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Determinants of Farmers' Income in Rural Agricultural Communities

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ABSTRACT
This study aims to analyze the effect of access to capital, technology utilization, village institutions, and infrastructure availability on farmers' income in Nitneo Village. This research employs a quantitative approach using multiple linear regression analysis supported by partial and simultaneous hypothesis testing as well as the coefficient of determination. The findings indicate that all independent variables simultaneously have a significant influence on farmers' income. Partially, technology utilization, village institutions, and infrastructure show a significant effect, while access to capital does not have a significant impact. Furthermore, the model demonstrates a relatively strong ability to explain variations in farmers' income. Improvements that need to be undertaken include enhancing technology utilization, strengthening village institutions, and improving agricultural infrastructure to sustainably increase farmers' income.

Keywords : *Farmers' Income, Capital, Technology, Village Institutions, Infrastructure*

1. Introduction

The agricultural sector remains one of the most important pillars of rural economic development and plays a strategic role in improving community welfare, particularly in regions where the majority of the population depends on farming activities as their primary source of income. In Indonesia, agriculture continues to contribute significantly to regional economic growth and employment generation, especially in rural areas. Studies have shown that the agricultural sector serves as a leading sector in supporting local economic development and reducing rural poverty (Bangkole et al., 2024; Martauli, 2021). Likewise, research on regional economic structures indicates that agriculture remains a basic sector with strong multiplier effects on village economies and household welfare (Yuningsih et al., 2023). However, despite the considerable agricultural potential possessed by many rural areas, the income level of farmers often remains relatively low and unstable due to various structural and institutional constraints.

Nitneo Village, located in West Kupang District, Kupang Regency, is an agrarian village with considerable agricultural resources, including productive land and a workforce that is largely engaged in farming activities. Nevertheless, the improvement of farmers' income has not been proportional to the available resource potential. Similar conditions have been observed in several rural areas where the agricultural sector contributes substantially to economic activities, yet farmers continue to face challenges related to productivity, market access, technology utilization, and institutional support (Bangkole et al., 2024; Mulyana et al., 2024). This phenomenon suggests that the availability of natural resources alone is insufficient to improve farmers' welfare without effective support systems that enable farmers to utilize these resources productively and sustainably.

Previous studies have identified several factors that influence farmers' income, including access to capital, technology utilization, institutional support, and infrastructure availability. Access to capital is considered an important factor because it enables farmers to purchase production inputs and adopt innovations that can improve productivity. Empirical studies indicate that credit access and rural financial institutions positively influence agricultural

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production and farmers' economic performance (Gelata et al., 2023; Zhang et al., 2024; Wang et al., 2025). Furthermore, technology utilization has become increasingly important in modern agriculture. The adoption of agricultural technologies, digital farming applications, and extension-based innovations has been shown to enhance productivity, efficiency, and farm income (Ruzzante et al., 2021; Tong et al., 2025; Li et al., 2025). In Indonesia, the development of digital agricultural services also provides opportunities for farmers to access information, consultation services, and market information more efficiently (Alhafiz & Sela, 2025).

In addition to capital and technology, the role of village institutions is increasingly recognized as a critical component of rural economic development. Farmer groups, Village-Owned Enterprises (BUMDes), and other community-based institutions contribute to strengthening farmers' access to information, production resources, marketing channels, and collective economic activities. Previous studies have demonstrated that strengthening village institutions can improve agricultural productivity, enhance local economic resilience, and support sustainable rural development (Edy & Suherman, 2021; Nurdin et al., 2023; Rahman et al., 2024; Jusriadi et al., 2025). Moreover, infrastructure availability, including transportation networks, irrigation systems, and digital connectivity, plays a crucial role in reducing production and transaction costs while facilitating access to markets and agricultural services. Adequate rural infrastructure has been found to contribute significantly to community welfare and economic development in rural areas (Wahyuni, 2024; Kumar et al., 2025).

