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Production and Processing Practices, Industry Challenges, and Value Chain Efficiency of Cassava in Pandan, Catanduanes: A Correlational Analysis

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Abstract

Cassava production in Pandan, Catanduanes, Philippines, contributes to local livelihoods but faces financial, infrastructural, market-related, and production constraints that may undermine value chain performance and competitiveness. This study assessed cassava production, processing, and marketing practices, stakeholder challenges, and value chain efficiency. It further examined the relationships among these variables and the extent to which industry practices and stakeholder challenges predict value chain efficiency as a basis for developing a strategic intervention framework. A quantitative descriptive-correlational research design was employed, involving 140 farmers, processors, and traders selected through stratified random sampling. Data were collected using a validated researcher-developed questionnaire and analyzed through descriptive statistics, Pearson product–moment correlation, and multiple linear regression. Results indicated high levels of implementation of industry practices, substantial stakeholder challenges, and high perceived value chain efficiency. Industry practices exhibited a positive relationship with value chain efficiency, whereas stakeholder challenges demonstrated a negative relationship. Collectively, these variables accounted for 51.0% of the variance in value chain efficiency. These findings suggest that stronger industry practices and fewer stakeholder constraints are associated with improved value chain performance. The study underscores the importance of strengthening technological adoption, market access, financial support, infrastructure development, risk management, and stakeholder coordination. Accordingly, a strategic intervention framework is proposed to address identified constraints, improve value chain integration, and promote the competitiveness, resilience, and sustainability of the local cassava industry.

Keywords: cassava industry, value chain efficiency, production and marketing practices, stakeholder challenges, agricultural value chain, strategic intervention framework

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INTRODUCTION

Cassava is an economically important agricultural commodity that contributes to food security, rural livelihoods, and industrial development. Its competitiveness depends not only on agricultural productivity but also on effective coordination among producers, processors, traders, and other value chain participants. Studies demonstrate that inclusive stakeholder participation, efficient resource utilization, and value chain upgrading can improve livelihood opportunities and market performance (Apata, 2019; Darko-Koomson et al., 2020). These findings emphasize the importance of examining cassava development as an interconnected system rather than focusing exclusively on farm-level production.

International evidence further highlights the significance of technological innovation, resource efficiency, and sustainable processing

in strengthening cassava value chains. Research in China and Thailand demonstrates how improvement of resource allocation and cleaner production practices can enhance operational efficiency (Fu et al., 2018; Pingmuanglek et al., 2017). Emerging processing technologies also offer opportunities for product diversification and value addition (Lilavanichakul & Yoksan, 2023). Collectively, these studies establish that value chain performance depends on integrated production, processing, technological, and marketing capabilities. However, their applicability to geographically isolated agricultural communities requires further empirical examination.

In the Philippines, cassava contributes to agricultural livelihoods, yet production and marketing inefficiencies continue to constrain its economic potential. Onsay (2021) documented interconnected production, post-harvest, and marketing challenges in Camarines Sur, underscoring the importance of coordinated value chain management. Although national legislation supports agricultural modernization, technology adoption, and market development (Republic Act No. 8435, 1997; Republic Act No. 11321, 2019), translating these policy priorities into effective local interventions remains challenging, particularly in communities experiencing geographical isolation, limited infrastructure, and restricted access to agricultural resources.

Existing research also identifies technological limitations, inefficient resource allocation, and inadequate market support as constraints on cassava industry development. Evidence from Zambia and Nigeria illustrates the potential contributions of mechanized processing, improved resource utilization, and appropriate production technologies to profitability and value addition (Abass et al., 2017; Moses et al., 2024). Nevertheless, these studies primarily examine individual value chain components, providing limited understanding of how interconnected industry practices and stakeholder challenges jointly explain overall value chain efficiency. This limitation highlights the need for integrated, context-sensitive assessments encompassing multiple stakeholder groups and operational dimensions.

Despite these contributions, four interrelated research gaps remain. First, a contextual gap arises from the limited empirical attention given to geographically isolated island communities, particularly Catanduanes. Second, an empirical gap concerns the simultaneous assessment of production, processing, marketing, and technology-adoption practices alongside stakeholder challenges. Third, an analytical gap involves the limited examination of the combined predictive contributions of these factors to value chain efficiency. Finally, a research-to-practice gap persists because localized evidence is seldom translated into integrated strategic interventions addressing operational constraints, stakeholder coordination, and sustainable industry development.

