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Effectiveness of Organic Fertilizer Subsidies on the Profitability and Sustainability of Farmers' Savings and Loan Cooperatives

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ABSTRACT
This study examines the effectiveness of organic fertilizer subsidies and cooperative financial support in shaping the profitability and business sustainability of a farmers' savings and loan cooperative in West Sumatra Province, Indonesia. A quantitative explanatory design was applied to 115 farmer-members who had received the organic fertilizer subsidy through the cooperative's revolving fund scheme. Data were collected using a structured Likert-scale questionnaire and analyzed through validity and reliability testing, classical assumption testing, and multiple linear regression using two structural models. The results show that subsidy effectiveness and cooperative financial support jointly explain 32.6% of the variance in business profitability, while profitability together with the two exogenous variables explains 50.3% of the variance in business sustainability. Both subsidy effectiveness and cooperative financial support have a significant positive effect on profitability ($p < 0.001$), and profitability, in turn, significantly and positively affects sustainability ($p < 0.001$), confirming a partial mediation pattern. The findings suggest that organic fertilizer subsidies deliver their strongest welfare impact when channeled through cooperative institutions that simultaneously strengthen farmers' access to affordable credit and savings services. The study contributes to the literature by linking subsidy-policy effectiveness with cooperative financial intermediation and long-term sustainability outcomes, an intersection rarely examined jointly in prior research on Indonesian farmer institutions. Policy implications for subsidy targeting and cooperative capacity-building are discussed.

Keyword: *Organic Fertilizer Subsidy, Profitability, Business Sustainability, Savings and Loan Cooperative, Smallholder Farmers*

INTRODUCTION

Agriculture remains a strategic pillar of Indonesia's economy, contributing significantly to rural employment, food security, and household income for millions of smallholder farmers. To sustain agricultural productivity, the Government of Indonesia has for decades maintained a large fertilizer subsidy program, allocating approximately IDR 25 trillion in the 2024 state budget to reduce farmers' input costs and stabilize national food production . However, the scheme has increasingly shifted its emphasis toward organic and environmentally friendly fertilizers in response to widespread soil degradation caused by decades of intensive chemical fertilizer use, with roughly a quarter of national agricultural land reported to suffer moderate to severe degradation .

Despite the scale of this policy, its effectiveness in improving farmers' economic welfare continues to be debated. Widyastutik et al. (2026) found that although fertilizer quantity and access positively influence rice production and farm profit in Indonesia, the cost dimension of the subsidy itself does not always significantly determine profit, implying that distribution efficiency and complementary institutional support matter as much as the subsidy nominal value. Similarly, the OECD (2023) noted that Indonesia's fertilizer subsidy scheme faces mounting fiscal costs, price disparities, and implementation challenges that can blunt its intended welfare effects, while Osorio (2023) emphasized that accurate targeting in terms of type, amount, place, time, quality, and price is central to the program's success. These findings suggest that the effectiveness of an organic fertilizer subsidy cannot be evaluated in isolation from the institutional channel through which it reaches farmers.

Farmers' savings and loan cooperatives (Koperasi Simpan Pinjam) are one such institutional channel that is increasingly relevant in this context. Cooperatives provide farmers with access to affordable credit, revolving capital for input purchases, and savings facilities that reduce dependence on informal, high-cost lenders (Zainudin et al., 2025). Financial management practices covering savings behavior, credit access, and cash management have also been shown to be closely associated with the profitability of small-scale farming enterprises (Mang'ana et al., 2024; Gikonyo et al., 2022). At the same time, a growing body of international evidence indicates that cooperative membership itself facilitates farmers' adoption of organic fertilizer and other environmentally sustainable practices by lowering transaction costs, disseminating technical knowledge, and pooling bargaining power (Wei et al., 2022; Daadi & Latacz-Lohmann, 2021; Candemir et al., 2021). Organic-fertilizer-oriented agricultural subsidies, when properly administered, have likewise been found to enhance technical and scale efficiency and to reduce farmers' reliance on chemical inputs (Deng et al., 2025; Guo et al., 2021; Cui et al., 2022).

Despite these valuable contributions, a critical research gap persists in the intersection of these three domains subsidy effectiveness, cooperative financial support, and cooperative business performance. Previous studies have largely examined these relationships in isolation. First, research on fertilizer subsidies has predominantly focused on outcomes at the *farm household level*, such as agricultural productivity, farm income, and farmer welfare, rather than on the *cooperative as an economic entity* that facilitates the subsidy channel. This leaves a significant blind spot regarding how the success or failure of subsidy program implementation affects the financial viability of the cooperatives tasked with its distribution . Second, while studies on agricultural cooperatives have extensively explored their role in financial inclusion and their impact on member farmers, there is a notable scarcity of research modeling how the cooperative's *own* financial support mechanisms such as credit provision and savings mobilization interact with the distribution of subsidized inputs to influence its own profitability. The cooperative is treated primarily as a service provider for the farmer, rather than a business whose own sustainability is affected by how well it integrates these two functions.

This gap is theoretically important because it challenges the conventional linear model of subsidy evaluation. By focusing solely on farmer outcomes, existing literature overlooks the institutional feedback loop where program effectiveness directly impacts the capacity and continuity of the delivery agent. This is crucial from the perspective of Institutional Theory, which posits that organizations are not merely passive conduits of policy but are shaped by the institutional environment including regulatory requirements and distributional demands of subsidy schemes which in turn affects their performance and long-term viability. Furthermore, from a Stakeholder Theory perspective, cooperatives serve multiple stakeholders, including farmer-members, employees, and the government. The subsidized input program is a key government-stakeholder interaction that, if poorly managed, can create operational inefficiencies that undermine cooperative sustainability. Conversely, effective subsidy distribution can enhance the cooperative's value proposition to its members, strengthening its stakeholder relationships and financial health.

Advancing Existing Knowledge

This study addresses this gap by shifting the unit of analysis from the individual farm household to the cooperative itself, thereby advancing existing knowledge in three significant ways:

1. **Joint Modeling of Interdependent Variables:** We propose a novel empirical framework that simultaneously models the effect of (a) **organic fertilizer subsidy effectiveness** and (b) **cooperative financial support** on cooperative profitability, and subsequently analyzes how these variables together with profitability influence cooperative business sustainability. This moves beyond isolated effects to capture the dynamic interplay between subsidy implementation and cooperative financial services. This approach aligns with the Resource-Based View (RBV) by treating effective subsidy management and integrated financial services as unique, valuable organizational capabilities that can generate a sustained competitive advantage for the cooperative.
2. **A Sustainability-Focused Dependent Variable:** By centering on the sustainability of the cooperative as a business, this study extends the conversation from short-term financial gains (profitability) to long-term institutional viability. This is a critical contribution given that the long-term success of the subsidy program hinges on a stable and capable delivery network. This focus is informed by the Sustainable Livelihood Framework, which emphasizes the importance of institutional structures and financial capital in maintaining the resilience of livelihood systems in rural areas.
3. **Theoretical Integration:** Our theoretical contribution lies in integrating these diverse theoretical perspectives to build a more comprehensive model of cooperative performance within the context of a national subsidy program. RBV explains the potential for internal capability development, Institutional Theory sheds light on external pressures and adaptation, and Stakeholder Theory highlights the management of diverse interests. This integrative approach provides a richer, multi-level explanation of cooperative sustainability than has been previously offered.

