



Research Article



Productivity and Welfare of Rice Farmers in Indonesia: A Policy Reorientation toward Innovation and Total Factor Productivity

Arif Haryana¹

¹ Ministry of National Development Planning/National Development Planning Agency

Abstract

This article examines the persistent stagnation of rice productivity and the limited welfare gains experienced by rice farmers in Indonesia despite decades of price-based policy interventions. Drawing on policy analysis, secondary data, and previous research on national rice policy, the study argues that price support mechanisms have been insufficient to address structural constraints such as small farm sizes, regional productivity disparities, and weak innovation diffusion. The analysis highlights dysfunctions within Indonesia's agricultural innovation system that impede the translation of research outputs into on-farm productivity gains. The paper proposes a reorientation of rice policy from price support toward productivity-led growth through strengthened research, extension, and institutional coordination. This policy shift is framed in alignment with Indonesia's National Medium-Term Development Plan (RPJMN), emphasizing the strategic role of the National Research and Innovation Agency (BRIN) in enabling an integrated and innovation-driven food security strategy. The findings contribute to the food policy literature by demonstrating that sustainable improvements in farmer welfare and food security are more likely to emerge from innovation-centered policies than from administratively maintained price regimes.

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Correspondence Email:

arif.haryana@gmail.com

1. Introduction

Agriculture, particularly the food crop subsector, plays a strategic role in Indonesia's economy as a provider of staple food, a major source of employment, and a pillar of rural socio-economic stability. Rice, as the dominant staple food, carries strong economic, social, and political dimensions. Despite its strategic importance, the persistence of poverty among rice farmers—especially smallholders—remains a central paradox of Indonesia's agricultural development.

For decades, national rice policy has been largely oriented toward stabilizing and supporting paddy and rice prices with the stated objective of protecting farmers' incomes. However, mounting empirical evidence suggests that this approach has failed to deliver broad-based welfare improvements. Instead, high rice prices tend to disproportionately burden small farmers and poor households, many of whom are net consumers of rice.

This article advances the argument that productivity growth—rather than price support—is the primary pathway for improving rice farmer welfare and reducing rural poverty. Building on the policy perspectives of Simatupang and integrating the author's previous research on national rice policy, this study systematically analyzes farm fragmentation, productivity stagnation, and failures in the agricultural innovation system, and proposes a new direction for rice policy reform in Indonesia.



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Contribution to the Literature

This article makes three main contributions to the literature on food policy and agricultural economics. First, it develops an integrated analytical framework linking rice policy orientation, economic incentives, and productivity dynamics to farmer welfare outcomes—an approach that remains underdeveloped in the Indonesian rice policy literature (Timmer, 2017; Warr, 2023). Second, by integrating national empirical evidence with the author's prior policy research, the article demonstrates the structural limitations of rice price support policies under conditions of inelastic supply and fragmented farm structures (Dorward et al., 2004). Third, the article proposes a paradigm shift from price-based interventions toward productivity- and innovation-driven strategies, thereby enriching the broader debate on food security, productivity growth, and equity in developing countries (Hazell & Ramasamy, 1991; Warr, 2023).

2. Conceptual Framework and Literature Review

2.1 Rice Price Policy and Farmer Welfare

The conventional rationale for rice price policy in developing countries is grounded in the objectives of income stabilization for farmers and food affordability for consumers. Governments often intervene through price floors, procurement schemes, trade restrictions, and retail price ceilings to manage volatility in staple food markets (Timmer, 2017; Dorward et al., 2004). In theory, higher farmgate prices should improve farmer incomes and incentivize production. However, the welfare effects of such interventions depend critically on farm structure, market integration, and household consumption patterns. In contexts where most rice farmers operate at small scale and are net rice consumers, price increases may yield limited or even negative net welfare effects once higher input costs and consumption expenditures are taken into account (Warr, 2023).

Empirical studies increasingly show that price-based interventions alone are insufficient to generate sustained poverty reduction among rice farmers. Evidence from Southeast Asia suggests that supply response to price incentives is often weak due to land constraints, low capital intensity, and limited access to technology (Hazell & Ramasamy, 1991; Timmer, 2017). Moreover, price support policies tend to create distributional distortions, benefiting larger producers and market intermediaries more than smallholders. These findings challenge the assumption that price stabilization is an effective long-term instrument for farmer welfare and point to the need for complementary productivity-enhancing strategies.

