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DETERMINANTS OF RICE PRODUCTIVITY: THE ROLE OF FERTILIZER SUBSIDIES, ACCESS TO AGRICULTURAL TECHNOLOGY, AND FARMERS' SOCIAL CAPITAL IN KARAWANG REGENCY, WEST JAVA

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ABSTRACT

Rice productivity plays a crucial role in strengthening food security and agricultural sustainability in Indonesia. This study aims to examine the relationships between fertilizer subsidies, access to agricultural technology, farmers' social capital, and perceived rice productivity in Karawang Regency, West Java. A quantitative approach with an explanatory research design was employed, involving 70 rice farmers as respondents. Primary data were collected through structured questionnaires using a five-point Likert scale and analyzed using multiple linear regression with IBM SPSS Statistics version 25. The findings reveal that fertilizer subsidies, agricultural technology access, and farmers' social capital have positive and statistically significant relationships with perceived rice productivity. The simultaneous F-test confirms the statistical significance of the regression model, with an R^2 of 0.481, indicating that the three predictors collectively explain 48.1% of the variation in perceived rice productivity. Fertilizer subsidies emerged as the strongest predictor, followed by farmers' social capital and agricultural technology access. These findings highlight the importance of integrating agricultural input support, technological accessibility, and farmer cooperation to strengthen agricultural performance. The study provides empirical insights for developing integrated agricultural policies and supporting sustainable rice farming in Karawang Regency.

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A. INTRODUCTION

Agriculture remains a fundamental sector in Indonesia's economic development, particularly in supporting national food security, rural livelihoods, and sustainable agricultural production. Rice occupies a strategic position as the primary staple food consumed by most Indonesians, making improvements in rice productivity essential for maintaining food availability and economic stability. However, agricultural productivity is influenced by interconnected factors, including production inputs, technological advancement, institutional support, and farmers' socioeconomic conditions. Karawang Regency, West Java, is one of Indonesia's major rice-producing regions, with paddy production reaching approximately 1.19 million tons in 2025, an increase from 1.04 million tons in 2024 (BPS, 2026). Despite this substantial production capacity, maintaining agricultural sustainability requires improvements in resource efficiency, accessibility, and production management. Furthermore, increases in total production do not

necessarily indicate higher productivity because agricultural output may also be affected by harvested area, cropping intensity, climatic conditions, and cultivation practices. Therefore, understanding the determinants of rice productivity at the farmer level is essential for developing effective agricultural policies and strengthening the long-term sustainability of rice farming in Karawang Regency.

Fertilizer subsidies represent an important government policy instrument designed to improve farmers' access to essential agricultural inputs while reducing production costs. Through subsidized fertilizer programs, farmers, particularly smallholders with limited financial resources, are expected to obtain fertilizers at more affordable prices and apply them according to cultivation requirements. Nevertheless, the effectiveness of fertilizer subsidies depends on distribution accuracy, availability, timeliness, and farmers' ability to access appropriate quantities. Hidayat et al. (2026) identified fundamental issues in the management of the distribution and allocation of subsidized fertilizers in Indonesia, emphasizing the importance of institutional coordination and effective distribution mechanisms. Similarly, Widyastutik et al. (2026), examining agricultural households in Karawang and Lombok, identified fertilizer quantity, cultivated land area, and labor as important contributors to rice production. These findings indicate that agricultural productivity depends not only on financial assistance but also on the availability and effective utilization of production resources. Consequently, evaluating fertilizer subsidies from farmers' perspectives is important for understanding how government agricultural support relates to rice productivity.

Access to agricultural technology is another important factor associated with productivity improvement because technological innovations can enhance cultivation efficiency, resource management, and agricultural decision-making. Agricultural technologies include mechanized equipment, improved cultivation techniques, irrigation systems, agricultural information services, and digital tools that support farming activities. Appropriate technological adoption may improve planting efficiency, optimize agricultural inputs, reduce labor requirements, and minimize production losses (Liang, 2020; Mariyono & Kuntariningsih, 2026; Tang et al., 2021). However, technological availability does not automatically ensure productivity improvements because adoption depends on affordability, technical knowledge, infrastructure, and access to agricultural extension services. Farmers with limited financial resources or insufficient technological capabilities may encounter difficulties utilizing available innovations. Alongside technological resources, farmers' social capital also contributes to agricultural development through interpersonal trust, cooperation, shared norms, and participation in agricultural networks (Abas, 2016; Park et al., 2025). Social relationships may facilitate information exchange, collective problem-solving, and access to farming resources. Rustinsyah (2015) demonstrated the importance of social capital in implementing subsidized fertilizer programs among small farmers in rural Java, highlighting how community relationships and institutional cooperation can strengthen agricultural program implementation. Accordingly, agricultural technology and social capital represent complementary resources that may influence farmers' capacity to improve cultivation practices and production performance.

