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A performance improvement model for coconut-based cooperatives through value chain integration and livelihood assets in North Maluku

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ABSTRACT

Introduction: Coconut-based cooperatives in North Maluku play a strategic role in the community economy but face persistent challenges such as low product value-added and limited market access. Integrating value chains and livelihood assets is therefore essential to enhance their institutional performance. **Methods**: This study employs a quantitative approach using Structural Equation Modeling–Partial Least Squares (SEM-PLS). Primary data were collected from 285 cooperative administrators and members through purposive sampling and structured questionnaires with a five-point Likert scale. **Results**: Findings indicate that all tested direct effect pathways are statistically significant (t-statistic > 1.960; p-values < 0.05). Specifically, value chain integration and livelihood assets serve as critical mediating variables that bridge the influence of exogenous factors (primary/support activities and various capitals) on cooperative performance. Strong path coefficients highlight the strategic importance of these mediation mechanisms. The results demonstrate that performance is determined not only by internal management but also by strengthened value chain linkages and enhanced member asset capacity. **Conclusion**: Improving cooperative performance requires a holistic approach that integrates institutional aspects, value chain coordination, and member capacity building. This study offers a theoretical model for commodity-based cooperatives and provides a policy foundation for promoting sustainable rural economic development in North Maluku.

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INTRODUCTION

The plantation subsector is one of the agricultural sectors that holds an important position in supporting the regional economic structure. Agricultural development is a complex process that reflects social change, including shifts in national structures, societal attitudes, and institutional arrangements (Puspapratiwi et al., 2025). The objectives of agricultural development are to encourage economic growth, increase income, and reduce poverty (Etuk & Ayuk, 2021). The contribution of the plantation subsector as a source of state revenue from the non-oil and gas sector is significantly greater compared to other subsectors. The export value of plantation commodities contributes positively to the agricultural trade balance (Hestina et al., 2023).

Coconut (Cocos nucifera) is one of the most important fruit-bearing trees in the world, providing food for millions of people, particularly in tropical and subtropical regions. Due to its numerous uses, it is often referred to as the tree of life or a heaventree (DebMandal & Mandal, 2011). Coconut plays an important role in the economic, social, and cultural life of communities in Indonesia. Geographically, it has spread and is cultivated in almost every province in Indonesia. Coconut can be utilized to produce various products. Coconut shells can be processed into coir fiber, coir yarn, coco peat, and mats. Coconut water can be processed into coconut drinks, nata de coco, coconut vinegar, and coconut sauce. Coconut meat can be processed into coconut flour, coconut milk, coconut butter, coconut oil, virgin coconut oil, copra, young coconut products, and various processed food products. In addition, coconut in Indonesia can also be developed into processed products such as doormats and car seat fillers (Alouw & Wulandari, 2020).

Eastern Indonesia, including North Maluku, relies on coconut as a significant smallholder plantation commodity. North Maluku Province is one of the major coconut-producing regions. Based on data from Statistics Indonesia (BPS) (2021), the total coconut plantation area reached 221,804 hectares, with total production equivalent to 211,802 tons of copra. Statistical data indicate that smallholder coconut plantation production in North Maluku Province is recorded on a large scale. Therefore, the issue of improving the performance of local economic institutions, such as cooperatives, has become increasingly important to enhance trade governance and value distribution at the farmer and processing-actor levels. Many coconut value chains are still characterized by post-harvest limitations, inconsistent

product quality, weak bargaining power of producers, and fragmentation of actors from upstream to downstream (Zainol et al., 2023).

Cooperatives have the potential to become a “coordination engine” to improve value chain efficiency through production volume consolidation, quality standardization, access to financing, and strengthening market networks. According to (ICARE, 2022) cooperative practices can enhance productivity, facilitate resource sharing, and improve access to financial support, which ultimately promotes the resilience and sustainability of agrifood systems. However, strengthening cooperatives cannot rely solely on improvements in internal management. Cooperatives need to be understood as a value chain strategy that organizes relationships among actors, governance mechanisms, and value-added distribution. On the other hand, improving cooperative performance, particularly commodity-based cooperatives, is also strongly influenced by the livelihood asset capacity of members or farming households. The livelihood assets framework emphasizes that various forms of capital (natural, physical, human, social, and financial) shape livelihood strategy choices and influence the ability of actors to survive, adapt, and improve their welfare. According to (He & Ahmed, 2022), livelihood capital plays an important role in shaping livelihood strategies and their transformation, thereby influencing the economic sustainability of rural households. Challenges in the coconut commodity sector, such as aging coconut trees, limited access to technology and extension services, and weak farmer institutions, contribute to low income levels and increased risks to farming sustainability. These conditions ultimately limit cooperative members ability to invest in improving productivity and product quality (Sulistyorini et al., 2025).

Many studies have examined the strengthening of the coconut sector from the perspectives of production, policy, and supply chains. For instance, Amores et al. (2020) analyzed global coconut value chain efficiency and found that fragmented coordination among actors reduces value added at the producer level. Similarly, Briones (2018) focused on policy interventions in coconut-producing countries, highlighting that government support improves productivity but often fails to strengthen institutional capacity at the grassroots level. In addition, Haggblade et al. (2017) examined agro-industry development and emphasized the importance of upgrading supply chains to enhance rural incomes. However, these studies tend to analyze production efficiency, policy frameworks, or value chains separately, without deeply addressing the institutional dynamics of cooperatives. In particular, there is still limited integration of two key mechanisms simultaneously at the cooperative level, namely value chain integration as a mechanism for improving efficiency and value addition across actors, and livelihood assets as the fundamental capacity of cooperative members that determines their ability to adopt innovations, maintain supply consistency, and ensure product quality. This study addresses this gap by integrating both mechanisms within a single analytical framework to better explain cooperative performance in the coconut sector.

Therefore, developing a performance improvement model for coconut cooperatives that integrates value chain linkages and livelihood assets is particularly crucial at this time, as the coconut sector is facing increasing market competition, demand for higher product quality, and the need for supply chain resilience in the face of economic and logistical uncertainties. In the context of North Maluku—despite its rich natural resource base persistent challenges such as fragmented market access, limited institutional capacity, and high logistics costs make it difficult for cooperatives to compete effectively. Integrating value chain linkages enables better coordination, efficiency, and value addition across actors, while strengthening livelihood assets enhances the capacity of cooperative members to adopt innovations, maintain consistent supply, and meet market standards. The simultaneous integration of these two dimensions is therefore essential to ensure not only short-term performance improvement but also long-term sustainability and competitiveness of coconut cooperatives in the region.

