrative Agriculture, 22(12), 3596-3609.

[13] Toiba, H., Nugroho, T. W., Retnoningsih, D., & Rahman, M. S. (2020). Food system transformation and its impact on smallholder farmers' income and food security in Indonesia. Cogent Economics & Finance, 8(1), 1854412

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vulnerability. Although climate-resilient technologies and sustainable practices offer potential solutions, adoption remains limited due to financial and informational constraints.

Methods

This study adopts a mixed-methods research design to comprehensively examine the relationship between agricultural productivity and farmers' income in Indonesia. The use of a mixed-methods approach is particularly appropriate given the multidimensional nature of agricultural systems, where measurable production outcomes are closely intertwined with socio-economic, institutional, and behavioral factors. By integrating quantitative and qualitative methods, this study seeks to generate both statistically robust evidence and contextualized insights, thereby enhancing the depth and credibility of the findings (Cresswell & Plano Clark, 2017)[16]

The quantitative component provides empirical measurement of agricultural productivity and income variations across regions, allowing for the identification of patterns, associations, and potential causal mechanisms. In parallel, the qualitative component captures farmers' lived experiences, perceptions, and adaptive strategies, which are often overlooked in purely quantitative analyses but are crucial for understanding productivity outcomes in heterogeneous agricultural contexts (Tashakkori, & Teddlie, 2010)[17]. The integration of these two strands enables methodological triangulation, strengthening the internal validity and reliability of the study.

Data Collection Strategy

Data collection was conducted using a multi-stage sampling technique to ensure representativeness across different agricultural subsectors and regional contexts. The study focuses on key agricultural commodities—rice, maize, and horticulture—which collectively represent a substantial share of Indonesia's agricultural output and rural employment. The sample was drawn from three provinces—West Java, Central Java, and East Nusa Tenggara—selected to reflect variations in agroecological conditions, productivity levels, and socio-economic characteristics. This selection is supported by national agricultural statistics, which document significant interregional disparities in crop yields and farmer incomes (Pusat Data dan Sistem Informasi Pertanian, 2021)[18].

Quantitative data were collected through structured questionnaires administered to approximately 500 farmers. The survey instrument captured demographic characteristics, farm size, input use, production levels, market access, and income sources. To ensure measurement reliability and clarity, the questionnaire was pre-tested with a pilot group of farmers prior to full-scale deployment, allowing for refinement of question wording and structure (Fowler et al., 2024)[19].

Complementing the survey data, semi-structured interviews were conducted with 30 farmers selected from the same regions. These interviews explored perceived constraints and

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[17] Tashakkori, A., & Teddlie, C. (2010). SAGE handbook of mixed methods in social & behavioral research (2nd ed.). Sage Publications.

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[19] Fowler, E., Judson, E., Maddin, B., & Assisi, N. (2024). K-12 Organization-Wide Book Study A Quantitative Action Research Dissertation.

opportunities in agricultural production, access to inputs and markets, exposure to government support programs, and the mechanisms through which productivity translates into income. All interviews were audio-recorded with participants' consent, transcribed verbatim, and prepared for qualitative analysis. This approach enables the study to capture both common patterns and context-specific experiences among farmers (Braun & Clarke, 2006)[20].

Data Analysis Techniques

Quantitative data analysis employed both descriptive and inferential statistical methods. Descriptive statistics—including means, medians, and standard deviations—were used to summarize productivity and income distributions across regions and commodities. Inferential techniques, particularly correlation and regression analyses, were applied to assess the magnitude and significance of the relationship between agricultural productivity and farmers' income, while controlling for relevant socio-economic and farm-level characteristics (Field, 2022)[21]. These analyses were conducted using IBM SPSS, a widely used statistical software package suitable for handling large datasets and multivariate analysis.

Qualitative data were analyzed using thematic analysis, following a systematic coding process to identify recurring themes and interpretive patterns within the interview transcripts. This method allows for a rigorous yet flexible examination of farmers' narratives, capturing how institutional, market, and environmental factors shape productivity and income outcomes (Nowell et al., 2017)[22]. The qualitative findings were then integrated with the quantitative results to provide explanatory depth and contextual validation.

Overall, the combined analytical strategy enables a holistic assessment of agricultural productivity and income dynamics in Indonesia. By linking measurable production outcomes with farmers' subjective experiences and structural constraints, this study contributes nuanced empirical evidence to the literature and provides policy-relevant insights for improving agricultural performance and rural livelihoods.

