INTERNATIONAL JOURNAL OF FINANCIAL ECONOMICS (IJEFE) https://wikep.net/index.php/IJEFE
Vol. 3 No. 3 September 2026, page 393-408 e-ISSN: 3063-3648

DETERMINANTS OF RICE FARMERS' PRODUCTION AND INCOME IN SUBAK JAKA, KUKUH VILLAGE, MARGA DISTRICT, TABANAN REGENCY

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Abstract. Rising rice production in Bali Province has not been fully matched by improved farmer welfare, as reflected in the Farmers' Terms of Trade (Nilai Tukar Petani/NTP) for the food-crop subsector, which fell below 100 in 2021 and 2022. This condition is compounded by farmers' practice of selling unhulled rice directly to buyers/collectors (pembeli/pengepul) rather than through village-owned enterprises (BUMDes), leaving the selling price highly dependent on market mechanisms and the farmers' weak bargaining position. This study aims to analyze the influence of social capital, agricultural technology, land area, and farming experience on rice production and farmer income, and to examine the mediating role of rice production, among farmers of Subak Jaka, Kukuh Village, Marga District, Tabanan Regency. A sample of 73 respondents was drawn from a population of 276 farmers using proportionate stratified random sampling across five tempek groups, and data were analyzed using Partial Least Squares–Structural Equation Modeling (PLS-SEM) with SmartPLS 4.0. Results show that social capital, agricultural technology, land area, and farming experience each significantly and positively affect rice production. For income, social capital and agricultural technology remain significant, while land area and farming experience do not. Rice production acts as a partial mediator for social capital and technology, and a full mediator for land area and farming experience, indicating that strengthening subak institutions, technology adoption, and marketing systems should be prioritized to improve farmer welfare.
Keywords: social capital, agricultural technology, land area, farming experience, production, farmer income, PLS-SEM

INTRODUCTION

Indonesia has considerable potential as an agrarian country, supported by its vast territory, rich biodiversity, fertile soil, and high level of community participation in the agricultural sector, which plays a strategic role in the national economy and in meeting domestic food needs (Sihite et al., 2025). The development of the agricultural sector needs to be supported by policies capable of increasing productivity while maintaining a balance among economic growth, efficiency, and farmers' welfare, particularly for smallholder farmers and low-income communities (Gaskell, 2020; Sugiantara & Suyana, 2019). Agriculture also constitutes an important component of regional economic development because it contributes to food provision, income generation, employment opportunities, poverty alleviation, and food security. Therefore, effective and sustainable agricultural development requires support from both the government and the community (Sarfiah et al., 2019). Bali Province, covering an area of 5,590.15 km^2 and comprising nine regencies/cities, has substantial agricultural land potential. However, it faces increasing pressure from agricultural land conversion due to the expansion of industrial and residential areas. Consequently, the availability of agricultural land needs to be maintained to meet the food requirements of the continuously growing population (Badan Pusat Statistik Provinsi Bali, 2024)

Table 1. Rice Production by Regency/City in Bali Province, 2020–2024 (Tons)

No.	Regency/City	2020	2021	2022	2023	2024
1	Jembrana	47,178.10	50,258.40	58,158.77	63,854.00	56,064.49
2	Tabanan	142,846.03	166,880.26	169,265.45	169,511.90	163,226.78
3	Badung	83,587.23	90,233.06	99,406.39	104,711.29	97,113.36
4	Gianyar	91,622.56	117,895.26	133,658.86	123,419.53	114,966.06
5	Klungkung	25,764.98	24,805.55	25,734.39	28,592.07	24,675.67
6	Bangli	13,626.32	19,653.20	21,630.80	20,576.28	17,809.51
7	Karangasem	41,009.95	40,868.57	52,090.59	47,628.13	48,086.36
8	Buleleng	62,836.23	82,975.62	90,707.72	91,383.19	89,942.72
9	Denpasar	23,697.05	25,340.89	29,948.63	23,904.26	23,588.01
Bali Province		**532,168.45**	**618,910.81**	**680,601.60**	**673,580.65**	**635,473.35**

Source: Badan Pusat Statistik Provinsi Bali, 2025

As shown in Table 1, Tabanan Regency has the highest rice production in Bali and is widely recognized as the “rice granary” of Bali Province due to its substantial contribution to rice production. Rice serves not only as a staple food commodity but also as a major source of income for many farmers in Tabanan. The regency consistently recorded the highest rice production in Bali, with production generally increasing over the observed period before declining in 2024 from 169,511.90 tons to 163,226.78 tons. This decline may have been influenced by several factors, including agricultural land conversion and climate change, which can affect cultivation processes and production levels. Other regencies, such as Gianyar and Badung, also recorded relatively high rice production, although their production levels remained below those of Tabanan. In contrast, Bangli and Klungkung recorded the lowest rice production, with each producing less than 30,000 tons.