The relationships between fertilizer subsidies, access to agricultural technology, and farmers' social capital suggest that rice productivity should be examined through an integrated perspective rather than through individual production factors alone. Fertilizer subsidies primarily address financial constraints associated with agricultural inputs, technological accessibility supports improvements in cultivation efficiency, and social capital facilitates knowledge exchange, cooperation, and institutional support. Farmers who obtain subsidized fertilizers may achieve better production outcomes when they possess sufficient technological knowledge to utilize these inputs effectively, while participation in agricultural networks may improve access to information concerning subsidies and cultivation innovations. Previous studies have examined these dimensions through different research perspectives. Widyastutik et al. (2026) investigated the role of fertilizer subsidies and production inputs in rice farming, Rustinsyah (2015) emphasized social capital in agricultural subsidy implementation, and Hidayat et al. (2026) examined institutional challenges in fertilizer distribution. However, these studies primarily addressed specific aspects of agricultural development, leaving opportunities for further investigation into the combined relationships between financial support, technological accessibility, social capital, and rice productivity. This research addresses that gap by integrating these three determinants within a unified quantitative framework at the farmer level in Karawang Regency, providing a more comprehensive perspective on agricultural productivity.

Based on these considerations, this study aims to examine the individual and simultaneous relationships between fertilizer subsidies, access to agricultural technology, farmers' social capital, and rice productivity in Karawang Regency, West Java. The study contributes to agricultural productivity literature by integrating policy-related, technological, and social dimensions into a single empirical model, thereby providing insights into their relative associations with farmers' production performance. Using a quantitative approach based on primary survey data, the research seeks to identify how differences in agricultural input support, technology accessibility, and social relationships are associated with perceived rice productivity. From a pragmatic perspective, the current findings are anticipated to yield significant information for policymakers, local government institutions, farmer organizations, and agricultural extension services in designing more integrated agricultural development strategies. Improving fertilizer distribution mechanisms, strengthening technological accessibility, and enhancing cooperation among farmers may support more effective agricultural resource utilization and sustainable farming practices. Ultimately, this study is expected to contribute to evidence-based agricultural policymaking and efforts to strengthen rice productivity and long-term food security in Karawang Regency.

B. LITERATURE REVIEW

1. Theoretical Foundation of Agricultural Productivity

Agricultural productivity reflects the efficiency of utilizing production resources, including land, labor, capital, technology, and agricultural inputs, to achieve optimal agricultural output. Schultz (1964) emphasized that agricultural transformation requires investment in modern inputs, human capital, and technological innovation, while Barney (1991), through the resource-based view, highlighted the importance of resource ownership and utilization in determining performance. In this context, fertilizer subsidies improve access to production inputs, agricultural technology enhances cultivation efficiency, and farmers' social capital facilitates cooperation, information exchange, and institutional support. Agricultural productivity is therefore influenced not only by resource availability but also by farmers' ability to utilize resources effectively within their socioeconomic and institutional environments (Park et al., 2025; Tang et al., 2021). Accordingly, this study integrates agricultural production theory, the resource-based view, diffusion of innovations theory, and social capital theory to examine the contributions of fertilizer subsidies, agricultural technology access, and farmers' social capital to rice productivity in Karawang Regency.