These gaps are particularly relevant to Pandan, Catanduanes, where geographical conditions may intensify transportation difficulties, infrastructure limitations, technological constraints, and market accessibility concerns. Such circumstances potentially influence production costs, processing opportunities, distribution efficiency, and stakeholder participation. However, the extent to which these conditions shape local cassava industry practices and perceived value chain efficiency remains insufficiently documented. Consequently, findings from established cassava-producing regions cannot automatically be generalized to Pandan without considering its distinctive geographical, institutional, and socioeconomic characteristics.

Against this background, the present study assesses cassava production, processing, marketing, and technology-adoption practices, stakeholder challenges, and value chain efficiency among farmers, processors, and traders in Pandan, Catanduanes. Specifically, it examines the relationships among these

variables and determines the extent to which industry practices and stakeholder challenges statistically predict value chain efficiency. By integrating multiple operational dimensions and stakeholder perspectives, the study contributes localized empirical evidence to agricultural value chain research, particularly within geographically isolated and resource-constrained settings.

Drawing on the empirical findings, the study proposes a strategic intervention framework addressing identified operational weaknesses, stakeholder constraints, and opportunities for value chain improvement. The framework prioritizes coordinated production and processing improvements, technological adoption, market development, resource accessibility, and institutional collaboration. Ultimately, the study seeks to inform context-responsive agricultural development initiatives that strengthen value chain efficiency, enhance stakeholder participation, and support the long-term competitiveness, resilience, and sustainability of the cassava industry in Pandan, Catanduanes.

Statement of the Problem. This study aimed to assess the production, processing, and marketing practices, challenges, and value chain efficiency of the cassava industry in Pandan, Catanduanes, Philippines. Specifically, it seeks to determine how existing industry practices and challenges influence the efficiency of the cassava value chain and to develop evidence-based interventions for its improvement.

Specifically, the study sought to answer the following questions:

1. What is the extent of adoption of cassava industry practices among key stakeholders in terms of:
   1.1 production techniques and farm management;
   1.2 post-harvest handling, processing, and storage;
   1.3 marketing and distribution; and
   1.4 technology and innovation adoption?
2. What is the extent of challenges encountered by key stakeholders in the cassava industry in terms of:
   2.1 access to capital and financial resources;
   2.2 infrastructure, equipment, and processing facilities;
   2.3 pest, disease, and production-related risks; and
   2.4 market price volatility, competition, and market access?
3. What is the level of cassava value chain efficiency in terms of:
   3.1. accessibility and reliability of input supply;
   3.2. coordination between production and processing;
   3.3. efficiency of distribution and marketing channels; and
   3.4. profitability and benefits accruing to value chain stakeholders?
4. Is there a significant relationship between the extent of industry practices and the level of cassava value chain efficiency?
5. Is there a significant relationship between the extent of challenges encountered and the level of cassava value chain efficiency?
6. Do industry practices and challenges significantly predict the level of cassava value chain efficiency?
7. Based on the findings, what strategic intervention framework may be proposed to strengthen cassava production and processing practices, address industry challenges, and improve value chain efficiency in Pandan, Catanduanes?

Null Hypotheses. The following null hypotheses were tested at a 0.05 level of significance:

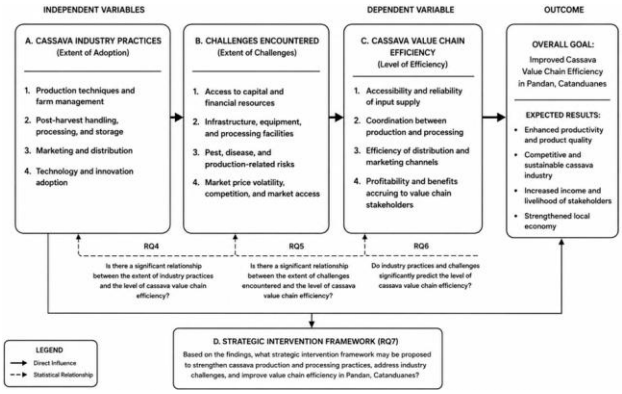
Ho_1. There is no significant relationship between the extent of industry practices and the level of cassava value chain efficiency.

Ho_2. There is no significant relationship between the extent of challenges encountered and the level of cassava value chain efficiency.

Ho₃. Industry practices and challenges do not significantly predict the level of cassava value chain efficiency.