In the context of agricultural development, the availability of paddy fields is an important indicator for assessing the sustainability of food production, particularly because rice is a major agricultural commodity. Changes in the area of paddy fields are influenced not only by natural factors but also by development pressures, population growth, and land conversion (Barrett, 2022). Economists emphasize that the sustainability of food production is highly dependent on the availability of agricultural land. Paddy fields constitute a limited and relatively inelastic factor of production; therefore, changes in their area can affect long-term agricultural production (Fuglie et al., 2021). Agricultural land conversion has consequently become an important concern because it not only reduces the cultivated area but may also decrease the efficiency of production systems and increase vulnerability to local food crises.

Table 2 presents data on the area of paddy fields cultivated with rice across districts in Tabanan Regency during the 2020–2024 period. The data indicate that each district exhibits different patterns in the development of paddy field areas. Several districts, such as Penebel and Tabanan, demonstrate relatively stable conditions, with paddy field areas remaining generally consistent throughout the period. However, some districts show a gradual declining trend, while others exhibit considerable fluctuations in the area of paddy fields cultivated with rice.

Table 2. Area of Paddy Fields Cultivated with Rice by District in Tabanan Regency, 2020–2024

No.	District	2020 (Ha)	2021 (Ha)	2022 (Ha)	2023 (Ha)	2024 (Ha)
1	West Selemadeg	624	748	748	748	748
2	Selemadeg	1,443	1,709	1,049	10	869
3	East Selemadeg	957	1,225	458	361	304
4	Kerambitan	751	1,194	1,091	1,037	948
5	Tabanan	1,804	1,804	1,806	1,706	1,806
6	Kediri	1,716	1,810	1,896	2,733	2,733
7	Marga	1,500	1,589	1,831	1,844	1,432
8	Baturiti	1,524	1,481	902	1,430	1,276
9	Penebel	3,745	3,864	3,864	3,864	3,864
10	Pupuan	797	729	808	795	758
Total		**14,861**	**16,153**	**14,453**	**14,528**	**14,738**

Source: Tabanan Regency Agriculture Office.

Marga District is one of the ten districts in Tabanan Regency. The district experienced an increase in paddy field area from 2020, reaching its peak in 2023, followed by a considerable decline in 2024. This condition indicates complex dynamics in land utilization influenced by social and economic factors (Suryani et al., 2023). From the supply perspective, this decline may be associated with a reduction in major factors of production, particularly agricultural land resulting from its conversion to non-agricultural uses. From an external perspective, climate change, which affects rainfall patterns and planting seasons, also contributes to production instability (IPCC, 2021; FAO, 2023). From an environmental economics perspective, this condition reflects a trade-off between economic development and the sustainability of agricultural land resources..

Table 3. Paddy Field Area in Marga District in 2025 (Ha)

No	Village	Subak	Area (Ha)
1	Baru	Susut	49,00
		Pinge	41,00
		Baru	60,00
2	Tua	Kedokan	71,00
		Pama	46,00
		Belaluan	41,00
3	Payangan	Bunutin	24,00
		Payangan	81,00
		Gelagah	33,00
4	Dauh Puri	Sidang Rapuh	70,00
		Ole	40,00
5	Dajan Puri	Gangsang	81,00
6	Geluntung	Uma Bali	73,00
7	Petiga	Semingan	58,00
		Bena	67,00
8	Marga	Penataran	120,00
9	Kuwum	Apit Jaring	118,00

10	Tegal Jadi	Adeng	44,00
		Pengembungan	46,00
		Tegal Jadi	53,00
11	Kukuh	Delod Kukuh	30,00
		Saih	62,00
		Jaka	46,77
		Dukuh	42,00
12	Beringkit	Sungi I	64,00
13	Peken	Tinjak Menjangan	32,00
14	Batan Nyuh	Guama	180,00
15	Selanbawak	Selanbawak	58,00
16	Cau Belayu	Luwus I	99,00
	Total		**1829,77**

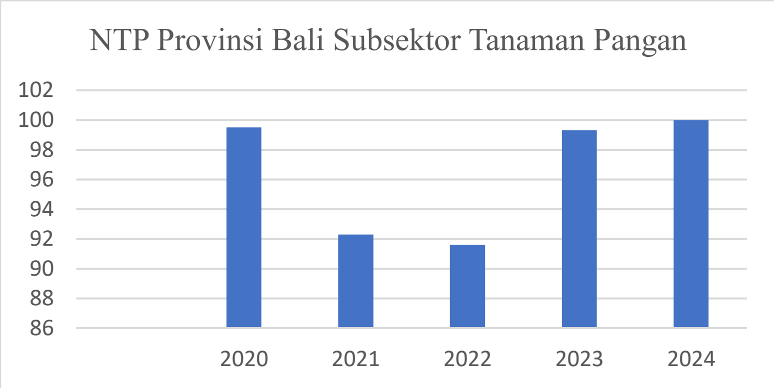
Source: Marga Agricultural Extension Agency