Although numerous studies have examined the effects of capital access, technology adoption, institutional support, and infrastructure on agricultural performance, most previous studies have focused on these factors separately or within different socio-economic contexts. Studies on credit access primarily emphasize financing and technology adoption (Gelata et al., 2023; Wang et al., 2025), while research on agricultural technology mainly focuses on productivity and income enhancement (Li et al., 2025; Tong et al., 2025). Other studies investigate village institutions and infrastructure independently as determinants of rural development (Rahman et al., 2024; Wahyuni, 2024). However, limited empirical evidence is available regarding the simultaneous influence of these four factors on farmers' income at the village level, particularly in eastern Indonesia and specifically in Nitneo Village. This gap indicates the need for a more comprehensive analysis that integrates financial, technological, institutional, and infrastructural dimensions within a single empirical framework.

Therefore, this study is important because it provides a holistic understanding of the determinants of farmers' income in Nitneo Village. The novelty of this research lies in its integrated examination of access to capital, technology utilization, village institutions, and infrastructure availability as simultaneous determinants of farmers' income in a rural agricultural setting that has received limited scholarly attention. The findings are expected to contribute to the literature on rural economic development by offering empirical evidence from eastern Indonesia while also providing practical recommendations for policymakers and local governments in designing more effective farmer empowerment programs and sustainable village economic development strategies. Accordingly, this study aims to analyze the influence of access to capital, technology utilization, village institutions, and infrastructure availability on farmers' income in Nitneo Village, West Kupang District.

2. Literature Review

Rural Economic Development

Rural economic development refers to a process of improving community welfare through the optimization of local resources, increased productivity, employment creation, and equitable distribution of economic benefits. In agrarian regions, agriculture serves as a major driver of economic growth and rural livelihoods. Empirical evidence indicates that the agricultural sector contributes significantly to regional economic development and plays an

important role in increasing household income and reducing poverty (Martauli, 2021; Bangkole et al., 2024). Furthermore, the identification of agriculture as a leading economic sector in many rural areas demonstrates its strategic role in stimulating local economic activities and strengthening regional competitiveness (Yuningsih et al., 2023). Therefore, improving the performance of the agricultural sector is an important strategy for promoting sustainable rural economic development.

Farmers' Income Theory

Farmers' income represents the economic returns obtained from agricultural activities after considering production costs and operational expenditures. The level of income reflects the success of farmers in utilizing available resources, including land, labor, capital, technology, and management capabilities. Previous studies indicate that farmers' income is strongly associated with productivity, efficiency, market access, and institutional support (Mulyana et al., 2024). Higher productivity and more efficient resource utilization generally lead to improved farm profitability and household welfare. Consequently, efforts to increase farmers' income require not only improvements in production factors but also supportive institutional and infrastructural environments.

Access to Capital and Farmers' Income

Access to capital is one of the most important determinants of agricultural development because it enables farmers to purchase inputs, adopt innovations, and expand production activities. Limited access to financial resources often constrains farmers from investing in productivity-enhancing technologies and improving farm management practices. Empirical studies have shown that access to rural credit positively affects agricultural productivity, technology adoption, and farm income (Gelata et al., 2023; Girma, 2022). Similarly, Zhang et al. (2024) found that rural financial institutions play a significant role in increasing production input utilization and improving agricultural performance. Wang et al. (2025) further demonstrated that access to credit facilitates the adoption of modern agricultural technologies, which subsequently contributes to higher farm productivity and income. Therefore, improved financial access is expected to enhance farmers' economic performance and welfare.

H1: Access to capital has a positive effect on farmers' income.

Technology Utilization and Farmers' Income

Technology utilization has become a key factor in improving agricultural productivity and sustainability. Technological innovations enable farmers to optimize resource use, reduce production costs, improve efficiency, and increase crop yields. A meta-analysis conducted by Ruzzante et al. (2021) revealed that agricultural technology adoption significantly improves agricultural productivity across developing countries. Similarly, Tong et al. (2025) reported that climate-smart agricultural technologies positively influence both farmers' income and production yields. Agricultural extension services also play an important role in accelerating technology adoption among farmers (Amrullah et al., 2025; Li et al., 2025; Wang et al., 2026). Moreover, the development of digital agricultural services, including mobile-based consultation applications, provides farmers with easier access to information and technical guidance that support decision-making processes (Alhafiz & Sela, 2025). These findings suggest that greater technology utilization is likely to contribute to increased farmers' income.