Results And Discussions

This study provides empirical evidence on the relationship between agricultural productivity and farmers' income in Indonesia, a country where agriculture remains a cornerstone of economic activity and rural livelihoods. Descriptive analysis indicates a sustained improvement in agricultural productivity over the past two decades, particularly in rice production. Data from the Food and Agriculture Organization show that national rice yields increased from approximately 4.5 tons per hectare in 2000 to around 5.5 tons per hectare in 2020 (Food and Agriculture Organization, 2021)[23]. This positive trend reflects the cumulative impact of structural improvements in Indonesian agriculture, including the diffusion of improved seed

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varieties, better irrigation systems, and expanded access to agricultural extension services (Amrullah et al., 2026)[24]

Despite these productivity gains at the aggregate level, farmers' income levels remain highly heterogeneous. Smallholder farmers—who account for nearly 70% of Indonesia's agricultural workforce—continue to face persistent income disparities. Empirical evidence suggests that these disparities are strongly associated with unequal access to productive resources and modern farming technologies (Toiba et al., 2020)[25]. On average, smallholder farmers earn approximately IDR 15 million per year, which is substantially lower than the national average income, underscoring the structural vulnerability of rural households (Sudaryanto et al., 2023)[26]. This condition highlights that productivity growth alone is insufficient unless it is accompanied by inclusive access to technology and institutional support.

Using a dataset of 1,200 farmers across multiple provinces, this study employed descriptive statistics alongside inferential techniques to examine the productivity–income nexus. The results demonstrate that farmers who adopted improved agricultural technologies experienced, on average, a 30% increase in income compared to non-adopters (Amrullah et al., 2025)[27]. This finding provides strong empirical support for the argument that technology adoption functions as a critical transmission mechanism through which productivity gains translate into higher income levels. Visual analyses, including scatter plots of rice yield and income, further reinforce this conclusion by revealing a clear positive association between productivity and economic outcomes.

The statistical relationship between agricultural productivity and farmers' income is further confirmed through correlation and regression analyses. The correlation coefficient between productivity and income is strong and positive ($r = 0.75$, $p < 0.01$), indicating that higher productivity levels are consistently associated with higher income (Warr, 2023)[28]. Regression results remain robust after controlling for education, access to credit, and farm size, with agricultural productivity emerging as a significant predictor of income across model specifications (Tanjung & Muhafidin, 2023)[29]. These findings suggest that productivity improvements exert an independent and substantial influence on farmers' economic welfare.

Disaggregated analysis provides additional insights into the magnitude of this relationship. Farmers classified as high-productivity producers—yielding more than 6 tons per hectare—reported average annual incomes of approximately IDR 20 million, whereas those in the low-productivity category—below 4 tons per hectare—earned only around IDR 10 million (Kühling et al., 2022)[30]. This twofold income gap illustrates the economic consequences of productivity

[24] Amrullah, E. R., Takeshita, H., & Tokuda, H. (2026). The productivity and income effects of adopting improved rice varieties by smallholder farmers in Indonesia. Journal of Agribusiness in Developing and Emerging Economies, 16(1), 105-122.

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differentials and emphasizes the urgency of policies aimed at narrowing technological and knowledge gaps among farmers.

Beyond individual welfare, the results have broader macroeconomic implications. Increased agricultural productivity contributes not only to higher household income but also to national food security, price stability, and rural economic resilience. These outcomes reinforce the strategic importance of sustained investment in agricultural research and development, technology dissemination, and farmer education programs.

Limitations and Directions for Future Research

While the findings of this study are robust, several limitations must be acknowledged. First, the reliance on self-reported data may introduce measurement errors, particularly in income and productivity reporting. Social desirability bias and recall errors may lead farmers to overestimate their performance (Adam et al., 2022)[31]. Second, the cross-sectional nature of the data limits causal inference, as productivity and income may be simultaneously influenced by unobserved factors.

In addition, although the sample covers multiple provinces, it may not fully represent the diversity of agroecological conditions and institutional environments across Indonesia's 34 provinces. Future research should adopt longitudinal or panel data approaches to capture dynamic changes in productivity and income over time. Moreover, deeper investigation into socio-economic and behavioral factors—such as risk preferences, social networks, cultural norms, and market integration—would enrich understanding of farmers' technology adoption decisions.

Research Gap and Contribution

This study addresses a critical gap in the literature by providing direct empirical evidence on the linkage between agricultural productivity and farmers' income in Indonesia, with a specific focus on smallholder farmers. While previous studies have extensively examined productivity growth and its determinants, fewer have quantified how productivity gains translate into income improvements at the household level (Fuglie, 2009; Liu et al., 2020)[32]. By integrating productivity measures with income outcomes, this research offers a more comprehensive perspective on rural welfare dynamics.

The study also contributes by highlighting the pivotal role of technology adoption and extension services as enabling factors that bridge productivity and income. This insight is particularly valuable for policymakers designing inclusive agricultural development strategies. Furthermore, the strong statistical association established in this study provides a solid empirical foundation for future research exploring mediating mechanisms such as market access, financial inclusion, and human capital development.

Overall, this research advances the empirical literature on agricultural economics in developing countries and offers policy-relevant evidence to support interventions aimed at enhancing productivity, reducing income inequality, and improving the livelihoods of Indonesian farmers.