Scope and Delimitation of the Study. The study was conducted in Pandan, Catanduanes, Philippines, in 2026, involving key cassava industry stakeholders, particularly smallholder farmers, processors, and traders. It examined industry practices in production, post-harvest processing, marketing, and technology adoption; challenges related to capital, infrastructure, pest and disease management, and market conditions; and value chain efficiency in input access, production-to-processing linkages, distribution, profitability, and stakeholder benefits. It also examined the relationships and predictive effects of industry practices and challenges on value chain efficiency. The study was limited to stakeholders within Pandan and excluded other locations, crops, agricultural enterprises, experimental interventions, and market simulations; hence, findings are contextualized to the local cassava industry in 2026.

Theoretical and Conceptual Framework. This study is anchored on Porter's Value Chain Theory (Porter, 1985) and the Resource-Based View (RBV) (Wernerfelt, 1984), which provide complementary perspectives for examining cassava industry practices, challenges, resources, and value chain efficiency in Pandan, Catanduanes. Porter's framework conceptualizes value creation through interconnected activities, including production, post-harvest processing, marketing, and supporting functions, whose coordination influences operational efficiency and competitiveness. Ruan (2020) reinforces its applicability in examining activity integration, resource utilization, and cost management. Complementarily, RBV explains how financial, technical, human, technological, and organizational resources influence stakeholders' capabilities to implement improved practices, overcome operational constraints, and sustain competitive advantage (Wernerfelt, 1984; Lubis, 2022). Together, these theories establish the conceptual basis for examining industry practices and challenges as distinct factors associated with value chain efficiency.



Note: RQ – Research Question

Figure 1

Conceptual Framework of the Study

Author's Note. *This figure was developed with the assistance of AI-based figure generation tools. All generated content was carefully reviewed, revised where necessary, and approved by the researcher before its inclusion in the manuscript.*

As illustrated in Figure 1, industry practices and industry challenges serve as independent predictor variables, while cassava value chain efficiency constitutes the outcome variable. Production, post-harvest processing, marketing, and technology-adoption practices represent value-adding activities potentially associated with greater efficiency (Porter, 1985; Ruan, 2020). Conversely, financial, infrastructural, technological, and market-related challenges represent constraints potentially associated with reduced operational efficiency (Wernerfelt, 1984; Lubis, 2022). Challenges are treated as direct predictors because the study examines their independent statistical associations with efficiency rather than their role in transmitting or modifying the effects of industry practices. Accordingly, mediation and moderation mechanisms are neither hypothesized nor tested. This specification aligns with Research Questions (RQs) 4 and 5 concerning relationships and RQ 6 examining their predictive contribution.

The framework further informs the strategic intervention framework addressed in Research Question 7. Guided by empirical findings, the proposed interventions seek to strengthen

value-adding practices, optimize resource utilization, reduce operational constraints, and improve stakeholder coordination. Thus, the framework integrates activity-based value creation and resource-dependent capabilities to explain variations in cassava value chain efficiency. Its application supports evidence-based interventions intended to improve production, processing, marketing performance, stakeholder benefits, competitiveness, resilience, sustainability, and local economic development in Pandan, Catanduanes.

LITERATURE REVIEW

The reviewed literature is synthesized into three interconnected themes: cassava production, processing, and marketing practices; challenges affecting the cassava value chain; and value-chain integration and efficiency. Emphasis is placed on convergent findings, contrasting perspectives, and methodological differences to establish how operational practices, systemic constraints, and stakeholder coordination collectively shape industry performance and sustainability.

Cassava Production, Processing, and Marketing Practices. Existing studies generally agree that cassava competitiveness depends on efficient resource utilization, production management, post-harvest handling, and market participation. Research examining farm-level efficiency emphasizes appropriate input allocation and production practices (Fu et al., 2018; Cahyaningsih et al., 2023), whereas processing-oriented investigations highlight drying, starch extraction, quality preservation, and post-harvest management (Nainggolan et al., 2024; Chamorro et al., 2025). Although these studies differ in their operational focus, they collectively demonstrate that production efficiency alone cannot adequately explain overall value-chain performance.

However, findings concerning technological improvements reveal important qualifications. Processing innovations may reduce losses and enhance product quality, yet their practical benefits depend on financial capacity, technical competence, infrastructure, and operational scale (Olugbenga et al., 2020; Adaigho et al., 2025). This distinction suggests that technological effectiveness under favorable conditions does not necessarily translate into widespread adoption or improved stakeholder outcomes. Consequently, production-oriented and technology-focused evidence must be interpreted alongside institutional support, market accessibility, and resource availability when assessing local industry practices.