The expected contribution of this study is to develop and empirically validate a performance improvement model for coconut cooperatives by integrating value chain linkages and livelihood assets using SEM-PLS analysis. Specifically, this study aims to examine the direct and indirect effects of these variables on cooperative performance, as well as to identify the role of mediating mechanisms in strengthening institutional outcomes. Based on these empirical findings, the study provides an evidence-based foundation for formulating operational policy and implementation strategies for local governments, cooperative facilitators, and business actors. These strategies include measurable interventions such as crop rejuvenation programs, quality standardization systems, value chain financing schemes, and capacity-building initiatives to strengthen the socio-economic capital of members, thereby enabling cooperatives to enhance value addition and improve farmers welfare.

METHODS

Research time and location

The research was conducted in 2025, with the location purposively selected in North Maluku Province based on its relevance to the study context, particularly due to its significant potential in coconut-based cooperative development.

Data types and sources

The data used in this study consisted of both primary and secondary data. Primary data were obtained directly from respondents, while secondary data were collected from relevant documents, reports, and institutional records to support the analysis.

Population and sample

The sample in this study was determined using purposive sampling, where respondents were selected based on their knowledge, experience, and ability to provide relevant information related to the research problems and objectives. This approach is widely recognized as an effective non-probability sampling technique for selecting information-rich cases aligned with specific research objectives (Memon et al., 2025; Dahal, 2024). Purposive sampling enables researchers to obtain in-depth and context-specific insights, particularly in studies requiring respondents with specific expertise. This technique is often applied due to limitations in time, resources, and funding that restrict the possibility of selecting large and geographically dispersed samples. The total sample size in this study was 285 respondents.

Data collection and techniques

The primary data were collected using a structured questionnaire with a five-point Likert scale (1 = strongly disagree to 5 = strongly agree) to measure all research variables. In addition, observation, focus group discussions (FGDs), and interviews were conducted as supporting methods to enrich contextual understanding and validate the quantitative findings through triangulation.

Data analysis method

To address the research objectives, this study employs Structural Equation Modeling–Partial Least Squares (SEM-PLS) using SmartPLS software. SEM-PLS is suitable for predictive and exploratory analysis, does not require strict normality assumptions, and can handle complex models with relatively large indicators and constructs (Hair et al., 2019; Sarstedt et al., 2021). The analysis includes measurement model evaluation (validity and reliability) and structural model assessment (hypothesis testing).

RESULTS AND DISCUSSION

Outer model test result

The outer model analysis was conducted to ensure that the measurement instruments used were appropriate and met the criteria of validity and reliability. In this model analysis, the relationships between latent variables and their indicators are specified. The results of the outer model testing include convergent validity, discriminant validity, and construct reliability tests.

a. Convergent validity test

Convergent validity was assessed by examining the standardized outer loadings of each indicator on its respective construct. These loadings reflect the extent to which an indicator shares a high proportion of variance with the underlying latent construct. In line with Joseph F. Hair Jr. et al. (2019), an outer loading value of 0.70 or higher is considered indicative of adequate convergent validity, while values between 0.50 and 0.70 may be retained in exploratory research if supported by theoretical justification.

In this study, most constructs were operationalized using multiple indicators and demonstrated satisfactory loading values above the recommended threshold. However, several variables (X6, X9, Y1, and Y2) exhibited loading values of 1.000. This condition does not necessarily indicate superior validity, but rather reflects that these constructs were measured using single indicators. Such specification is acceptable in PLS-SEM when the constructs are concrete, unidimensional, and directly observable. Nevertheless, the use of single-item measures limits the assessment of internal consistency and should be interpreted with caution.

Based on the results presented in Table 1, all indicators in the reflective measurement model demonstrate loading factor values exceeding the recommended threshold of 0.700. This indicates that each indicator is able to adequately represent its respective latent construct. The loading values range from 0.776 to 0.925 for most constructs, reflecting strong correlations between indicators and their underlying variables. According to Joseph F. Hair Jr. et al. (2019), outer loading values above 0.700 indicate that indicators explain more than 50% of the variance of the latent construct, thereby confirming acceptable convergent validity.

However, several constructs—namely Social Capital (X6), Political Capital (X9), Value Chain (Y1), and Livelihood Asset (Y2)—exhibit loading values of 1.000. This condition does not indicate superior measurement quality, but rather reflects that these constructs were operationalized using single indicators. While such specification may be acceptable

when the constructs are concrete and unidimensional, it limits the assessment of internal consistency and measurement error. Therefore, the interpretation of these constructs should be approached with caution.

Table 1. Convergent validity test results

Variable	Indicator	Loading factor	Criteria	Description
Primary activities	X1.1	0.816	>0.700	Fulfilled
	X1.2	0.902	>0.700	Fulfilled
	X1.3	0.925	>0.700	Fulfilled
	X1.4	0.864	>0.700	Fulfilled
Support activities	X2.1	0.884	>0.700	Fulfilled
	X2.2	0.874	>0.700	Fulfilled
	X2.3	0.873	>0.700	Fulfilled
	X2.4	0.776	>0.700	Fulfilled
Human capital	X3.1	0.891	>0.700	Fulfilled
	X3.2	0.907	>0.700	Fulfilled
	X3.3	0.878	>0.700	Fulfilled
	X3.4	0.861	>0.700	Fulfilled
	X3.5	0.834	>0.700	Fulfilled
Natural capital	X4.1	0.891	>0.700	Fulfilled
	X4.2	0.881	>0.700	Fulfilled
	X4.3	0.857	>0.700	Fulfilled
Financial capital	X5.1	0.802	>0.700	Fulfilled
	X5.2	0.887	>0.700	Fulfilled
	X5.3	0.850	>0.700	Fulfilled
	X5.4	0.873	>0.700	Fulfilled
	X5.5	0.858	>0.700	Fulfilled
Social capital	X6.1	1.000	>0.700	Fulfilled
Physical capital	X7.1	0.811	>0.700	Fulfilled
	X7.2	0.819	>0.700	Fulfilled
	X7.3	0.833	>0.700	Fulfilled
	X7.4	0.843	>0.700	Fulfilled
Entrepreneurship	X8.1	0.862	>0.700	Fulfilled
	X8.2	0.818	>0.700	Fulfilled
	X8.3	0.898	>0.700	Fulfilled
Politics capital	X9.2	1.000	>0.700	Fulfilled
Value chain	Y1.1	1.000	>0.700	Fulfilled
Livelihood asset	Y2.1	1.000	>0.700	Fulfilled
Cooperative performance	Z1.1	0.880	>0.700	Fulfilled
	Z1.3	0.913	>0.700	Fulfilled