H2: Technology utilization has a positive effect on farmers' income.

Village Institutions and Farmers' Income

Village institutions serve as important mechanisms for facilitating cooperation, information exchange, resource mobilization, and market access among farmers. Institutions

such as farmer groups and Village-Owned Enterprises (BUMDes) contribute to strengthening agricultural production systems and improving rural economic resilience. Edy and Suherman (2021) found that BUMDes institutions play a significant role in increasing agricultural production through support services and business facilitation. Likewise, Nurdin et al. (2023) emphasized that strengthening village institutions contributes to community empowerment and local economic development. Studies by Rahman et al. (2024), Febrianti and Hayati (2023), and Jusriadi et al. (2025) further demonstrate that effective institutional governance enhances food security, economic opportunities, and community participation in village development programs. In addition, institutional support has been identified as a critical factor in encouraging agricultural technology adoption and improving farm performance (Saifan et al., 2021). Therefore, strong village institutions are expected to positively influence farmers' income.

H3: Village institutions have a positive effect on farmers' income.

Infrastructure Availability and Farmers' Income

Infrastructure plays a fundamental role in supporting agricultural production and rural economic development. Adequate infrastructure, such as roads, irrigation systems, communication facilities, and digital connectivity, facilitates access to markets, production inputs, extension services, and financial resources. Wahyuni (2024) found that infrastructure development significantly contributes to improving rural welfare and economic activities in East Nusa Tenggara. Moreover, Kumar et al. (2025) reported that access to digital infrastructure and services positively affects farm income by improving information accessibility and market participation. Improved infrastructure also reduces transportation costs, increases production efficiency, and strengthens agricultural competitiveness. Consequently, infrastructure availability is expected to contribute positively to farmers' income.

H4: Infrastructure availability has a positive effect on farmers' income.

Relationship Between Farmers' Income and Rural Economic Growth

Farmers' income is not only an indicator of household welfare but also an important determinant of rural economic growth. Higher agricultural income increases purchasing power, stimulates local consumption, and encourages investment in productive activities. Research by Martauli (2021) and Bangkole et al. (2024) indicates that the agricultural sector contributes significantly to regional economic growth through income generation and employment creation. As farmers' income increases, multiplier effects emerge through increased demand for goods and services, business expansion, and improved economic resilience within rural communities. Therefore, efforts to increase farmers' income contribute not only to individual welfare but also to broader rural economic development.

3. Research Methods

This study employs a quantitative approach to analyze the influence of access to capital, technology adoption, village institutions, and infrastructure availability on farmers' income in Nitneo Village. The research design used is an associative study, aimed at identifying relationships and influences among variables. The data used in this study consist of primary data obtained through the distribution of questionnaires to farmers, as well as secondary data obtained from relevant agencies and various supporting literature.

The population in this study consists of all active farmers who own land in Nitteo Village, totaling 87 respondents. Given the relatively small population size, the entire population was used as the study sample (saturation sampling). Data collection techniques included questionnaires, observations, and documentation. The independent variables in this

study include access to capital (X1), technology utilization (X2), village institutions (X3), and infrastructure availability (X4), while the dependent variable is farmer income (Y).

The data analysis technique used was multiple linear regression to determine the effect of the independent variables on the dependent variable. Hypothesis testing was conducted using a partial test (t-test) to examine the individual effects of each variable, a simultaneous test (F-test) to assess the combined effects of the variables, and the coefficient of determination (R^2) to measure the model's ability to explain variations in farmers' income. All analyses were performed using statistical software to ensure the research results are objective and scientifically valid.