2. Rice Productivity

Rice productivity refers to the amount of rice or paddy produced per unit of agricultural land, commonly measured in kilograms or tons per hectare (FAO). It reflects agricultural production efficiency and is influenced by soil fertility, seed quality, fertilizer application, irrigation, technology, and cultivation practices. Productivity can be assessed through objective yield measurements or farmers' perceptions of harvest improvement, production consistency, and cultivation efficiency. This study focuses on perceived rice productivity measured using a Likert-scale questionnaire rather than actual physical yields. Dewi et al. (2026) emphasized the importance of agricultural interventions and technical efficiency in improving smallholder rice farming performance. Therefore, sustainable rice productivity requires efficient resource utilization, appropriate technology, and institutional support to strengthen food security and farmers' economic sustainability in Karawang Regency.

3. Fertilizer Subsidies

Fertilizer subsidies are government policy instruments designed to reduce agricultural input costs and improve farmers' access to essential fertilizers, thereby supporting rice productivity. Their effectiveness depends on affordability, availability, distribution timeliness, accessibility, and appropriate fertilizer application. From an agricultural production perspective, subsidies can improve input utilization, although excessive fertilizer use may reduce efficiency and cause environmental degradation. Widyastutik et al. (2026) found that fertilizer quantity, cultivated land area, and labor positively contributed to rice production, while fertilizer costs did not significantly influence farm profitability. Similarly, Priyanto et al. (2023) highlighted the relevance of fertilizer and agricultural machinery subsidies to paddy productivity. However, administrative barriers, unequal distribution, and supply limitations may reduce subsidy

effectiveness. Therefore, this study conceptualizes fertilizer subsidies as farmers' perceived accessibility and effectiveness of subsidized fertilizer provision in supporting rice cultivation and productivity in Karawang Regency.

4. Access to Agricultural Technology

Access to agricultural technology refers to farmers' ability to obtain, adopt, and utilize innovations, including mechanized equipment, improved seed varieties, irrigation systems, precision farming, and digital agricultural services, to enhance production efficiency. Rogers (2003), through the diffusion of innovations theory, emphasized that technology adoption depends on relative advantage, compatibility, complexity, trialability, and observability. Mgendi et al. (2022) found that agricultural training and demonstration programs increased technology adoption among smallholder rice farmers, highlighting the importance of extension and irrigation services. Similarly, research in Banten, Indonesia, indicated that improved rice variety adoption was associated with higher productivity and income, supported by education, farming experience, and access to agricultural information. However, financial constraints, limited technical knowledge, and inadequate infrastructure may restrict technology adoption. Therefore, this study conceptualizes agricultural technology access as farmers' perceived ability to obtain and utilize appropriate innovations based on their availability, affordability, ease of use, and technical support to improve rice productivity in Karawang Regency.

5. Farmers' Social Capital

Social capital refers to resources embedded in social networks, trust, shared norms, and cooperation that facilitate collective action and access to agricultural resources. Coleman (1988) emphasized its role in supporting coordination, while Putnam (1993) highlighted the importance of trust and reciprocity in strengthening institutional participation. Nahapiet and Ghoshal (1998) identified three dimensions of social capital: structural, relational, and cognitive, reflecting social networks, interpersonal trust, and shared understanding. In agricultural communities, social capital facilitates information exchange, resource sharing, irrigation management, and access to government assistance. Uphoff and Wijayaratna (2000) demonstrated the benefits of collective action for agricultural performance, while Kehinde et al. (2021) highlighted the relevance of social networks to farm productivity. Similarly, Wardhana et al. (2020) found that farmer cooperation was associated with improved agricultural income in Indonesia. However, limited participation and exclusionary networks may restrict these benefits. Accordingly, this study examines farmers' social capital through participation, trust, cooperation, reciprocity, and information exchange in relation to perceived rice productivity in Karawang Regency.

6. Development of Research Hypotheses

Fertilizer subsidies, access to agricultural technology, and farmers' social capital are expected to contribute positively to rice productivity through improved resource accessibility, cultivation efficiency, and agricultural cooperation. Fertilizer subsidies reduce financial constraints and enable farmers to obtain essential production inputs, although their effectiveness depends on availability, distribution timeliness, and appropriate application. Priyanto et al. (2023) found that fertilizer subsidies were associated with increased paddy productivity, while Widyastutik et al. (2026) highlighted the importance of fertilizer quantity in rice production. Similarly, agricultural technology improves cultivation practices through mechanization, improved seed varieties, irrigation systems, and agricultural information services. Rogers (2003) emphasized that technological adoption depends on perceived advantages, compatibility, and complexity, while Mgendi et al. (2022) demonstrated the importance of agricultural training in encouraging technology adoption. Furthermore, farmers' social capital strengthens productivity through cooperation, trust, information exchange, and collective resource management (Coleman, 1988; Putnam, 1993). Uphoff and Wijayaratna (2000) highlighted the contribution of farmer organizations to agricultural performance, while Wardhana et al. (2020) identified positive associations between farmer cooperation and agricultural income.