b. Discriminant validity test

Table 2. Discriminant validity test results

Variable	X1	X2	X3	X4	X5	X6	X7	X8	X9	Y1	Y2	Z	Description
X1	**0.878**												Fulfilled
X2	0.425	**0.853**											Fulfilled
X3	0.368	0.358	**0.875**										Fulfilled
X4	0.340	0.329	0.448	**0.876**									Fulfilled
X5	0.275	0.211	0.358	0.326	**0.854**								Fulfilled
X6	0.151	0.234	0.234	0.207	0.225	**1.000**							Fulfilled
X7	0.213	0.198	0.072	0.080	0.202	0.033	**0.827**						Fulfilled
X8	0.243	0.209	0.212	0.160	0.242	0.156	0.014	**0.860**					Fulfilled
X9	0.015	0.057	0.052	0.075	0.173	-0.005	0.063	0.109	**1.000**				Fulfilled
Y1	0.243	0.231	0.202	0.243	0.212	0.232	0.192	0.269	0.183	**1.000**			Fulfilled
Y2	0.301	0.230	0.342	0.339	0.367	0.239	0.224	0.266	0.256	0.589	**1.000**		Fulfilled
Z1	0.148	0.245	0.185	0.203	0.229	0.082	0.072	0.172	0.168	0.611	0.617	**0.897**	Fulfilled

The results of the discriminant validity test using the Fornell-Larcker Criterion show that the square root value of the Average Variance Extracted (AVE) for each construct is higher than the correlation values among other latent variables (Table 2). This indicates that each construct has a better ability to explain the variance of its indicators compared to other constructs in the research model. Therefore, it can be concluded that each latent variable has a clear level of distinction and does not overlap with others in measuring the investigated concepts.

c. Reliability test and construct reliability

Table 3. Construct validity test results

Variable	Ave	Criteria	Description
Primary activities	0.770	>0.500	Fulfilled
Support activities	0.728	>0.500	Fulfilled
Human capital	0.765	>0.500	Fulfilled
Natural capital	0.768	>0.500	Fulfilled
Financial capital	0.730	>0.500	Fulfilled
Social capital	1.000	>0.500	Fulfilled
Physical capital	0.683	>0.500	Fulfilled
Entrepreneurship	0.740	>0.500	Fulfilled
Politics capital	1.000	>0.500	Fulfilled
Value chain	1.000	>0.500	Fulfilled
Livelihood asset	1.000	>0.500	Fulfilled
Cooperative performance	0.804	>0.500	Fulfilled

The results of the construct validity test using the Average Variance Extracted (AVE) value indicate that all variables have AVE values greater than 0.500 (Table 3). Therefore, each construct can be considered to have met the construct validity criteria. The AVE value reflects the ability of a construct to explain the variance of the indicators that form it. According to (Hair et al., 2019), an AVE value of ≥ 0.500 indicates that the construct can explain more than 50% of the variance of its indicators, suggesting that the indicators used have a good level of representation of the measured latent variables.

Table 4. Construct reliability test results

Variable	Cronbach's alpha	Composite reliability	Criteria	Desription
Primary activities	0.903	0.931	>0.700	Fulfilled
Support activities	0.876	0.914	>0.700	Fulfilled
Human capital	0.923	0.942	>0.700	Fulfilled
Natural capital	0.849	0.908	>0.700	Fulfilled
Financial capital	0.907	0.931	>0.700	Fulfilled
Social capital	1.000	1.000	>0.700	Fulfilled
Physical capital	0.850	0.896	>0.700	Fulfilled
Entrepreneurship	0.823	0.895	>0.700	Fulfilled
Politics capital	1.000	1.000	>0.700	Fulfilled
Value chain	1.000	1.000	>0.700	Fulfilled
Livelihood asset	1.000	1.000	>0.700	Fulfilled
Cooperative performance	0.758	0.892	>0.700	Fulfilled

The results of the construct reliability test using Cronbach's Alpha and Composite Reliability values indicate that all test results meet the required criteria of greater than 0.700; therefore, each variable satisfies construct reliability. Accordingly, the indicators used in the final stage can be applied for the final modeling (Table 4).

Inner model test result

The inner model analysis, also referred to as inner relations, structural model, or substantive theory, describes the relationships between latent variables based on substantive theory. The inner model analysis can be evaluated using the R-square value for dependent constructs. In evaluating the inner model using Partial Least Squares (PLS), the process begins by examining the R-square value for each dependent latent variable. The interpretation is similar to regression analysis. Changes in the R-square value can be used to assess the influence of certain independent latent variables on dependent latent variables and to determine whether the effect is substantive. The results of the inner model testing include the coefficient of determination (R-square) value.

Table 5. Coefficient of determination test result

Variable	R square	R square adjusted
Value chain	0.079	0.070
Livelihood asset	0.301	0.276
Cooperative performance	0.475	0.470

Based on the results presented in Table 5, the coefficient of determination (R^2) for Value Chain is 0.079, indicating that primary activities and support activities explain only 7.9% of the variance in the value chain. According to Joseph F. Hair Jr. et al. (2017) and Chin (1998), R^2 values of 0.75, 0.50, and 0.25 are categorized as substantial, moderate, and weak, respectively. Therefore, the R^2 value of 0.079 can be classified as weak, suggesting that the model has limited

explanatory power in predicting the value chain construct. The relatively low R^2 value may be attributed to the presence of external and contextual factors that are not incorporated into the model. In the context of North Maluku, value chain dynamics are likely influenced by structural constraints such as limited transportation infrastructure, high logistics costs, restricted market access, and variability in institutional support. These external conditions may play a more dominant role than internal organizational activities, thereby reducing the explanatory contribution of primary and support activities in the model.

