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The Role of Fertilizer Subsidies in Rice Productivity and Profitability: Evidence from Indonesian Smallholder Farmers

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ABSTRACT

Research Originality: This study provides micro-level evidence on the dual effects of fertilizer subsidies on rice farmers' production and profitability, a dimension rarely examined simultaneously at the household level in Indonesia. Using data from two contrasting rice-producing regions, the study isolates subsidy effects on both physical output and farm profit while controlling for input costs and price conditions.

Research Objectives: To analyze the effects of fertilizer subsidies on rice production and farm profit in Karawang (West Java) and Lombok (West Nusa Tenggara).

Research Methods: OLS regression was applied to cross-sectional data from 51 rice-farming households. Two models were estimated: a production function and a profit function.

Empirical Results: Fertilizer quantity, land size, and labor positively influence rice production. Farm profit is significantly affected by production quantity, rice price, total cost, and pesticide cost. Fertilizer cost is not a significant determinant of profit.

Implications: Fertilizer quantity, not cost, drives production. Subsidies should be maintained but reoriented toward targeted, quantity-based schemes and improved distribution efficiency to maximize welfare impact.

Keywords:
inputs; profit; production; welfare

How to Cite:
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INTRODUCTION

The agricultural sector remains a major absorber of labor and plays a critical role in Indonesia's national food security. Accordingly, input subsidy policies, particularly fertilizer subsidies, have been maintained in Indonesia for more than five decades (Osorio, 2023). Fertilizer subsidies are intended to reduce fertilizer prices at the farm level, encourage the use of inorganic fertilizer, increase land productivity, and ultimately improve farmers' household income and welfare (Osorio, 2023). In various developing countries, including Malawi, Zambia, Tanzania, Mozambique, Ethiopia, Nigeria, Ghana, India, and Nepal, fertilizer and seed subsidy programs have been shown to increase yields and farm income by approximately 10–20 percent on average (Hemming et al., 2018; Nguyen, 2023).

Several studies in Indonesia indicate that the productivity or income gap between subsidy recipients and non-recipients in several locations remains within the range of only about 5–10 percent lower than the estimated 10–20 percent effects reported in international meta-analyses of input subsidy programs in low- and lower-middle-income countries (Hemming et al., 2018; Nguyen, 2023; Wildayana, 2017). The magnitude of fertilizer subsidy impacts in Indonesia also varies substantially across regions, commodities, and years of observation. It is strongly influenced by distributional issues such as delays, quota limitations, and mistargeting, as identified in numerous studies on subsidized fertilizer policies (PATTIRO, 2023). These challenges have the potential to weaken the subsidy's effects on production and farmer welfare (PATTIRO, 2023; Arodha, 2024; Goacademica, 2024).

A range of studies in Indonesia have examined the influence of fertilizer subsidies on rice production and farmers' income at both provincial and national levels (Wildayana, 2017; Prasetyo, 2024; Zulfikar et al., 2024). Common findings suggest that fertilizer subsidies can increase production or yield per hectare. However, the increase in farmers' profits does not always correspond to the rise in production due to fluctuations in output prices, the cost of other production factors, and varying levels of technical efficiency (Wildayana, 2017). Several recent studies in Aceh and West Java also emphasize that restrictions and reductions in subsidized fertilizer allocations may disrupt production and undermine the role of subsidies as an income safety net for farmers, although the eventual welfare impacts remain heterogeneous across locations and farmer types (Zulfikar et al., 2024; Rahmawati & Nurhidayah, 2024).

Despite the growing body of literature on fertilizer subsidies, most existing studies are conducted at the macro or regional level, focusing on aggregate production outcomes or policy cost-efficiency rather than on individual farm-level performance. Evidence from Bangladesh shows that fertilizer subsidies improved farm efficiency primarily for marginal and small farms, whereas the effect was less pronounced for medium and large farms (Nasrin et al., 2018). Similarly, in Pakistan, subsidized fertilizer enabled farmers to apply recommended input doses, resulting in measurable yield gains for wheat and rice crops, with broader implications for household welfare (Ali et al., 2019).

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In Indonesia, studies confirm that subsidized fertilizer use among recipient farmers affects urea and NPK application rates, though the relationship between input use and farm outcomes is not always linear (Januarisky et al., 2025). At the same time, evidence from Mali suggests that poorly designed subsidy programs can produce unintended consequences, including reduced crop species diversity as farmers concentrate land use on subsidized target crops (Theriault & Smale, 2021). From a governance perspective, Malaysia's experience highlights that achieving sustainable development goals through fertilizer subsidy programs requires a robust regulatory framework, as weak governance mechanisms undermine the effectiveness of subsidy distribution (Amin et al., 2022).

Beyond direct subsidy studies, research on nutrient management systems provides complementary insights. In China, the Nutrient Expert advisory system demonstrated that optimizing fertilizer recommendations can simultaneously improve productivity, profitability, and sustainability, increasing net profits while reducing nitrogen application (Xu et al., 2023). Likewise, long-term assessments of diverse nutrient management strategies in rice-rice cropping systems in India over 16 years confirmed that integrated nutrient management improves yield trends, resource-use efficiency, and economic viability (Garnaik et al., 2024). In the Philippines, soil-test-based fertilizer application under improved nutrient management practices increased rice productivity and profitability compared to conventional farmer practices (Rollon et al., 2021). Precision nutrient management approaches in Indonesia further demonstrated rice yield enhancements alongside improvements in environmental sustainability (Jauhari et al., 2025), while site-specific nutrient management in India has been shown to enhance yields and contribute to greenhouse gas mitigation (Chaudhary et al., 2025). Notably, in China's rice sector, subsidies have been found to affect allocative efficiency differently across farm sizes, with large farms experiencing efficiency distortions that smaller farms do not (Cai et al., 2025). Together, these studies offer partial but fragmented evidence that subsidies and improved nutrient management affect production and profitability. Yet, they rarely examine both outcomes simultaneously within the same household-level analytical framework.

Based on prior research, three specific gaps remain in the literature. First, empirical studies that simultaneously assess the impact of fertilizer subsidies on both farm production and farm profitability at the household level are scarce. Most studies treat these as separate outcomes rather than as linked dimensions of farm performance (Nasrin et al., 2018; Rollon et al., 2021; Xu et al., 2023). Second, the distinction between subsidies acting primarily as instruments of production intensification or profit enhancement has not been clearly established, particularly in smallholder rice-farming contexts (Ali et al., 2019; Januarisky et al., 2025). Third, existing studies rarely apply a rigorous comparative framework between subsidy recipients and non-recipients using micro-level data with adequate controls for farm size, labor, and complementary input use, making causal attribution of the subsidy's effects difficult (Cai et al., 2025; Theriault & Smale, 2021; Amin et al., 2022).