The simultaneous contribution of fertilizer subsidies, agricultural technology access, and farmers' social capital can be explained through the resource-based perspective, which emphasizes the importance of effectively utilizing complementary resources to improve performance (Barney, 1991). Fertilizer subsidies enhance input affordability,

technological accessibility supports efficient production management, and social capital facilitates knowledge dissemination and institutional cooperation. These factors may reinforce one another, as farmers with better technological knowledge can utilize subsidized fertilizers more effectively, while stronger social networks can improve access to agricultural information and assistance programs. Although previous studies have examined these determinants separately, their combined relationships with agricultural productivity require further empirical investigation. Therefore, this study integrates the three variables into a multiple linear regression model to examine their individual and simultaneous associations with perceived rice productivity in Karawang Regency, West Java.

H1: Fertilizer subsidies have a positive and significant effect on rice productivity in Karawang Regency, West Java.

H2: Access to agricultural technology has a positive and significant effect on rice productivity in Karawang Regency, West Java.

H3: Farmers' social capital has a positive and significant effect on rice productivity in Karawang Regency, West Java.

H4: Fertilizer subsidies, access to agricultural technology, and farmers' social capital simultaneously have a significant effect on rice productivity in Karawang Regency, West Java.

C. RESEARCH METHODS

This research utilised a quantitative methodology with an explanatory framework to investigate the associations between fertilizer subsidies (X1), access to agricultural technology (X2), farmers' social capital (X3), and perceived rice productivity (Y) in Karawang Regency, West Java, Indonesia. A cross-sectional survey was conducted involving 70 rice farmers actively engaged in rice cultivation. The quantitative approach was selected to systematically measure research variables and test their statistical relationships (Creswell & Creswell, 2018). Respondents were required to have direct experience in rice farming and voluntarily participate in the study. If participants were recruited based on these predetermined criteria, the sampling procedure would be classified as purposive sampling, a nonprobability technique emphasizing respondent relevance rather than random selection (Etikan et al., 2016). The individual farmer served as the unit of analysis, with primary data collected through structured questionnaires to capture farmers' experiences and perceptions regarding agricultural support, technological accessibility, social relationships, and production performance.

The research instrument employed a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), following the measurement principles introduced by Likert (1932). Fertilizer subsidies were measured through affordability, availability, accessibility, distribution timeliness, and suitability of supply. Access to agricultural technology was assessed through technology availability, affordability, ease of use, agricultural information access, and technical assistance. Farmers' social capital was measured through interpersonal trust, farmer-group participation, cooperation, reciprocity, and information sharing, while rice productivity was evaluated through perceived harvest improvement, production consistency, cultivation efficiency, and output performance. Accordingly, the dependent variable represented perceived rice productivity rather than actual physical yields. Questionnaire responses were coded numerically, and composite scores were calculated using the average of relevant indicators. Instrument quality was assessed through corrected item–total correlations, with values ≥ 0.30 considered acceptable, and Cronbach's alpha, with coefficients ≥ 0.70 indicating satisfactory internal consistency (Cronbach, 1951).

Data were analyzed using IBM SPSS Statistics version 25 through descriptive statistics, validity and reliability testing, classical assumption tests, multiple linear regression, and hypothesis testing. Descriptive analysis included frequencies, percentages, means, and standard deviations, while classical assumption testing examined residual normality, multicollinearity, heteroscedasticity, linearity, and influential observations. Multicollinearity was evaluated using tolerance values above 0.10 and variance inflation factors (VIF) below 10, while residual normality and heteroscedasticity were assessed through appropriate statistical and graphical diagnostics. Multiple linear regression was applied using the model (Y=beta_0+beta_1X_1+beta_2X_2+beta_3X_3+varepsilon), where Y represents perceived rice productivity, X1 fertilizer subsidies, X2 agricultural technology access, and X3 farmers' social capital. Partial t-tests were used to examine individual predictor significance, while the F-test evaluated their simultaneous contribution at a

significance level of 0.05. The coefficient of determination (R^2) and adjusted R^2 were used to assess the model's explanatory power. Given the cross-sectional observational design, the findings were interpreted as statistical associations rather than definitive causal relationships.