2.2 Productivity, Structural Constraints, and Rice Sector Performance

Productivity growth has long been recognized as the primary driver of income growth and poverty reduction in agriculture (Hayami & Ruttan, 1985). In the rice sector, yield improvements, cost reductions, and total factor productivity (TFP) growth are essential for enhancing farm profitability under conditions of declining farm size and rising labor costs. However, productivity outcomes are shaped not only by technological availability but also by structural factors such as land fragmentation, irrigation infrastructure, and regional agroecological conditions. In Indonesia, the persistence of small and fragmented landholdings limits economies of scale and constrains farmers' ability to adopt mechanization and modern input packages.

The literature further highlights significant regional disparities in rice productivity, reflecting uneven access to infrastructure, extension services, and innovation networks (FAO, 1998; World Bank, 2023). While core rice-producing regions benefit from relatively advanced irrigation and market access, outer island regions often face higher production risks and lower technology adoption rates. These structural and spatial constraints help explain why national-level productivity indicators may mask substantial internal heterogeneity and why uniform policy instruments—such as nationwide price support—are ill-suited to address localized productivity challenges.

2.3 Agricultural Innovation Systems and Policy Orientation

The agricultural innovation systems (AIS) framework emphasizes that productivity growth emerges from interactions among multiple actors, including research institutions, extension services, private firms, and farmers, rather than from isolated technological breakthroughs (World Bank, 2012). Effective innovation systems require not only adequate investment in research and development but also strong coordination mechanisms, feedback loops,

and institutional incentives that facilitate technology diffusion and adaptation. In rice-based systems, where technologies are often location-specific, the alignment between research agendas and farmer needs is particularly critical.

Recent studies suggest that policy orientation plays a decisive role in shaping the performance of innovative systems. Price-centric policy regimes may inadvertently weaken innovation incentives by reducing competitive pressure and diverting fiscal resources away from research and extension (Timmer, 2017; Warr, 2023). Conversely, productivity-oriented policies that prioritize innovation, human capital, and institutional coordination tend to generate more durable welfare gains (Fuglie, 2018; 2020). This literature provides the conceptual foundation for the present study's argument that reorienting rice policy from price support toward innovation-led productivity growth is essential for achieving sustainable farmer welfare and food security in Indonesia.

Drawing on the conceptual framework outlined above, this study employs a qualitative policy analysis supported by secondary data to examine the links between rice price policy, productivity performance, and innovation system functioning in Indonesia. The methodological approach is informed by the agricultural innovation systems perspective and focuses on identifying structural constraints, institutional interactions, and policy trade-offs rather than estimating short-term price effects. This framework guides the selection of data, indicators, and comparative evidence presented in the following section.

3. Methodology

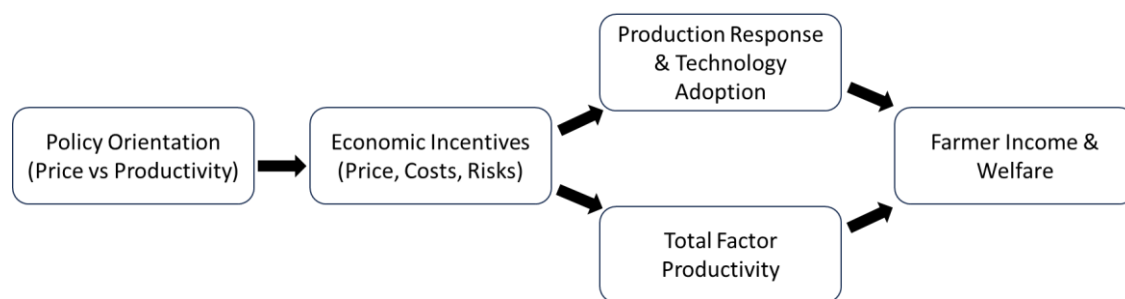
3.1 Research Design and Approach

This study adopts a qualitative policy-oriented research design combined with institutional economic analysis. The approach is intended to capture structural and systemic features of rice policy that are not easily addressed through purely quantitative methods. The analysis operates at two levels: a macro level focusing on national rice policy, innovation systems, and market structures, and a micro level examining farm structure, household behavior, and welfare outcomes.

3.2 Analytical Framework

The analytical framework (Figure 1) integrates three pillars: productivity theory (TFP), political economy of food pricing, and agricultural innovation systems. Policy orientation shapes economic incentives faced by farmers, which influence production responses and technology adoption, thereby determining productivity and welfare outcomes. The framework also highlights feedback loops that reinforce productivity stagnation and rural poverty.

