



The Effect of Capital on the Income of Lowland Rice Farmers in Luwu Regency

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Abstract

Purpose: This study aims to analyze the effect of business capital on the income of lowland rice farmers in Luwu Regency and examine the significant relationship between business capital and farmers' income.

Research Methodology: This study uses a quantitative approach with a causal associative research design. The population consists of 150 lowland rice farmers who are members of farmer groups in Luwu Regency. A sample of 50 respondents was selected using Proportional Stratified Random Sampling. Data were collected through questionnaires and farm financial documentation. Data analysis was performed using descriptive analysis, classical assumption tests, and simple linear regression analysis with SPSS 26.

Results: The findings show that the average business capital invested by farmers is IDR 8,120,000 per planting season, with an average income of IDR 13,650,000. Business capital has a positive and significant effect on farmers' income, indicating that higher capital utilization contributes to increased income levels.

Conclusions: Business capital plays an important role in improving the income of lowland rice farmers in Luwu Regency. Greater capital availability enables farmers to optimize production activities and achieve higher income.

Limitations: This study only focuses on business capital and does not include other factors affecting farmers' income. The research area is also limited to several districts in Luwu Regency.

Contribution: This study contributes to agricultural economic literature by providing empirical evidence regarding the role of capital in production activities. The findings provide recommendations for improving farmers' access to capital through government programs and financial institutions to support agricultural productivity and welfare.

Keywords: *Business Capital, Farmer Income, Lowland Rice Farming, Quantitative Approach, Simple Linear Regression*

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1. Introduction

The agricultural sector is a vital component of the economic structure of Luwu Regency. The region is recognized as one of the food production centers with extensive rice field areas and fertile land conditions that support rice cultivation. A large proportion of the population in Luwu Regency depends on agriculture, particularly rice farming, as their main source of livelihood. Therefore, the success of agricultural development in this area plays an important role in determining regional economic growth and improving community welfare. In agricultural production activities, farmers require a combination of various production factors, including land, labor, technology, and capital. Among these factors, capital often becomes the

main constraint limiting farmers' ability to increase production and income ([Khanal & Omobitan, 2020](#)).

Capital in farming activities functions as a production-supporting resource used to finance various operational needs, including land preparation, procurement of production inputs (seeds, fertilizers, and pesticides), labor costs, as well as harvesting and post-harvesting activities ([Anik, Rahman, & Sarker, 2017](#)). According to [Soekartawi \(2018\)](#), capital is a critical production factor because without sufficient capital availability, other production factors such as land and labor cannot be utilized optimally. Adequate capital enables farmers to access higher-quality production inputs and adopt more advanced agricultural technologies, which ultimately contribute to increased land productivity.

Field observations indicate the existence of significant income disparities among lowland rice farmers in Luwu Regency. Based on preliminary data obtained from the [Dinas \(2024\)](#), differences in harvest yields were identified, ranging from 3 to 7 tons of dry grain per hectare. This variation is strongly suspected to be influenced by differences in farmers' capital capacity. Farmers with greater access to capital tend to be able to apply appropriate fertilizer doses, use superior seeds, and utilize agricultural machinery, while farmers with limited capital are only able to conduct farming activities using limited production inputs.

Farmers' income is defined as the difference between the value of production received and the total costs incurred during the farming process. The level of income is highly influenced by the efficiency and effectiveness of production factor utilization. Based on production economic theory, additional production inputs supported by adequate capital availability can increase output until reaching an optimal level. This argument is consistent with previous research conducted by [Key \(2020\)](#), which found that capital has a significant positive effect on production output and farmers' income, indicating that increased capital utilization is followed by higher income levels. The issue of limited farmer capital in Indonesia, including Luwu Regency, remains a major challenge. Many farmers still rely on self-financing with limited resources, while access to formal financial institutions is often constrained by administrative requirements and collateral limitations. Although various government programs, such as the People Business Credit (*Kredit Usaha Rakyat*/KUR) and agricultural input assistance programs, have been introduced, their effectiveness in improving farmers' income requires further quantitative and empirical evaluation.