The coefficient of determination results show that the effect on livelihood assets obtained an R-square value of 0.301, indicating that the influence on livelihood assets can be explained by 30.1% through human capital, natural capital, financial capital, social capital, physical capital, entrepreneurship, and political capital, while the remaining variance is explained by other variables. The coefficient of determination results show that the effect on cooperative performance obtained an R-square value of 0.475, indicating that the influence on cooperative performance can be explained by 47.5% through the value chain and livelihood assets, while the remaining variance is explained by other variables.

Table 6. Stone-geisser (Q^2) test result

Variable	Q Square
Value Chain (Y1)	0.059
Livelihood Asset (Y2)	0.249
Cooperative Performance (Z1)	0.371

The results of the predictive relevance test using the Q-square value for the relationships between variables show that the Q^2 value is greater than 0 ($Q^2 > 0$), indicating that the structural model has predictive relevance (Table 6).

Table 7. Effect Size (f^2) Test Result

Variable	Y1	Y2	Z	Description
Primary activities	0.028	-	-	Small
Support activities	0.022	-	-	Small
Human capital	-	0.022	-	Small
Natural capital	-	0.026	-	Small
Financial capital	-	0.022	-	Small
Social capital	-	0.018	-	Small
Physical capital	-	0.033	-	Small
Entrepreneurship	-	0.024	-	Small
Politics capital	-	0.049	-	Small
Value chain	-	-	0.180	Moderate
Livelihood asset	-	-	0.192	Moderate

The effect size test results indicate that the influence between variables obtained f^2 values greater than zero, demonstrating small to moderate effects at the structural level (Table 7).

Research model development

Based on the testing of the latent variable model in this study, the variables are classified into two groups, namely exogenous variables and endogenous variables. The exogenous variables include primary activities, support activities, human capital, natural capital, financial capital, social capital, physical capital, entrepreneurship, and political capital, while the endogenous variables include value chain, livelihood assets, and cooperative performance. A model is considered good if the development of the hypothetical model is theoretically supported by empirical data. The results of the analysis using Partial Least Squares (PLS) to determine the influence between variables comprehensively can be seen in Figure 1.

The outer model, which measures the relationship between variables and their indicators, shows that all indicators for each variable have met the required testing criteria, namely convergent validity, discriminant validity, and construct reliability. Primary activities are measured by four indicators, namely raw materials, processing, product distribution, and sales and marketing. The product distribution indicator is the leading indicator in measuring or explaining primary activities, with a factor loading value of 0.925. The dominance of the product distribution indicator (0.925) suggests that for cooperatives in North Maluku, the ability to reach wider markets is a more critical performance driver than raw material procurement alone. This underscores the importance of strengthening logistical networks to improve value distribution. Support activities are measured by four indicators, namely suppliers, technology development, human resources, and company infrastructure. The supplier indicator is the leading indicator in measuring or explaining support activities, with a factor loading value of 0.884.

Natural capital in this study is measured using three indicators, namely land resources, water resources, and land productivity. As presented in Table 1, the land resources indicator demonstrates the highest loading factor (0.891),

indicating that it is the most dominant indicator in explaining natural capital. This finding suggests that variations in natural capital are primarily driven by land-related attributes rather than other environmental components. The high loading of land resources (0.891) confirms that in an agrarian-based economy like North Maluku, secure land tenure and plantation size remain the most influential factors in determining a household's natural capital capacity and production scale.

The dominance of land resources can be understood within the specific context of North Maluku, where agricultural activities particularly smallholder coconut plantations are highly dependent on land ownership and land availability. In many rural areas, land size and tenure status directly determine production capacity, access to financing, and long-term livelihood security. Moreover, the archipelagic and fragmented geographic structure of the region often limits land expansion and creates disparities in land access, making land a critical and often scarce resource.

In addition, agrarian conditions and land governance policies in Indonesia further reinforce the central role of land in shaping rural economic outcomes. Previous studies have highlighted that in plantation-based economies, land ownership and land control serve as fundamental determinants of productivity and asset accumulation, particularly in regions with limited infrastructure and market accessibility. Therefore, the high loading of land resources reflects not only its statistical dominance but also its substantive importance in the local agrarian system.