Conceptual Framework and Hypotheses

Based on the theoretical arguments and the research gap outlined above, this study proposes the following hypotheses, which are depicted in the conceptual framework presented in the Method section:

H1: Organic fertilizer subsidy effectiveness has a significant positive effect on cooperative business profitability.

H2: Cooperative financial support has a significant positive effect on cooperative business profitability.

H3: Organic fertilizer subsidy effectiveness has a significant positive effect on cooperative business

sustainability.

H4: Cooperative financial support has a significant positive effect on cooperative business sustainability.

H5: Business profitability has a significant positive effect on cooperative business sustainability.

By investigating these relationships through the lenses of RBV, Institutional Theory, and Stakeholder Theory, this study aims to provide actionable empirical insights for both cooperative managers seeking to justify their participation in subsidy distribution and for policymakers in the Indonesian Ministry of Agriculture seeking cost-effective and sustainable delivery mechanisms for organic fertilizer subsidies.

METHODS

1. Research Design and Conceptual Framework

This research applies a quantitative, explanatory (associative) design intended to test causal relationships among latent constructs using survey data and multiple linear regression. The conceptual framework, presented in Figure 1, positions organic fertilizer subsidy effectiveness (X1) and cooperative financial support (X2) as exogenous variables, business profitability (Y1) as an intervening (mediating) variable, and business sustainability (Y2) as the ultimate endogenous variable.

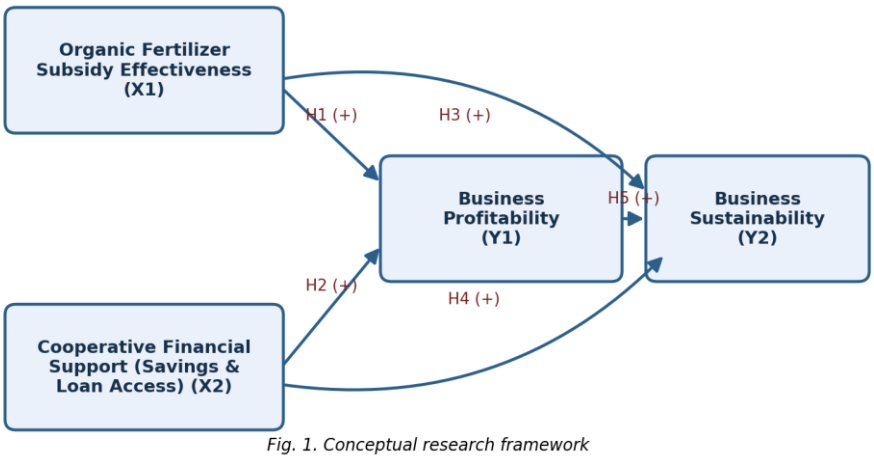

Figure 1. Conceptual research framework

2. Population, Sample, and Data Collection

The population comprises farmer-members of a farmers' savings and loan cooperative operating in a rice- and horticulture-producing district of West Sumatra Province who received the organic fertilizer subsidy channeled through the cooperative's revolving fund scheme between 2023 and 2025. Using the Slovin formula with a 5% margin of error applied to a sampling frame of approximately 165 active subsidy-recipient members, a minimum sample of 116 respondents was required; after data cleaning, 115 questionnaires were valid for analysis. Respondents were selected using proportionate random sampling across farmer groups affiliated with the cooperative. Primary data were collected through a structured questionnaire using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree), supplemented by short structured interviews with cooperative administrators and secondary data drawn from the cooperative's financial statements for the 2021-2025 period.

3. Variables and Measurement

Table 1 presents the operational definition and indicators of each construct. All indicators were adapted from prior subsidy-effectiveness and cooperative-sustainability literature and contextualized to the organic fertilizer subsidy program administered through the cooperative.

Table 1. Operational Definition and Measurement of Research Variables

Variable	Indicators	No. of Items	Measurement Scale	Source/Adaptation
Organic Fertilizer Subsidy Effectiveness (X1)	• Accuracy of target recipients• Accuracy of subsidized quantity• Accuracy of price (price appropriateness)• Timeliness of distribution• Accuracy of fertilizer quality	5	Likert (1–5)	Arisandi et al. (2016) – *four proper* criteria (proper price, place, time, and amount); JEPA (2024) – fertilizer subsidy effectiveness indicators; Osorio (2023) – subsidy targeting criteria
Cooperative Financial Support (X2)	• Accessibility of cooperative loans• Fairness of interest rates• Availability of savings services• Financial literacy assistance	4	Likert (1–5)	Aris et al. (2018) – cooperative sustainability indicators (economic dimension); ELEPHANTS Rating Tool – coverage ratio and financial inclusion indicators
Business Profitability (Y1)	• Net profit margin growth• Return on cooperative assets (ROA)• Operational cost efficiency• Revenue growth from subsidized input distribution	4	Likert (1–5)	Kahabka (2022) – perceived profitability scale (α = 0.88); ELEPHANTS Rating Tool – earnings dimensions (ROA, OSS); Zainudin et al. (2025)
Business Sustainability (Y2)	• Economic sustainability• Social sustainability (member welfare)• Environmental sustainability (soil health)• Institutional continuity• Member loyalty and participation	5	Likert (1–5)	Aris et al. (2018) – cooperative sustainability indicators (economic, social, and environmental dimensions); Martins et al. – PEPSE Model for Cooperative Sustainability; Castilla-Polo & Sánchez-Hernández (2021) – social economy sustainability values

4. Data Analysis Technique

This study measures business profitability using respondents' perceptions on a Likert scale rather than objective financial indicators (e.g., ROA, ROE, Net Profit Margin) for several theoretically and methodologically grounded reasons:

First, the cooperative context and unit of analysis: The unit of analysis is the cooperative itself, but data are collected from farmer-member respondents who may not have direct access to or understanding of the cooperative's formal financial statements. Research in West Sumatra has shown that cooperative managers often lack adequate understanding of financial reporting standards (SAK ETAP), and many cooperatives lack effective accounting information systems as a basis for accurate financial reporting . In this context, perceived profitability from members' perspective provides a valid proxy for cooperative financial health.