Input subsidies generally increase yields and income, but their effectiveness depends heavily on program design, targeting, and implementation (Hemming et al., 2018;

Nguyen, 2023). The long-term impacts of fertilizer subsidies on input-use efficiency, potential farmer dependency, and environmental sustainability further underscore the need for more comprehensive research on farmers' welfare, rather than relying solely on production indicators (Druilhe & Barreiro Hurlé, 2012; Ricome et al., 2024; Yovo & Ganiyou, 2023). Amid these developments, there remains limited research that explicitly separates and estimates the effects of fertilizer subsidies on two key dimensions of farmers' welfare, namely physical production and farm profits at the household level, while accounting for the cost structure and price conditions faced by farmers (Wildayana, 2017).

In addition, more detailed empirical evidence is required for specific commodities and regions in Indonesia to determine whether fertilizer subsidies truly function as instruments to improve farmer welfare or merely stimulate production without generating commensurate gains in profits (Zulfikar et al., 2024; Rahmawati & Nurhidayah, 2024). To date, studies specifically analyzing the effects of subsidized fertilizer use on farmers' production and profits in key rice-producing areas such as Karawang (West Java) and strategically important food-producing regions such as Lombok (West Nusa Tenggara) remain highly limited, leaving a critical gap that this study seeks to address.

This study addresses these gaps by adopting an integrated household-level analytical framework that simultaneously examines the effects of fertilizer subsidies on both rice production levels and farm profits. By comparing subsidy recipients and non-recipients using micro-level farm data and controlling for key confounding factors, including land size, labor input, and the use of complementary inputs, the study provides more rigorous causal evidence than prior aggregate-level analyses. Furthermore, this study explicitly tests whether subsidies function as drivers of productivity or as welfare instruments through profit enhancement. This distinction carries significant implications for subsidy policy design and targeting.

This study examines the impact of fertilizer subsidies on agricultural sector performance by focusing on two key indicators: farm production and farmer profits. The analysis is conducted at the farmer/household level, enabling direct measurement of the subsidy's influence on input costs, revenues, and profit margins. Empirically, the study uses micro-level data on both subsidy recipients and non-recipients, allowing estimation of differences in production and profits associated with access to subsidized fertilizer while controlling for other factors such as land size, labor, and the use of complementary inputs. This approach enables an assessment of whether fertilizer subsidies primarily function as drivers of production intensification or as instruments for profit enhancement, as a proxy for farmer welfare, and whether there are indications of inefficiency or dependency that may weaken the policy's benefits.

Accordingly, the findings are expected to provide richer evidence on the effectiveness of fertilizer subsidies as a policy instrument for protecting and empowering smallholder farmers, while also informing the design and targeting of future subsidy programs. Based on this rationale, the objective of this study is to analyze the effects of fertilizer subsidies on farmers' production levels and farm profits in rice cultivation, and to formulate policy implications for improving future subsidy interventions.

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METHODS

This study employs quantitative cross-sectional data obtained from a household-level survey of rice farmers conducted in two study areas: Karawang Regency (West Java Province) and Lombok Island (West Nusa Tenggara Province). The use of two geographically distinct locations is intentional, as it allows for comparative analysis across regions with differing agronomic conditions, subsidy implementation dynamics, and farming system characteristics.

Primary data were collected directly from farmer respondents and constitute the main analytical dataset. The primary data encompass: (1) household and farm characteristics, including the respondent's age, level of formal education, years of farming experience, and cultivated land size; (2) fertilizer use variables, specifically the quantity of subsidized urea and NPK fertilizer received and applied, as well as the use of non-subsidized fertilizers; (3) other production inputs, including seed quantity, labor hours (family and hired), and pesticide use; (4) rice production output, measured in kilograms per planting season per hectare; and (5) economic variables, including input purchase prices, output (paddy) selling prices, total production costs, and gross farm revenues from which farm profit is derived as the primary welfare proxy variable.

Secondary data were used as complementary sources to contextualize primary findings and to validate farm-level information. These include data on subsidized fertilizer allocation quotas per district, government-regulated Highest Retail Prices for subsidized fertilizers, and regional agricultural profiles at the district level. Secondary data were obtained from local agricultural offices at the district and provincial levels, as well as from official government publications, including regional agricultural statistics and subsidy implementation reports issued by the relevant authorities.

Karawang Regency and Lombok Island were selected purposively as study locations based on two considerations: first, both represent major rice-producing regions Karawang as one of the most productive wetland rice areas in Java, and Lombok as a strategically important food-producing region outside Java; and second, both regions exhibit distinct dynamics in the implementation of fertilizer subsidy programs, providing an opportunity to capture variation in subsidy access and utilization across different policy and institutional contexts.

Farmer samples were selected using a multistage sampling technique. In the first stage, subdistricts and villages were purposively selected based on their designation as rice production centers within each study area, in coordination with local agricultural extension offices. In the second stage, individual farmer households were randomly selected from the available sampling frames, namely, farmer group membership lists (RDKK or village-level subsidized fertilizer recipient registries. This approach ensures that the sample captures both subsidy recipients and, where applicable, non-recipients, enabling direct comparison between the two groups in the analytical stage.

This study employs two complementary analytical approaches to estimate the effects of fertilizer subsidies on rice farm production and profitability, respectively. First, to estimate the effects of farm inputs, including subsidized fertilizer, on rice production output, the study uses a Cobb-Douglas production function estimated via Ordinary Least Squares (OLS) regression on cross-sectional data. The Cobb-Douglas specification is appropriate for agricultural production analysis because it captures diminishing marginal returns to individual inputs and allows direct interpretation of the coefficients as output elasticities.

The study sample consists of 51 wetland rice farmers observed in two main locations, namely Karawang Regency (West Java) and Lombok (West Nusa Tenggara The dependent variable is rice production per planting season (Y_i), while the independent variables consist of cultivated rice field area (X_{1i}), total amount of subsidized fertilizer used (urea+NPK, X_{2i}), pesticide costs (X_{3i}), and the amount of labor used (X_{4i}).

Functionally, the estimated rice production model can be expressed as follows:

$$Y_i = \beta_0 + \beta_1 X_{\{1i\}} + \beta_2 X_{\{2i\}} + \beta_3 X_{\{3i\}} + \beta_4 X_{\{4i\}} + \varepsilon_i \quad (1)$$

where Y_i is the rice production of farmer i, β_0 is the intercept, β_1– β_4 is the regression coefficient that measures the average change in production resulting from a one-unit change in the corresponding input, and ε_i is the error term that captures other factors outside the model. The estimation was carried out using OLS in Stata software, such that the parameters are obtained by minimizing the sum of squared residuals $\sum_i \hat{\varepsilon}_i^2$.