D. RESULTS AND DISCUSSION

1. Descriptive Statistical Analysis

Descriptive statistical analysis was used to summarize the distribution of composite scores for the four research variables.

Table 1. Descriptive Statistics of Research Variables

Variable	N	Minimum	Maximum	Mean	Std. deviation
Fertilizer Subsidies (X1)	70	1.40	5.00	3.177	0.790
Agricultural Technology (X2)	70	1.20	5.00	3.166	0.754
Farmers' Social Capital (X3)	70	1.20	5.00	3.189	0.721
Perceived Rice Productivity (Y)	70	1.00	5.00	3.194	0.856

Table 1 presents the descriptive statistics of the research variables based on 70 respondents. Fertilizer subsidies (X1) recorded a mean of 3.177 with a standard deviation of 0.790 and values ranging from 1.40 to 5.00, while agricultural technology (X2) had a mean of 3.166, a standard deviation of 0.754, and values ranging from 1.20 to 5.00. Farmers' social capital (X3) showed a mean of 3.189 with a standard deviation of 0.721 and values between 1.20 and 5.00. Meanwhile, perceived rice productivity (Y) recorded the highest mean of 3.194, with a standard deviation of 0.856 and values ranging from 1.00 to 5.00. Overall, the mean scores indicate moderate perceptions across all research variables, with farmers' social capital showing the lowest variability and perceived rice productivity exhibiting the greatest variation in respondents' assessments.

2. Validity and Reliability Test Results

2.1 Validity Test

The validity assessment used corrected item–total correlations to evaluate the consistency of questionnaire items with their respective constructs. An item was considered to satisfy the preliminary screening criterion when its corrected item–total correlation was at least 0.30.

Table 2. Corrected Item–Total Correlation Results

Variable	Item 1	Item 2	Item 3	Item 4	Item 5
Fertilizer Subsidies (X1)	0.724	0.688	0.711	0.704	0.714
Agricultural Technology (X2)	0.653	0.670	0.775	0.700	0.714
Farmers' Social Capital (X3)	0.586	0.689	0.645	0.642	0.677
Perceived Rice Productivity (Y)	0.745	0.770	0.836	0.753	0.731

Table 2 presents the corrected item–total correlation results for all research variables. Fertilizer subsidies (X1) recorded correlation values ranging from 0.688 to 0.724, while agricultural technology (X2) ranged from 0.653 to 0.775. Farmers' social capital (X3) showed values between 0.586 and 0.689, whereas perceived rice productivity (Y) recorded values ranging from 0.731 to 0.836. All questionnaire items exceeded the minimum acceptance threshold of 0.30, indicating satisfactory item–total correlations across the four variables. Therefore, all measurement items were considered acceptable for further reliability testing and statistical analysis.

2.2 Reliability Test

Reliability testing was conducted using Cronbach's alpha to assess the internal consistency of the five questionnaire items representing each research variable. A coefficient of 0.70 or higher was adopted as the conventional benchmark for satisfactory reliability.

Table 3. Reliability Test Results

Variable	Number of items	Cronbach's alpha	Interpretation
Fertilizer Subsidies (X1)	5	0.877	Reliable
Agricultural Technology (X2)	5	0.874	Reliable
Farmers' Social Capital (X3)	5	0.842	Reliable
Perceived Rice Productivity (Y)	5	0.907	Reliable

Table 3 presents the reliability test results for the four research variables, each measured using five questionnaire items. Fertilizer subsidies (X1) recorded a Cronbach's alpha of 0.877, followed by agricultural technology (X2) at 0.874 and farmers' social capital (X3) at 0.842. Meanwhile, perceived rice productivity (Y) demonstrated the highest reliability coefficient of 0.907. All variables exceeded the minimum Cronbach's alpha threshold of 0.70, indicating satisfactory to excellent internal consistency. These findings confirm that the measurement instruments are reliable and suitable for subsequent statistical analysis.