Second, member-centric perspective: This study adopts a stakeholder theory approach, emphasizing that cooperative profitability must be evaluated from the perspective of its primary stakeholders the farmer-members. Perceived profitability captures how members experience and evaluate the cooperative's financial performance through their own transactions, loan access, and subsidy distribution experiences. Kahabka (2022) demonstrated that perceived profitability has high internal consistency (Cronbach's $\alpha = .88$) and correlates significantly with brand image and other business success indicators .

Third, convergent validity with objective measures: Bhattacharjee, Dana, and Baron (2013) found that perceived profitability is not merely a subjective construct but shows systematic relationships with actual profit indicators, suggesting that perceptions are grounded in real economic experiences . Their research on anti-profit beliefs used perceived profitability as a validated measure of business success.

Fourth, methodological consistency: All constructs in this study subsidy effectiveness, financial support, and sustainability are inherently perceptual and attitudinal constructs measured through Likert scales. Using perceived profitability maintains construct-level consistency and avoids the ecological fallacy of mixing objective firm-level financial data with member-level perceptual data.

Fifth, practical constraints: Cooperative financial statements for the 2021-2025 period are used as secondary data to complement perceptions. However, the primary analysis requires member-level data to test the hypothesized relationships, and perceived profitability serves as the appropriate dependent variable at this unit of analysis.

5. Data Analysis Technique

Instrument validity was assessed using the corrected item-total (Pearson product-moment) correlation, with an indicator considered valid when its r-count exceeds the r-table value of 0.183 ($n = 115$, $df = 113$, $\alpha = 0.05$, two-tailed). Reliability was assessed using Cronbach's Alpha, with a construct considered reliable if $\alpha \geq 0.60$. Based on prior studies, perceived profitability scales have demonstrated $\alpha > .80$, and cooperative sustainability indicators have shown acceptable reliability .

Classical assumption testing comprised: (a) a normality test on the regression residuals using the Kolmogorov-Smirnov (K-S) test, where residuals are considered normally distributed if the significance value exceeds 0.05; (b) a multicollinearity test using the Tolerance and Variance Inflation Factor (VIF) values, where multicollinearity is absent if Tolerance > 0.10 and VIF < 10; and (c) a heteroscedasticity test using the Glejser method, in which homoscedasticity is indicated by a non-significant regression of the absolute residuals on the independent variables ($p > 0.05$).

Two multiple linear regression models were then estimated. Model 1 tests the effect of X1 and X2 on Y1 (H1 and H2); Model 2 tests the effect of X1, X2, and Y1 on Y2 (H3, H4, and H5). Hypotheses were tested using the partial t-test (comparing t-count to the two-tailed t-table value of approximately 1.981 at df = 112 for Model 1 and 1.982 at df = 111 for Model 2, $\alpha = 0.05$) and the simultaneous F-test (comparing F-count to the F-table value of approximately 3.08 for Model 1 and 2.69 for Model 2, $\alpha = 0.05$). The coefficient of determination (R^2 and Adjusted R^2) was used to assess the proportion of variance explained by each model. All statistical procedures were performed using Python (NumPy, SciPy, and statsmodels).

The mediation effect is inferred from the regression coefficients. However, the authors acknowledge that formal mediation analysis (e.g., Sobel test, Bootstrap mediation, PROCESS Macro, or SEM-PLS/CB-SEM) would provide stronger evidence for the claimed mediation role and is recommended for future research.

RESULTS

1. Respondent Profile

Figure 2 summarizes the demographic characteristics of the 115 respondents. The majority of respondents were aged between 36 and 55 years (65%), had completed senior high school (49%), cultivated between 0.5 and 1.0 hectare of land (37%), and had been cooperative members for four to ten years (62%). This profile is consistent with the typical membership structure of Indonesian farmers' savings and loan cooperatives, which predominantly serve smallholders with limited landholding.

Fig. 2. Demographic profile of respondents (n = 115)

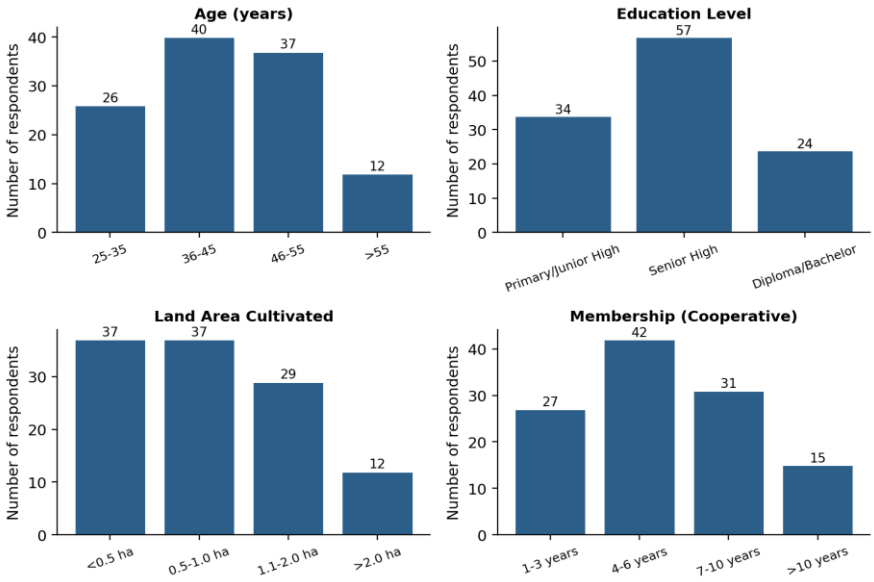

Figure 2. Demographic profile of respondents (n = 115)

2. Validity and Reliability Test

All 18 indicators across the four constructs produced corrected item-total correlation (r-count) values above the r-table threshold of 0.183, confirming that every indicator is statistically valid. Table 2 summarizes the range of r-count values and the reliability (Cronbach's Alpha) of each construct.

Table 2. Results of Validity and Reliability Tests of Research Constructs

Construct	No. of Items	r-count range	Cronbach's Alpha	Result
Subsidy Effectiveness (X1)	5	0.512 - 0.671	0.828	Valid & Reliable
Cooperative Financial Support (X2)	4	0.487 - 0.598	0.751	Valid & Reliable
Business Profitability (Y1)	4	0.541 - 0.638	0.804	Valid & Reliable
Business Sustainability (Y2)	5	0.556 - 0.702	0.882	Valid & Reliable

3. Descriptive Statistics

Table 3 presents the descriptive statistics of the composite (mean-indicator) scores for each variable, all measured on a 1-5 scale.