Marga District consists of 16 villages, one of which is Kukuh Village. Kukuh Village comprises eight administrative hamlets (banjar dinas) and is located at an elevation of 300–500 meters above sea level, with relatively high rainfall, making it suitable for rice cultivation. Based on data on agricultural land area in Marga District in 2025, agricultural land in Kukuh Village is distributed among several subak, including Subak Delod Kukuh, Saih, Jaka, and Dukuh. One of the subak examined further in this study is Subak Jaka, which covers an area of 46.77 hectares. Subak Jaka was selected because its land area is relatively smaller than that of several other subak in Marga. Despite its relatively limited area, traditional activities within Subak Jaka, including rituals, sangkep (traditional meetings), and gotong royong (mutual cooperation), remain actively practiced. Unlike Jatiluwih, Subak Jaka is neither designated as a World Cultural Heritage site nor developed as an agrotourism center. Therefore, it does not receive special promotional attention and more closely represents the typical conditions experienced by the majority of Balinese farmers rather than an exceptional case.

Most subak systems in Bali, including Subak Jaka, currently operate on a medium scale and face considerable pressure from changes in land use (Marga Agricultural Extension Agency, 2025). This condition makes Subak Jaka relevant for examining how the subak system continues to survive amid modernization, agricultural land conversion, and socioeconomic changes within the community. Agricultural product marketing is another important issue that needs to be considered in efforts to increase farmers' income. Rice farmers' decisions to sell harvested paddy to middlemen indicate limitations in market access that may weaken farmers' bargaining position (Gryseska et al., 2024). Based on preliminary observations and interviews with the pekaseh (head of the subak) of Subak Jaka in Kukuh Village, farmers generally do not sell their harvested paddy through Village-Owned Enterprises (Badan Usaha Milik Desa—BUMDes); instead, most farmers market their produce independently to collectors. Consequently, paddy selling prices are largely determined by market mechanisms and farmers' bargaining position. Farmers also face unstable paddy prices, dependence on collectors, and limited marketing access in the distribution of their harvest. Therefore, even when production increases, farmers' income does not necessarily increase because it is also affected by selling prices, rising production costs, and weak institutional support.

Based on data from Statistics Bali Province (Badan Pusat Statistik Provinsi Bali), the Farmers' Terms of Trade (Nilai Tukar Petani—NTP) in the food crop subsector fluctuated from year to year during the 2020–2024 period.

Figure 1. Farmers' Terms of Trade in the Food Crop Subsector of Bali Province



Source: Statistics Bali Province, 2024

As shown in Figure 1, the Farmers' Terms of Trade (Nilai Tukar Petani—NTP) in 2020 was close to 100, indicating that farmers were approaching the break-even point. However, in 2021 and 2022, the NTP declined sharply to below 100, indicating increasing pressure on farmers' welfare, as the costs incurred by farmers exceeded the income they received. This condition was associated with rising production costs, including the prices of fertilizers, seeds, and pesticides. In 2023, the NTP increased to nearly 99, indicating an improvement in farmers' economic conditions, and in 2024, it reached the break-even level of 100. Nevertheless, these fluctuations indicate that farmers' welfare remains unstable and that increases in agricultural production have not been consistently accompanied by increases in farmers' income. Fluctuations in the NTP are also closely related to the prices of agricultural commodities received by farmers, including the selling price of harvested paddy.

Based on paddy price data from Statistics Bali Province, prices at the farmer and milling levels ranged from IDR 4,000 to IDR 6,000 per kilogram. Compared with the government purchase price, these prices were relatively above the minimum standard established by the government. Theoretically, this condition should provide greater price and income security for farmers. However, even when paddy prices are relatively favorable, farmers' revenue is determined by both the selling price and the quantity of production, while production costs include various expenditures such as labor, fertilizers, and other costs incurred during the production process. In this regard, rice farmers in Bali continue to face various constraints that affect their income, including limited land area, technology use, farming experience, and distinctive social obligations associated with religious ceremonies.

Within the subak system, agricultural activities are closely associated with religious rituals conducted from the pre-planting stage through harvest ceremonies. These activities require additional material and labor costs. Although they provide social and spiritual value and strengthen social capital among farmers, from an economic perspective, they may increase the production costs borne by farmers. Therefore, even when paddy prices are above the Government Purchase Price (Harga Pembelian Pemerintah—HPP), farmers' income does not necessarily increase because it is influenced by various factors, including social capital, technology, land area, and farming experience.

This indicates that farmers' income should not be analyzed solely from the perspective of selling prices but should also take into account the broader range of factors that influence income.