Previous empirical studies have demonstrated a consistent relationship between capital and agricultural income. [Wang, Weng, and Huo \(2023\)](#) confirmed that farmers with greater business capital obtain average incomes that are twice as high as those with limited capital. These findings indicate that capital availability plays an important role in determining farmers' economic outcomes. Although numerous studies have examined similar issues, research specifically measuring the effect of capital on farmers' income in Luwu Regency using a quantitative approach and comprehensive statistical analysis remains limited. The regional characteristics, socio-economic conditions, and farming patterns in Luwu Regency have unique features that require specific empirical investigation. Therefore, this study is important to determine the extent to which capital contributes to farmers' income and to provide strong statistical evidence regarding the causal relationship between business capital and income among lowland rice farmers.

2. Literature Review and Hypothesis/es Development

2.1 Production Theory and Agricultural Input

Production theory explains the relationship between production inputs and the output generated from production activities. In agricultural activities, production output is determined by the combination of several factors, including land, labor, technology, and capital ([Sheng, Ding, & Huang, 2019](#); [Guth, & Smeđzik-Ambroży, 2020](#)). Farmers must allocate these production factors efficiently to achieve optimal productivity and maximize income. Capital plays an important role because it enables farmers to obtain other production inputs needed during the farming process. In the agricultural sector,

production activities require continuous financial support, starting from land preparation, seed procurement, fertilizer application, pesticide use, labor payment, until harvesting activities ([Khan, Begum, Nielsen, & Hoff, 2021](#); [Mapanje, Karuaihe, Machethe, & Amis, 2023](#)). Adequate capital availability allows farmers to improve the quality and quantity of production inputs, adopt better farming technologies, and increase production efficiency. Therefore, capital is considered one of the strategic factors determining agricultural productivity and economic outcomes ([Potapov, 2020](#)).

The Cobb-Douglas production function illustrates that output is influenced by the combination of capital and labor inputs. The function assumes that increasing production inputs will increase output under certain conditions ([Vasyl, 2021](#)). In the context of rice farming, increased capital availability provides farmers with greater opportunities to improve production capacity through better input utilization. However, the effectiveness of capital depends on farmers' ability to allocate and manage resources efficiently ([De, Ferrari, & Knickel, 2018](#)).

2.2 Business Capital

Capital refers to the amount of funds or assets owned by business actors and used to finance all operational activities in order to produce goods or services with economic value. In the context of farming activities, [Soekartawi \(2018\)](#) defines capital as all tools, materials, and costs incurred to produce agricultural products. Capital can be classified into two main types: fixed capital and working capital. Fixed capital refers to assets whose economic value is utilized over a long period or more than one production cycle, such as land, buildings, and agricultural machinery ([Dukoski, 2019](#)). Meanwhile, working capital refers to resources whose value is fully consumed within a single production process, such as seeds, fertilizers, pesticides, and labor costs.

According to [Bastian \(2010\)](#), capital can be viewed based on its source, namely own capital and borrowed capital. Own capital refers to funds originating from farmers' personal resources without any repayment obligations, while borrowed capital is obtained from external parties with an obligation to repay the principal amount along with interest according to the agreed terms. The amount of capital owned by farmers determines their ability to manage farming activities ([Zawadzka, Strzelecka, & Szafraniec-Siluta, 2021](#)). The greater the available capital, the greater the farmers' ability to allocate resources optimally to achieve maximum production outcomes (([Khan, Begum, Nielsen, & Hoff, 2021](#)); [Yi, Wang, & Chen, 2021](#)). Limited capital is one of the main challenges faced by small-scale farmers. Farmers with inadequate capital often experience difficulties in accessing high-quality inputs and modern agricultural technologies. As a consequence, limited production capacity may reduce productivity and negatively affect income ([Rubery, Keizer, & Grimshaw, 2016](#)). Conversely, farmers with better capital access tend to have greater flexibility in managing production activities and improving farming efficiency ([Khan et al., 2021](#)).

In the Cobb-Douglas production function theory, capital is one of the main input variables, along with labor, that influences the amount of output produced. The production function can be mathematically expressed as $Q = f(K, L)$, where Q represents production quantity, K represents capital, and L represents labor ([Azam, 2020](#)). This indicates that production is a function of capital and labor, where an increase in capital input will technically increase output, assuming other factors remain constant (*ceteris paribus*). The measurement indicators of business capital in this study refer to [Rahman, Jacobsen, Healey, Roshetko, and Sunderland \(2017\)](#), which measures capital based on the total cash costs incurred by farmers during one planting season. These costs include land preparation costs, seed purchases, fertilizer costs, pesticide costs, labor costs, irrigation costs, and other expenses measured in Indonesian Rupiah (IDR).