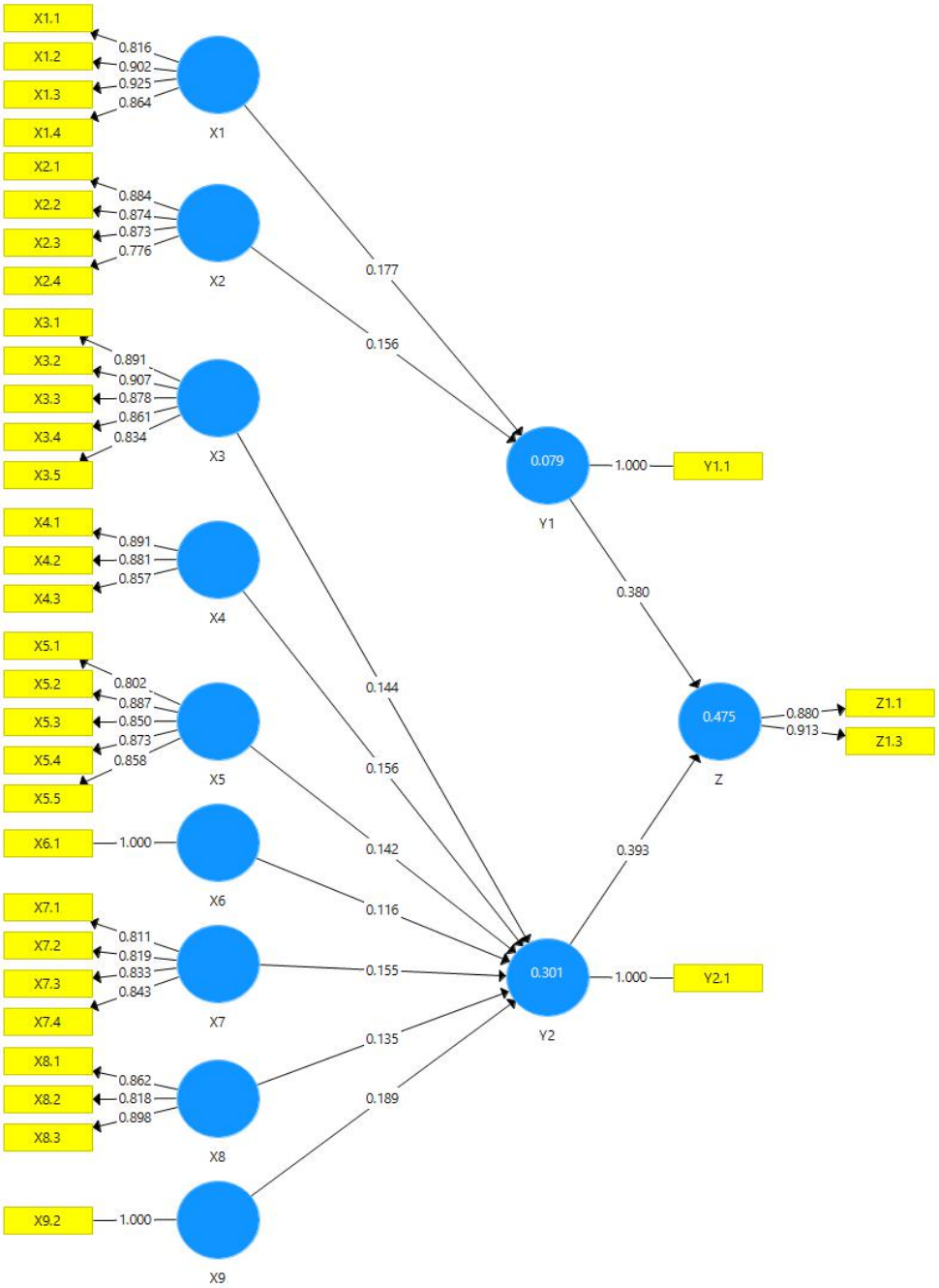

Figure 1. Research model path diagram

Financial capital is measured by five indicators, namely income, expenditure, coconut production, access to credit, and labor costs. The expenditure indicator is the leading indicator in measuring or explaining financial capital, with a factor loading value of 0.887. The prominence of the expenditure indicator (0.887) highlights that financial sustainability for these cooperatives depends heavily on their ability to manage operational costs efficiently amidst fluctuating market prices for coconut products. Social capital is measured by one indicator, namely member participation. The member participation indicator is the leading indicator in measuring or explaining social capital, with a factor loading value of 1.000. The use of a single-item measure for social capital reflects that member participation is the core, non-negotiable pillar of cooperative resilience and trust-based coordination in rural communities. Physical capital is measured by four indicators, namely production equipment, availability of transportation facilities, market availability, and road access. The road access indicator is the leading indicator in measuring or explaining physical capital, with a factor loading value of 0.843. The leading role of road access (0.843) reflects the archipelagic nature of North Maluku, where logistical infrastructure is the primary physical constraint for efficient commodity transport and value chain integration.

Entrepreneurship is measured by three indicators, namely leadership, managerial aspects, and innovation efforts. The innovation efforts indicator is the leading indicator in measuring or explaining entrepreneurship, with a factor loading value of 0.898. The high loading for innovation efforts (0.898) emphasizes that for cooperatives to thrive in a competitive market, they must move beyond traditional trading and adopt value-added processing technologies. Political capital is measured by one indicator, namely participation in government-led activities. The participation in government-led activities indicator is the leading indicator in measuring or explaining political capital, with a factor loading value of 1.000. This indicates that for smallholder cooperatives, strong alignment with government-led development programs is a vital strategic asset for obtaining institutional support and policy protection.

The value chain is measured by one indicator, namely the value chain. The value chain indicator is the leading indicator in measuring or explaining the value chain, with a factor loading value of 1.000. Livelihood assets are measured by one indicator, namely livelihood assets. The livelihood assets indicator is the leading indicator in measuring or explaining livelihood assets, with a factor loading value of 1.000. Cooperative performance is measured by two indicators, namely participation and innovation capability. The innovation capability indicator is the leading indicator in measuring or explaining cooperative performance, with a factor loading value of 0.913. Specifically, the leading role of innovation capability (0.913) in measuring cooperative performance underscores that long-term institutional success is determined by the ability to adapt and differentiate products in a globalized coconut market.

The inner model, which measures the relationships among variables, shows several significant relationships between primary activities, social capital, physical capital, entrepreneurship, and political capital with the value chain and livelihood assets. Furthermore, similar significant results are also shown in the influence of the value chain and livelihood assets on cooperative performance.

Hypothesis testing

Hypothesis testing can be examined through the t-statistic values and probability values. In hypothesis testing using statistical values, for an alpha level of 5%, the t-statistic threshold used is 1.960. Therefore, the criteria for accepting or rejecting the hypothesis are that Ha is accepted and H0 is rejected when the t-statistic > 1.960. To reject or accept the hypothesis using probability values, Ha is accepted if the p-value < 0.05. Based on the empirical data used in this study, hypothesis testing can be conducted on the proposed hypotheses. The following presents the results of hypothesis testing based on path coefficient values and T-statistics / P-values (Table 8).

Table 8. Results of the direct effect significance test

No	Effect	Path coefficient	T	P	Description
1	X1 -> Y1	0.177	2.533	0.012	Significant
2	X2 -> Y1	0.156	2.238	0.026	Significant
3	X3 -> Y2	0.144	2.082	0.038	Significant
4	X4 -> Y2	0.156	2.169	0.031	Significant
5	X5 -> Y2	0.142	2.134	0.033	Significant
6	X6 -> Y2	0.116	2.063	0.040	Significant
7	X7 -> Y2	0.155	2.836	0.005	Significant
8	X8 -> Y2	0.135	2.145	0.032	Significant
9	X9 -> Y2	0.189	3.048	0.002	Significant
10	Y1 -> Z	0.380	6.547	0.000	Significant
11	Y2 -> Z	0.393	6.787	0.000	Significant

a). The effect of primary activities on the value chain

The significance test of the effect of primary activities on the value chain obtained a path coefficient of 0.177, with a t-statistic value of 2.533 and a significance value of 0.012. These results indicate that the t-statistic value is greater

than the t-table value (t > 1.960) and the significance value is less than 0.05 (p < 0.05). Therefore, it can be concluded that primary activities have a positive and significant effect on the value chain, meaning that higher or better primary activities will significantly contribute to a higher or better value chain. In this study, the primary activities variable has indicators such as raw materials, processing, product distribution, sales and marketing, and services. The positive effect of primary activities on the value chain is supported by various studies (Nariyono et al., 2018), which indicate that optimization and efficiency in the main activities within the value chain can generate significant added value for a business. Primary activities, which include inbound logistics, operations, outbound logistics, as well as distribution, marketing, and sales, have a positive and significant effect on the value chain of coconut processed-product cooperatives. At the inbound logistics stage, efficient management in procuring and distributing coconut raw materials becomes a critical initial step to ensure the sustainability of the production process. Well-organized operations in processing coconuts into processed products, such as white copra and coconut oil, can improve production efficiency and produce high-quality products. With increased efficiency and effectiveness in primary activities, cooperatives can achieve cost savings, improved product quality, and greater competitiveness in the market. Furthermore, effective management of primary activities can create opportunities for product innovation, diversification, and broader market development, all of which positively and significantly contribute to enhancing the value chain of coconut processed-product cooperatives.