Sustainability-oriented studies extend this discussion by emphasizing resource recovery, waste utilization, and product diversification. Circular processing approaches demonstrate opportunities to transform cassava residues into valuable resources (Lerdlattaporn et al., 2021), while bioplastic development illustrates potential industrial applications (Lilavanichakul & Yoksan, 2023). Nevertheless, technological feasibility and environmental benefits do not independently establish commercial viability or stakeholder accessibility. These differing emphases reveal a methodological limitation: studies frequently assess individual production, processing, or sustainability outcomes rather than their combined relationships with value-chain efficiency. This study therefore integrates these operational dimensions within a localized assessment.

Challenges Affecting the Cassava Value Chain. The literature consistently identifies institutional weaknesses, resource limitations, and market constraints as barriers to cassava value-chain development. Governance-oriented investigations emphasize policy implementation, contractual arrangements, and institutional coordination (Inegbedion et al., 2020; Nguyen, 2020; Olomu et al., 2020). Although these studies generally recognize coordination as essential to industry performance, they also suggest that improved integration does not necessarily ensure equitable benefit distribution. Thus, operational efficiency and stakeholder inclusiveness represent related but conceptually distinct outcomes requiring careful examination.

Socioeconomic investigations introduce additional perspectives by examining differences in stakeholder participation and access to opportunities. Gender-related disparities influence involvement across cassava activities (Olaomo, 2021), whereas limited youth participation presents concerns regarding enterprise development and industry continuity (Udemezue et al., 2024). Unlike institution-centered analyses, these studies emphasize demographic and participation-related dimensions of value-chain development. Their complementary findings indicate that improvements in productivity or profitability may remain unevenly distributed unless access to resources, participation opportunities, and stakeholder benefits are considered alongside operational performance.

Operational and market-oriented evidence further identifies post-harvest losses, technological deficiencies, weak distribution systems, and price instability as interconnected constraints (Olugbenga et al., 2020; Adaigho et al., 2025; Duangbootsee, 2024). However, improved processing capacity and stronger market integration do not necessarily guarantee proportionate financial returns to producers, particularly when price transmission remains imperfect. These findings challenge assumptions that operational upgrading automatically improves outcomes for all stakeholders. Methodologically, existing investigations emphasize different institutional, socioeconomic, or market dimensions, leaving their combined associations with efficiency insufficiently established in geographically isolated settings.

Cassava Value-Chain Integration and Efficiency. Existing research broadly agrees that cassava value-chain efficiency requires coordinated production, processing, distribution, and marketing activities. Supply-chain investigations emphasize actor integration, information exchange, and performance monitoring (Nattassha et al., 2020), while governance-oriented studies highlight institutional arrangements and resource coordination (Nguyen, 2020; Olomu et al., 2020). Conversely, farm-level economic analyses concentrate on input allocation and productive efficiency (Cahyaningsih et al., 2023). These approaches offer complementary explanations but differ in their units of analysis, demonstrating the limitations of evaluating value-chain performance exclusively through individual enterprises or production activities.

A notable methodological distinction concerns how efficiency is operationalized. Technical and economic efficiency studies primarily examine input-output relationships and resource utilization (Fu et al., 2018; Cahyaningsih et al., 2023), whereas market-oriented and sustainability investigations emphasize price transmission, profitability, value addition, and environmental performance (Duangbootsee, 2024; Olugbenga et al., 2020; Lerdlattaporn et al., 2021). Consequently, apparently contrasting assessments may reflect differences in measurement rather than genuinely inconsistent findings. A value chain may demonstrate productive efficiency while experiencing weak market returns, unequal benefit distribution, or environmental constraints, supporting the need for multidimensional assessment.

Recent investigations further emphasize digitalization, information accessibility, innovation, and stakeholder collaboration as mechanisms for improving value-chain performance (Adeuyi, 2024; Lutta et al., 2024; Olanrewaju, 2024). Nevertheless, technological and organizational improvements remain dependent on infrastructure, institutional capacity, stakeholder competence, and economic incentives. Across these methodological perspectives, a persistent limitation is the insufficient integration of industry practices and operational challenges as simultaneous predictors of value-chain efficiency. The present study addresses this limitation through a localized, stakeholder-based assessment that examines their individual relationships and collective predictive contributions within the cassava industry of Pandan, Catanduanes.

Research Gap. Overall, the literature converges on the importance of resource efficiency, technological improvement, institutional coordination, and market integration, but differs in its measurement approaches, analytical priorities, and interpretations of stakeholder benefits. Existing research remains geographically fragmented and methodologically compartmentalized, with limited integrated examination of industry practices, stakeholder challenges, and value-chain efficiency.