2.3 Farmers' Income

Farmers' income refers to the difference between the total value of production obtained and all production costs incurred during one production period. This definition is consistent with [Wienhold and Goulao \(2023\)](#), who states that farming income represents the return received by farmers for the sacrifice of labor, knowledge, and capital invested in their farming activities. This income reflects the

net profit that becomes the actual possession of farmers and can be used for household needs or reinvested for the following planting season.

Mathematically, farming income can be formulated as follows:

$$\pi = TR - TC \quad (1)$$

Formula 1 illustrates that farmers' income is calculated as the difference between total revenue obtained from rice production and the total costs incurred during the farming process. This measurement reflects the net income received by farmers after deducting all production-related expenses.

Where: π = Farming income/profit, TR (Total Revenue) = Total revenue = Price $\times$ Production quantity, TC (Total Cost) = Total cost = Fixed costs + Variable costs.

According to [Soekartawi \(2018\)](#), farmers' income is influenced by two main factors, namely internal and external factors. Internal factors include land size, farmers' managerial ability, technology, and capital. Meanwhile, external factors include production input prices, harvest prices, government policies, and environmental conditions. Among these factors, internal factors such as capital play a dominant role because they are factors that can be directly controlled by farmers. The more efficiently farming activities are managed, the greater the income obtained. This efficiency largely depends on farmers' ability to allocate their capital effectively. The measurement indicator of the income variable in this study refers to [Soekartawi \(2018\)](#), namely net income calculated from the difference between the sales value of harvested rice or grain and the total production costs incurred during one planting season, measured in Indonesian Rupiah (IDR).

In rice farming, increased production capacity generally leads to higher revenue, provided that production costs remain efficiently controlled. Farmers who are able to invest more capital can improve input quality, increase productivity, and produce higher-value outputs ([Ruben, Kuijpers, & Dijkxhoorn, 2022](#)). Therefore, improving access to capital is often considered an important approach to increasing farmers' welfare and reducing economic vulnerability. Empirical studies on rice farming income demonstrate that farm income is strongly associated with production capacity and farmers' socio-economic characteristics. Differences in land management, resource availability, and production inputs contribute to variations in income among farmers ([Kulyakwave, Xu, Yu, Sary, & Muyobozi, 2020](#)).

2.4 Relationship between Business Capital and Farmers' Income

The relationship between business capital and income is based on economic production theory, which states that additional inputs will increase output until reaching a certain level. Capital functions as a means to obtain other production factors. When capital increases, farmers are able to purchase larger quantities of production inputs with better quality, resulting in increased production capacity ([Ngenoh, Kurgat, Bett, Kebede, & Bokelmann, 2019](#)). Higher quantity and quality of production directly increase sales value, and when the increase in revenue exceeds the increase in costs, farmers' income will also increase. An empirical study conducted by [Lee and Lee \(2018\)](#) found a positive and significant relationship between capital and income. This finding demonstrates the existence of economies of scale, where invested capital generates greater returns.

Furthermore, [Balafoutis, Beck, Fountas, Vangeyte, Soto, and Eory \(2017\)](#) emphasized that sufficient capital availability enables farmers to implement appropriate technologies that can reduce production costs per unit and increase agricultural yields. Without adequate capital, farmers may become trapped in a poverty cycle, where low income prevents capital accumulation, and limited capital leads to low productivity and reduced future income. Based on theoretical perspectives and previous empirical studies, the hypothesis proposed in this study is:

H₁: Business capital has a positive and significant effect on the income of lowland rice farmers in Luwu Regency.

3. Research Methodology

3.1 Research Approach and Type

This study employs a quantitative approach. The quantitative approach was selected because this research aims to test hypotheses and measure the magnitude of relationships between variables using numerical data and statistical analysis (Creswell, 2014). The type of research used is causal associative research, which aims to examine the cause-and-effect relationship between the independent variable (business capital) and the dependent variable (farmers' income). This research design enables the researcher to determine whether business capital contributes significantly to variations in farmers' income.

3.2 Research Location and Period

This research was conducted in Luwu Regency, South Sulawesi Province, Indonesia. The research location was selected based on the consideration that Luwu Regency is one of the major rice production centers in South Sulawesi, with a large number of rice farmers and diverse farming scales. Therefore, the area is considered representative for examining the relationship between capital and farmers' income. The research was conducted for three months, from June to August 2026.