b). The effect of support activities on the value chain

The significance test of the effect of support activities on the value chain obtained a path coefficient of 0.156, with a t-statistic value of 2.238 and a significance value of 0.026. These results indicate that the t-statistic value is greater than the t-table value (t > 1.960) and the significance value is less than 0.05 (p < 0.05). Therefore, it can be concluded that support activities have a positive and significant effect on the value chain, meaning that higher or better support activities will significantly contribute to a higher or better value chain. In this study, there is a significant finding that support activities have a positive and significant effect on the value chain. In value chain analysis, support activities refer to supporting functions that are not directly involved in production but have a significant impact on the efficiency and effectiveness of business processes. These functions may include human resource management, technology development, procurement of raw materials, and infrastructure. Efforts made in these supporting aspects provide tangible contributions to increasing added value within the value chain. Cooperatives have successfully managed human resources, implemented appropriate technology, and established efficient raw material procurement systems. These results can provide a basis for recommending improvements or optimization in specific aspects of support activities to maximize the effectiveness of the value chain of coconut processed-product cooperatives in North Maluku Province. According to (Nariyono et al. 2018), the support activities variable in the value chain has a fundamental role in achieving competitive advantage. Each activity within the value chain must be carried out and analyzed to understand the process of gaining competitive advantage.

c). The effect of human capital on livelihood assets

The significance test of the effect of human capital on livelihood assets obtained a path coefficient of 0.144, with a t-statistic value of 2.082 and a significance value of 0.038. These results indicate that the t-statistic value is greater than the t-table value (t > 1.960) and the significance value is less than 0.05 (p < 0.05). Therefore, it can be concluded that human capital has a positive and significant effect on livelihood assets, meaning that higher or better human capital will significantly contribute to higher or better livelihood assets. The effect of human capital on livelihood assets in coconut processed-product cooperatives highlights the important role of human resources in enhancing the cooperatives' livelihood assets. Human capital includes education, labor availability, knowledge and skills, experience, and health involved in cooperative activities. In this study, it can be concluded that improvements in human capital, both among cooperative members and management, have a significant positive impact on livelihood assets. Cooperative members who possess strong skills and knowledge regarding coconut farming practices and business management can directly improve the productivity and operational efficiency of the cooperative. In addition, skilled and knowledgeable managers are able to effectively manage human resources, plan effective business strategies, and implement policies that support cooperative development.

Improvement in human capital can also strengthen relationships among cooperative members, enhance adaptability to market changes, and support innovation in the production and marketing of coconut processed products. In addition to providing internal benefits for the cooperative, the improvement of human capital can also create employment opportunities and improve the living standards of cooperative members. Thus, the results of this study indicate that investment in developing the skills and knowledge of cooperative members and management is a highly relevant strategy for improving the livelihood assets of coconut processed-product cooperatives. Future recommendations may include continuous training and education for cooperative members, efforts to strengthen human resource management, and capacity building for cooperative management to enhance the cooperative's operational performance in the market. According to (Aazami and Shanazi 2020), their study found that human capital

has a positive and significant effect on community livelihoods, highlighting its importance in determining the level of livelihoods.

d). The effect of natural capital on livelihood assets

The significance test of the effect of natural capital on livelihood assets obtained a path coefficient of 0.156, with a t-statistic value of 2.169 and a significance value of 0.031. These results indicate that the t-statistic value is greater than the t-table value (t > 1.960) and the significance value is less than 0.05 (p < 0.05). Therefore, it can be concluded that natural capital has a positive and significant effect on livelihood assets, meaning that higher or better natural capital will significantly contribute to higher or better livelihood assets. The finding that natural capital has a positive and significant effect on livelihood assets in coconut processed-product cooperatives illustrates the close relationship between natural resources. Natural capital includes natural assets such as land, water, and plantations that contribute to coconut production. In this study, the results indicate that the wise utilization and management of natural resources by cooperatives have a positive impact on the development of livelihood assets. The sustainability of natural capital can increase coconut productivity, ensure a sustainable supply of raw materials, and support environmentally friendly agricultural practices. The sustainability in the utilization of natural resources enables cooperatives to maintain and increase the production of coconut processed products sustainably, without harming the surrounding environment. According to (Prayitno et al., 2025), natural capital, as part of livelihood assets, contributes to enhancing communities' adaptive capacity in facing various social and economic challenges, indicating that the quality and sustainability of natural resources play a role in strengthening livelihood resilience. Meanwhile. According to (Yang & Cui, 2025), natural capital has a significant influence on the formation of livelihood capital, which implies an improvement in farmers' sustainable production behavior through cognitive mediation mechanisms, thereby strengthening the relationship between natural resource management and the enhancement of livelihood capacity.

e). The effect of financial capital on livelihood assets

The significance test of the effect of financial capital on livelihood assets obtained a path coefficient of 0.142, with a t-statistic value of 2.134 and a significance value of 0.033. These results indicate that the t-statistic value is greater than the t-table value (t > 1.960) and the significance value is less than 0.05 (p < 0.05). Therefore, it can be concluded that financial capital has a positive and significant effect on livelihood assets, meaning that higher or better financial capital will significantly contribute to higher or better livelihood assets. The research finding that financial capital has a positive and significant effect on livelihood assets reflects the close relationship between financial sustainability and the development of livelihood assets. Financial capital, which involves capital and financial resources available to cooperatives, is identified as an important factor that positively influences economic development and the welfare of cooperative members. Adequate financial capital provides cooperatives with the ability to invest in technology, expand production, and enhance operational capacity. This, in turn, can improve productivity, efficiency, and the competitiveness of cooperatives in the coconut processed-product market. Sufficient financial resources also enable cooperatives to address potential economic challenges, such as fluctuations in raw material prices or changes in market conditions. According to (Syafrial et al., 2022), access to financial capital, such as business financing and working capital support, influences the improvement of smallholder farmers' household food security, which reflects an overall enhancement of livelihood assets.