Figure 1. Analytical Framework Linking Rice Policy Orientation



, Economic Incentives, Productivity, and Farmer Welfare

The framework illustrates how the orientation of rice policy—whether price-based or productivity-based—shapes economic incentives faced by rice farmers, including output prices, input costs, and production risks. These incentives influence farmers' production responses and technology adoption decisions, which in turn affect total factor productivity (TFP). Improvements in productivity and production performance ultimately determine farm income and farmer welfare. The framework also highlights that price-oriented policies may generate weak productivity responses under conditions of inelastic supply and fragmented farm structures, whereas innovation-driven policies strengthen productivity-led welfare improvements.

3.3 Data Sources and Analytical Techniques

The study relies exclusively on secondary data, including official statistics from Statistics Indonesia (BPS, 2024; 2025), national policy documents, peer-reviewed literature, and previous research on rice policy, rice trade, and price stabilization. Data are analyzed using thematic and comparative analysis, with validity ensured through triangulation across sources.

4. Results and Discussion

4.1 Farm Fragmentation and the Dynamics of Rice Farmer Poverty

Rice farming in Indonesia is dominated by small and marginal farmers (*petani gurem*). The proportion of small and marginal farmers increased from 55,33% in 2013 to 60,84% in 2023 (BPS Agricultural Census), reflecting a long-term process of land fragmentation. Small farm size constrains economies of scale, limits technology adoption, and reduces farmers' capacity to escape poverty. Rural poverty remains significantly higher than urban poverty, and agriculture—particularly rice farming—continues to be a defining characteristic of poor households.

Micro-level evidence indicates that landholding size is a critical determinant of farmer welfare. Smallholders often rely on income diversification and non-farm employment as survival strategies, underscoring the limited capacity of rice farming alone to provide a pathway out of poverty.

4.2 Productivity Stagnation and Regional Disparities

Since the mid-2010s, rice productivity growth in Indonesia has stagnated, in contrast to more consistent productivity gains observed in crops such as maize. Significant regional disparities persist, reflecting unequal access to irrigation, infrastructure, technology, and government support. Irrigation infrastructure plays a central role in stabilizing production, enabling multiple cropping, and facilitating technology adoption.

Rice productivity in Indonesia has shown signs of stagnation, raising concerns about the long-term sustainability of rice production. Effendy et.al. (2023) showed that lowland rice farming is experiencing decreasing returns and technical inefficiency. National average rice productivity increased only marginally over recent years — from about 5.20 tons per hectare in 2018 to 5.29 tons per hectare in 2024 — representing an increase of only 0,3 percent per year that provide indicative of intensification limits rather than structural productivity gains. Mariyono (2018a; 2018b) show that TFP growth in rice production has stagnated/declined with positive contributions from technical change and scale effects, and negative or weak contributions from technical and allocative efficiency. Growth in rice output is driven largely by input use and cropping intensity rather than TFP improvements.

For a recent year (2018–2024), the average growth of rice productivity—including TFP growth in Indonesia was extremely low, around 0.32% per year, indicating a very slow improvement in efficiency of rice production factors and suggesting TFP growth in the rice sector has been minimal (Azmi, 2025).

Stagnated/declined TFP growth in rice production indicates that the efficiency of production factors or mastery of technology in the agricultural sector is still weak. Low productivity and TFP growth underscoring a persistent stagnation trend in rice yields that has been difficult to shift without significant technological or institutional innovation.

Regional disparities in rice productivity remain pronounced and structural in nature. According to BPS-based regional assessments, average wetland rice yields in Indonesia differ markedly across geographic clusters: in Java —traditional rice production center area— farmers achieve on the average of 5.6 ton/ha, whereas in Sulawesi, Sumatera, and Nusa Tenggara yields are lower at 4.8–5.1 ton/ha, and in Kalimantan, Maluku, and Papua yields fall below 4.0 ton/ha (BPS, 2025). These differences reflect not only biophysical conditions such as irrigation access and water availability but also socioeconomic constraints including access to quality inputs, extension services, and markets. Such regional yield gaps point to uneven adoption of productivity-enhancing technologies and infrastructure, suggesting that national averages mask significant internal heterogeneity in performance. However, Azmi (2025) revealed that TFP growth in rice agriculture in non-central regions (including Maluku, Gorontalo, Riau) is higher compared to traditional central regions in Java, which is related to the growth of irrigation

infrastructure, meaning that improving irrigation outside Java is a highly relevant strategy to increase productivity, alongside innovations and the adoption of technology.