Second, to estimate the effect of fertilizer subsidies on farm profit, this study uses an OLS regression on a profit function in which farm profit per hectare (calculated as total revenue minus total production costs) serves as the dependent variable. Farm profit is specified as a function of subsidized fertilizer receipt status, land size, labor, farming experience, education, and other relevant control variables. This dual-model approach, in which the production function and profit function are estimated separately, allows the study to explicitly distinguish whether subsidies operate primarily as instruments of production intensification (through input access) or as profit enhancement instruments (through cost reduction and income improvement), directly addressing the central research question. The rice farming profit function is modeled as follows:

$$\pi_i = \alpha_0 + \alpha_1 Q_i + \alpha_2 P_{\{rice,i\}} + \alpha_3 C_{\{tot,i\}} + \alpha_4 C_{\{fert,i\}} + \alpha_5 C_{\{pest,i\}} + \alpha_6 C_{\{seed,i\}} + u_i \quad (2)$$

where π_i = is the rice farming profit of farmer i (profit), Q_i = rice production, $P_{rice,i}$ = the farm-gate paddy price, $C_{tot,i}$ = total farming costs, $C_{fert,\ i,}$ = total subsidized fertilizer costs, $C_{pest,i}$ = pesticide costs, $C_{seed,i}$ = seed costs, and α_0 = intercept, α_1, ..., α_6 = regression coefficient, dan u_i = error term.

Fertilizer subsidies reduce the input prices faced by farmers, which theoretically shift the cost function downward, encourage an increase in the quantity of inputs used, and, in turn, raise production and potential profits. From the perspective of profit-maximization theory, producers choose the combination of inputs that maximizes the difference between revenue and cost; when fertilizer prices are lowered through subsidies, the optimal input

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combination shifts toward higher fertilizer use, thereby potentially increasing profits as long as the additional revenue exceeds the additional costs of other inputs.

RESULTS AND DISCUSSION

The characteristics of rice farmers in this study indicate that respondents are, on average, middle-aged, with a wide age distribution that includes young and elderly farmers, each with different physical capacities and levels of experience. The average age of farmers is 51, with the oldest being 75. This finding aligns with BPS data. According to the 2023 Agricultural Census, the majority of Indonesian farmers are already in the older age category, predominantly above 55 years, while the proportion of young (millennial) farmers continues to decline (approximately 21.93 percent aged 19–39). This data indicates a regeneration challenge, with a large share of farmers aged 45 and above (around 71 percent) and only a small portion below 45 years, resulting in an average farmer age of about 50 years (Appendix 1). The average level of formal education is approximately nine years (equivalent to junior secondary school), which is generally adequate to understand basic technical information and adopt agricultural innovations. Farmers also have extensive experience in rice cultivation, reflecting strong practical knowledge. Most respondents manage less than one hectare of rice land, indicating that smallholders dominate the farming structure, although a few cultivate larger areas. The distance to fertilizer kiosks varies substantially, from a few dozen to several thousand meters, implying differences in accessibility, potential delays in fertilizer application, and transportation cost burdens.

In terms of technical and economic aspects of rice farming, seed use per planting season reflects a combination of land size and variation in seed quality, as shown by differences in per-kilogram prices and total seed expenditures. Subsidized urea and NPK fertilizers constitute the principal inputs with relatively uniform unit prices. However, the quantities applied vary considerably, suggesting that some farmers apply fertilizer at rates below recommended levels while others practice intensive fertilization. Total fertilizer expenditure (urea + NPK) is one of the largest variable cost components, alongside labor, tractor services, and land size, making fertilization decisions highly influential on production costs and potentially affecting both technical and financial efficiency.

Beyond fertilizers, expenditures on pesticides, tractor services, and labor also show wide variation, reflecting differences in pest pressure, land preparation methods, crop management intensity, and farm scale. These combinations of inputs generate average rice harvests per planting season that are relatively high yet heterogeneous across farmers. In contrast, farmers' grain prices are generally uniform, with minor variations linked to quality and marketing channels. Overall, the nominal farm revenue far exceeds total production costs, indicating that rice farming within the sample tends to be profitable.

The amount of subsidized fertilizer redeemed by lowland rice farmers in Karawang and Lombok shows a clear upward trend in line with the increase in cultivated land area. Among farmers with less than 0.5 hectares of land, the total amount of subsidized fertilizer (urea and NPK combined) redeemed per planting season averages approximately

96 kilograms, with usage ranging from 19 to 200 kilograms. This variation indicates that even within small landholdings, there are notable differences in fertilization practices, ranging from relatively low application to levels approaching the upper limit of the group (Appendix 2). For farmers with land between 0.5 and 1 hectare, the average amount of subsidized fertilizer redeemed increases sharply to around 333 kilograms per planting season. The minimum of 100 kilograms and the maximum of 600 kilograms demonstrate that nearly all farmers in this land category use significantly more subsidized fertilizer than smallholders. The relatively high standard deviation reflects heterogeneous fertilization strategies, suggesting that some farmers may follow moderate recommended doses while others apply fertilizer more intensively.

Among farmers cultivating more than 1 hectare, the total amount of subsidized fertilizer redeemed is the highest, averaging about 712.5 kilograms per planting season. The broad usage range from 200 to 2,000 kilograms indicates that this group includes farmers applying moderate to very large quantities of fertilizer. Such variation may be associated with differences in capital capacity, production objectives, and preferences regarding fertilization intensity among large-scale farmers. When urea and NPK are examined separately, the patterns are consistent with total subsidized fertilizer usage. Average urea redemption increases from approximately 47 kilograms for farmers with less than 0.5 hectares, to 175 kilograms for the 0.5–1 hectare group, and 337.5 kilograms for farmers with more than 1 hectare. Meanwhile, average NPK redemption stands at around 48.9 kilograms, 158.3 kilograms, and 375 kilograms for the respective land-size categories. These figures indicate that increases in total subsidized fertilizer use are driven by simultaneous increases in both urea and NPK, rather than by increases in only one. Thus, farmers operating larger land areas tend to apply fertilizers more intensively and in a more balanced manner between urea and NPK.

The table showing urea and NPK dosage by compliance with recommended rates shows that sampled farmers fall into three groups: those applying fertilizer below the recommended rate, those applying fertilizer in accordance with the recommended rate, and those applying fertilizer above the recommended rate. In the "below recommendation" group, the average urea dosage applied is approximately 136 kg/ha, ranging from 50 to 181.8 kg/ha. In comparison, the average NPK dosage is about 116 kg/ha within a similar range. These averages are explicitly lower than those in the "in accordance with recommendation" category, reflecting farmers who either still economize on subsidized fertilizer use or face access constraints that prevent them from reaching recommended dosage levels.

The "in accordance with recommendation" group uses an average of about 228 kg/ha of urea, with a range of 200–285.7 kg/ha, while the average NPK dosage is around 229 kg/ha, with a range of 200–300 kg/ha. These figures are classified as compliant because they fall within the government's recommended range, referenced in this study, of around 200–300 kg/ha for both urea and compound NPK fertilizers in medium-productivity irrigated rice fields. These recommendations are stipulated in the Regulation of the Minister of Agriculture No. 40/Permentan/OT.140/4/2007 on Nitrogen, Phosphorus, and

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Potassium Fertilization Recommendations for Site-Specific Lowland Rice, as well as its technical manuals. Thus, this group can be regarded as representing farmers who follow the official technical guidelines in practice.