f). The effect of social capital on livelihood assets

The significance test of the effect of social capital on livelihood assets obtained a path coefficient of 0.169, with a t-statistic value of 2.628 and a significance value of 0.009. These results indicate that the t-statistic value is greater than the t-table value (t > 1.960) and the significance value is less than 0.05 (p < 0.05). Therefore, it can be concluded that social capital has a positive and significant effect on livelihood assets, meaning that higher or better social capital will significantly contribute to higher or better livelihood assets.Top of FormBottom of Form The research finding that social capital has a positive and significant effect on livelihood assets in coconut processed-product cooperatives indicates that social capital, which includes the active participation of cooperative members, has an inherent positive impact on cooperative development. When cooperatives build strong social capital, their members can support each other in various aspects, ranging from knowledge and information exchange to coordination in carrying out business activities. Strong relationships and trust among cooperative members not only create a positive working environment but also open opportunities for collaboration that can improve operational efficiency and competitiveness in the coconut processed-product sector. Social capital also strengthens member involvement in cooperative decision-making and management, which in turn can enhance responsibility, motivation, and loyalty toward the cooperative. With strong support and active participation from its members, cooperatives can better overcome economic challenges and optimize existing opportunities. The results of this study provide a foundation for strategic recommendations, such as strengthening social capacity-building programs, promoting transparency and member participation, and enhancing communication and collaboration with relevant stakeholders. Therefore, social capital can be considered a key element in building a strong foundation for enhancing the livelihood assets of coconut

processed-product cooperatives, providing positive impacts both at the cooperative level and in the lives of its members. According to (Prayitno et al., 2025; Yang & Cui, 2025), social capital plays a role in enhancing community capacity through strengthening social networks, community cooperation, and trust among members, thereby expanding access to economic resources and information that support livelihood sustainability.

g). The effect of physical capital on livelihood assets

The significance test of the effect of physical capital on livelihood assets obtained a path coefficient of 0.155, with a t-statistic value of 2.836 and a significance value of 0.005. These results indicate that the t-statistic value is greater than the t-table value ($t > 1.960$) and the significance value is less than 0.05 ($p < 0.05$). Therefore, it can be concluded that physical capital has a positive and significant effect on livelihood assets, meaning that higher or better physical capital will significantly contribute to higher or better livelihood assets. Physical capital has a positive and significant effect on livelihood assets in coconut processed-product cooperatives, illustrating the central role of physical assets in strengthening economic sustainability and the welfare of cooperative members. Physical capital, which includes equipment, transportation, market facilities, and road access, has been proven to be a key driver in improving livelihood assets. When cooperatives have access to and effectively manage physical capital, it can enhance their production efficiency and capacity. For example, the availability of modern coconut processing facilities, advanced agricultural equipment, or efficient transportation systems can directly improve production, product quality, and market access for cooperatives. This positive influence is not only limited to the cooperative's operational performance but also creates a direct impact on the livelihood assets of cooperative members. Improvement in infrastructure and equipment can create new employment opportunities, increase members' income, and establish economic stability at the individual level. In addition, adequate physical capital can ensure the sustainability of production and income for cooperative members in the long term. Thus, the results of this study provide a basis for policy recommendations and management strategies that focus on the development and maintenance of physical capital. Investment in modern infrastructure, technological upgrades, and the maintenance of cooperative physical assets is key to supporting sustainable growth, improving livelihood assets, and enhancing the welfare of coconut processed-product cooperative members. According to (Ma'ruf et al., 2025), physical capital, such as production equipment, agricultural technology, and transportation facilities, has a significant and positive influence on the sustainability of farmers' household livelihoods. Physical facilities support economic stability and overall livelihood capacity, including through improvements in production efficiency and market access. Meanwhile according to (Mohammadi, 2021), Physical capital is an important factor in improving the sustainable livelihoods of cooperative members, where access to infrastructure and production equipment has been proven to be a strong predictor of the success of sustainable livelihood strategies. Thus, according to (Azumah, 2023), physical capital is able to expand income opportunities and improve the welfare of rural communities.

h). The effect of entrepreneurship on livelihood assets

The significance test of the effect of entrepreneurship on livelihood assets obtained a path coefficient of 0.135, with a t-statistic value of 2.145 and a significance value of 0.032. These results indicate that the t-statistic value is greater than the t-table value ($t > 1.960$) and the significance value is less than 0.05 ($p < 0.05$). Therefore, it can be concluded that entrepreneurship has a positive and significant effect on livelihood assets, meaning that higher or better entrepreneurship will significantly contribute to higher or better livelihood assets. Entrepreneurship has a positive and significant effect on livelihood assets in coconut processed-product cooperatives, illustrating the central role of entrepreneurship in enhancing economic sustainability and the livelihood assets of cooperative members. Entrepreneurship includes the involvement of cooperative members in innovation, business development, and risk management to create added value for the cooperative and its members. This positive influence not only affects the overall performance of the cooperative but also provides a direct impact on the livelihood assets of cooperative members. Entrepreneurship that develops within cooperatives can create new employment opportunities, increase individual income, and enhance economic sustainability. Furthermore, the ability to adapt to market changes and face challenges can improve the economic resilience of cooperative members. The results of this study provide a foundation for practical recommendations, including entrepreneurship training for cooperative members, support for innovation, and managerial capacity building. By promoting an entrepreneurial mindset, coconut processed-product cooperatives can achieve sustainable growth, enhance the livelihood assets of their members, and make a positive contribution to local economic development. According to (Kabir et al., 2012), entrepreneurship has a positive relationship with strengthening financial capital, physical capital, and social capital, which are important components of livelihood assets, and it improves living standards through the diversification of income sources and economic opportunities.