4. Results and Discussions

Results

Validity Test

Table 1. Validity Test Results

Variable	Question Item	Calculated r Value	Table r Value	Notes
Access to Capital (X1)	X1 1	0.420	0.2108	Valid
	X1 2	0.595	0.2108	Valid
	X1 3	0.316	0.2108	Valid
	X1 4	0.451	0.2108	Valid
	X1 5	0.373	0.2108	Valid
	X1 6	0.510	0.2108	Valid
	X1 7	0.247	0.2108	Valid
	X1 8	0.319	0.2108	Valid
Use of Modern Technology (X2)	X2 1	0.226	0.2108	Valid
	X2 2	0.297	0.2108	Valid
	X² 3	0.231	0.2108	Valid
	X² 4	0.341	0.2108	Valid
	X² 5	0.374	0.2108	Valid
	X² 6	0.268	0.2108	Valid
	X² 7	0.327	0.2108	Valid
Role of Village Institutions (X3)	X3 1	0.443	0.2108	Valid
	X3 2	0.332	0.2108	Valid
	X3 3	0.412	0.2108	Valid
	X3 4	0.408	0.2108	Valid
	X3 5	0.376	0.2108	Valid
	X3 6	0.417	0.2108	Valid
	X3 7	0.269	0.2108	Valid
	X3 8	0.373	0.2108	Valid
Infrastructure Availability (X4)	X4 1	0.305	0.2108	Valid
	X4 2	0.237	0.2108	Valid
	X4 3	0.345	0.2108	Valid
	X4 4	0.408	0.2108	Valid
	X4 5	0.382	0.2108	Valid
	X4 6	0.264	0.2108	Valid

Variable	Question Item	Calculated r Value	Table r Value	Notes
	X4 7	0.379	0.2108	Valid
	X4 8	0.469	0.2108	Valid
Farmers' Income (Y)	Y 1	0.372	0.2108	Valid
	Y 2	0.487	0.2108	Valid
	Y 3	0.551	0.2108	Valid
	Y 4	0.453	0.2108	Valid
	Y 5	0.380	0.2108	Valid
	Y 6	0.289	0.2108	Valid
	Y 7	0.515	0.2108	Valid
	Y 8	0.357	0.2108	Valid

Source: Processed Primary Data, 2026

Based on Table 1, it is evident that all items in each variable have a significance value less than 0.05. This indicates that all indicators used in the study are capable of accurately measuring the variables under investigation and align with the established concepts. Consequently, the research instrument is deemed valid and suitable for data collection.

Reliability Test

Table 2. Reliability Test Results

Variable	Number of Questions	Test Results	Criteria	Notes
Access to Capital (X1)	8	0.667	>0.60	Reliable
Use of Modern Technology (X2)	7	0.793	>0.60	Reliable
Role of Village Institutions (X3)	8	0.844	>0.60	Reliable
Availability of Infrastructure (X4)	8	0.691	>0.60	Reliable
Farmers' Income (Y)	8	0.818	>0.60	Reliable

Source: Processed Primary Data, 2026

Based on Table 2, it is evident that all variables have *Cronbach's Alpha* values above 0.60. This indicates that the research instrument possesses a good level of internal consistency in measuring the variables under study. Consequently, the research instrument is deemed reliable and suitable for further analysis.

Test of Classical Assumptions

Normality Test

Table 3. Results of the Normality Test (*Kolmogorov-Smirnov*)

Notes	Value
N	87
Test Statistic	0.066
Asympt. Sig. (2-tailed)	0.200
Monte Carlo Sig. (2-tailed)	0.440

Source: Processed Primary Data, 2026

Based on Table 3, the Asymp. Sig. (2-tailed) value is **0.200**. This value is greater than the significance level used in the study, which is **0.05 (0.200 > 0.05).** These results indicate that the residual data in the regression model are normally distributed. In other words, there is no significant deviation of the data distribution from the normal distribution.

Multicollinearity Test

Table 4. Results of the Multicollinearity Test

Variable	Tolerance	VIF
X1	0.504	1.985
X2	0.494	2.025
X3	0.926	1.080
X4	0.979	1.021

Source: Processed Primary Data, 2026

Based on Table 4, it is evident that all independent variables have *tolerance* values greater than 0.10 and *VIF* values less than 10. This indicates that there is no multicollinearity in the regression model. Thus, the independent variables are not highly correlated with one another and are suitable for use in regression analysis.