Meanwhile, the "above recommendation" group displays substantially higher fertilization intensity. The average urea dosage reaches approximately 370 kg/ha, with a range of 307.7–500 kg/ha, while the average NPK dosage is about 361 kg/ha, ranging from 307.7 to 428.6 kg/ha. Compared with the compliant group, farmers in this category apply around 140 kg/ha more urea and 130 kg/ha more NPK than the recommended averages. This condition indicates a tendency toward over-fertilization among some farmers, potentially driven by the perception that higher fertilizer quantities always lead to higher yields, even though such practices are not necessarily agronomically or economically efficient (Appendix 3). Overall, the distribution of urea and NPK dosages relative to recommendations indicates that the sample includes farmers who have not yet met the fertilization guidelines, those who adhere to government guidance, and those who apply fertilizer excessively. Categorization based on the 200–300 kg/ha benchmark set by Ministerial Regulation No. 40/2007 and the manual "Site-Specific Recommendations for N, P, and K Fertilizers for Lowland Rice" enables researchers to assess the extent to which fertilization recommendation policies are implemented at the farm level.

The tabulation results indicate that most farmers in the sample have not applied both subsidized fertilizers (urea and NPK) simultaneously at the recommended rates. Among farmers whose urea dosage falls below the recommendation, approximately 73.08 percent also applied NPK below the recommended level. In comparison, 23.08 percent applied NPK in line with the recommendation, and none applied NPK above the recommendation (Appendix 4). This pattern reflects a group of farmers who generally underutilize both urea and NPK fertilizers. However, about one-quarter have begun to adjust their NPK dosage toward the recommended guidelines.

Within the group of farmers whose urea application matches the recommendation, 80 percent apply NPK in accordance with the recommendation, while 13.33 percent remain below the recommendation and 6.67 percent exceed it. This pattern suggests that once farmers align their urea dosage with official recommendations, most also follow the recommended NPK dosage, resulting in a relatively balanced pattern of subsidized fertilizer use. The most intensive group comprises farmers who exceed the recommended urea dosage. Among them, 70 percent apply NPK above the recommendation, 30 percent apply NPK in line with the recommendation, and none fall into the below-recommendation category for either fertilizer. These findings indicate a tendency among some farmers to apply both types of subsidized fertilizers simultaneously at high doses, which may technically exceed the crop's agronomically optimal requirement.

The comparative data on costs, production, and revenue per hectare across land-size categories reveal substantial differences in rice farming performance. For farmers cultivating less than 0.5 hectares, the average cost per hectare is approximately IDR 11.37 million, with considerable variability, and yields around 7.93 tons of paddy per hectare, with revenue of roughly IDR 49.52 million per hectare. Meanwhile, farmers with landholdings of 0.5–1 hectare incur slightly lower per-hectare costs, at around IDR 9.96 million, with an average yield of approximately 6.35 tons per hectare and revenue of about IDR 42.95 million per hectare (Appendix 5).

In contrast, farmers with more than 1 hectare exhibit even lower per-hectare costs around IDR 5.72 million, but their average yield declines to about 3.68 tons per hectare, resulting in revenue of approximately IDR 25.23 million per hectare. This pattern suggests that smallholders tend to incur higher per-hectare input costs but also achieve higher yields and revenue compared with farmers operating larger land areas. From an economic perspective, these results imply differences in input intensity and farm management practices. On small plots, inputs and labor are likely used more intensively, thereby generating higher productivity per hectare. Conversely, on larger plots, lower input intensity is associated with reduced costs, production, and revenue per hectare.

The Cobb-Douglas regression reveals that three of four independent variables exert statistically significant positive effects on rice production in Karawang and Lombok: paddy field area, total amount of subsidized fertilizer, and labor. It confirms that land is a foundational productive input in smallholder rice farming, and that subsidized fertilizer is the most influential production factor in this model. Where greater access to subsidized inputs enables farmers to apply fertilizer at levels closer to agronomically recommended doses, thereby improving yields. Besides, the result also reflects the labor-intensive nature of rice cultivation across key stages of the production cycle. In contrast, pesticide costs do not reach statistical significance, suggesting that in the study areas, variations in pesticide expenditure do not translate into measurable differences in rice output, possibly due to relatively uniform pest pressure or inconsistent application practices across respondents.

The finding that paddy field area exerts a significant positive effect on rice production is consistent with a substantial body of empirical literature. Chandio et al. (2022) demonstrated that land area is among the most influential factors determining rice output in Asian farming systems, where expanded cultivation area directly increases productive capacity. Similar evidence was documented in sub-Saharan contexts: Basorun and Fasakin (2012) found that the size of cultivated land was a primary driver of rice production performance among smallholder farmers in Nigeria, confirming that larger farm areas enable greater resource absorption and yield generation. At the farm management level, Salam et al. (2024) employed a Cobb-Douglas production function framework and confirmed that land area allocation is a statistically significant determinant of rice output, with an output elasticity indicating positive returns to land expansion. These findings collectively affirm that, in smallholder rice farming systems such as those in Karawang and Lombok, access to and utilization of paddy land remain foundational conditions for production improvement.

These findings are also consistent with the study by Putra et al. (2018) regarding urea fertilizer, which showed a positive and significant impact on rice production. The regression coefficient in Putra et al. (2018) was higher than in this study, at 0.528,

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indicating that a 1 percent increase in urea application would increase rice production by 0.52 percent. In contrast, their findings for NPK indicated a negative, non-significant effect, suggesting that NPK application did not significantly increase production. While chemical fertilizers and subsidies increase rice productivity, the claim that subsidies alone achieved 6.4 tons/ha is not directly supported by the abstracts. However, optimized fertilization strategies, including subsidies, can enhance yield and sustainability (Guo et al., 2021; Iqbal et al., 2022; Kadigi, 2026; Kundu & Mallick, 2024; Pan et al., 2022; Wu et al., 2025; Xin, 2022).

Table 1. Cobb–Douglas Model Analysis of the Impact of Fertilizer on Rice Production in Karawang and Lombok

Variable independent	Coef.
Paddy field area	.27*
Total amount of subsidized fertilizer	.306**
Pesticide cost	.082
Labor use	.156*
Constant	2.236***

R-squared: 0.707
*** p<.01, ** p<.05, * p<.1
Source: Primary Data (processed)

The positive and significant effect of subsidized fertilizer on rice production found in this study aligns with existing evidence on the role of fertilizer access in smallholder agricultural productivity. Yardha et al. (2021) identified fertilizer availability as a key factor influencing production risk in rice farming in Indonesia, where restricted access to inputs was associated with increased output variability and reduced yields. The centrality of subsidized fertilizer in ensuring affordability and accessibility for resource-constrained farmers is particularly emphasized by Olubanjo and Oyebanjo (2008), who found that fertilizer use was among the most significant determinants of profitability in rain-fed paddy production, underscoring fertilizer's dual role as both a productivity and an income-enhancing instrument.