Differences in access to technology, land area, farming experience, and social capital are expected to influence production levels, which ultimately affect farmers' income in Kukuh Village. This condition indicates uncertainty in the relationship between agricultural production and farmers' income. Rice production is an important indicator of farming success and serves as an intermediary variable linking production inputs to farmers' income. In rice farming, production is influenced by a combination of social, economic, and technical factors, while farmers' income is determined not only by the production factors they possess but also by the level of output generated (Supriyo & Indriani, 2022). Therefore, rice production serves as a mediating variable that explains how social capital, land area, technology, and farming experience indirectly influence the income of rice farmers in Kukuh Village, Marga District. The principle of optimizing the use of production factors emphasizes their efficient utilization. In economic terminology, efficiency can be classified into three categories: technical efficiency, allocative efficiency (price efficiency), and economic efficiency (Supriyo & Indriani, 2022).

The use of production factors is considered technically efficient when the value of the marginal product is equal to the price of the corresponding production factor, while economic efficiency is achieved when agricultural activities attain both technical and price efficiency (Soekartawi, 2019). Increasing demands for resource-use efficiency have also highlighted the importance of technology adoption. Appropriate agricultural technology can enhance the competitiveness of agricultural products by improving the efficiency with which production factors are utilized. Farmers must also distinguish between technical knowledge and organizational or managerial knowledge. Technical knowledge is applied as physical capital, whereas managerial knowledge is applied as human capital. Agricultural production can increase either through the addition of one or more production factors or through improvements in the utilization patterns of existing production factors without increasing their quantity. In this context, social factors may also contribute to improvements in farmers' production and income.

The use of modern technology in agriculture also plays an important role in improving agricultural output. Putra et al. (2022) revealed that the adoption of agricultural technologies, such as improved crop varieties and efficient irrigation systems, can increase rice production. With appropriate technology, farmers can optimize their yields, thereby contributing to higher income. However, farmers' income is also strongly influenced by the prevailing price of rice at the farm level. Issues related to rice prices and the availability of production inputs are closely associated with institutional support. Insufficient institutional support weakens farmers' bargaining position, limiting their ability to influence selling prices that are often determined unilaterally by traders. Collaboration among farmers, agricultural officers, traders, and entrepreneurs may help address these problems, strengthen farmers' motivation, promote technology adoption, and improve production performance. Many agricultural technologies have not yet been widely adopted due to limited capital. Furthermore, some farmers cultivate land that they do not personally own but instead manage as tenants or sharecroppers, which may reduce their income. Thus, the success of agricultural development in the era of globalization depends substantially on farmers' mastery of agricultural technology and their ability to remain competitive.

Agricultural land area is another important factor affecting production and farmers' income. In general, a larger cultivated area provides greater potential for agricultural output, which may subsequently increase farmers' income. Agricultural land is therefore an important determinant of agricultural commodity production, as larger areas generally provide greater production capacity (Maryoni, 2025). Data from Statistics Indonesia indicate that farmers with larger landholdings have greater potential to produce higher quantities of rice. Antari and Utami (2019) similarly found that farmers with larger land areas tend to earn higher incomes than farmers with limited landholdings.

In this context, increasing rice production requires support from various factors, including social capital, agricultural technology, land area, and farming experience, to ensure that the outcomes achieved are optimal and sustainable (Putri & Wulandari, 2018). Social capital, as an intangible resource encompassing relational networks, trust, and social norms, has been identified as an important factor supporting improvements in agricultural production. According to Suryani and Wijaya (2020), social capital enables farmers to exchange information and resources that facilitate the adoption of new agricultural technologies in Gianyar Regency. This is particularly relevant given that technology adoption continues to face various social and economic barriers.

Kartika and Santoso (2021), in their study conducted in Bangli Regency, explained that the application of technologies such as the jajar legowo planting system and modern agricultural machinery can significantly increase rice production. However, their study did not examine how these technologies interact with social capital and farming experience in villages with different characteristics. A study conducted by Wahyu Utami et al. (2022) in Subak Gubug, Tabanan, found that land area and production significantly influenced rice farmers' income, but did not examine social capital or technology. Similarly, Rahmawati et al. (2019) reported that although land area positively affected productivity, production performance was highly dependent on land management and the successful integration of other factors, such as farming experience. Furthermore, Nurhayati et al. (2022), in a study conducted in Central Java, found that social capital significantly influenced rice farmers' productivity and income, particularly because strong social networks facilitated information distribution and cooperation among farmers in managing agricultural land and marketing their products.

Most previous studies have focused on conventional economic factors, such as land area and production costs, while comprehensive studies examining the effects of social capital—particularly subak mutual cooperation, rituals, and local wisdom unique to the Balinese subak system—together with technology adoption, land area, and farming experience on rice production and farmers' income remain limited, particularly in Kukuh Village, Marga District, Tabanan Regency. This research gap is important because the social and economic characteristics of the study area differ from those examined in previous studies, thereby requiring a context-specific analysis to support more targeted agricultural policies with tangible impacts on the welfare of local farmers. The findings of this study are expected to provide useful policy input for the Tabanan Regency Agriculture Office, particularly in supporting subak preservation and strengthening local food security.