Moreover, findings from established cassava-producing regions may not adequately represent resource-constrained island communities. Addressing these contextual, empirical, and analytical gaps, the present study examines cassava production, processing, marketing, and technology-adoption practices alongside stakeholder challenges as predictors of perceived value-chain efficiency in Pandan, Catanduanes. Its findings provide a localized empirical basis for developing coordinated, evidence-informed interventions that strengthen industry competitiveness, stakeholder participation, operational resilience, and sustainability.

METHODS

Research Design. The study employed a quantitative, non-experimental, descriptive-correlational research design to examine cassava industry practices, stakeholder challenges, and perceived value chain efficiency in Pandan, Catanduanes, Philippines. Descriptive statistics assessed the extent of industry practices, severity of challenges, and level of perceived value chain efficiency. Pearson product–moment correlation examined the relationships among the study variables, while multiple linear regression determined the collective predictive contributions of industry practices and stakeholder challenges to value chain efficiency. As variables were observed without manipulation, the design examined statistical associations rather than causal relationships. This approach provided an empirical basis for developing a strategic intervention framework to strengthen the local cassava industry (Creswell & Creswell, 2018).

Population, Sample, and Sampling Technique. The study population comprised 200 cassava farmers, processors, and traders engaged in the cassava value chain in Pandan, Catanduanes, during Calendar Year 2026, as identified through the Municipal Agriculture Office. Using Slovin's formula at a 5% margin of error, the minimum calculated sample size was approximately 134 respondents, which was increased to 140 to strengthen sample representation. Proportionate stratified random sampling was employed, with respondents classified into farmers, processors, and traders according to their primary value chain activities. Samples were proportionally allocated across the three strata, followed by random selection within each group. This procedure promoted stakeholder representation and reduced potential selection bias (Taherdoost, 2017).

Instrumentation. Data were collected using a validated researcher-developed structured questionnaire consisting of three sections. Part I assessed cassava industry practices in terms of production and farm management, post-harvest processing and storage, marketing and distribution, and technology and innovation. Part II examined stakeholder challenges involving access to capital, infrastructure and facilities, pest and disease management, and market competition and price fluctuations. Part III measured perceived value chain efficiency in terms of input supply and accessibility, production-to-processing linkages, distribution and marketing channels, and profit margins or stakeholder benefits. Responses were measured using a four-point Likert-type scale, with higher scores indicating greater implementation of practices, more severe challenges, and higher perceived efficiency.

Face and content validity were evaluated by five experts specializing in agricultural production, agribusiness, and cassava value chain research. The questionnaire was pilot-tested among 30 cassava stakeholders excluded from

the final sample to assess clarity, comprehensibility, and internal consistency. Cronbach's alpha yielded an overall coefficient of 0.93, indicating excellent internal consistency. The scoring and interpretation scheme is presented in Table 1.

Table 1
Evaluation and Scoring of Cassava Industry Practices, Challenges, and Value Chain Efficiency

Assigned points	Numerical range	Practices	Challenges	Value chain efficiency
4	3.25–4.00	Highly Practiced	Major Challenge	Highly Efficient
3	2.50–3.24	Practiced	Moderate Challenge	Efficient
2	1.75–2.49	Less Practiced	Minor Challenge	Less Efficient
1	1.00–1.74	Never Practiced	Not a Challenge	Least Efficient

Note. *Higher scores indicate greater implementation of industry practices, greater severity of stakeholder challenges, and higher perceived value chain efficiency.*

Data-Gathering Procedure. Data were collected during the first quarter of 2026 in Pandan, Catanduanes, following formal authorization from the Municipal Agriculture Office and concerned cooperative leaders. From the identified population of 200 cassava stakeholders, 140 respondents were selected through proportionate stratified random sampling. Following informed consent, the researcher personally administered validated questionnaires to the selected farmers, processors, and traders. Respondents received standardized instructions, explanations of the rating scales, and adequate time to complete the instruments without undue influence. All 140 distributed questionnaires were retrieved, yielding a 100% retrieval rate. Completed questionnaires were reviewed for completeness, assigned identification codes, and encoded using Microsoft Excel. Responses were screened for missing values, duplicate entries, and encoding inconsistencies to ensure data accuracy and consistency. Questionnaires and electronic records were handled confidentially, with access restricted to authorized researchers. The verified dataset was subsequently prepared for descriptive and inferential statistical analyses, providing the empirical basis for the proposed strategic intervention framework.