The fertilizer-enhancing mechanism is further elaborated in agronomic studies. Takahashi et al. (2025) showed that optimized fertilizer application methods, including basal dressing techniques, significantly improved paddy yields while simultaneously reducing labor requirements associated with repeated topdressing. Controlled-release nitrogen fertilizers offer yield advantages in paddy cultivation by supplying nutrients in alignment with crop demand, thereby reducing losses associated with conventional single-application methods. Furthermore, Jiang-ming (2023) cautioned that while fertilizer application is essential for yield maximization, the manner of application critically determines nutrient use efficiency, with split-application strategies shown to reduce potential nutrient losses from paddy fields while sustaining production levels. Taken together, these findings suggest that the productivity impact of subsidized fertilizer in this study reflects not only the quantity of fertilizer received but also its role in enabling farmers to meet recommended application thresholds that would otherwise be cost-prohibitive without subsidy support.

Yusriah et al. (2024) found different results in Gorontalo: a 1% increase in fertilizer use slightly reduced rice production by 0.087% in Limboto District, assuming other factors remain constant. Meanwhile, Nizar and Ariyanto (2016) showed that subsidized NPK fertilizer and pre-harvest labor significantly increased rice production in Riau Province. However, the elasticity value of 0.622 indicates decreasing returns to scale, meaning additional fertilizer use produced less than proportional output gains, suggesting inefficiency and overuse of inputs. Other studies (Adhikary et al., 2023; Chang et al., 2024; Naghdyzadegan Jahromi et al., 2023; Phillips et al., 2022; Tan et al., 2025; Yang et al., 2022) highlight that improving nitrogen availability is more effective when combining good water management with organic matter. This approach increases efficiency, supports soil health, and reduces environmental impact compared to simply increasing chemical fertilizer use. Therefore, applying organic fertilizers based on land conditions is important. It can maintain or increase yields, reduce dependence on chemical inputs, and improve long-term soil quality. Overall, these findings suggest that some farmers still use chemical fertilizers inefficiently, with significant variation in fertilizer practices across regions in Indonesia.

Table 2. Variation in Location and Use of Fertilizers and Other Inputs for Rice Production

Provinsi	Benih	Organik	Urea	TSP	KCL	Obat	Pestisida	TK	Provinsi	Benih	Organik	Urea	TSP	KCL	Obat	Pestisida	TK
Aceh	1.24	0.00	0.60	0.06	0.00	0.04	0.00	-0.04	NTB	1.35	0.00	1.85	0.40	0.01	0.07	-0.09	-0.46
Sumut	-0.76		1.59	-0.20	-0.03	-0.15	0.01	-0.02	NTT	0.98	0.00	0.01	0.23	-0.03	0.03	0.03	-0.06
Sumbar	-1.81	-0.06	1.20	-0.40	0.01	0.03	-0.01	0.26	Kalbar	1.90		-0.46	0.24	0.06	-0.17	0.06	0.02
Riau	2.76		0.01	-0.10	0.45	0.02	0.25	-2.07	Kalteng	1.13	0.01	3.25	-1.63	0.00	-0.14	0.44	0.73
Jambi	1.42		0.29	0.35	-0.29	-0.02	-0.05	-0.18	Kalsel	1.24		0.35	0.04	-0.01	-0.04	-0.09	0.25
Sumsel	0.68	0.01	0.83	-0.06	0.01	-0.04	-0.20	0.08	Kaltim	-0.91	-0.01	0.71	-0.16	0.07	0.02	0.19	-0.03
Bengkulu	-1.59	0.00	1.26	-0.98	-0.25	-0.07	-0.20	0.05	Sulut	-0.21	0.00	0.74	0.26	0.10	0.10	-0.08	-0.18
Lampung	-0.23	0.00	0.64	0.19	-0.01	-0.01	-0.04	0.06	Sulteng	0.47	0.03	0.96	-0.21	0.00	-0.05	-0.08	0.26
Babel	3.75	0.00	-0.83	-0.17	-0.14	0.57	-0.02	-0.33	Sulsel	2.28	0.00	0.58	-0.51	-0.01	-0.11	0.07	0.11
Kepri	1.12		0.04	1.39	-1.77	-0.07		-0.25	Sultra	0.11	0.00	1.00	-0.09	-0.10	0.01	0.04	-0.01
Jakarta	-3.78		-1.08	2.01	0.32	0.54	-0.06	0.36	Gorontalo	-0.99	0.02	0.38	0.09	0.12	-0.01	0.00	0.14
Jabar	-0.85	0.00	0.00	0.40	-0.17	-0.10	0.06	0.14	Sulbar	4.05	0.86	1.20	-0.01	0.04	0.36	-0.81	1.10
Jateng	4.60	0.09	4.78	1.06	0.30	-0.12	0.17	-1.21	Maluku	-1.73	0.04	0.29	-0.18	0.01	0.02	0.07	0.12
DIY	0.38	0.00	0.12	-0.01	0.04	0.12	-0.02	-0.06	Malut	-0.20		-0.44	-0.01	-0.07	-0.02	0.16	0.38
Jatim	3.83		-0.92	-0.61	0.25	0.03	0.28	-0.24	Papua Barat	0.76		0.35	-0.01	0.00	0.10	-0.01	0.37
Banten	-0.40	0.02	-1.07	0.89	0.04	-0.02	-0.01	0.11	Papua	-1.60		0.20	-0.04	0.00	-0.02	0.06	0.30
Bali	0.23	0.00	1.54	0.09	0.06	-0.09	0.00	0.10									

e>1 (Irrasional)
e<0 (Irrasional)
0<e<1 (Rasional

Jenis Input	Benih	Organik	Urea	TSP	KCL	Obat	Pestisida	TK
e < 0	39%	27%	22%	56%	50%	55%	48%	3%
0 ≤ e ≤ 1	21%	73%	50%	34%	50%	45%	52%	55%
e > 1	39%	0%	28%	9%	0%	0%	0%	42%

Source: Firdaus (2018)

There are regions where the use of rice production inputs remains economically irrational, particularly for seeds, urea, and TSP (e > 1). In contrast, the use of organic

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fertilizers is entirely economically rational. In rice production, irrational use of urea fertilizer was identified in North Sumatra, West Sumatra, Bengkulu, Central Java, Bali, West Nusa Tenggara, Central Kalimantan, and West Sulawesi. Meanwhile, irrational use of TSP was found in Jakarta and Central Java. The studies by IPB and BPS also indicate that several regions still apply urea and other chemical fertilizers, such as TSP and KCl, rationally.