METHOD

This study employed a quantitative method with an associative research design to analyze the effects of social capital, technology, land area, and farming experience on rice farmers' income, with rice production serving as a mediating variable. The study was conducted in Subak Jaka, Kukuh Village, Marga District, Tabanan Regency, which was selected because it represents a transitional setting between traditional agricultural systems and modern economic development. The research variables comprised social capital, technology, land area, farming experience, production, and income. Social capital was measured through compliance with customary subak norms, trust, social networks and cooperation, preservation of local wisdom, implementation of the Tri Hita Karana philosophy, and participation in subak traditions and rituals (Yustika, 2015). Technology was measured based on the use of pest sprayers, rice-field plowing machinery, fertilizers, and modern rice varieties (Srimenganti & Hardiyanto, 2023). Production was measured in kilograms per harvest season, income in Indonesian rupiah per harvest season, land area in are, and farming experience in years, while social capital and technology were measured using a 1–5 Likert scale in accordance with the operational definitions of the research variables (Moh. Nazir, 2005).

The study population consisted of 276 rice farmers distributed across five tempek within Subak Jaka, comprising 15 farmers in Pangkung, 126 in Gede, 72 in Dayang, 26 in Tirta Nadi, and 37 in Delod Sema. Based on the Slovin formula with a 10% margin of error, a sample of 73 respondents was obtained. The sample was determined using proportionate stratified random sampling according to the proportion of farmers in each tempek, after which respondents were selected through simple random sampling. The sample consisted of 5 farmers from Pangkung, 33 from Gede, 19 from Dayang, 7 from Tirta Nadi, and 10 from Delod Sema. Respondents were selected based on the criteria that they were actively engaged in rice farming during the most recent harvest season, were willing to participate in interviews, and resided in and managed agricultural land within one of the tempek of Subak Jaka. The study utilized primary data obtained directly from farmers through observation, structured interviews, and in-depth interviews with farmers and the pekaseh of Subak Jaka (Sugiyono, 2023).

Data analysis was conducted using descriptive and inferential statistics. Descriptive statistics were employed to describe respondents' characteristics and response tendencies based on mean values, while inferential analysis was performed using Structural Equation Modeling (SEM) based on Partial Least Squares (PLS) with SmartPLS 4.0 (Dhamayantie & Fauzan, 2017). The outer model was evaluated using convergent validity, discriminant validity, composite reliability, and Cronbach's Alpha, while the inner model was assessed based on R-Square (R^2), path coefficients, and t-statistics obtained through the bootstrapping procedure. Hypothesis testing was conducted at a 5% significance level, with the criteria of t-statistic ≥ 1.96 and p-value ≤ 0.05, using 5,000 bootstrap subsamples. Mediation testing was performed by analyzing the effects of the exogenous variables on production, the effect of production on income, and the direct effects of the exogenous variables on income to determine whether production functioned as a full mediator (full mediation), a partial mediator (partial mediation), or did not serve as a mediating variable (Ghozali & Latan, 2015; Hair et al., 2022).

RESULTS AND DISCUSSION

Results of Inferential Analysis

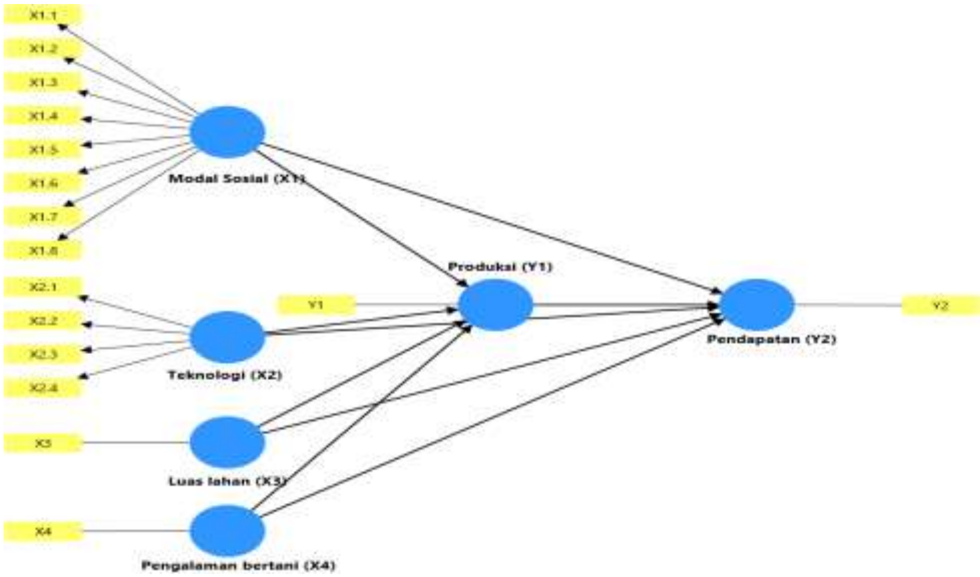
Inferential analysis is a statistical approach used to examine the relationships and effects among research variables and to draw conclusions about the population based on data obtained from the sample. This analysis was conducted to test the formulated research hypotheses and determine the effects of the independent variables on the dependent variables. In this study, the analysis employed a Structural Equation Modeling (SEM) approach based on Partial Least Squares (PLS).