Data Analysis. Data were analyzed using descriptive and inferential statistical procedures aligned with the research objectives. Frequency, percentage, weighted mean, and ranking summarized respondent characteristics, industry practices, stakeholder challenges, and perceived value chain efficiency. Pearson product–moment correlation (r) examined the relationships between industry practices and efficiency and between stakeholder challenges and efficiency. Multiple linear regression assessed the simultaneous predictive contributions of industry practices and challenges to perceived value chain efficiency. Statistical significance was evaluated at the 0.05 level. The regression model was interpreted with consideration of linearity, independence of errors, homoscedasticity, residual normality, and multicollinearity; diagnostic procedures and results should be reported according to the analyses actually performed. Findings informed the development of a strategic intervention framework addressing identified operational constraints and opportunities for value chain improvement (Field, 2018).

Ethical Considerations. Ethical standards were observed throughout the research process. Appropriate institutional and local permissions were secured before data collection, and informed consent was obtained from all respondents. Participation was voluntary, with participants informed of the study's objectives, confidentiality safeguards, and right to withdraw without penalty. Respondent identities were protected through coded questionnaires, restricted data access, and aggregate reporting. Collected information was used exclusively for academic research and handled in accordance with applicable confidentiality and data-protection requirements. Findings were reported accurately and objectively, with respect for participants' socioeconomic circumstances, cultural context, and livelihood activities. These safeguards promoted participant welfare, research integrity, and responsible data management (Mertens, 2020; Israel & Hay, 2006).

RESULTS

This section presents cassava industry practices, stakeholder challenges, perceived value chain efficiency, their relationships and predictive associations, and the proposed strategic intervention framework for Pandan, Catanduanes.

Cassava Industry Practices. Table 2 indicates highly rated cassava industry practices among 140 stakeholders (grand WM = 3.37, SD = 0.69). Production techniques and farm management ranked highest (WM = 3.47, SD = 0.63), followed by post-harvest processing and storage (WM = 3.43, SD = 0.67). Marketing and distribution (WM = 3.30, SD = 0.74) and technology and innovation adoption (WM = 3.28, SD = 0.73) ranked lower, with greater response dispersion. Importantly, "Highly Practiced" reflects respondents' ratings against predefined scale thresholds, not independently verified technological advancement or the absence of constraints. Thus, relatively established routine activities can coexist with financing, infrastructure, and market difficulties, while lower-ranked innovation and marketing practices identify priorities for improvement.

Table 2

Composite Summary of Practices in cassava production, processing, and marketing as observed among key stakeholders in terms of (n = 140)

Dimensions	Weighted Mean	Standard Deviation	Verbal Interpretation	Rank
Production Techniques and Farm Management	3.47	0.63	Highly Practiced	1
Post-Harvest Processing and Storage Methods	3.43	0.67	Highly Practiced	2
Marketing and Distribution Strategies	3.30	0.74	Highly Practiced	3
Adoption of Technology and Innovation	3.28	0.73	Highly Practiced	4
Grand Weighted Mean	**3.37**	**0.69**	**Highly Practiced**	—

Notes. *3.25 – 4.00 –Highly Practiced; 2.50 – 3.24 –Practiced; 1.75 – 2.49 –Less Practiced; 1.00 – 1.74 –Least Practiced*

Challenges Encountered by Stakeholders. Table 3 shows substantial perceived challenges (grand WM = 3.34, SD = 0.71), despite the favorable practice ratings in Table 2. Limited access to capital and financing ranked highest (WM = 3.39, SD = 0.70), followed by inadequate infrastructure and facilities (WM = 3.37, SD = 0.70). Market price fluctuations and competition (WM = 3.31, SD = 0.72) and pest and disease management (WM = 3.29, SD = 0.72) were also rated major challenges. These findings are not inherently inconsistent: stakeholders may continue implementing familiar production and processing activities while encountering substantial costs, risks, and resource shortages. However, the survey does not establish which coping mechanisms sustain these activities. Financial and infrastructure constraints remain priorities for targeted intervention.