4.3 Evaluation of Paddy and Rice Price Policies

Indonesia's rice price policies have long focused on stabilizing farmgate paddy prices and consumer rice prices through state intervention and procurement mechanisms. Perum Bulog, the state food logistics agency, often sets a government purchase price for unhusked rice (gabah) that is insulated from global price fluctuations; for example, a mandated purchase price of around Rp 6,500 per kilogram is enforced regardless of international market trends, effectively decoupling domestic prices from global rice markets. This insulation contributes to domestic price stability from a policy perspective but may also prevent domestic prices from reflecting global supply conditions, particularly when global prices are substantially lower (e.g., below US \$400/ton) due to import bans and production surpluses elsewhere.

Domestic paddy and rice prices in Indonesia are relatively high and often diverge from global price trends. While intended to protect farmers, such price policies have limited effects on production due to low supply elasticity and instead generate higher consumer prices, increased input costs, and broader inflationary pressures. As a result, price-based policies tend to benefit larger landowners while disadvantaging small farmers and poor consumers.

Empirical data from Statistics Indonesia (BPS) illustrates the mixed outcomes of price support on actual price levels. In late 2024, the reported price of paddy at the farmer level ranged from as low as Rp 4,000/kg to as high as Rp 11,900/kg, with rice milling prices reaching up to Rp 17,000/kg for premium quality rice in some provinces. Despite these official figures, average paddy prices declined year-on-year for several quality classes between 2023 and 2024 while rice prices at the milling level remained high and varied regionally, indicating that price supports did not uniformly elevate farmer revenues and that gains were unevenly distributed across regions and quality grades. Additionally, short-term fluctuations in farmers' terms of trade (FTT) — an indicator comparing indices of prices received by farmers versus prices paid for inputs — show volatility: modest increases in early 2024 were countered by subsequent declines, reflecting instability in real income prospects despite price supports. (BPS, 2024a)

Consumer-level rice prices further demonstrate the limited reach of price support policy in controlling market outcomes. Average retail rice prices in mid-2025, for example, were recorded significantly above official government ceilings retail price (HET), with medium rice priced about 14 % above the mandated cap in some regions, despite government market operations distributing subsidized rice at selected outlets to contain price pressures. These patterns suggest that while price policy interventions have succeeded in preventing price collapse and shielding farmers from global price shocks, they have not effectively insulated poor consumers from high staple costs nor ensured that price supports translate consistently into improved welfare for smallholder producers. The persistence of high retail prices alongside variable paddy price transmission highlights structural inefficiencies in the rice value chain, including market power imbalances, distribution bottlenecks, and weak linkages between producer pricing and consumer affordability.

4.4 Dysfunction in the Agricultural Innovation System

Indonesia's agricultural innovation system, particularly for rice, exhibits structural weaknesses that have constrained the generation, dissemination, and adoption of productivity-enhancing technologies. A critical indicator of this dysfunction is the stagnation in research productivity and adoption of modern rice varieties: between 2015 and 2023, the share of high-yielding and stress-tolerant rice varieties used by farmers increased by only 5–7 percent, despite significant investments in varietal development by public research institutions. This slow diffusion contrasts sharply with countries such as Vietnam and Thailand, where improved variety adoption exceeded 40 percent within comparable periods following targeted extension and seed dissemination programs. Moreover, public agricultural R&D expenditure in Indonesia remains low relative to the size of the agricultural sector, at around 0.15 percent of agricultural GDP (ISAAA, 2024), significantly below the 0.5–1.0 percent benchmark observed in other emerging economies, suggesting underinvestment in the very engine of productivity growth. These structural deficiencies are compounded by fragmented institutional responsibilities: research, extension, and input supply are managed by separate agencies with overlapping mandates and limited coordination, leading to duplication of effort and weak linkages between scientific innovations and on-farm practices (World Bank, 2023).