Outer Model Assessment

a) Partial Least Squares (PLS) Model Scheme

This study employed the Partial Least Squares (PLS) analysis technique using SmartPLS 4.1.1.8. The PLS model scheme used in this study is presented below.

Figure 2. Partial Least Squares (PLS) Model Scheme



Sumber : Data Primer Diolah, 2026

b) Convergent Validity

Table 4. Convergent Validity Test Results

Variable	Indicator	Outer Loading	Description
Social Capital (X1)	$X_{1.1}$	0.832	Valid
	$X_{1.2}$	0.817	Valid
	$X_{1.3}$	0.837	Valid
	$X_{1.4}$	0.843	Valid
	$X_{1.5}$	0.773	Valid
	$X_{1.6}$	0.775	Valid
	$X_{1.7}$	0.785	Valid
	$X_{1.8}$	0.838	Valid
Technology (X2)	$X_{2.1}$	0.858	Valid
	$X_{2.2}$	0.916	Valid
	$X_{2.3}$	0.835	Valid
	$X_{2.4}$	0.854	Valid

Source: Processed Primary Data, 2026

Based on the convergent validity test results presented in Table 4, all indicators of the Social Capital (X1) variable have outer loading values ranging from 0.773 to 0.838, while those of the Technology (X2) variable range from 0.835 to 0.916. All values exceed the minimum threshold of 0.70, indicating that all indicators are valid, adequately reflect their respective constructs, and are suitable for further analysis.

c) Discriminant Validity

Table 5. Heterotrait-Monotrait Ratio (HTMT)

Construct Relationship	Heterotrait-Monotrait Ratio (HTMT)
Social Capital (X1) ↔ Land Area (X3)	0.062
Income (Y2) ↔ Land Area (X3)	0.538
Income (Y2) ↔ Social Capital (X1)	0.514
Farming Experience (X4) ↔ Land Area (X3)	0.184
Farming Experience (X4) ↔ Social Capital (X1)	0.076
Farming Experience (X4) ↔ Income (Y2)	0.073
Production (Y1) ↔ Land Area (X3)	0.806
Production (Y1) ↔ Social Capital (X1)	0.174
Production (Y1) ↔ Income (Y2)	0.803
Production (Y1) ↔ Farming Experience (X4)	0.109
Technology (X2) ↔ Land Area (X3)	0.143
Technology (X2) ↔ Social Capital (X1)	0.121
Technology (X2) ↔ Income (Y2)	0.262
Technology (X2) ↔ Farming Experience (X4)	0.057
Technology (X2) ↔ Production (Y1)	0.074

Source: Processed Primary Data, 2026

Based on Table 5, the HTMT test results indicate that all pairs of constructs have HTMT values below 0.90. The highest HTMT value is observed for the relationship between Production and Land Area, at 0.806, while the lowest value is found for the relationship between Technology and Farming Experience, at 0.057. Since all HTMT values are below the established maximum threshold, the criteria for discriminant validity based on the HTMT method are satisfied. This indicates that each variable measures a distinct construct and that there is no substantial overlap among the constructs.

In addition to HTMT, discriminant validity was also assessed using the Average Variance Extracted (AVE). The AVE value indicates the proportion of variance in the indicators explained by the latent construct. A construct is considered valid when its AVE value exceeds 0.50. The results of the AVE assessment are presented in Table 6.

Table 6. Discriminant Validity Based on the Average Variance Extracted (AVE) Method

	Average Variance Extracted (AVE)	Description
Social Capital (X_1)	0.661	Valid
Technology (X_2)	0.750	Valid

Source: Processed Primary Data, 2026

Based on Table 6, the Social Capital variable has an AVE value of 0.661, while the Technology variable has an AVE value of 0.750. Both values exceed the minimum threshold of 0.50, indicating that all constructs satisfy the discriminant validity criteria based on the AVE method. These results demonstrate that each construct is able to explain a greater proportion of the variance in its indicators than the variance attributable to measurement error, indicating that the measurement model has adequate discriminant validity.

Therefore, the measurement model is suitable for proceeding to the reliability and structural model assessment stages.

d) Composite Reliability

Tabel 7. Composite reliability

	Cronbach's alpha	Composite Reliability
Social Capital (X_1)	0.927	0.940
Technology (X_2)	0.893	0.923

Source: Processed Primary Data, 2026

Table 7 shows that all constructs with more than one indicator satisfy the reliability criteria. This is demonstrated by the Cronbach's Alpha and Composite Reliability values for each variable, all of which exceed the minimum threshold of 0.70. These results indicate that each construct demonstrates a very high level of internal consistency in measuring the variables examined in this study. Therefore, the research instrument is considered reliable and suitable for use in subsequent stages of analysis.