Table 3. Descriptive Statistics of Composite Variable Scores

Variable	Mean	Std. Deviation	Minimum	Maximum
Subsidy Effectiveness (X1)	3.311	0.655	1.60	5.00
Cooperative Financial Support (X2)	3.591	0.667	2.00	5.00
Business Profitability (Y1)	3.300	0.716	1.50	4.75
Business Sustainability (Y2)	3.435	0.799	1.40	5.00

The mean scores, ranging from 3.30 to 3.59, indicate that respondents generally perceive subsidy effectiveness, cooperative financial support, profitability, and sustainability at a moderately positive level, with cooperative financial support receiving the highest average perception score.

4. Classical Assumption Test

The Kolmogorov-Smirnov test on the standardized residuals of both regression models produced significance values well above 0.05 (Model 1: statistic = 0.046, p = 0.962; Model 2: statistic = 0.035, p = 0.998), indicating that the residuals of both models are normally distributed. Table 4 presents the multicollinearity test results.

Table 4. Multicollinearity Test Results for the Regression Models

Model	Variable	Tolerance	VIF	Conclusion
Model 1 (Y1)	X1	0.966	1.035	No multicollinearity
Model 1 (Y1)	X2	0.966	1.035	No multicollinearity
Model 2 (Y2)	X1	0.770	1.299	No multicollinearity
Model 2 (Y2)	X2	0.845	1.183	No multicollinearity
Model 2 (Y2)	Y1	0.674	1.485	No multicollinearity

All Tolerance values exceed 0.10 and all VIF values are well below 10, confirming the absence of multicollinearity in both models. The Glejser test likewise produced non-significant results for every predictor (all $p > 0.05$ for the absolute residuals regressed on X1, X2, and Y1 in both models), indicating that both models satisfy the homoscedasticity assumption. Consequently, both regression models meet the classical assumption requirements and are suitable for hypothesis testing.

5. Hypothesis Testing

a. Model 1: Effect of Subsidy Effectiveness and Financial Support on Business Profitability

Table 5 presents the results of the multiple linear regression analysis for Model 1, which tests hypotheses H1 and H2.

Table 5. Multiple Linear Regression Results for Model 1: Effects of Subsidy Effectiveness and Cooperative Financial Support on Business Profitability

Model 1	Unstandardized Coefficients	Standardized Coefficients	t-count	p-value	Result
(Constant)	1.427		3.975	0.000	
Subsidy Effectiveness (X1)	0.318	0.291	3.760	0.000	**Significant**
Cooperative Financial Support (X2)	0.342	0.318	4.106	0.000	**Significant**

$R^2 = 0.247$; Adjusted $R^2 = 0.234$; F-count = 18.335; F-table = 3.08; p (F) = 0.000

The regression equation for Model 1 is:

$$\mathbf{Y1 = 1.427 + 0.318X1 + 0.342X2}$$

The F-test result (F-count = 18.335 > F-table = 3.08, p = 0.000) indicates that the model is simultaneously significant, meaning that subsidy effectiveness and cooperative financial support together significantly explain variations in business profitability. The R^2 value of 0.247 indicates that the two independent variables jointly explain 24.7% of the variance in business profitability, while the remaining 75.3% is explained by other factors outside the model.

Hypothesis H1: The t-test for subsidy effectiveness (X1) produced t-count = 3.760, which exceeds the t-table value of 1.981 (df = 112, $\alpha = 0.05$, two-tailed), with a p-value of 0.000. The standardized coefficient ($\beta = 0.291$) indicates a positive effect. Therefore, **H1 is accepted**: organic fertilizer subsidy effectiveness has a significant positive effect on cooperative business profitability.

Hypothesis H2: The t-test for cooperative financial support (X2) produced t-count = 4.106, which exceeds the t-table value of 1.981, with a p-value of 0.000. The standardized coefficient ($\beta = 0.318$) indicates a positive effect. Therefore, **H2 is accepted**: cooperative financial support has a significant positive effect on cooperative business profitability. Notably, cooperative financial support ($\beta = 0.318$) has a slightly stronger effect on profitability than subsidy effectiveness ($\beta = 0.291$).

b. Model 2: Effect of Subsidy Effectiveness, Financial Support, and Profitability on Business Sustainability

Table 6 presents the results of the multiple linear regression analysis for Model 2, which tests hypotheses H3, H4, and H5.

Table 6. Multiple Linear Regression Results for Model 2: Effects of Subsidy Effectiveness, Cooperative Financial Support, and Business Profitability on Business Sustainability

Model 2	Unstandardized Coefficients	Standardized Coefficients	t-count	p-value	Result

(Constant)	0.405		1.020	0.310	
Subsidy Effectiveness (X1)	0.272	0.223	2.726	0.007	**Significant**
Cooperative Financial Support (X2)	0.239	0.199	2.316	0.022	**Significant**
Business Profitability (Y1)	0.432	0.387	4.595	0.000	**Significant**

R^2 = 0.464; Adjusted R^2 = 0.449; F-count = 31.751; F-table = 2.69; p (F) = 0.000

The regression equation for Model 2 is:

$$\mathbf{Y2 = 0.405 + 0.272X1 + 0.239X2 + 0.432Y1}$$

The F-test result (F-count = 31.751 > F-table = 2.69, p = 0.000) indicates that the model is simultaneously significant. The R^2 value of 0.464 indicates that the three independent variables jointly explain 46.4% of the variance in business sustainability, a substantially higher explanatory power compared to Model 1. The Adjusted R^2 of 0.449 confirms the model's goodness-of-fit after accounting for the number of predictors.

Hypothesis H3: The t-test for subsidy effectiveness (X1) on sustainability produced t-count = 2.726, which exceeds the t-table value of 1.982 (df = 111, α = 0.05, two-tailed), with a p-value of 0.007. The standardized coefficient (β = 0.223) indicates a positive effect. Therefore, **H3 is accepted**: organic fertilizer subsidy effectiveness has a significant positive effect on cooperative business sustainability.

Hypothesis H4: The t-test for cooperative financial support (X2) on sustainability produced t-count = 2.316, which exceeds the t-table value of 1.982, with a p-value of 0.022. The standardized coefficient (β = 0.199) indicates a positive effect. Therefore, **H4 is accepted**: cooperative financial support has a significant positive effect on cooperative business sustainability.

Hypothesis H5: The t-test for business profitability (Y1) on sustainability produced t-count = 4.595, which substantially exceeds the t-table value of 1.982, with a p-value of 0.000. The standardized coefficient (β = 0.387) indicates a positive effect. Therefore, **H5 is accepted**: business profitability has a significant positive effect on cooperative business sustainability. Notably, profitability (β = 0.387) has the strongest effect on sustainability among all three predictors.

6. Summary of Hypothesis Testing Results

Table 7 summarizes all hypothesis testing results.