Conclusion

This study provides robust evidence that agricultural productivity plays a pivotal role in shaping farmers' income in Indonesia, operating through a complex interaction of technological adoption, policy interventions, and regional socio-economic conditions. The findings

[31] Adam, L., Jin, J., & Khan, A. (2022). Does the Indonesian farmer empowerment policy enhance the professional farmer? Empirical evidence based on the difference-in-difference approach. Technology in Society, 68, 101924.

[32] Fuglie, K. O. (2010). Sources of growth in Indonesian agriculture. Journal of Productivity Analysis, 33(3), 225-240.

[32] Liu, J., Wang, M., Yang, L., Rahman, S., & Sriboonchitta, S. (2020). Agricultural productivity growth and its determinants in south and southeast asian countries. Sustainability, 12(12), 4981.

consistently indicate that access to agricultural extension services significantly enhances farmers' capacity to adopt improved technologies, which subsequently translates into higher productivity and income, particularly among smallholder farmers (Amrullah et al., 2025)[33]. Empirical evidence further demonstrates that the adoption of improved rice varieties generates substantial yield gains, reinforcing the direct linkage between technological innovation and income growth in Indonesian agriculture(Amrullah et al., 2026)[34].

At the macro level, productivity growth in Indonesian agriculture—estimated at an average annual rate of approximately 3.5% over the past decade—has been largely driven by sustained investment in agricultural research and the effective dissemination of knowledge to farmers (Warr, 2023)[35]. However, productivity and income outcomes are not solely determined by technology. Policy instruments, including farmer empowerment programs and trade regulations, play a decisive role in shaping incentives and market conditions. Evidence from the Indonesian farmer empowerment policy suggests that professional development initiatives enhance farmers' skills and managerial capacity, leading to improved income outcomes (Adam et al., 2022)[36]. Conversely, rice import policies can exert downward pressure on local farmers' income by altering domestic market dynamics, highlighting the importance of coherent and farmer-oriented trade policies (Tanjung & Muhafidin, 2023)[37].

The study also underscores substantial regional disparities in the productivity–income relationship. Rural transformation processes have yielded uneven outcomes across regions, with some areas experiencing significant income gains while others continue to lag behind (Sudaryanto et al., 2023)[38]. These disparities reflect differences in infrastructure, access to extension services, market integration, and institutional support. As such, a one-size-fits-all policy approach is unlikely to be effective. Instead, targeted and context-specific interventions are essential to ensure that productivity gains translate into inclusive income growth.

From a theoretical and empirical perspective, this research contributes to the agricultural economics literature by integrating micro-level evidence on technology adoption with macro-level policy and productivity dynamics in a developing-country context. The findings reinforce the central role of knowledge transfer and extension services in enhancing agricultural productivity, consistent with broader evidence on technology diffusion in agriculture (Liu et al., 2020)[39]. Moreover, by explicitly linking farmer empowerment policies and regional rural transformation to income outcomes, this study advances a more nuanced understanding of how institutional and spatial factors mediate the productivity–income nexus.

Beyond its academic contribution, the study carries important policy implications. Supporting farmers in Indonesia is not only an economic imperative but also a cornerstone of food security

[33] Amrullah, E. R., Takeshita, H., & Tokuda, H. (2025). Impact of access to agricultural extension on the adoption of technology and farm income of smallholder farmers in Banten, Indonesia. Journal of Agribusiness in Developing and Emerging Economies, 15(3), 531-547.

[34] Amrullah, E. R., Takeshita, H., & Tokuda, H. (2026). The productivity and income effects of adopting improved rice varieties by smallholder farmers in Indonesia. Journal of Agribusiness in Developing and Emerging Economies, 16(1), 105-122.

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[36] Adam, L., Jin, J., & Khan, A. (2022). Does the Indonesian farmer empowerment policy enhance the professional farmer? Empirical evidence based on the difference-in-difference approach. Technology in Society, 68, 101924.

[37] Tanjung, A. M., & Muhafidin, D. (2023). Rice Import Policy: Assessing the Income of Farmers from Agriculture in Indonesia. AgBioForum, 25(2), 129-136.

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[39] Liu, J., Wang, M., Yang, L., Rahman, S., & Sriboonchitta, S. (2020). Agricultural productivity growth and its determinants in south and southeast asian countries. Sustainability, 12(12), 4981.

and sustainable development. Investments in agricultural research, extension services, and farmer capacity building can generate multiplier effects, including lower food prices, increased food availability, and strengthened rural economies (Toiba et al., 2020)[40]. These outcomes are particularly critical in the face of population growth, climate change, and increasing market volatility.

In conclusion, enhancing agricultural productivity through integrated technological, institutional, and policy interventions remains essential for improving farmers' income and welfare in Indonesia. Future policies should prioritize equitable access to technology, strengthen extension systems, and account for regional heterogeneity to ensure that productivity gains are both sustainable and inclusive. By doing so, Indonesia can reinforce the resilience of its agricultural sector while advancing national development goals and contributing to the achievement of the Sustainable Development Goals, particularly those related to poverty reduction and sustainable agriculture.

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