Structural Model Evaluation Results (Inner Model)

The inner model evaluation aims to assess the ability of the research model to explain the relationships among latent variables formulated based on the research hypotheses. The evaluation is conducted by examining the R-square value as an indicator of the model's goodness of fit. The PLS model can be evaluated by examining the R-square predictive relevance of the variables. In assessing the structural model using PLS, the Q-square value for each endogenous latent variable can also be used to determine the predictive strength of the structural model. If the Q-square value is greater than zero, the research model is considered to have relevant predictive capability and is therefore suitable for explaining the relationships among the variables under investigation.

1) R-Square Value

Table 8. R-Square Test Results

Variable	R-square	R-square adjusted
Production (Y_1)	0.756	0.742
Income (Y_2)	0.837	0.825

Source: Processed Primary Data, 2026

Based on Table 8, the R-square value for Production is 0.756, indicating that 75.6% of the variation in Production can be explained by social capital, technology, land area, and farming experience, while the remaining 24.4% is explained by other factors outside the model. Meanwhile, the R-square value for Income is 0.837, indicating that 83.7% of its variation can be explained by the variables included in the model, while the remaining 16.3% is attributable to other factors. Therefore, both values fall within the substantial category and demonstrate the model's strong explanatory power (Hair et al., 2022).

2) Predictive-Relevance (Q-Square)

The Q-square assessment of the inner model is used to evaluate predictive relevance, where a value greater than zero indicates that the model has adequate predictive capability. Based on the calculation of Q-square = $1 - [(1 - 0.756)(1 - 0.837)]$, a value of 0.961 was obtained, indicating very strong predictive relevance. Thus, the model is able to explain 96.1% of the variation in the data, while the remaining 3.9% is influenced by other factors outside the research model.

Hypothesis Testing

Table 9. Direct Effect Test Results

Hypothesis	Original Sample	T-Statistics	P-Value	Decision
Social Capital → Production	0.125	2.141	0.032	Significant
Technology → Production	0.141	2.257	0.024	Significant
Land Area → Production	0.867	19.480	0.000	Significant
Farming Experience → Production	0.263	4.338	0.000	Significant
Social Capital → Income	0.352	6.277	0.000	Significant
Technology → Income	0.186	3.601	0.000	Significant
Land Area → Income	−0.174	1.761	0.078	Not Significant
Farming Experience → Income	−0.075	1.262	0.207	Not Significant
Production → Income	0.880	8.925	0.000	Significant

Source: Processed Primary Data, 2026

Based on the test results presented in Table 9, social capital (β = 0.125; t = 2.141; p = 0.032), technology (β = 0.141; t = 2.257; p = 0.024), land area (β = 0.867; t = 19.480; p = 0.000), and farming experience (β = 0.263; t = 4.338; p = 0.000) have positive and significant effects on production; therefore, H0 is rejected for each of these relationships. With respect to income, social capital (β = 0.352; t = 6.277; p = 0.000) and technology (β = 0.186; t = 3.601; p = 0.000) have positive and significant effects, whereas land area (β = −0.174; p = 0.078) and farming experience (β = −0.075; t = 1.262; p = 0.207) do not have significant effects; therefore, H0 is accepted for these two relationships. Meanwhile, production has a positive and significant effect on income, with a coefficient of 0.880, a t-statistic of 8.925, and a p-value of 0.000, indicating that an increase in production is associated with an increase in farmers' income. Overall, these findings demonstrate that social capital, technology, land area, and farming experience contribute to increasing production, whereas improvements in farmers' income are primarily supported by social capital, technology, and production.

Indirect Effect Test

Table 10. Indirect Effect Test Results

Relationship	Original Sample	T-Statistics	P-Value	Decision
Social Capital → Production → Income	0.110	2.177	0.030	Significant
Technology → Production → Income	0.124	2.254	0.024	Significant
Land Area → Production → Income	0.763	7.746	0.000	Significant
Farming Experience → Production → Income	0.231	3.885	0.000	Significant

Source: Processed Primary Data, 2026

Based on the data analysis results presented in Table 10, the original sample, p-value, and t-statistic for each relationship are explained as follows:

1) The Mediating Role of Production in the Effect of Social Capital on Income

Social capital has an indirect effect on income through production, with a coefficient of 0.110, a t-statistic of 2.177, and a p-value of 0.030. These results indicate that production is able to mediate the relationship between social capital and farmers' income.

2) The Mediating Role of Production in the Effect of Technology on Income

Technology has an indirect effect on income through production, with a coefficient of 0.124, a t-statistic of 2.254, and a p-value of 0.024. These results indicate that production also serves as a mediator in the relationship between technology and farmers' income.

3) The Mediating Role of Production in the Effect of Land Area on Income

Land area has the largest indirect effect on income through production, with a coefficient of 0.763, a t-statistic of 7.746, and a p-value of 0.000. This finding indicates that an increase in land area contributes to higher production, which ultimately leads to an increase in farmers' income.