Glesjer Method Heteroscedasticity Test

Table 5. Heteroscedasticity Test Results

Variable	Significance
X1	0.531
X2	0.526
X3	0.743
X4	0.393

Source: Processed Primary Data, 2026

Based on Table 5, it is evident that the significance values (Sig.) for all independent variables relative to the residuals are above the significance level of 0.05. A significance value greater than 0.05 indicates that there is no significant relationship between the independent variables and the absolute residual values; therefore, it can be concluded that there is no heteroscedasticity in the regression model used.

Linearity Test

Table 6. Linearity Test Results

No	Variable	Sig. Deviation from Linearity	Description
1	X1 → Y	0.457	Linear
2	X2 → Y	0.390	Linear
3	X3 → Y	0.300	Linear
4	X4 → Y	0.348	Linear

Source: Processed Primary Data, 2026

Based on Table 6, it is evident that the significance values for Deviation from Linearity for all independent variables relative to the dependent variable are above 0.05, specifically 0.457 for access to capital (X1), 0.390 for technology utilization (X2), 0.300 for village institutions (X3), and 0.348 for infrastructure availability (X4). These values indicate that there is no significant deviation from a linear relationship between each independent variable and the dependent variable. Thus, it can be concluded that the relationship between the variables of access to capital, technology utilization, village institutions, and infrastructure availability and farmers' income is linear. This indicates that the multiple linear regression model used in this study meets the assumption of linearity, making it suitable for further analysis.

Multiple Linear Regression Analysis

Table 7. Results of Multiple Regression Analysis

Variable	B
X1	-0.016
X2	0.236

X3	0.196
X4	0.288

Source: Processed Primary Data, 2026

Based on Table 7, the data analysis yields the following multiple linear regression equation:

Y = 2.357 – 0.016X1 + 0.236X2 + 0.196X3 + 0.288X4

This equation indicates that not all independent variables have positive coefficients**.** The variable for access to capital (X1) actually has a negative coefficient, while the utilization of technology (X2), village institutions (X3), and infrastructure availability (X4) have positive coefficients. This implies that any increase in the variables of technology utilization, village institutions, and infrastructure availability will be followed by an increase in farmers' income, assuming other variables remain constant. Meanwhile, an increase in access to capital is actually followed by a decrease in farmers' income, although its effect is relatively small.

1. The constant value of **2.357** indicates that when all independent variables are held constant, farmers' income is 2.357. This suggests the presence of other factors outside the research model that also influence farmers' income, such as natural conditions, commodity prices, and the size of farmland.
2. The regression coefficient for the variable "access to capital" (X1), which is **-0.016,** indicates that this variable has a negative effect on farmers' income. This means that when access to capital increases by 1%, farmers' income will decrease by 1.6%, assuming all other variables remain constant. This effect is relatively small, so its impact is not very noticeable in practice. This suggests that, in the context of this study, increased access to capital does not necessarily lead directly to higher income; in fact, the relationship tends to be inverse.
3. The regression coefficient for the technology utilization variable (X2) of **0.236** indicates that the use of technology in agricultural activities contributes significantly to income growth. When technology utilization increases by 1%, farmers' income also increases by 23.6%. This value is quite substantial, indicating that technology plays a tangible role in boosting farmers' income.
4. The regression coefficient for the village institutional variable (X3) of **0.196** indicates that the existence and role of village institutions have a significant influence on farmers' income. When the role of village institutions increases by 1%, farmers' income also increases by 19.6%. This value indicates that village institutions make a meaningful contribution to supporting increases in farmers' income
5. The regression coefficient for the infrastructure availability variable (X4) of **0.288** indicates that infrastructure is the variable with the greatest influence compared to the others. When infrastructure availability increases by 1%, farmers' income also increases by 28.8%. This value is the highest compared to the other variables, so it can be concluded that infrastructure is the most dominant factor influencing farmers' income.

t-Test (Partial Test)

Table 8. Results of the t-Test

Variable	Regression Coefficient	T	Sig.
X1	-.016	-.239	.811
X2	..236	5.682	**<** .001
X3	.196	4.862	**<** .001
X4	.288	6.630	**<** .001