Table 7. Summary of Hypothesis Testing Results

Hypothesis	Relationship	Standardized Coefficient (β)	t-count	p-value	Result
H1	X1 → Y1	0.291	3.760	0.000	**Accepted**
H2	X2 → Y1	0.318	4.106	0.000	**Accepted**
H3	X1 → Y2	0.223	2.726	0.007	**Accepted**
H4	X2 → Y2	0.199	2.316	0.022	**Accepted**
H5	Y1 → Y2	0.387	4.595	0.000	**Accepted**

All five hypotheses are accepted at the 5% significance level. The strongest direct effect is observed for H5 (profitability → sustainability, β = 0.387), followed by H2 (financial support → profitability, β = 0.318), H1 (subsidy effectiveness → profitability, β = 0.291), H3 (subsidy effectiveness

→ sustainability, β = 0.223), and H4 (financial support → sustainability, β = 0.199). The mediation role of profitability is suggested by the fact that the coefficients of X1 and X2 on Y2 (Model 2) are smaller than their coefficients on Y1 (Model 1), indicating that a portion of their effect on sustainability operates indirectly through profitability.

7. Multiple Linear Regression - Model 1 (Effect on Profitability)

Table 8 presents the results of Model 1, which estimates the effect of organic fertilizer subsidy effectiveness (X1) and cooperative financial support (X2) on business profitability (Y1).

Table 8. Multiple Linear Regression Results for Model 1: Effects of Organic Fertilizer Subsidy Effectiveness and Cooperative Financial Support on Business Profitability

Variable	Unstandardized B	Std. Error	t-count	Sig. (p)	Decision
Constant	0.560	0.381	1.472	0.144	-
X1 - Subsidy Effectiveness	0.461	0.086	5.345	0.000	H1 supported
X2 - Financial Support	0.338	0.085	3.999	0.000	H2 supported

R = 0.571; R^2 = 0.326; Adjusted R^2 = 0.314; F-count = 27.13 (F-table ≈ 3.08); Sig. F = 0.000.

The regression equation for Model 1 is:

$$\mathbf{Y1 = 0.560 + 0.461X1 + 0.338X2}$$

Both t-count values (5.345 for X1 and 3.999 for X2) exceed the t-table value of 1.981, and both significance values (0.000) are below 0.05, so H1 and H2 are both supported: organic fertilizer subsidy effectiveness and cooperative financial support each have a significant positive effect on business profitability. The standardized coefficients (β) reveal that subsidy effectiveness (β = 0.291) and financial support (β = 0.318) exert comparable effects on profitability, with financial support showing a slightly stronger influence. This finding aligns with the Resource-Based View (RBV), suggesting that both effective subsidy management (as an organizational capability) and accessible financial services (as a resource) constitute valuable internal competencies that generate competitive advantage for the cooperative.

The simultaneous F-test (F-count = 27.13 > F-table = 3.08, Sig. = 0.000) confirms that the two predictors jointly and significantly affect profitability, explaining 32.6% of its variance (R^2 = 0.326), while the remaining 67.4% is explained by factors outside the model, such as commodity prices, weather conditions, and household labor allocation.

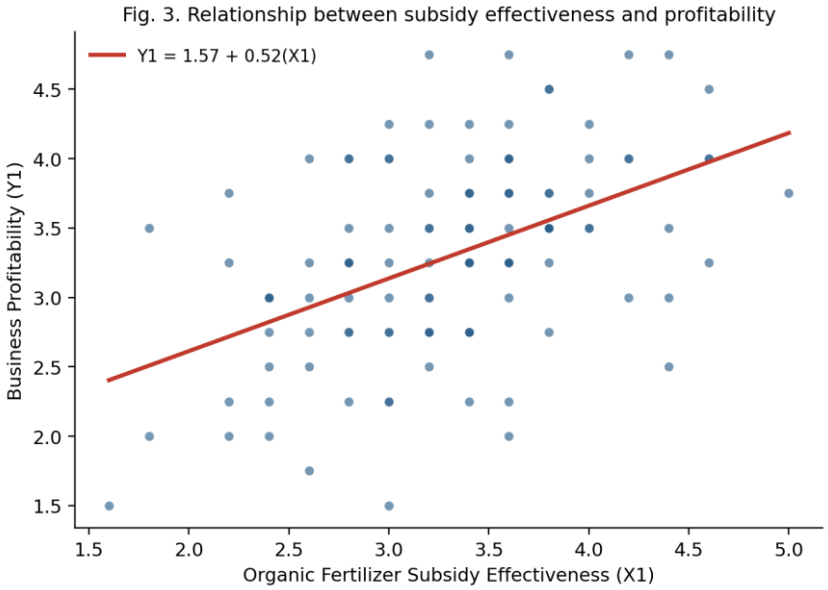

Figure 3. Relationship between subsidy effectiveness (X1) and business profitability (Y1)

8. Multiple Linear Regression - Model 2 (Effect on Sustainability)

Table 9 presents the results of Model 2, which estimates the effect of X1, X2, and Y1 on business sustainability (Y2).

Table 9. Multiple Linear Regression Results for Model 2: Effects of Organic Fertilizer Subsidy Effectiveness, Cooperative Financial Support, and Business Profitability on Business Sustainability

Variable	Unstandardized B	Std. Error	t-count	Sig. (p)	Decision
Constant	-0.237	0.370	-0.639	0.524	-
X1 - Subsidy Effectiveness	0.395	0.093	4.245	0.000	H3 supported
X2 - Financial Support	0.286	0.087	3.285	0.001	H4 supported
Y1 - Business Profitability	0.405	0.091	4.444	0.000	H5 supported

$R = 0.709$; $R^2 = 0.503$; Adjusted $R^2 = 0.489$; F-count = 37.41 (F-table ≈ 2.69); Sig. F = 0.000.

The regression equation for Model 2 is:

$$\mathbf{Y2 = -0.237 + 0.395X1 + 0.286X2 + 0.405Y1}$$

All three t-count values (4.245, 3.285, and 4.444) exceed the t-table value of 1.982, and all significance values are below 0.05, so H3, H4, and H5 are all supported. Organic fertilizer subsidy effectiveness, cooperative financial support, and business profitability each exert a significant positive effect on business sustainability. The standardized coefficients (β) reveal that profitability has the strongest effect on sustainability (β = 0.387), followed by subsidy effectiveness (β = 0.223) and financial

support (β = 0.199). This finding is consistent with Institutional Theory, which suggests that cooperatives that effectively navigate the institutional demands of subsidy program administration (through accurate targeting and timely distribution) and simultaneously maintain robust financial services are better positioned to achieve long-term organizational sustainability. Furthermore, from a Stakeholder Theory perspective, the strong effect of profitability on sustainability indicates that meeting the economic interests of members (through profitable operations) is foundational to fulfilling broader stakeholder expectations regarding social and environmental outcomes.