4) The Mediating Role of Production in the Effect of Farming Experience on Income

Farming experience also has a significant indirect effect on income through production, with a coefficient of 0.231, a t-statistic of 3.885, and a p-value of 0.000. This finding demonstrates that farming experience contributes to farmers' income through its effect on production.

Mediation Effect Testing

Table 11. Mediation Effect Test Results

Relationship	Direct Effect	Indirect Effect	Type of Mediation
Social Capital → Income	Significant	Significant	Partial Mediation
Technology → Income	Significant	Significant	Partial Mediation
Land Area → Income	Not Significant	Significant	Full Mediation
Farming Experience → Income	Not Significant	Significant	Full Mediation

Source: Processed Primary Data, 2026

As shown in Table 11, production serves as a partial mediator in the relationships between social capital and income and between technology and income. This is because both the direct and indirect effects in these relationships are statistically significant. Meanwhile, production serves as a full mediator in the relationships between land area and income and between farming experience and income, as their direct effects on income are not statistically significant, whereas their indirect effects through production are significant.

Discussion

The findings demonstrate that social capital, technology, land area, and farming experience have positive and significant effects on rice production in Subak Jaka. Social capital, reflected in trust, norms, networks, and local wisdom values, strengthens coordination among farmers, particularly in water management and collective activities, while technology, including the use of tractors and improved rice varieties, enhances the efficiency of cultivation processes. Land area is the dominant factor in increasing production capacity, whereas farming experience develops farmers' practical knowledge and accuracy in determining fertilization schedules, controlling pests, and managing farming activities. These findings reinforce the Cobb-Douglas production theory, which suggests that production is determined not only by physical inputs but also by efficiency, technology, and human capital.

In terms of income, social capital and technology have direct positive and significant effects on farmers' income. Social capital can reduce transaction costs through cooperation, trust, collective input purchasing, and relationships with buyers, while technology adoption improves efficiency in terms of time, labor, and production costs. In contrast, land area and farming experience have negative but statistically insignificant direct effects on income. An increase in land area is also accompanied by higher production costs, while farming experience contributes more strongly to technical cultivation skills than to marketing capabilities and price negotiation. This condition is also influenced by farmers' dependence on collectors and the limited effectiveness of marketing institutions in strengthening farmers' bargaining position.

Production has a positive and significant effect on farmers' income, with a coefficient of 0.880, representing the strongest effect in the income model. Higher rice production increases the quantity of harvested output available for sale, thereby potentially increasing farmers' revenue and income. Nevertheless, increased production does not necessarily guarantee a proportional improvement in farmers' welfare because selling prices remain largely determined by collectors due to the absence of formal marketing institutions at the subak or village level. These findings confirm that production is a key variable linking various input factors to improvements in farmers' income.

The mediation analysis indicates that production significantly mediates the effects of social capital ($\beta = 0.110$; $p = 0.030$), technology ($\beta = 0.124$; $p = 0.024$), land area ($\beta = 0.763$; $p = 0.000$), and farming experience ($\beta = 0.231$; $p = 0.000$) on income. Production serves as a partial mediator in the relationships between social capital and income and between technology and income because both the direct and indirect effects are significant. In contrast, production serves as a full mediator in the relationships between land area and income and between farming experience and income because only the indirect effects are significant. Overall, the findings emphasize the central role of production as a mechanism linking social capital, technology, land area, and farming experience to increased rice farmers' income. Therefore, efforts to improve the welfare of farmers in Subak Jaka should focus on strengthening social capital, accelerating technology adoption, protecting productive agricultural land, transferring farming knowledge, and strengthening agricultural marketing institutions.

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CONCLUSION

Based on the results of the analysis and discussion regarding the determinants of rice production and farmers' income in Subak Jaka, Kukuh Village, Marga District, Tabanan Regency, the following conclusions can be drawn:

1. Social capital, technology, land area, and farming experience individually have positive and significant effects on rice production in Subak Jaka. Land area is the most dominant determinant, followed by farming experience, technology, and social capital.
2. Social capital and technology have direct positive and significant effects on farmers' income, whereas land area and farming experience do not have significant direct effects on income.
3. Rice production has a positive and significant effect on farmers' income and has the largest coefficient among all relationships in the model, confirming its central role as a major determinant of farmers' income.
4. Production serves as a mediating variable in all relationships between the exogenous variables and income. It acts as a partial mediator in the relationships between social capital and income and between technology and income, while serving as a full mediator in the relationships between land area and income and

between farming experience and income. In the case of land area, the results indicate that land area increases income through production, whereas its direct effect on income is not statistically significant. This condition highlights the importance of integration between production and post-production processes, particularly agricultural product marketing, in optimizing the economic benefits received by farmers. Overall, all thirteen hypotheses examined in this study are supported by the empirical findings, with nine direct-effect tests and four mediation-effect tests producing results consistent with the underlying theoretical framework.

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