Source: Processed Primary Data 2026

Based on the results of the t-test in Table 8, the partial hypothesis testing results indicate varying effects of the independent variables on farmers' income. Access to capital (X1) has a regression coefficient of -0.016, a t-value of -0.239, and a significance value of 0.811,

which is greater than the significance level of 0.05. Therefore, H_0 is accepted and H_1 is rejected, indicating that access to capital does not have a significant effect on farmers' income. The negative coefficient further suggests that increased access to capital tends to be associated with a slight decrease in income; however, this relationship is very weak and statistically insignificant, implying that the available capital may not be utilized optimally for productive agricultural activities. In contrast, technology utilization (X2) demonstrates a significant positive effect on farmers' income, with a regression coefficient of 0.236, a t-value of 5.682, and a significance level of less than 0.001. This result confirms H_2, indicating that greater adoption and utilization of agricultural technology contribute to higher income levels. Similarly, village institutions (X3) show a significant positive influence on farmers' income, as reflected by a regression coefficient of 0.196, a t-value of 4.862, and a significance level below 0.001. Thus, H_3 is accepted, suggesting that institutions such as farmer groups and Village-Owned Enterprises (BUMDes) play an important role in enhancing farmers' access to information, production inputs, and market opportunities, which ultimately improve income. Furthermore, infrastructure availability (X4) has the strongest positive effect on farmers' income, with a regression coefficient of 0.288, a t-value of 6.630, and a significance level below 0.001. Consequently, H_4 is accepted, indicating that better infrastructure significantly increases farmers' income. The highest t-value among all variables demonstrates that infrastructure is the most dominant factor influencing farmers' income, as adequate transportation, irrigation, and supporting facilities facilitate agricultural production and market distribution more effectively.

Simultaneous Test (F-Test)

Table 9. F-Test Results

Model	F
Regression	35.227
Residual	

Source: Processed Primary Data, 2026

Based on Table 9, the ANOVA test results yielded a calculated F-value of 35.227 with a significance level of < 0.001**.** Since the significance level is less than 0.05, H_0 is rejected and H_1 is accepted**.** This indicates that, simultaneously, the variables of access to capital (X1), technology utilization (X2), village institutions (X3), and infrastructure availability (X4) have a significant effect on farmers' income (Y). This indicates that most of the variation in farmers' income can be explained by the combination of independent variables in the research model.

Coefficient of Determination (R^2)

Table 10. Results of the Coefficient of Determination Test

Model	R	R Square	Adjusted R-Square
1	.795	.632	.614
a.		Predictors: (constant), X4, X3, X1, X2	

Source: Processed Primary Data, 2026

Based on Table 10, the Adjusted R-Square value of 0.614 indicates that 61.4% of the variation in farmers' income can be explained by the independent variables used in this study. Meanwhile, the remaining 38.6% is explained by other factors outside this research model that were not examined.

Discussion

The Effect of Access to Capital on Farmers' Income in Nitneo Village

The findings indicate that access to capital has not yet become a determining factor in increasing farmers' income in Nitneo Village. Although farmers generally have opportunities to obtain financing through formal and informal sources, the availability of capital alone is

insufficient to improve economic performance when it is not accompanied by effective management and productive utilization. In many cases, capital is still used to meet short-term household needs rather than being allocated to activities that directly support agricultural productivity. This condition suggests that financial accessibility must be accompanied by adequate financial literacy, business planning, and investment-oriented decision-making among farmers.

These findings differ from studies that emphasize the positive role of rural credit in improving agricultural productivity and income. Gelata et al. (2023) found that access to credit strengthens farmers' production capacity and supports business expansion, while Girma (2022) highlighted that credit accessibility facilitates the adoption of agricultural technologies that contribute to higher productivity. Similarly, Zhang et al. (2024) demonstrated that rural financial institutions play an important role in increasing the use of production inputs, and Wang et al. (2025) showed that credit access encourages technology adoption and farm modernization. However, the results of this study suggest that the effectiveness of capital depends largely on farmers' ability to transform financial resources into productive investments. This finding also supports the argument of Saifan et al. (2021) that financial resources alone are insufficient without complementary support such as institutional assistance, technology adoption, and extension services. Therefore, improving farmers' financial management skills and strengthening institutional support mechanisms are essential to maximizing the benefits of capital access.