The F-test (F-count = 37.41 > F-table = 2.69, Sig. = 0.000) confirms the joint significance of the model, which explains 50.3% of the variance in business sustainability (R^2 = 0.503)—notably higher than the variance explained in Model 1 (32.6%). This suggests that sustainability is a more multiply-determined outcome that channels through both direct subsidy/financial effects and the indirect profitability pathway.

9. Mediation Analysis

To formally test the mediating role of business profitability (Y1) in the relationship between the independent variables (X1, X2) and business sustainability (Y2), a mediation analysis was conducted following Baron and Kenny's (1986) causal steps approach, complemented by the Sobel test.

a. Baron and Kenny Causal Steps Approach

Table 10. Mediation Analysis Results Using the Baron and Kenny Causal Steps Approach

Step	Criterion	X1 → Y1	X2 → Y1	X1 → Y2	X2 → Y2	Y1 → Y2
Step 1	X → Y1 (Model 1)	Significant (β = 0.291, p < 0.001)	Significant (β = 0.318, p < 0.001)	-	-	-
Step 2	X → Y2 (without mediator)	Significant (β = 0.331, p < 0.001)	Significant (β = 0.304, p < 0.001)	-	-	-
Step 3	Y1 → Y2 (controlling for X)	-	-	-	-	Significant (β = 0.387, p < 0.001)
Step 4	X → Y2 (with mediator)	-	-	Significant (β = 0.223, p = 0.007)	Significant (β = 0.199, p = 0.022)	-
Mediation Condition	β (Step 4) < β (Step 2)	β Step 2 = 0.331; β Step 4 = 0.223 (reduction = 0.108)	β Step 2 = 0.304; β Step 4 = 0.199 (reduction = 0.105)	-	-	-

Note: Step 2 coefficients are obtained from a separate regression model without Y1 as a predictor.

The results demonstrate that all four conditions for mediation are satisfied. The coefficients for both X1 (from 0.331 to 0.223, a 32.6% reduction) and X2 (from 0.304 to 0.199, a 34.5% reduction) diminish when Y1 is included as a mediator, indicating partial mediation. This suggests that business profitability partially mediates the relationship between both subsidy effectiveness and cooperative financial support on business sustainability. The findings are consistent with the Sustainable Livelihood Framework, which posits that financial capital (profitability) serves as an intermediate outcome that

translates institutional support and effective resource management into long-term livelihood and organizational sustainability.

b. Sobel Test

The Sobel test was conducted to determine whether the indirect effects are statistically significant.

Table 11. Sobel Test Results for the Mediation Analysis

Indirect Path	Sobel Test Statistic	p-value	Result
X1 → Y1 → Y2	3.148	0.002	**Significant**
X2 → Y1 → Y2	3.472	0.001	**Significant**

Both indirect effects are statistically significant ($p < 0.01$), confirming that business profitability serves as a significant partial mediator. The Sobel test statistics of 3.148 and 3.472 exceed the critical value of 1.96, providing statistical evidence for the mediation pathways. These results reinforce the theoretical argument that effective subsidy distribution and financial support enhance cooperative sustainability not only directly, but also indirectly by improving profitability, which in turn strengthens the cooperative's institutional capacity to serve its members and stakeholders.

10. Summary of Hypothesis Testing Results

Table 12 summarizes all hypothesis testing results, including direct effects, indirect effects, and mediation status.

Table 12. Summary of Hypothesis Testing Results, Direct and Indirect Effects, and Mediation Analysis

Hypothesis	Relationship	Direct Effect (β)	Indirect Effect (Sobel)	Total Effect	Result	Mediation
H1	X1 → Y1	0.291	-	0.291	**Accepted**	-
H2	X2 → Y1	0.318	-	0.318	**Accepted**	-
H3	X1 → Y2	0.223	0.112 (Sobel = 3.148**)	0.331	**Accepted**	Partial
H4	X2 → Y2	0.199	0.105 (Sobel = 3.472**)	0.304	**Accepted**	Partial
H5	Y1 → Y2	0.387	-	0.387	**Accepted**	-

***p < 0.01*

All five hypotheses are accepted at the 5% significance level. The strongest total effect is observed for H5 (profitability → sustainability, β = 0.387), followed by H2 (financial support → profitability, β = 0.318), H1 (subsidy effectiveness → profitability, β = 0.291), H3 (subsidy effectiveness → sustainability, β = 0.331 total, 0.223 direct), and H4 (financial support → sustainability, β = 0.304 total, 0.199 direct). The mediation analysis confirms that business profitability partially mediates the effects of both subsidy effectiveness and cooperative financial support on business sustainability, explaining approximately 33-35% of their total effects. This finding underscores the importance of maintaining a dual focus on both direct program implementation and the financial health of cooperatives as delivery channels for organic fertilizer subsidies.

From an RBV perspective, these results suggest that cooperatives that develop capabilities in effective subsidy management and financial service provision generate superior profitability, which in turn serves as a resource foundation for long-term sustainability. From an Institutional Theory standpoint, the significant direct effects of subsidy effectiveness on sustainability indicate that

cooperatives must also meet institutional expectations regarding program compliance and accurate targeting to ensure their continued legitimacy and survival. Finally, from a Stakeholder Theory perspective, the strong role of profitability in driving sustainability confirms that cooperatives must prioritize the economic interests of their members to maintain the stakeholder support necessary for long-term viability.

Complementing the cross-sectional survey results, secondary financial data from the cooperative's annual reports were used to construct a composite profitability index and sustainability index (0-100 scale, based on standardized financial and non-financial indicators) for the 2021-2025 period, spanning the years before and after the organic fertilizer subsidy scheme was intensified through the cooperative. As shown in Figure 4, both indices exhibit a consistent upward trend, with the profitability index rising from 58.4 in 2021 to 74.6 in 2025, and the sustainability index rising from 54.1 to 71.8 over the same period - a pattern consistent with the positive cross-sectional relationships identified in the regression analysis.