3.3 Population and Sample

$$n = \frac{N}{1 + N(e)^2} \quad (2)$$

$$n = \frac{150}{1 + 150(0,1)^2} = \frac{150}{2,5} = 60 \quad (3)$$

The population in this study consists of Formula 2 and 3, all lowland rice farmers who are members of farmer groups registered with the Agriculture Office of Luwu Regency, totaling 150 farmers. The sampling technique used was Proportional Stratified Random Sampling, which is a sampling method that considers strata or levels based on farmers' land ownership size (small-scale land, medium-scale land, and large-scale land). This technique was applied to ensure that the selected sample was proportionally distributed and represented each category of farmer characteristics. The sample size was determined using the Slovin formula with a 10% margin of error:

Based on the initial calculation, the required sample size was 60 respondents. However, in this study, the sample size was adjusted and determined to be 50 respondents due to considerations of research accessibility, an acceptable level of error, and the assumption that the collected data had reached saturation and adequately represented the population.

3.4 Operational Definition of Variables

This study consists of two variables, namely:

1. Independent Variable (*X*): Business capital refers to all expenses incurred by farmers for lowland rice farming activities during one planting season. The measurement of business capital is based on the total cash costs consisting of land preparation costs, seed costs, fertilizer costs, pesticide costs, labor costs, and other related expenses, measured in Indonesian Rupiah (IDR).

2. Dependent Variable (*Y*): Farmers' income refers to the difference between total revenue obtained from rice production sales and all production costs incurred during the farming process. The measurement is based on the amount of net profit received by farmers during one planting season, expressed in Indonesian Rupiah (IDR).

3.5 Data Collection Techniques

The data used in this study consist of primary and secondary data.

1. Primary Data: Primary data were obtained directly through questionnaires distributed to respondents. The questionnaire consisted of closed-ended questions regarding production costs and production outcomes experienced by farmers during the most recent planting season.
2. Secondary Data: Secondary data were obtained from relevant institutions, such as the Agriculture Office of Luwu Regency, the Central Statistics Agency (BPS), and relevant literature used as supporting information.

The data collection process was conducted through field surveys by distributing questionnaires to the 50 selected respondents. The questionnaire completion process was assisted by the researcher to ensure that the information provided was accurate and reflected the actual farming conditions.

3.6 Data Analysis Techniques

Data analysis in this study employed descriptive statistical analysis and inferential statistical analysis. The stages of data analysis are as follows:

3.6.1 Descriptive Analysis

Descriptive analysis was used to describe the characteristics of the research data, including the mean, minimum value, maximum value, and standard deviation of the business capital and farmers' income variables.

3.6.2 Classical Assumption Test

Before conducting regression analysis, the data were required to fulfill classical assumption tests to ensure that the regression model met the Best Linear Unbiased Estimator (BLUE) criteria. The classical assumption tests included:

- Normality Test: Conducted to determine whether the data were normally distributed using the Kolmogorov-Smirnov test.
- Linearity Test: Conducted to examine whether the relationship between the independent and dependent variables was linear using the Deviation from Linearity test.
- Heteroscedasticity Test: Conducted to determine whether the residual variance was constant using the Glejser test.

3.6.3 Simple Linear Regression Analysis

Simple linear regression analysis was used to determine the effect of business capital (*X*) on farmers' income (*Y*). The regression equation used in this study is:

$$Y = a + bX + e \quad (4)$$

Formula 4 is used to measure the effect of business capital on farmers' income. In this model, Y represents farmers' income, X represents business capital, a represents the constant value, b represents the regression coefficient indicating the effect of capital, and e represents the error term.

Where: Y = Farmers' Income, a = Constant, b = Regression Coefficient (effect value), X = Business Capital, e = Error term

3.6.4 Hypothesis Testing (t -Test)

The t -test was used to examine the partial significance of the independent variable's effect on the dependent variable. The decision criteria are: if $t\text{-count} > t\text{-table}$ or the significance value (Sig.) < 0.05 , then H_0 is rejected and H_a is accepted, indicating a significant effect.