Table 3

Composite Summary of Challenges encountered in the cassava industry (n = 140)

Dimensions	Weighted Mean	Standard Deviation	Verbal Interpretation	Rank
Limited Access to Capital and Financing	3.39	0.70	Major Challenge	1
Inadequate Infrastructure and Facilities	3.37	0.70	Major Challenge	2
Pest and Disease Management	3.29	0.72	Major Challenge	4
Market Price Fluctuations and Competition	3.31	0.72	Major Challenge	3
Grand Weighted Mean	**3.34**	**0.71**	**Major Challenge**	—

Notes. *3.25 – 4.00 – Strongly Agree / Major Challenge; 2.50 – 3.24 – Agree / Moderate Challenge; 1.75 – 2.49 – Disagree / Minor Challenge;1.00 – 1.74 – Strongly Disagree / Not a Challenge*

Cassava Value Chain Efficiency. Table 4 reports high perceived, rather than independently measured, value chain efficiency (grand WM = 3.37, SD = 0.68). Production-to-processing linkages ranked highest (WM = 3.48, SD = 0.62), followed by input supply and accessibility (WM = 3.36, SD = 0.68). Profit margins and stakeholder benefits (WM = 3.33, SD = 0.70) and distribution and marketing channels (WM = 3.32, SD = 0.71) ranked lower.

Table 4

Composite Summary of Level of value chain efficiency of the cassava industry (n = 140)

Dimensions	Weighted Mean	Standard Deviation	Verbal Interpretation	Rank
Input Supply and Accessibility	3.36	0.68	Highly Efficient	2
Production-to-Processing Linkages	3.48	0.62	Highly Efficient	1
Distribution and Marketing Channels	3.32	0.71	Highly Efficient	4
Profit Margins and Stakeholder Benefits	3.33	0.70	Highly Efficient	3
Grand Weighted Mean	**3.37**	**0.68**	**Highly Efficient**	—

Notes. *3.25 – 4.00 –Highly Efficient; 2.50 – 3.24 –Efficient;1.75 – 2.49 –Less Efficient 1.00 – 1.74 –Least Efficient*

High perceived efficiency can coexist with major challenges because the scales assess different constructs and the categorical labels conceal meaningful differences within the upper rating band. Moreover, common self-report

measurement may contribute to favorable ratings; objective cost, throughput, and income records would be needed to corroborate efficiency.

Industry Practices and Value Chain Efficiency. Table 5 shows a significant positive relationship between production and processing practices and perceived value chain efficiency ($r = 0.624$, $p < .001$). Stakeholders reporting stronger practices also tended to report greater efficiency, despite the substantial challenges identified elsewhere. This within-sample association helps explain how favorable practice and efficiency ratings can occur alongside high overall challenge scores: group means do not describe identical experiences for every respondent. The null hypothesis is rejected at $\alpha = .05$. Nevertheless, the cross-sectional, self-reported data establish association, not causation or objectively verified operational gains.

Table 5

Relationship between Production and Processing Practices and Value Chain Efficiency in the Cassava Industry (n = 140)

Variables	Statistical Test	*r*	*p*-value	Decision	Interpretation
Production and processing practices and value chain efficiency	Pearson product-moment correlation	0.624	< .001	Reject H_0	Significant positive relationship

Table 6

Relationship between Stakeholders' Challenges and Value Chain Efficiency in the Cassava Industry (n = 140)

Variables	Statistical Test	*r*	*p*-value	Decision	Interpretation
Challenges encountered by stakeholders and value chain efficiency	Pearson product-moment correlation	−0.587	< .001	Reject H_0	Significant negative relationship

Industry Challenges and Value Chain Efficiency. Table 6 reveals a significant negative relationship between stakeholder challenges and perceived value chain efficiency ($r = -0.587$, $p < .001$). Although both constructs have high grand means, respondents reporting more severe challenges tended to report lower efficiency relative to other respondents. Thus, high aggregate ratings do not negate the inverse individual-level relationship. The null hypothesis is rejected at $\alpha = .05$. Addressing financing, infrastructure, production, and market constraints remains relevant, but the observed correlation neither establishes causation nor demonstrates that eliminating challenges would automatically increase efficiency.

Industry Practices and Challenges in Cassava Industry. Table 7 shows a significant negative relationship between industry practices and stakeholder challenges ($r = -0.472$, $p < .001$). The coexistence of high mean ratings therefore does not imply that the same respondents experienced uniformly strong practices and severe constraints; stronger reported practices were associated with relatively fewer challenges. The null hypothesis is rejected at $\alpha = .05$. This pattern offers a statistical explanation for the seemingly contrasting descriptive results, although it cannot establish whether improved practices reduce challenges, fewer challenges enable better practices, or both reflect other influences.