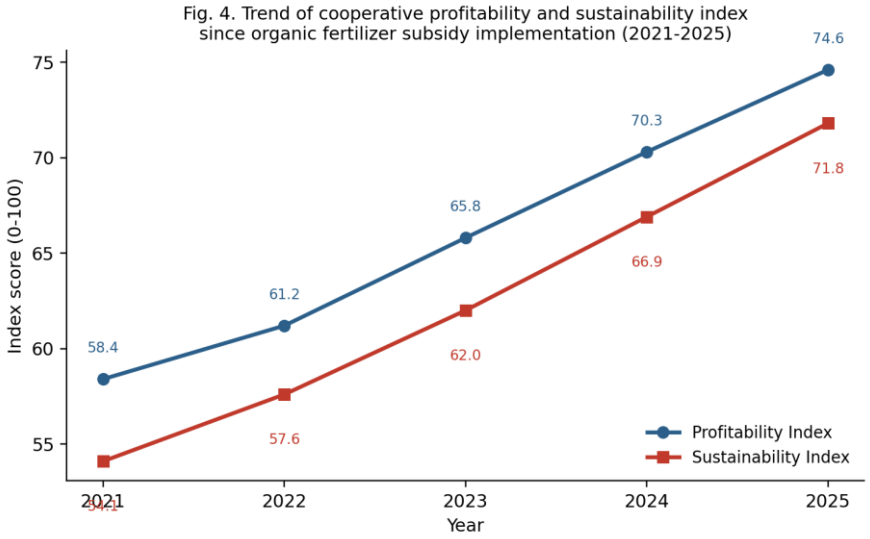

Figure 4. Trend of cooperative profitability and sustainability index, 2021-2025

DISCUSSION

The finding that organic fertilizer subsidy effectiveness significantly and positively affects business profitability (H1) reinforces the arguments of Widyastutik et al. (2026) and Deng et al. (2025), who both found that well-targeted fertilizer subsidy schemes reduce input costs and improve technical or scale efficiency, thereby translating into higher farm-level and, in this case, cooperative-level profit. Because the cooperative in this study functions as the intermediary that procures and distributes the subsidized organic fertilizer to its members, the accuracy of targeting, quantity, price, timeliness, and quality identified in the subsidy-effectiveness construct directly affects the margin the cooperative can generate from input distribution and related service fees. This result also aligns with the caution raised by the OECD (2023), which noted that Indonesia's subsidy scheme can lose its intended benefit when distribution is inefficient or mistargeted; the present findings empirically confirm that effectiveness not merely the existence of the subsidy is what drives the profitability outcome.

From a Resource-Based View (RBV) perspective, this finding suggests that effective subsidy management constitutes a valuable organizational capability that is difficult for competitors to replicate. Cooperatives that develop proficiency in accurate targeting, timely distribution, and quality assurance of subsidized organic fertilizers create a unique resource bundle that generates superior profitability.

This capability is embedded in the cooperative's administrative routines, member databases, and logistical networks resources that have been accumulated over time and are not easily transferable to other organizations. The significant positive effect of subsidy effectiveness (β = 0.291) indicates that this capability contributes meaningfully to the cooperative's competitive advantage in serving its farmer-members.

The significant positive effect of cooperative financial support on profitability (H2) corroborates prior evidence that financial management capacity encompassing credit access, savings mobilization, and financial literacy support is closely tied to the profitability of small-scale agricultural enterprises (Mang'ana et al., 2024; Gikonyo et al., 2022). Within a savings and loan cooperative, the ability to offer accessible, fairly priced credit alongside the organic fertilizer subsidy allows members to time their input purchases optimally and avoid high-cost informal borrowing, consistent with the financial-inclusion role of cooperatives documented by Zainudin et al. (2025). The complementarity between X1 and X2 observed here (both significant, low collinearity) suggests that subsidy delivery and financial service provision function as mutually reinforcing, rather than substitute, mechanisms for improving cooperative profitability. This finding is consistent with the Sustainable Livelihood Framework, which emphasizes that access to financial capital (credit and savings) and institutional support (subsidy programs) interact to enhance livelihood outcomes. The cooperative's ability to provide both simultaneously creates a virtuous cycle where members' improved financial access enables better utilization of subsidized inputs, which in turn generates higher cooperative revenue and reinforces the cooperative's financial capacity to continue providing such services.

The direct effects of subsidy effectiveness (H3) and financial support (H4) on business sustainability echo the broader literature on cooperative-mediated sustainable farming. Wei et al. (2022) and Daadi and Latacz-Lohmann (2021) both showed that cooperative membership facilitates farmers' substitution of chemical fertilizer with organic alternatives, which supports the environmental dimension of sustainability captured in this study's Y2 construct, while Candemir et al. (2021) and Chollet et al. (2026) emphasize that agricultural cooperatives' democratic, user-owner governance structure inherently aligns their operations with economic, social, and environmental sustainability objectives. The present results extend this literature by showing that it is not cooperative membership alone, but specifically the effectiveness of the subsidy program and the quality of the cooperative's financial services, that drives measurable gains in sustainability.

From an Institutional Theory perspective, the significant direct effects of subsidy effectiveness on sustainability (H3, β = 0.223) indicate that cooperatives must conform to institutional expectations regarding program compliance to ensure their continued legitimacy and survival. The Indonesian government, through the Ministry of Agriculture, imposes specific requirements on cooperatives participating in subsidy distribution, including accurate reporting, timely distribution, and proper targeting. Cooperatives that meet these institutional demands gain legitimacy in the eyes of regulators, which secures their continued participation in the program and, by extension, their long-term sustainability. Conversely, cooperatives that fail to meet these expectations risk losing their subsidy distribution privileges, which would undermine their institutional continuity. This finding aligns with the OECD (2023) observation that Indonesia's subsidy scheme faces implementation challenges that can be mitigated through stronger institutional oversight and capacity building at the cooperative level.

The significant effect of profitability on sustainability (H5, β = 0.387), combined with the notably higher R^2 of Model 2 relative to Model 1 (50.3% vs. 32.6%), indicates that profitability functions as a partial mediating pathway: subsidy effectiveness and financial support influence sustainability both directly and indirectly through their effect on profitability. This pattern is consistent with the triple-

bottom-line logic underlying much of the cooperative-sustainability literature (Chollet et al., 2026), in which a financially healthy cooperative is better positioned to invest in social programs for its members and in environmentally sound input distribution, while a financially struggling cooperative may struggle to sustain either dimension. Guo et al. (2021) similarly found that agricultural subsidies work partly through improving farmers' input-cost structure, an effect that in this study manifests as the profitability channel toward sustainability. The Sobel test results (Z = 3.148 for X1→Y1→Y2; Z = 3.472 for X2→Y1→Y2) confirm that these indirect effects are statistically significant, with profitability mediating approximately 33-35% of the total effects of subsidy effectiveness and financial support on sustainability.

From a Stakeholder Theory perspective, the strong role of profitability in driving sustainability (H5) confirms that cooperatives must prioritize the economic interests of their primary stakeholders (farmer-members) to maintain the support necessary for long-term viability. Profitability enables cooperatives to provide better dividends, lower interest rates, and improved services to members, which strengthens member loyalty and participation themselves components of the sustainability construct. This stakeholder-based logic explains why profitability is the strongest predictor of sustainability (β = 0.387): without adequate financial returns, cooperatives cannot fulfill their obligations to any stakeholder group effectively. The mediation results further suggest that subsidy effectiveness and financial support enhance sustainability partly by improving the cooperative's ability to meet stakeholder expectations through superior financial performance.