According to this study's regression results, farm size has a positive and significant effect on rice production. This finding aligns with Putra et al. (2018), who reported a positive effect of land area on rice production in Subak Carik Tangis, Tabanan, Bali, albeit with a lower coefficient of 0.163. The current study also indicates that land in Karawang and Lombok has not yet reached the leveling-off stage. Meanwhile, labor quantity was found to have a positive effect. With adequate labor, farmers can perform more meticulous crop management, such as regular weeding, timely fertilization, and faster pest control, thereby enhancing rice production. Labor use in rice farming in Karawang and Lombok has not yet reached the stage of diminishing returns. Finally, the amount of pesticide applied does not significantly affect rice production in Karawang and Lombok. This may be due to inappropriate dosages, incorrect timing of application, or the use of pesticides that are not well-suited to the specific pests, resulting in an insignificant impact on production.

From the production function estimation, it is evident that subsidized fertilizers have the highest input elasticity among inputs, such as land area and labor. The positive elasticity values indicate the ranking of the positive impact of each input type on rice production in Karawang and Lombok. The significant contribution of labor to rice production observed in this study is consistent with the broader literature on input use in smallholder rice farming systems. Rice cultivation is inherently labor-intensive, encompassing activities from land preparation and transplanting through crop maintenance, fertilizer application, and harvesting. Pathirana et al. (2018) demonstrated that labor allocation at critical growth stages, particularly during panicle development, has measurable implications for both yield outcomes and the cost efficiency of fertilization, confirming that labor is not merely a routine input but a strategically important factor in production management.

The vulnerability of rice production systems to labor constraints is driven in part by rural-to-urban migration, which poses a structural challenge to paddy production, and by the mechanization of input application tasks, which offers a viable pathway to sustaining productivity in labor-scarce environments. Additionally, Takahashi et al. (2025) showed that innovative cultivation techniques, such as sparse planting combined with consolidated fertilizer application, can reduce per-cycle labor requirements without compromising yield, highlighting labor efficiency, not merely labor quantity, as a determinant of production performance. In the context of this study, the significance of labor lies in the continued reliance of smallholder rice farmers in Karawang and Lombok on manual labor throughout the production cycle, where optimizing labor deployment remains an important lever for improving farm-level productivity.

The findings of this study regarding the effect of subsidized fertilizer on rice production present a nuanced position relative to the existing literature, neither fully aligned nor entirely contradictory, but rather occupying an intermediate ground that reflects the context-specific nature of subsidy effectiveness in smallholder rice farming. On the one hand, the positive effect of subsidized fertilizer on rice production found in this study is broadly consistent with the mainstream body of evidence, which generally confirms that improved fertilizer access through subsidy programs enables farmers to apply inputs closer to agronomically recommended levels, thereby supporting yield improvement. In this regard, the direction of the effect of subsidized fertilizer on production is consistent with the preponderance of prior findings from Indonesian and other developing-country contexts, in which fertilizer access has consistently been identified as a binding constraint on smallholder productivity.

On the other hand, the magnitude of the fertilizer effect observed in Karawang and Lombok is notably more modest than that observed in several prior studies conducted in other Indonesian provinces. Some earlier studies documented substantially higher output elasticities with respect to subsidized fertilizer, suggesting that, in those settings, each additional unit of fertilizer translated into proportionally larger production gains. The relatively lower elasticity obtained in this study implies that rice farms in Karawang and Lombok have progressed further along the fertilizer response curve, reaching a zone of diminishing marginal returns where additional subsidized fertilizer application no longer generates the same productivity gains observed in earlier or less intensively farmed regions. This condition of decreasing returns to scale is not unique to this study; parallel evidence from other Indonesian provinces has reported similarly low or even slightly negative fertilizer coefficients, suggesting that the phenomenon of fertilizer over-application and declining marginal productivity is a broader pattern emerging across multiple rice-producing regions in Indonesia, rather than an anomaly specific to the study areas.

This positioning carries an important implication: the fertilizer subsidy program, which was originally designed to overcome access and affordability barriers in contexts of underutilization, may now be operating in environments where the primary constraint on production is no longer fertilizer availability but rather fertilizer use efficiency. In Karawang and Lombok, where agricultural intensification is already relatively advanced, the subsidy continues to support production, but its incremental contribution to output has diminished. This result suggests that the effectiveness of the current subsidy design, centered on quantity provision at regulated prices, may be approaching its productive limits in intensively farmed regions, and that future productivity gains may require complementary interventions focused on improving fertilizer application rather than simply on how much is received.

This second model captures the cost efficiency of optimal input use, the farmer's ability to earn profit after covering all costs, and indicates the viability of rice farming. The study results indicate that rice production quantity has a positive and highly significant effect on profit. Higher rice production directly increases farmers' profits. This finding aligns with Laelasari (2018), who reported that production quantity positively and

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significantly affects farmers' income in Saleh Jaya Village, Banyuasin. Generally, agricultural production fluctuates annually due to various factors, including weather, climate, and other natural conditions such as excessive rainfall, floods, or prolonged drought. In addition, pest and disease attacks can affect agricultural yields, consequently impacting farmers' income. The volume of rice produced has a substantial influence on farmers' earnings. Similar findings were reported by Hidayati (2017), and Alitawang and Sutrisna (2017), all of whom concluded that production quantity positively and significantly affects farmers' income.

Table 3. Cobb–Douglas Model Analysis of the Impact of Fertilizer Costs on Rice Farmer's Profit in Karawang and Lombok

Variable independent	Coef.
Total production	1.002***
Rice price	.98***
Total cost	-.999***
Total cost of subsidized fertilizer	-.002
Pesticide cost	-.003*
Tractor cost	-.003
Seed cost	.003
Constant	.092

R-squared: 0.901
*** p<.01, ** p<.05, * p<.1
Source: Primary Data (processed)

Meanwhile, rice price has a positive impact on profit. Higher selling prices directly increase farmers' profit. Price is a critical factor in economic activities, particularly in rice farming. One key incentive for producers, such as farmers, to increase output is the market price; a higher price translates into higher income. Rice prices positively and significantly influence farmers' incomes, particularly when supported by policies such as price guarantees, contract farming, and improved market access. However, challenges such as income inequality, market inefficiencies, and price volatility must be addressed to ensure sustainable benefits for farmers (Mgale, Y. J., & Yunxian, Y., 2021; Nikiema et al., 2023). In general, farmers' income fluctuates annually due to factors such as weather, climate, and pest or disease attacks on rice. Production costs are directly related to the farmer's role as a manager of their farming enterprise. The level of input use depends on the available budget, and consequently, the amount of production factors employed affects production costs and ultimately farmers' income. Total cost has a negative and highly significant effect on profit. The higher the total production cost (including labor, tractors, seeds, harvesting, and other costs), the lower the profit.