The Effect of Technology Utilization on Farmers' Income in Nitneo Village

Technology utilization has emerged as an important factor contributing to farmers' income growth in Nitneo Village. The adoption of agricultural technologies enables farmers to improve production efficiency, optimize resource utilization, reduce production risks, and enhance crop yields. Modern technologies also provide farmers with better access to information regarding cultivation techniques, weather conditions, input management, and market opportunities, thereby supporting more effective farming decisions.

The findings are consistent with the growing body of literature emphasizing the importance of technological innovation in agricultural development. Ruzzante et al. (2021), through a meta-analysis of technology adoption in developing countries, concluded that technological innovations significantly improve agricultural productivity and farm performance. Similarly, Tong et al. (2025) found that climate-smart agricultural technologies contribute positively to both farmers' income and agricultural output. The role of agricultural extension services in supporting technology adoption has also been highlighted by Alam et al. (2024), Amrullah et al. (2025), Li et al. (2025), and Wang et al. (2026), who demonstrated that effective extension programs accelerate technological diffusion and improve farmers' economic outcomes. Furthermore, Alhafiz and Sela (2025) emphasized the importance of digital agricultural platforms in providing farmers with real-time information and consultation services. These findings indicate that technology serves not only as a production tool but also as a strategic resource that enhances farmers' capacity to adapt to changing agricultural conditions and market dynamics.

The Effect of Village Institutions on Farmers' Income in Nitneo Village

Village institutions play a significant role in supporting farmers' economic activities and improving their income levels. Institutions such as farmer groups and Village-Owned Enterprises (BUMDes) function as mechanisms for facilitating cooperation, information exchange, access to resources, and collective economic action. Through these institutions, farmers can gain access to production inputs, training opportunities, extension services, and broader marketing networks, which ultimately strengthen their agricultural performance and bargaining position.

The findings support previous studies emphasizing the strategic role of rural institutions in economic development. Edy and Suherman (2021) demonstrated that BUMDes contribute to agricultural production by providing business support and facilitating access to production resources. Rahman et al. (2024) further highlighted the role of BUMDes in strengthening village economies and food security. Likewise, Febrianti and Hayati (2023) argued that institutional governance improvements enhance organizational effectiveness and community participation. Nurdin et al. (2023) found that empowering village institutions contributes to local economic development and community welfare, while Jusriadi et al. (2025) emphasized that strengthening farmer groups improves rural economic resilience. These findings indicate that effective institutions serve as an important bridge connecting farmers with financial resources, technological innovations, and market opportunities. Consequently, strengthening institutional capacity and increasing farmer participation remain crucial strategies for improving agricultural income and sustainable rural development.

The Effect of Infrastructure Availability on Farmers' Income in Nitneo Village

Infrastructure availability appears to be one of the most influential factors affecting farmers' income in Nitneo Village. Adequate infrastructure facilitates agricultural production, reduces transaction costs, improves market access, and enhances the efficiency of distribution systems. Transportation networks, irrigation facilities, communication infrastructure, and digital connectivity all contribute to creating a more supportive environment for agricultural activities and economic growth.

This finding is consistent with previous research emphasizing the role of infrastructure in rural development. Wahyuni (2024) found that infrastructure development significantly improves rural welfare and economic opportunities in East Nusa Tenggara. Similarly, Kumar et al. (2025) demonstrated that access to digital services and infrastructure positively affects farm income by improving information accessibility and market participation. The importance of infrastructure can also be understood within the broader context of regional development, where agriculture functions as a leading economic sector that requires adequate supporting facilities to maximize productivity and competitiveness (Martauli, 2021; Bangkole et al., 2024). Furthermore, Yuningsih et al. (2023) emphasized that regions with strong agricultural bases require supporting infrastructure to optimize the economic contribution of the sector. Therefore, investments in transportation systems, irrigation networks, and digital infrastructure remain critical for enhancing agricultural productivity and improving farmers' welfare.