The impacts of this dysfunctional innovation ecosystem are evident in farmer behavior and productivity outcomes. National farmer surveys indicate that only 22 percent of smallholder rice farmers regularly accessed extension services or advisory programs in the past five years, and fewer than 15 percent reported adopting recommended agronomic practices such as systematic soil testing, precision fertilizer application, or mechanized planting (BPS, 2024b). The lack of reliable extension support and feedback channels also diminishes farmers' capacity to experiment with or scale new technologies. This gap is particularly pronounced in outer island regions — such as Kalimantan and eastern Indonesia — where institutional presence and infrastructure are weaker, and adoption rates of key innovations like alternate wetting and drying (AWD) irrigation or integrated pest management (IPM) drop below 10 percent. Such evidence points not only to the scarcity of technological breakthroughs but also to systemic barriers preventing the translation of research into tangible productivity gains, reinforcing the need for institutional reforms that strengthen the innovation pipeline from research to widespread adoption.

Table 1. *Comparative Indicators of Agricultural Innovation*
Performance among Selected ASEAN Countries

Country	Agri R&D Intensity (% of Agri GDP)	Adoption of Improved Rice Varieties (%)	Regular Extension Access (%)
Indonesia	0.15	25	22
Vietnam	0.60	45	55
Thailand	0.80	50	60
Philippines	0.40	35	40
Malaysia	0.50	30	42
Cambodia	0.20	20	25

Table 1 compares key agricultural innovation indicators across selected ASEAN countries, including agricultural R&D intensity (as a percentage of agricultural GDP), adoption rates of improved rice varieties, and access to extension services. The figure highlights Indonesia's relative lag in research investment and innovation diffusion compared with regional peers such as Thailand and Vietnam, underscoring structural weaknesses in its agricultural innovation system.

4.5 Reorienting Rice Policy: From Price Support to Innovation

The proposed reorientation of rice policy toward innovation and productivity-led growth is firmly grounded in previous research on Indonesia's rice production–consumption balance, rice trade policy, and price stabilization mechanisms (Haryana, 2022; 2023; 2024). These studies consistently demonstrate that price-based interventions—such as high government purchasing prices, import restrictions, and retail price ceilings—have generated substantial economic costs while delivering limited long-term benefits for farmer welfare. In particular, the persistence of high domestic rice prices has failed to induce significant supply responses due to structural constraints, including small farm sizes, low elasticity of production, and weak technology adoption. As a result, price support policies tend to redistribute rents toward better-capitalized producers and intermediaries, while smallholders and net rice-consuming farm households experience minimal welfare gains.

Building on this evidence, the present study extends prior findings by explicitly linking rice price policy to productivity stagnation and innovation system failures. The analysis suggests that price support has inadvertently reduced incentives for efficiency-enhancing investments by insulating producers from competitive pressure and by

crowding out policy attention and fiscal resources that could otherwise be directed toward research, extension, and infrastructure. By integrating these insights into a unified analytical framework, this article advances a more comprehensive understanding of how rice policy orientation shapes long-term productivity trajectories and welfare outcomes. The proposed policy shift thus represents not a departure from past research, but a logical progression toward addressing the structural roots of rice sector underperformance in Indonesia.

4.6 An Integrated Policy Framework

A reoriented rice policy framework should place productivity measured through total factor productivity (TFP) at its core, with innovation serving as the principal transmission mechanism. This implies prioritizing investments in agricultural innovation system (AIS), revitalizing extension systems, and strengthening institutional coordination across the innovation value chain. Rather than relying on administratively determined price floors, policy instruments should aim to reduce production costs, improve resource use efficiency, and expand farmers' access to improved seed varieties, mechanization, irrigation technologies, and digital advisory services. International experience demonstrates that sustained productivity growth is most effectively achieved when innovation systems are coherent, adequately financed, and closely aligned with farmer needs (Timmer, 2017; Rajalahti, 2021; Warr, 2023). Rajalahti (2021) outlined five complementary areas of AIS investment that will be critical to spurring innovation and transforming countries' agri-food systems, including: (i) Strengthening innovation policy and governance, (ii) Reorienting agricultural Research and Development (R&D) to meet emerging challenges, (iii) Modernizing agricultural extension services, (iv) Building skills for innovation, and (v) Strengthening the enabling environment for agricultural innovation.