3.6.5 Coefficient of Determination (R^2)

The coefficient of determination (R^2) was used to determine the percentage contribution of the independent variable in explaining variations in the dependent variable. The value of R^2 ranges from 0 to 1. A value closer to 1 indicates that the independent variable has a greater ability to explain variations in the dependent variable. All statistical data processing in this study was conducted using the Statistical Package for the Social Sciences (SPSS) version 26 software

4. Results and Discussions

Before conducting regression analysis, classical assumption tests were performed to ensure that the regression model met the required statistical criteria.

1. Normality Test: The Kolmogorov-Smirnov test results show a significance value of $0.245 > 0.05$. This indicates that the residual data are normally distributed and meet the requirements for regression analysis.
2. Linearity Test: The results of the Deviation from Linearity test show a significance value of $0.387 > 0.05$. This indicates that the relationship between business capital and farmers' income is linear.
3. Heteroscedasticity Test: The Glejser test results show a significance value of $0.214 > 0.05$ for the business capital variable. This indicates that there is no heteroscedasticity problem, meaning that the residual variance is constant (homogeneous). Based on all classical assumption tests, it can be concluded that the data have fulfilled the requirements for simple linear regression analysis. Therefore, the regression model can be used to examine the effect of business capital on the income of lowland rice farmers in Luwu Regency.

4.1 Descriptive Analysis Results

Based on the data processing results from 50 respondents selected as the research sample, the descriptive analysis provides an overview of the business capital and income conditions of lowland rice farmers in Luwu Regency. The analysis shows variations in both business capital availability and farmers' income levels, which reflect differences in farming capacity, production scale, and economic conditions among respondents.

The average business capital invested by lowland rice farmers in Luwu Regency was IDR 8,120,000 per planting season. The lowest capital used by farmers was IDR 3,800,000, while the highest reached IDR 13,500,000. This variation indicates differences in farmers' ability to allocate financial resources for farming activities. The differences in capital capacity are influenced by several factors, including cultivated land size, production scale, and the economic conditions of individual farmers. Farmers with greater capital availability generally have wider opportunities to access better-quality production inputs and improve their farming practices.

Regarding farmers' income, the analysis shows that the average income obtained by farmers was IDR 13,650,000 per planting season. The lowest income received was IDR 5,200,000, while the highest reached IDR 24,800,000. The considerable variation in income levels indicates differences in farming performance among respondents. This condition is closely related to variations in the amount of capital invested, as farmers with greater capital tend to have better opportunities to optimize production inputs, improve farming efficiency, and achieve higher production outcomes. Therefore, capital availability becomes an important factor influencing differences in income among lowland rice farmers in Luwu Regency.

4.2 Simple Linear Regression Analysis Results

Simple linear regression analysis was conducted to determine the relationship pattern and the magnitude of the effect of business capital on farmers' income. The analysis aims to examine whether changes in business capital significantly influence variations in farmers' income. The data processing results using SPSS are presented in below.

Table 1. Descriptive Analysis Results

Variable	Regression Coefficient	t-Statistic	Sig.	Description
Constant	2.150	2.324	0.024	-
Business Capital (X)	1.412	10.985	0.000	Significant
R (R ²)	0.815 (0.664)			
F-statistic	120.673		0.000	Significant

Based on Table 1, the following regression equation was obtained:

Regression equation: $Y = 2.150 + 1,412X$. The interpretation of the regression equation above is:

1. Constant value of 2.150. This indicates that if business capital is assumed to be zero, the basic income level of farmers is estimated at IDR 2,150,000.
2. Coefficient value of 1.412. This indicates that every increase of IDR 1,000,000 in business capital will increase farmers' income by approximately IDR 1,412,000. This positive coefficient shows that higher business capital is associated with higher income levels among lowland rice farmers.

4.3 Hypothesis Testing Results

1. Partial Test (t-Test). Based on Table 1, the calculated t-value (t-count) is 10.985, while the critical t-value (t-table) at a 95% confidence level ($\alpha = 0.05$) with degrees of freedom ($df = n - 2 = 48$) is 2.011. Since the t-count value (10.985) is greater than the t-table value (2.011) and the significance value of $0.000 < 0.05$, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_a) is accepted. This indicates that business capital has a positive and significant effect on the income of lowland rice farmers in Luwu Regency.
2. Coefficient of Determination (R^2). The coefficient of determination (R^2) value is 0.664 or 66.4%. This indicates that the business capital variable is able to explain 66.4% of the variation in farmers' income. Meanwhile, the remaining 33.6% is explained by other variables not included in this research model, such as land size, rainfall conditions, selling prices, and farmers' managerial capabilities. This finding suggests that although business capital is a dominant factor influencing farmers' income, other production and environmental factors also contribute to determining income variations.