i). The effect of political capital on livelihood assets

The significance test of the effect of political capital on livelihood assets obtained a path coefficient of 0.189, with a t-statistic value of 3.048 and a significance value of 0.002. These results indicate that the t-statistic value is greater

than the t-table value (t > 1.960) and the significance value is less than 0.05 (p < 0.05). Therefore, it can be concluded that political capital has a positive and significant effect on livelihood assets, meaning that higher or better political capital will significantly contribute to higher or better livelihood assets. Becoming a member of an action council provides greater access to decision-making processes and policy formulation within the cooperative, while participation in government activities creates closer relationships with government entities. Active involvement in government policies and programs can open opportunities to obtain support, resources, and better market access. With strong political capital, cooperative members can experience improvements in livelihood assets through government policies and support that enhance cooperative activities. Furthermore, participation in decision-making processes can ensure that members' interests are considered and advocated for. Strengthening political capital, such as involving members in action councils and promoting participation in government activities, can be considered a strategic step to enhance the livelihood assets of cooperative members. Thus, cooperatives can serve as strong economic pillars, not only within the context of the value chain but also in empowering their members to achieve higher levels of welfare.

j). The effect of the value chain on cooperative performance

The significance test of the effect of the value chain on cooperative performance obtained a path coefficient of 0.380, with a t-statistic value of 6.547 and a significance value of 0.000. These results indicate that the t-statistic value is greater than the t-table value (t > 1.960) and the significance value is less than 0.05 (p < 0.05). Therefore, it can be concluded that the value chain has a positive and significant effect on cooperative performance, meaning that higher or better value chain performance will significantly contribute to higher or better cooperative performance. The finding that the value chain has a positive and significant effect on cooperative performance indicates that the integration and optimization of various stages within the value chain provide a tangible positive contribution to the overall performance of cooperatives. The value chain includes all activities involved in producing and delivering products or services to end consumers, ranging from raw material procurement to distribution and marketing of finished products. First, effective integration within the value chain enables cooperatives to maximize operational efficiency. Strong coordination among various stages, such as production, distribution, and marketing, can reduce waste, overhead costs, and the time required to bring products to market. This helps cooperatives produce goods at lower costs, increase profit margins, and ultimately improve financial performance. Second, an effective value chain can also create added value for cooperative products or services. By understanding consumer needs and preferences, cooperatives can produce products that better match market demands and are more competitive than those of their rivals. In this way, cooperative performance can improve through increased sales and market share. Third, a well-integrated value chain enables cooperatives to respond to market changes more quickly and flexibly. By understanding market dynamics, cooperatives can make strategic adjustments in production, distribution, and marketing processes, allowing them to remain relevant and compete effectively. Thus, the finding that the value chain has a positive and significant effect on cooperative performance emphasizes the importance of effective value chain management in supporting the sustainability and success of cooperatives. It also highlights the need to continuously update and improve value chain management strategies to remain responsive to market changes and achieve optimal performance. According to (Liu et al., 2025), cooperative involvement in strengthening the green agri-food value chain is able to increase production added value, strengthen market access, and improve the economic sustainability of cooperative members through vertical integration within the value chain. Furthermore, according to Syofya (2024), the value chain can improve farmers' income quality through the creation of added value and efficiency in marketing systems, which indirectly reflects improved performance of agribusiness-based economic institutions.

k). The effect of livelihood assets on cooperative performance

The significance test of the effect of livelihood assets on cooperative performance obtained a path coefficient of 0.393, with a t-statistic value of 6.787 and a significance value of 0.000. These results indicate that the t-statistic value is greater than the t-table value (t > 1.960) and the significance value is less than 0.05 (p < 0.05). Therefore, it can be concluded that livelihood assets have a positive and significant effect on cooperative performance, meaning that higher or better livelihood assets will significantly contribute to higher or better cooperative performance. The finding that livelihood assets have a positive and significant effect on cooperative performance indicates that the economic well-being of cooperative members, as reflected in the cooperative's livelihood assets, has a tangible positive impact on the overall performance of coconut processed-product cooperatives. Livelihood assets include various elements such as income, access to resources, education, health, and other factors that influence individuals economic lives. First, the improvement of cooperative members' livelihood assets can contribute to their purchasing power, which in turn can support increased sales of cooperative products or services. Members who have better economic resources tend to be more active in cooperative activities, purchase more products, and make greater contributions to the cooperative's economic growth. Second, the improved economic well-being of cooperative members can also create a more stable and sustainable environment for the cooperative. Members who are more prosperous are more likely to remain involved in the cooperative in the long term, thereby enhancing the organization's sustainability. This can help

the cooperative maintain strong and consistent membership. Third, improvements in livelihood assets can have a positive impact on the quality of the cooperative workforce. Members who are more economically secure tend to possess better knowledge, skills, and motivation to contribute to the cooperative's operational success. This can strengthen teamwork, enhance productivity, and positively affect the overall performance of the cooperative. According to (Prayitno et al., 2025), their study shows that livelihood assets, which include human, social, financial, physical, and natural capital, play an important role in enhancing communities' adaptive capacity in facing economic pressures, which indirectly improves productivity and the sustainability of collective economic activities. According to (Yang & Cui, 2025), livelihood capital can improve farmers' production performance through enhanced investment capacity, technology adoption, and business decision-making, which reflects the contribution of livelihood assets to improving the performance of agribusiness organizations. Furthermore (Liu et al., 2025), And, according to (Liu et al., 2025), cooperatives with members who possess strong livelihood assets tend to have better capabilities in developing product added value and maintaining the sustainability of the agribusiness value chain.

Thus, these findings indicate that improving the livelihood assets of cooperative members not only directly benefits individuals but can also become a key factor in achieving and maintaining strong overall cooperative performance. Therefore, cooperative development strategies should incorporate approaches that focus on improving members' economic well-being as an integral part of efforts to achieve the goals and sustainability of coconut processed-product cooperatives.

CONCLUSION

Based on the analysis results, it can be concluded that the cooperative performance improvement model based on coconut through the integration of the value chain and livelihood assets has been empirically proven. All tested causal relationships show positive and significant effects, both from exogenous variables to intermediary variables and from intermediary variables to cooperative performance. These findings indicate that value chain integration plays an important role in strengthening coordination among actors, improving distribution efficiency, and creating added value in coconut cooperatives. Furthermore, members livelihood assets, which reflect economic, social, and human resource capacities, have also been proven to significantly contribute to cooperative performance. The mediating variables play a strategic role as connecting mechanisms that strengthen the impact of exogenous variables on cooperative performance. Therefore, improving cooperative performance cannot be separated from a holistic approach that integrates institutional aspects, value chains, and the livelihood capacity of members.

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