3. Classical Assumption Test Results

3.1 Normality Test

The residual normality assessment was conducted using the Shapiro–Wilk test to determine whether the regression residuals followed a normal distribution. The results showed a Shapiro–Wilk statistic of 0.980 with a significance value of 0.317, exceeding the 0.05 threshold. This indicates no statistically significant departure from normality, suggesting that the regression residuals satisfy the normality assumption and are suitable for further multiple linear regression analysis.

3.2 Multicollinearity Test

Multicollinearity was examined using tolerance and variance inflation factor values.

Table 4. Multicollinearity Test Results

Independent variable	Tolerance	VIF	Interpretation
Fertilizer Subsidies (X1)	0.928	1.077	No problematic multicollinearity
Agricultural Technology (X2)	0.831	1.204	No problematic multicollinearity
Farmers' Social Capital (X3)	0.849	1.178	No problematic multicollinearity

Table 4 presents the multicollinearity test results for the three independent variables. Fertilizer subsidies (X1) recorded a tolerance value of 0.928 and a VIF of 1.077, while agricultural technology (X2) showed a tolerance value of 0.831 and a VIF of 1.204. Farmers' social capital (X3) had a tolerance value of 0.849 and a VIF of 1.178. All tolerance values exceeded 0.10, and all VIF values were below 10, indicating no problematic multicollinearity among the independent variables. Consequently, the regression model adheres to the multicollinearity assumption and is appropriate for subsequent investigation.

3.3 Heteroscedasticity Test

Heteroscedasticity was evaluated using the Breusch–Pagan test, which examines whether the variance of regression residuals is systematically related to the independent variables.

Table 5. Heteroscedasticity Test Results

Test	Test statistic	Sig.	Interpretation
Breusch–Pagan LM test	1.957	0.581	No significant evidence of heteroscedasticity

Table 5 presents the heteroscedasticity test results using the Breusch–Pagan Lagrange Multiplier (LM) test to assess whether the regression residuals exhibit constant variance. The results showed an LM statistic of 1.957 with a significance value of 0.581, exceeding the 0.05 threshold. This indicates no statistically significant evidence of heteroscedasticity, suggesting that the residual variance is consistent with the homoscedasticity assumption. Therefore,

the regression model shows no detected violation of the constant-variance assumption and is suitable for further statistical analysis.

4. Multiple Linear Regression Analysis

Multiple linear regression analysis was employed to estimate the relationships between fertilizer subsidies, access to agricultural technology, farmers' social capital, and perceived rice productivity.

Table 6. Multiple Linear Regression Results

Variable	B	Std. error	Beta	t	Sig.
Constant	-0.253	0.453	—	-0.559	0.578
Fertilizer Subsidies (X1)	0.471	0.100	0.434	4.719	$p < 0.001$
Agricultural Technology (X2)	0.239	0.110	0.211	2.167	0.034
Farmers' Social Capital (X3)	0.375	0.114	0.316	3.282	0.002

Table 6 presents the multiple linear regression results examining the relationships between fertilizer subsidies, agricultural technology, farmers' social capital, and perceived rice productivity. The regression model produced a constant of -0.253 ($p = 0.578$), indicating a statistically insignificant intercept. Fertilizer subsidies (X1) demonstrated a positive and significant association with perceived rice productivity ($B = 0.471$, $\beta = 0.434$, $t = 4.719$, $p < 0.001$), followed by agricultural technology (X2) ($B = 0.239$, $\beta = 0.211$, $t = 2.167$, $p = 0.034$) and farmers' social capital (X3) ($B = 0.375$, $\beta = 0.316$, $t = 3.282$, $p = 0.002$). Based on the standardized coefficients, fertilizer subsidies showed the strongest association with perceived rice productivity, followed by farmers' social capital and agricultural technology. Overall, all three independent variables exhibited positive and statistically significant relationships with perceived rice productivity at the 0.05 significance level, supporting the proposed individual research hypotheses.