4.4 Discussion

This study provides empirical evidence that business capital has a positive and highly significant effect on the income of lowland rice farmers in Luwu Regency. This finding supports the production theory perspective, which states that capital is one of the essential production factors determining the level of output generated ([Bórawski, Pawlewicz, Parzonko, Harper, & Holden, 2020](#)). The regression coefficient value of 1.412 indicates that capital utilization provides a positive return, where additional investment in production inputs contributes to a greater increase in farmers' income.

The positive effect of business capital can be explained through the operational mechanism of farming activities. Farmers with greater capital availability are able to allocate sufficient funds to purchase certified high-quality seeds with higher yield potential, apply fertilizers according to recommended doses, and provide adequate pesticides for crop protection ([Hassan, Jajja, Asif, & Foster, 2021](#)). Furthermore, sufficient capital enables farmers to utilize agricultural machinery services, such as tractors, planting machines, and harvesting machines, which improve time efficiency and enhance the quality of land management. These conditions ultimately contribute to increased productivity and higher farming output.

Conversely, farmers with limited capital tend to reduce production costs by minimizing fertilizer application, using self-saved seeds with lower quality, or relying on manual farming processes. These limitations may negatively affect plant growth, increase vulnerability to pest attacks, and result in lower harvest yields and grain quality. This condition is reflected in the field findings, where farmers with the lowest capital obtained an average yield of 4.2 tons per hectare, while farmers with the highest capital achieved an average yield of 6.7 tons per hectare.

The results are consistent with previous studies conducted by [Mumuni and Oladele \(2016\)](#) and [Akudugu \(2016\)](#), which found that business capital significantly contributes to improving agricultural productivity and farmers' income. Statistically, the significance value of 0.000 confirms that the relationship between business capital and farmers' income is not a random occurrence but represents a meaningful causal relationship. Furthermore, the contribution of business capital amounting to 66.4% indicates that capital is a dominant factor influencing the economic success of rice farming in the research area. This finding highlights that farmers' economic challenges are closely related to limitations in accessing adequate production capital.

The implications of this study suggest that improving farmers' income and welfare requires policy strategies focused on strengthening access to capital. Providing farmers with easier and more affordable financing opportunities can enhance their production capacity, which will ultimately lead to increased income. These findings also confirm the relevance of agricultural financing programs, such as the People Business Credit (*Kredit Usaha Rakyat*/KUR), and highlight the need to expand their accessibility considering the significant role of capital in improving farmers' economic performance.

5. Conclusions

Based on the results of data analysis and the discussion presented previously, several conclusions can be drawn. First, the characteristics of the research variables indicate that the average business capital invested by lowland rice farmers in Luwu Regency is IDR 8,120,000 per planting season, with an average income of IDR 13,650,000. There are considerable variations in both capital availability and income levels among respondents, reflecting differences in economic capacity and farming scale. Most of the capital allocation is still concentrated on production inputs, particularly fertilizers and labor costs, while the utilization of modern agricultural technology remains relatively limited.

Second, business capital has a positive and significant effect on the income of lowland rice farmers in Luwu Regency. This finding is supported by the hypothesis testing results, where the calculated t-value (10.985) is greater than the t-table value (2.011) and the significance value ($0.000 < 0.05$). The positive regression coefficient of 1.412 indicates that an increase in business capital leads to an increase in farmers' income. This finding confirms that greater access to business capital enables

farmers to improve production capacity, optimize the use of production inputs, and increase the economic value of agricultural outputs.

Third, business capital contributes 66.4% to variations in farmers' income, while the remaining 33.6% is influenced by other factors outside the research model. This result demonstrates that capital is a dominant factor affecting farmers' income; however, it does not operate independently without support from other factors. Therefore, improving capital access alone is not sufficient to achieve optimal income growth unless it is accompanied by effective farm management, technological adoption, and supportive agricultural environmental conditions.

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Author Contributions

HS contributed to the conceptualization of the study, data collection, data analysis, and manuscript preparation. WOR contributed to research supervision, methodological guidance, validation of findings, and critical review of the manuscript. Both authors have read and approved the final version of the manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article. The research was conducted independently, and all findings are presented objectively without any external influence that may affect the results or interpretation of the study.

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