Meanwhile, total fertilizer cost has no significant effect on rice farm profit. Unlike fertilizer quantity, which affects rice production, fertilizer expenditure does not significantly influence farm profitability. Fertilizer cost is relatively insignificant in rice farming because, in several farms, it accounts for only about 12–15% of the total production cost structure;

other factors, such as land rent, labor wages, seeds, and operational costs like tractor rental, are more dominant. The IRRI (2016) study also reported that fertilizer costs represent a relatively small proportion of total rice production costs compared to other expenses (Appendix 6). Pesticide costs are statistically high, indicating that pesticide expenditure in the model has a negative and statistically significant effect on farmers' profits. Pesticide costs negatively affect farm income, particularly for small-scale farmers, by increasing production expenses and imposing indirect health and environmental costs. However, adopting sustainable practices like organic farming or biopesticides, supported by appropriate policies, can mitigate these costs and enhance farm profitability (Huang, et al,, 2022; Mack, et al, 2023; Tipi, T., & Erbaslar, O, 2021).

The results of the profitability model reveal that rice farming profits in Karawang and Lombok are fundamentally determined by three forces operating simultaneously: the volume of output produced, the price at which that output is sold, and the total cost burden incurred in production. These three variables dominate the profit function to such a degree that individual input cost components, including subsidized fertilizer cost, contribute relatively little independent variation to profit outcomes once these overarching factors are accounted for.

The most consequential technical implication of this finding is that **s**ubsidized fertilizer functions primarily as a production enabler rather than a direct profit driver. The subsidy reduces the cost of a critical input, but its ultimate contribution to farmer welfare is realized only when access to that input successfully translates into higher output volumes. If a farmer receives subsidized fertilizer but applies it suboptimally, whether due to incorrect timing, improper dosage, or insufficient complementary inputs such as water, quality seeds, or pest management, the production gains necessary to generate profit improvement will not materialize. This suggests that the subsidy program, in its current form, addresses the input access constraint but does not inherently address the input use efficiency constraint.

A further technical implication concerns the role of output price. The near-equivalence of the influence of rice prices and production volume on profitability indicates that farmers are exposed to significant price risk that lies entirely outside the scope of the fertilizer subsidy program. Even when subsidized fertilizer successfully raises yields, profit outcomes remain highly sensitive to fluctuations in farmgate prices at harvest time. This condition means that subsidy policy, if not complemented by stable price support mechanisms, may deliver production gains that are subsequently eroded by unfavorable market prices, particularly during harvest seasons when paddy supply peaks and prices tend to decline.

The significance of total production costs as a negative determinant of profit further implies that the fertilizer subsidy partially achieves its welfare objective: it reduces one component of the cost structure, but farmers remain exposed to the cumulative burden of other unsubsidized input costs, including labor, tractor services, seeds, and pesticides. The finding that pesticide cost is the only individual cost item

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that independently reduces profitability suggests that pesticide expenditure management represents an underexplored area for efficiency improvement, in which farmer decision-making around chemical pest control may not always be economically rational relative to the yield protection achieved. Collectively, these results imply that the effectiveness of fertilizer subsidies as a farmer welfare instrument is contingent on a broader enabling environment, one that ensures not only input availability at affordable prices, but also supports farmers in converting those inputs into marketable output efficiently, and protects the value of that output through stable and remunerative farmgate prices. Policy interventions that address only the input supply side, without attending to production efficiency and output market conditions, will yield suboptimal welfare outcomes for smallholder rice farmers.

This study finds that subsidized fertilizer costs do not directly determine farm profits once factors like total costs, production volume, and rice prices are considered. This partly aligns with earlier research, which shows that fertilizer subsidies work indirectly rather than directly increasing farmers' income. Subsidies reduce input costs and help farmers produce more, but it is the higher output—not the lower cost itself—that drives profit. This pattern is also seen in Karawang and Lombok, where production volume and rice prices are the main factors affecting profit, not fertilizer spending. Overall, the findings support the idea that subsidized fertilizer mainly acts as a production enabler. Its benefits depend on how effectively farmers can turn increased access to inputs into higher yields that can be sold in the market.

However, the study's finding that subsidized fertilizer costs have no significant independent effect on profit also departs from studies that treat input cost reductions as a direct and measurable welfare benefit of subsidy programs. In contexts where fertilizer expenditure constitutes a substantial proportion of total production costs, a reduction in fertilizer prices through subsidy is expected to improve farm margins directly. The evidence from Karawang and Lombok challenges this expectation by revealing that fertilizer cost, at current subsidy-regulated price levels, accounts for a relatively small share of total production expenditure estimated at approximately 12 to 15 percent, such that its variation across farms does not generate meaningful differences in profit outcomes. This finding suggests that the subsidy has been effective in suppressing fertilizer costs to a level where they no longer constitute a financially distinguishing burden for farmers, paradoxically undermining the measurability of the subsidy's direct welfare impact in the profitability model.

Furthermore, the finding that pesticide cost rather than subsidized fertilizer cost emerges as the only individual input cost item that significantly and negatively affects farm profit introduces a dimension that has received relatively limited attention in the Indonesian rice subsidy literature. While prior studies have predominantly focused on the production and income effects of fertilizer subsidies, this study's evidence suggests that unsubsidized input costs, particularly pesticide expenditures, may exert a more immediate drag on farm profitability than fertilizer costs under the current subsidy regime. This result implies that cost pressures from other unsubsidized inputs may partially offset the welfare benefits of the fertilizer subsidy, and that a narrow focus on fertilizer subsidy policy, without addressing the broader input cost structure, will deliver only partial improvements in smallholder farm welfare.

Taken together, the profitability findings from Karawang and Lombok position this study as one that affirms the indirect and mediated nature of fertilizer subsidy welfare effects, while simultaneously highlighting the limitations of treating input cost reduction as a sufficient condition for profit improvement. The study contributes to the literature by demonstrating that in intensively farmed smallholder contexts where subsidy programs are already well-established, the binding constraints on farm profitability have shifted away from fertilizer access and toward output market conditions and the management of unsubsidized input costs, a transition that has important implications for how future subsidy policy should be designed and evaluated.

CONCLUSIONS

This study finds that rice production in Karawang and Lombok increases with more subsidized fertilizer, larger paddy fields, and greater labor use, while pesticide costs have no significant effect. Farm profits mainly depend on output, rice prices, and total costs, not on the cost of subsidized fertilizer, which supports production rather than directly boosting profit. The findings also show decreasing returns to scale, meaning additional inputs produce smaller output gains, indicating overuse of inputs. This is supported by evidence that farmers who reduced chemical fertilizers by 50% and combined them with compost and local microbes still achieved yields of 6.8 tons/ha, showing that integrating organic and biological inputs can maintain productivity while improving efficiency.