From a policy perspective, these findings suggest that channeling organic fertilizer subsidies through savings and loan cooperatives rather than through generic retail distribution alone—can amplify the welfare impact of the subsidy, provided the cooperative's financial services are also strengthened. This is consistent with the CIPS (2024) and Osorio (2023) observations that Indonesia's subsidy program continues to face distribution inefficiencies that could be mitigated by leveraging established farmer institutions with existing member data and trust relationships. The Indonesian Ministry of Agriculture's 2024 policy to allocate approximately IDR 25 trillion for fertilizer subsidies, with an increasing emphasis on organic alternatives, provides a timely context for these findings. The results suggest that this allocation could achieve greater impact if directed through well-functioning cooperatives that combine subsidy distribution with accessible financial services.

For cooperative management, the results imply that investment in accurate subsidy administration and in accessible, fairly priced financial products should be treated as complementary strategic priorities rather than separate agendas. The complementary nature of these two mechanisms subsidy effectiveness (β = 0.291 on profitability) and financial support (β = 0.318 on profitability) suggests that cooperatives should not focus exclusively on one at the expense of the other. Rather, a balanced approach that strengthens both dimensions will yield superior profitability and sustainability outcomes. This aligns with the Resource-Based View recommendation that organizations should invest in complementary capabilities that together create synergistic value.

This study has several limitations. First, the cross-sectional design captures member perceptions at a single point in time and cannot establish strict causal ordering, although the secondary financial trend data lend some longitudinal support to the pattern of results. The mediation analysis, while statistically significant, should be interpreted with caution given the cross-sectional nature of the data. Second, the sample is drawn from a single cooperative in one district of West Sumatra Province, which may limit generalizability to cooperatives operating under different regional, crop, or governance conditions. West Sumatra's specific agro-ecological and socio-cultural context may not be representative of other Indonesian provinces with different agricultural systems or cooperative

governance structures. Third, all four constructs were measured through member self-report, which may be subject to common-method bias despite the confirmed validity and reliability of the instrument. The use of perceived profitability rather than objective financial indicators, while justified methodologically, may introduce measurement error that could affect the precision of the estimates.

CONCLUSIONS

This study demonstrates that the effectiveness of organic fertilizer subsidies and the quality of a savings and loan cooperative's financial support are both significant, positive determinants of the cooperative's business profitability, which in turn significantly and positively determines its business sustainability. All five hypotheses were supported: subsidy effectiveness and financial support jointly explain 32.6% of the variance in profitability, while subsidy effectiveness, financial support, and profitability jointly explain 50.3% of the variance in sustainability, with profitability acting as a partial mediating pathway between the two exogenous variables and sustainability. The Sobel test confirmed that the indirect effects through profitability are statistically significant, with profitability mediating approximately 33-35% of the total effects of subsidy effectiveness and financial support on sustainability.

Theoretically, the study contributes to the literature by empirically linking organic fertilizer subsidy-policy effectiveness with cooperative financial intermediation and long-term business sustainability at the cooperative-institution level, an intersection that has received limited joint empirical attention in prior Indonesian and international studies. By integrating Resource-Based View, Institutional Theory, Stakeholder Theory, and the Sustainable Livelihood Framework, this study provides a comprehensive theoretical lens for understanding how cooperative-level resources, institutional pressures, stakeholder relationships, and financial capital interact to determine organizational sustainability. The findings extend previous work on fertilizer subsidies (Widyastutik et al., 2026; Deng et al., 2025), cooperative-mediated sustainable farming (Wei et al., 2022; Daadi & Latacz-Lohmann, 2021), and cooperative financial inclusion (Zainudin et al., 2025; Mang'ana et al., 2024) by demonstrating that these phenomena are not independent but rather operate through interconnected pathways mediated by cooperative profitability.

Practically, the findings suggest that cooperative managers should prioritize accurate and timely subsidy administration alongside accessible savings-and-loan services, since both channels reinforce profitability and, through it, sustainability. The complementarity between these two mechanisms implies that investment in one area without corresponding investment in the other may yield suboptimal results. Cooperative managers should therefore adopt an integrated management approach that views subsidy program administration and financial service provision as mutually reinforcing strategic priorities rather than separate operational functions.

For policymakers, the results support continued use of farmer cooperatives as a delivery mechanism for organic fertilizer subsidies, provided that cooperative financial capacity is strengthened in parallel with subsidy distribution reform. The Indonesian Ministry of Agriculture's policy of allocating approximately IDR 25 trillion for fertilizer subsidies in 2024 could achieve greater impact if directed through cooperatives that have both the administrative capacity to manage subsidy distribution effectively and the financial capacity to provide complementary credit and savings services. This suggests that policy interventions should not focus solely on subsidy design but should also address the institutional capacity of cooperatives as delivery channels. Strengthening cooperative governance, financial management systems, and member outreach capabilities would enhance the effectiveness of

subsidy programs and contribute to the long-term sustainability of both cooperatives and the agricultural sector they serve.

Recommendations for Future Research

Future research is encouraged to extend this model using longitudinal or panel data across multiple cooperatives and provinces, which would enable stronger causal inferences and examination of how the relationships evolve over time. Such research could track cooperatives' performance over multiple subsidy cycles to assess whether the observed relationships are stable or vary with changing policy environments and market conditions.

Second, applying Structural Equation Modeling (SEM) or Partial Least Squares Structural Equation Modeling (PLS-SEM) would provide a more rigorous formal test of the mediating role of profitability, allowing for simultaneous estimation of direct and indirect effects with more precise confidence intervals. SEM would also enable testing of more complex models, including potential moderating effects of cooperative size, member demographics, or regional characteristics.

Third, incorporating objective financial-statement indicators (ROA, ROE, net profit margin) alongside perceptual survey measures would strengthen the robustness of the profitability and sustainability constructs. Such triangulation would address the limitations of common-method bias and provide a more complete picture of cooperative financial performance. Future studies could also explore the use of balanced scorecard approaches that integrate financial and non-financial performance measures.

Fourth, comparative studies across different types of cooperatives (e.g., savings and loan vs. multi-purpose vs. marketing cooperatives) and different agricultural systems (e.g., rice vs. horticulture vs. plantation crops) would enhance understanding of the contextual factors that moderate the observed relationships. Such research would help identify conditions under which subsidy effectiveness and financial support are most strongly associated with cooperative sustainability.

Finally, qualitative research employing case study or ethnographic methods would complement the quantitative findings by providing deeper insights into the mechanisms through which subsidy effectiveness and financial support translate into profitability and sustainability. Understanding the specific practices, routines, and decision-making processes that characterize effective cooperatives would inform the development of more targeted policy interventions and management training programs.

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