5. Simultaneous Hypothesis Testing (F-Test)

The simultaneous F-test was used to evaluate the overall statistical significance of the regression model. This test examines whether fertilizer subsidies, access to agricultural technology, and farmers' social capital collectively explain variation in perceived rice productivity.

Table 7. ANOVA and Simultaneous F-Test Results

Model	Sum of squares	df	Mean square	F	Sig.
Regression	24.311	3	8.104	20.378	<0.001
Residual	26.246	66	0.398	—	—
Total	50.558	69	—	—	—

Table 7 presents the ANOVA and simultaneous F-test results examining the collective contribution of fertilizer subsidies, agricultural technology, and farmers' social capital to perceived rice productivity. The regression model recorded a sum of squares of 24.311 with 3 degrees of freedom and a mean square of 8.104, while the residual sum of squares was 26.246 with 66 degrees of freedom and a mean square of 0.398. The total sum of squares was 50.558 with 69 degrees of freedom. The F-test yielded a value of 20.378 with a significance level of $p < 0.001$, indicating that the regression model was statistically significant at the 0.05 level. These findings demonstrate that the three independent variables collectively explain a significant proportion of the variation in perceived rice productivity, supporting the simultaneous research hypothesis (H4).

6. Coefficient of Determination

The coefficient of determination results indicate the explanatory performance of the multiple linear regression model in assessing perceived rice productivity. The model recorded a correlation coefficient (R) of 0.693, indicating a positive relationship between the combined independent variables and perceived rice productivity. The R Square value of 0.481 demonstrates that fertilizer subsidies, agricultural technology, and farmers' social capital collectively explain 48.1% of the variation in perceived rice productivity, while the remaining 51.9% is attributable to factors not included

in the model and unexplained variation. Furthermore, the adjusted R Square of 0.457 indicates that the model explains approximately 45.7% of the variation after accounting for the number of predictors and sample size. The standard error of the estimate was 0.631, reflecting the residual variation in predicted productivity scores. Overall, these findings suggest that the regression model provides moderate explanatory power in understanding perceived rice productivity among farmers in Karawang Regency.

7. Discussion

The findings demonstrate that fertilizer subsidies have a positive and statistically significant relationship with perceived rice productivity in Karawang Regency (B = 0.471, β = 0.434, t = 4.719, $p < 0.001$), making them the strongest predictor among the three independent variables. This result suggests that farmers who perceive greater accessibility and effectiveness of subsidized fertilizers tend to report higher agricultural productivity. From the perspective of agricultural production theory, fertilizer subsidies can reduce financial constraints and facilitate access to essential inputs required for optimal crop development. These findings are consistent with Priyanto et al. (2023), who identified positive associations between fertilizer subsidies and paddy productivity across Indonesian provinces. Similarly, Widyastutik et al. (2026) emphasized the importance of fertilizer quantity, cultivated land area, and labor in determining rice production among smallholder farmers. However, Hidayat et al. (2026) highlighted institutional challenges in fertilizer allocation and distribution, indicating that subsidy effectiveness depends on availability, distribution accuracy, and timely delivery. Therefore, improving fertilizer subsidy governance and ensuring equitable access to agricultural inputs may strengthen farmers' production performance, particularly when subsidized fertilizers are applied according to cultivation requirements.

Access to agricultural technology also demonstrated a positive and statistically significant relationship with perceived rice productivity (B = 0.239, β = 0.211, t = 2.167, p = 0.034), although its standardized coefficient was the smallest among the investigated predictors. This finding indicates that farmers with better access to agricultural innovations tend to report improvements in cultivation efficiency and production performance. The result supports Rogers' (2003) diffusion of innovations theory, which explains that technology adoption depends on perceived advantages, compatibility, complexity, and other innovation characteristics. Agricultural technologies, including mechanized equipment, improved seed varieties, irrigation systems, and agricultural information services, can support more efficient resource utilization and production management. The finding is consistent with Mgendi et al. (2022), who demonstrated that agricultural training and demonstration programs encouraged improved technology adoption among smallholder rice farmers. Furthermore, Schultz (1964) emphasized the importance of technological innovation and human capital investment in transforming traditional agricultural systems. Nevertheless, the relatively smaller standardized coefficient suggests that technological accessibility may have a more limited direct statistical association with perceived productivity than fertilizer subsidies and social capital in the observed sample. Financial constraints, insufficient technical knowledge, and infrastructure limitations may restrict farmers' ability to benefit from available innovations. Accordingly, strengthening agricultural extension services, technical assistance, and affordable technology access remains important for supporting rice farming development in Karawang Regency.