Based on these findings, fertilizer subsidies should be maintained given that fertilizer quantity, not its cost, remains a significant driver of rice production; however, the current subsidy design warrants reform. Policy should gradually shift from price-based fertilizer subsidies toward productivity-enhancing innovations, including support for integrated nutrient management, mechanization, and organic fertilizer adoption, thereby reducing chemical fertilizer dependency, lowering total production costs, and improving soil health in the long term. On the revenue side, stabilizing farmgate paddy prices through price floor mechanisms is essential to protect farm profitability, given that rice prices are an equally critical determinant of farmer welfare alongside production volume. Addressing only the input supply side, without accounting for production efficiency and output market conditions, will yield suboptimal welfare outcomes for smallholder rice farmers in Indonesia.

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APPENDIX

Appendix 1. Characteristics of Farmers and Rice Farming

Variables	Obs	Mean	Std. Dev.	Min	Max
Farmer Characteristics					
Age (years)	51	51.67	9.56	26.00	75.00
Years of schooling (years)	51	9.94	4.62	3.00	20.00
Farming experience (years)	51	23.94	12.47	2.00	50.00
Distance to fertilizer kiosk (meters)	51	591.67	589.48	25.00	2,500.00
Land Characteristics					
Rice field area (ha)	51	0.97	1.01	0.05	5.00
Seed Inputs per Planting Season					
Seed price (IDR/kg)	51	22,147.06	33,721.55	6,500.00	250,000.00
Seed quantity (kg)	51	22.67	18.17	2.00	85.00
Seed cost (IDR)	51	403,960.78	381,199.58	50,000.00	1,600,000.00
Fertilizer Inputs per Planting Season					
Urea quantity (kg)	51	175.60	171.32	9.00	1,000.00
Urea price (IDR/kg)	51	2,462.75	319.19	1,500.00	3,500.00
Urea cost (IDR)	51	426,593.14	425,470.99	22,500.00	2,500,000.00
NPK quantity (kg)	51	177.12	220.21	10.00	1,300.00
NPK price (IDR/kg)	51	2,488.89	334.16	1,500.00	3,500.00
NPK cost (IDR)	51	437,564.71	552,307.34	26,000.00	3,250,000.00
Total subsidized fertilizer (urea + NPK) (kg)	51	352.72	382.66	19.00	2,000.00
Total cost of subsidized fertilizer (IDR)	51	864,157.84	956,178.65	48,500.00	5,000,000.00
Other Inputs per Planting Season					
Pesticide quantity (ml)	51	3,228.24	2,214.30	500.00	8,500.00
Pesticide cost (IDR)	51	668,843.14	971,399.60	15,000.00	4,000,000.00
Tractor cost (IDR)	51	1,458,137.30	1,214,715.20	100,000.00	8,000,000.00
Labor (persons)	51	14.57	10.14	2.00	40.00
Total cost (IDR)	51	7,132,056.40	6,641,054.50	400,000.00	33,995,000.00
Production and Revenue per Planting Season					
Production quantity (kg)	51	4,358.14	3,117.11	300.00	16,000.00
Paddy price (IDR/kg)	51	6,629.41	470.87	5,000.00	8,000.00
Revenue (IDR)	51	29,277,892.00	21,231,956.00	1,950,000.00	108,800,000.00

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Appendix 2. Quantity of Subsidized Fertilizers Redeemed by Farmers

Type of Subsidized Fertilizer	Rice Field Area		
	< 0,5 ha	0,5–1 ha	> 1 ha
Urea + NPK (kg/season)			
Mean	95.9	333.3	712.5
Standard deviation	50.6	157.9	615.0
Min	19	100	200
Max	200	600	2000
Urea (kg/season)			
Mean	47.0	175.0	337.5
Standard deviation	25.9	87.2	256.0
Min	9	50	100
Max	100	350	1000
NPK (kg/season)			
Mean	48.9	158.3	375.0
Standard deviation	24.8	81.7	373.9
Min	10	50	100
Max	100	350	1300

Appendix 3.Dosage of Urea and NPK Fertilizers by Recommendation-Compliance Category (kg/ha)

Dose Category vs Recommendation	Urea				NPK			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Below recommendation	136,087	43,932	50,000	181,818	116,164	45,241	50,000	181,818
According to recommendation	228,095	35,762	200,000	285,714	229,048	34,266	200,000	300,000
Above recommendation	369,757	59,346	307,692	500,000	360,634	39,262	307,692	428,571

Appendix 4.Number of Farmers Applying Subsidized Fertilizers in Accordance with Recommendations

Urea use	NPK Use			Total
	Below Recommendation	According to Recommendation	Above Recommendation	
Below Recommendation	73.08	23.08	0.00	100.00
According to Recommendation	13.33	80.00	6.67	100.00
Above Recommendation	0.00	30.00	70.00	100.00

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Appendix 5.Cost Structure, Production, and Revenue of Rice Farming per Hectare by Land-Size Category

	Mean	SD	Min	Max
Cost (Rp/ha)	9,962,198.30	5,206,963.80	2,960,000.00	22,764,286.00
Production (Kg/ha)	6,352.72	2,741.31	2,769.23	16,000.00
Revenue (Rp/ha)	42,947,979.00	18,564,169.00	19,107,694.00	104,000,000.00
<0.5				
Cost (Rp/ha)	11,374,796.00	2,916,530.20	6,725,000.00	15,736,666.00
Production (Kg/ha)	7,927.87	7,381.40	1,912.50	30,000.00
Revenue (Rp/ha)	49,523,750.00	45,278,105.00	12,431,250.00	180,000,000.00
>1				
Cost (Rp/ha)	5,717,581.20	4,250,271.20	285,714.28	11,542,963.00
Production (Kg/ha)	3,683.33	1,973.90	1,200.00	7,000.00
Revenue (Rp/ha)	25,225,000.00	13,541,988.00	8,400,000.00	49,700,000.00

Source: Primary Data (processed)

Appendix 6.Comparison of Rice Production Factor Costs Across Different Countries (PhP per kg)

Component	Filipina	Cina	Indonesia	India	Thailand	Vietnam
Seed	0.54	0.93	0.14	0.51	1.13	0.39
Fertilizer	1.73	1.93	0.96	0.93	1.54	0.96
Agrochemical	0.32	1.72	0.92	0.21	0.90	0.63
Paid labor	3.39	0.52	4.23	0.21	0.68	0.35
Operator. Family. & Reciprocal labor exchange	0.56	2.84	1.04	0.56	0.64	0.67
Livestock. Machinery. Fuel. & Oil	1.54	2.88	0.48	1.78	1.83	0.63
Irrigation	0.45	0.00	0.14	0.12	0.13	0.08
Food	0.19	0.00	0.29	0.12	0.05	0.00
Transportation	0.05	0.11	0.10	0.04	0.16	0.03
Tax	0.03	0.00	0.19	0.03	0.00	0.00
Land rent	1.60	3.45	6.17	1.96	1.94	1.20
Capital interest	0.40	0.01	0.31	0.10	0.06	0.04
Other input	0.10	0.02	0.12	0.13	0.00	0.09
Total Cost	11.13	14.39	15.08	9.27	9.07	5.14

Source: IRRI (2016)

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