The Simultaneous Effect of Access to Capital, Technology Utilization, Village Institutions, and Infrastructure Availability on Farmers' Income in Nitneo Village

The results demonstrate that farmers' income is influenced by the interaction of multiple factors rather than by a single determinant. Access to capital, technology utilization, village institutions, and infrastructure availability collectively create an enabling environment that supports agricultural productivity and income generation. While access to capital alone may not directly improve income, its effectiveness increases when combined with technology adoption, institutional support, and adequate infrastructure. This finding suggests that improving farmers' welfare requires an integrated development approach rather than isolated interventions.

The results support the broader perspective that agricultural development is multidimensional and depends on the interaction between financial, technological, institutional, and infrastructural factors. Studies by Alam et al. (2024), Amrullah et al. (2025), Li et al. (2025), and Wang et al. (2026) emphasize that technology adoption becomes more effective when supported by extension systems and enabling institutional environments. Likewise, Saifan et al. (2021) highlighted the interconnected roles of financing, technology, and

institutional support in agricultural development. The importance of institutional strengthening has been demonstrated by Rahman et al. (2024), Nurdin et al. (2023), Febrianti and Hayati (2023), Jusriadi et al. (2025), and Edy and Suherman (2021), while the contribution of infrastructure to rural welfare has been confirmed by Wahyuni (2024) and Kumar et al. (2025). Furthermore, studies by Martauli (2021), Bangkole et al. (2024), and Yuningsih et al. (2023) indicate that agriculture remains a strategic sector in driving regional economic growth and improving community welfare. Therefore, policies aimed at increasing farmers' income should focus on strengthening the synergy among financial access, technology utilization, institutional capacity, and infrastructure development to achieve sustainable rural economic growth.

5. Conclusion

This study examined the influence of access to capital, technology utilization, village institutions, and infrastructure availability on farmers' income in Nitneo Village, West Kupang District. The findings reveal that farmers' income is primarily influenced by technology utilization, village institutions, and infrastructure availability, whereas access to capital does not directly contribute to income improvement. These results suggest that financial resources alone are insufficient to enhance farmers' welfare unless they are accompanied by effective management, productive investment, and supporting agricultural systems.

Among the examined factors, infrastructure emerged as the most influential determinant of farmers' income, highlighting the importance of transportation facilities, irrigation systems, and supporting agricultural infrastructure in improving production efficiency and market accessibility. Technology utilization also plays a crucial role in increasing productivity and supporting more efficient farming practices, while village institutions contribute by facilitating access to information, resources, and economic opportunities. The findings indicate that farmers' income is shaped by the interaction of financial, technological, institutional, and infrastructural dimensions rather than by a single factor.

Theoretically, this study contributes to the literature on rural economic development by providing empirical evidence that improvements in farmers' welfare require an integrated development approach. The findings reinforce the argument that technology adoption, institutional capacity, and infrastructure development are essential complements to financial access in enhancing agricultural performance and income generation. This study also enriches the empirical literature on farmer income determinants in rural areas, particularly within the context of eastern Indonesia, where empirical studies remain relatively limited.

Practically, the findings imply that local governments and development stakeholders should prioritize the improvement of agricultural infrastructure, strengthen farmer groups and Village-Owned Enterprises (BUMDes), expand access to agricultural technologies and extension services, and improve farmers' managerial and financial capabilities. Such integrated interventions are expected to create a more supportive environment for sustainable agricultural development and rural economic growth.

This study is limited to a single rural area with specific socio-economic and agroecological characteristics, which may restrict the generalizability of the findings to other regions. In addition, the study focuses on four explanatory variables and does not fully capture other factors that may influence farmers' income, such as landholding size, farming experience, educational attainment, market accessibility, commodity price fluctuations, climate variability, and household characteristics.

Future research is recommended to expand the geographical scope by comparing multiple villages or districts with different agricultural and socio-economic conditions. Further studies may also incorporate additional variables related to human capital, market integration, digital agriculture adoption, climate resilience, and agricultural policy interventions to obtain a

more comprehensive understanding of farmers' income determinants. Moreover, the application of mixed-methods or longitudinal approaches would provide deeper insights into how financial, technological, institutional, and infrastructural factors interact over time to influence rural livelihoods and sustainable agricultural development.

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