Farmers' social capital exhibited a positive and statistically significant relationship with perceived rice productivity (B = 0.375, β = 0.316, t = 3.282, p = 0.002), representing the second-largest standardized coefficient in the regression model. This finding suggests that interpersonal trust, farmer-group participation, cooperation, and agricultural information exchange are positively associated with farmers' perceived production performance. The result aligns with Coleman (1988), who emphasized the role of social relationships in facilitating coordination and collective action, and Putnam (1993), who highlighted trust and reciprocity as important foundations of institutional cooperation. Furthermore, Nahapiet and Ghoshal (1998) explained that structural, relational, and cognitive dimensions of social capital provide resources that support knowledge exchange and collective activities. The findings are consistent with Uphoff and Wijayaratna (2000), who demonstrated the contribution of farmer organizations to agricultural system performance, and Kehinde et al. (2021), who examined the relevance of social capital to farming productivity. Similarly, Wardhana et al. (2020) identified positive associations between farmer cooperation and agricultural income in

Indonesia, while Rustinsyah (2015) emphasized the importance of social relationships in implementing subsidized fertilizer programs. These findings indicate that strengthening farmer organizations and encouraging inclusive agricultural cooperation may facilitate access to production resources, technological information, and institutional assistance. However, the benefits of social capital depend on equitable participation and the effectiveness of relationships within farming communities.

The simultaneous regression results indicate that fertilizer subsidies, access to agricultural technology, and farmers' social capital collectively have a statistically significant relationship with perceived rice productivity ($F = 20.378$, $p < 0.001$). The coefficient of determination ($R^2 = 0.481$) indicates that the three independent variables explain 48.1% of the variation in perceived rice productivity, while the adjusted R^2 of 0.457 demonstrates moderate explanatory power after accounting for model complexity. These findings support Barney's (1991) resource-based view, which emphasizes that performance is associated with the availability and effective utilization of complementary resources. Fertilizer subsidies represent policy-related financial support, agricultural technology provides productive capabilities, and social capital facilitates cooperation and access to institutional resources. Their integration within a single analytical framework contributes to understanding agricultural productivity beyond individual production factors, complementing the perspectives of Schultz (1964), Rogers (2003), and Coleman (1988). From a practical standpoint, the findings suggest that agricultural development initiatives should combine improvements in fertilizer distribution, technology accessibility, and farmer-group participation rather than addressing these dimensions independently. Nevertheless, the remaining 51.9% of unexplained variation indicates that other factors, including irrigation conditions, land characteristics, climatic variability, and cultivation practices, may warrant further investigation. Additionally, the cross-sectional design, sample of 70 farmers, and perception-based productivity measurements limit causal interpretation and broader generalization. Future research should incorporate larger samples, objective yield measurements, and longitudinal approaches to provide more comprehensive evidence regarding the determinants of sustainable rice productivity in Karawang Regency.

E. CONCLUSION

This study concludes that fertilizer subsidies, access to agricultural technology, and farmers' social capital are positively and significantly associated with perceived rice productivity in Karawang Regency, West Java. Fertilizer subsidies demonstrated the strongest relationship, followed by farmers' social capital and agricultural technology access. The simultaneous regression analysis confirmed that these three variables collectively contributed significantly to explaining perceived rice productivity, with an R^2 of 0.481 and an adjusted R^2 of 0.457. These findings emphasize the importance of accessible agricultural inputs, technological capabilities, and social cooperation in supporting farming performance. From a practical perspective, agricultural policymakers and local institutions should prioritize effective fertilizer distribution, affordable agricultural technologies, technical assistance, and stronger farmer organizations to improve agricultural resource utilization. However, the study's cross-sectional design, limited sample of 70 respondents, and reliance on perception-based productivity measurements restrict causal interpretation and generalizability. Future research should incorporate larger and more representative samples, objective agricultural yield data, and additional production-related factors to provide a more comprehensive understanding of sustainable rice productivity.

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