Institutional reform is central to operationalizing the proposed shift toward an innovation- and productivity-oriented rice policy, and this objective is explicitly aligned with Indonesia's National Medium-Term Development Plan (RPJMN), which places food security, agricultural productivity, and innovation-driven development at the core of national priorities. The establishment of the National Research and Innovation Agency (BRIN) offers a strategic opportunity to support the RPJMN's emphasis on strengthening research capacity, enhancing technology adoption, and improving inter-agency coordination within the food system. However, for BRIN to effectively contribute to rice sector transformation, its centralized research governance must be functionally integrated with the Ministry of Agriculture, local governments, and agricultural extension services. Given the applied and location-specific nature of rice innovation, achieving the RPJMN's food security targets requires continuous feedback loops between research, extension, and farmers. Without such coordination mechanisms, the consolidation of research functions risks weakening the transmission of innovation to the field, thereby limiting productivity gains. Ensuring that BRIN operates as an enabling institutional node within a broader agricultural innovation ecosystem is therefore essential for translating the RPJMN's strategic food security objectives into sustained improvements in rice productivity and farmer welfare.

Equally important, the framework requires a clear functional separation between rice price policy and social protection objectives. Food affordability for poor consumers should be addressed through targeted income support, cash transfers, or food assistance programs rather than through generalized price suppression or protectionist trade measures. Such separation reduces policy trade-offs and allows price signals to better reflect underlying supply-demand conditions, thereby encouraging efficiency and private sector participation. Within this integrated framework, the role of the state shifts from price setter to innovation enabler—facilitating coordination, correcting market failures, and ensuring that productivity gains translate into inclusive welfare improvements for smallholder farmers.

4.7 Implications for Food Security

Under a productivity- and innovation-oriented policy paradigm, food security is reconceptualized as a dynamic and long-term outcome rather than a short-term function of price stability alone. While price volatility management remains relevant, excessive reliance on price controls can undermine the resilience and adaptability of the food system. Productivity growth enhances food security by expanding domestic supply capacity, reducing unit production costs, and strengthening the sector's ability to respond to climatic, economic, and geopolitical shocks. In

this sense, innovation-driven rice policy contributes simultaneously to availability, accessibility, and stability dimensions of food security.

Moreover, this approach aligns food security objectives with broader goals of structural transformation and rural development. By raising farm productivity and incomes, innovation-centered policies reduce poverty at its source and lessen long-term dependence on fiscal transfers and market interventions. For Indonesia, where rice remains central to political economy and social stability, the shift from price protection to productivity enhancement represents a more sustainable strategy for balancing farmer welfare, consumer interests, and fiscal responsibility. The implications extend beyond rice, offering lessons for staple food policy design in other developing countries facing similar structural constraints.

5. Conclusion

This article demonstrates that persistent poverty among rice farmers in Indonesia is fundamentally a structural and institutional problem rather than a consequence of insufficient price protection. Drawing on policy analysis and comparative evidence, the study shows that prolonged reliance on paddy and rice price support has failed to generate sustained productivity growth and has delivered uneven welfare outcomes, particularly for smallholder farmers. Stagnant yields, fragmented landholdings, regional disparities, and a weak agricultural innovation system jointly constrain the capacity of rice farming to serve as a viable pathway out of poverty.

By reframing rice policy through the lens of productivity and innovation, this study contributes to the broader food policy literature by highlighting the long-term welfare limitations of price-based interventions in staple food sectors characterized by low supply elasticity. It also underscores how the political economy of food price stabilization, while often justified by short-term inflation and social stability concerns, can inadvertently entrench structural inefficiencies when not complemented by productivity-enhancing investments. The findings underscore that farmer welfare improvements are most likely to arise from total factor productivity growth enabled by coherent innovation systems, effective extension services, and supportive institutional arrangements, rather than from administratively maintained price levels. For policymakers, the implications are clear. A sustainable rice policy must move beyond short-term price stabilization toward strategies that enhance efficiency, resilience, and adaptive capacity within the rice sector. Such a shift not only strengthens national food security but also aligns rice policy with broader development objectives, including fiscal sustainability, rural poverty reduction, and structural transformation. In this sense, Indonesia's experience offers lessons of wider relevance for developing countries seeking to reconcile farmer welfare, consumer affordability, and long-term food system sustainability.

6. Limitations and Future Research

This study is subject to several limitations. First, reliance on secondary data and policy synthesis limits causal inference. Second, the lack of longitudinal microdata constrains analysis of household-level adjustment dynamics. Third, while the framework is broadly applicable, empirical findings remain context-specific to Indonesia. Future research should employ quantitative panel data and quasi-experimental methods to rigorously assess policy impacts, conduct cross-country comparative studies, and explore the integration of rice policy with social protection and rural livelihood diversification.

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