Table 7

Relationship between Industry Practices and Challenges in the Cassava Industry (n = 140)

Variables	Statistical Test	*r*	*p*-value	Decision	Interpretation
Industry practices and challenges encountered	Pearson product-moment correlation	−0.472	< .001	Reject H_0	Significant negative relationship

Predictors of Value Chain Efficiency. Table 8 shows that industry practices and challenges jointly predicted perceived value chain efficiency, $F(2,137) = 71.35$, $p < .001$, $R = 0.714$. The model accounted for 51.0% of observed variance ($R^2 = 0.510$; adjusted $R^2 = 0.503$). Practices were positively associated with efficiency ($B = 0.418$, $p < .001$, 95% CI [0.246, 0.590]), while challenges were negatively associated ($B = -0.382$, $p < .001$, 95% CI [−0.542, −0.222]). Their opposing adjusted coefficients reconcile the descriptive pattern: respondents may rate overall performance favorably, yet variation in constraints remains independently associated with lower perceived efficiency. The null hypothesis is rejected. The unexplained 49.0% of variance and reliance on self-reports caution against equating favorable categorical ratings with unrestricted or objectively verified efficiency.

Table 8
Multiple Regression Analysis of Industry Practices and Challenges as Predictors of Cassava Value Chain Efficiency (n = 140)

Predictor Variable	B (Coefficient)	Std. Error	t (df = 137)	p-value	95% CI	Interpretation
Intercept	1.284	0.423	3.035	0.003	0.446 to 2.122	Model intercept (extrapolated outside observed 1–4 scale)
Industry Practices (X_1)	0.418	0.087	4.805	<0.001	0.246 to 0.590	Significant positive predictor
Industry Challenges (X_2)	-0.382	0.081	-4.716	<0.001	-0.542 to -0.222	Significant negative predictor

Table 9
Model Summary

R	R^2	Adjusted R^2	F (2,137)	p-value	Interpretation
0.714	0.510	0.503	71.35	<0.001	Predictors jointly account for 51.0% of variance in perceived efficiency

Proposed Strategic Intervention Framework. Below is the proposed intervention framework derived from the findings of the study. The framework was developed in response to the key opportunities and challenges identified across the cassava value chain in Pandan, Catanduanes.

Framework Title: Cassava Value Chain Strengthening and Efficiency Enhancement Framework for Pandan, Catanduanes

Goal: To enhance cassava value chain efficiency and sustainability through improved practices, technology adoption, market development, and targeted reduction of key industry constraints.

Table 10
Proposed Strategic Intervention Framework for Strengthening the Cassava Value Chain in Pandan, Catanduanes

Strategic Component	Evidence-Based Priority	Key Interventions	Expected Outcome
1. Production and Processing Enhancement	Production (WM = 3.47); post-harvest processing (WM = 3.43); positive predictor of efficiency (B = 0.418).	Strengthen farm management, quality planting materials, post-harvest handling, processing, storage, and quality control.	Improved productivity, product quality, and production–processing integration.
2. Technology and Innovation	Lowest practice area: technology adoption (WM = 3.28).	Promote appropriate mechanization, processing technologies, digital tools, demonstrations, and technical training.	Increased technology adoption and operational efficiency.
3. Market Development and Value Addition	Marketing (WM = 3.30); lowest efficiency: distribution and marketing (WM = 3.32).	Strengthen market linkages, market information, collective marketing, product diversification, branding, and value addition.	Expanded markets, stronger bargaining capacity, and improved returns.
4. Financing and Infrastructure Support	Highest challenges: financing (WM = 3.39) and infrastructure (WM = 3.37).	Facilitate financing access; upgrade shared processing, storage, transport, and production facilities.	Improved resource access and reduced operational constraints.
5. Risk and Constraint Management	Market fluctuations (WM = 3.31); pest and disease management (WM = 3.29); challenges negatively predict efficiency (B = −0.382).	Strengthen pest and disease management, price information, market-risk strategies, and technical support.	Reduced production and market risks and improved value chain resilience.
6. Stakeholder Coordination and M&E	Practices and challenges significantly related (r = −0.472); predictors explain 51.0% of efficiency variance.	Establish stakeholder coordination, joint planning, performance monitoring, and periodic evaluation.	Sustained collaboration, adaptive interventions, and improved efficiency.

Pathway to Cassava Value Chain Enhancement

CURRENT CONDITIONS
Highly rated practices and perceived efficiency coexist with major challenges
↓
PRIORITY GAPS
Technology adoption + Marketing and distribution
↓
MAJOR CONSTRAINTS
Financing + Infrastructure + Market instability + Pest and disease
↓
STRATEGIC INTERVENTIONS
Production & Processing Enhancement | Technology & Innovation | Market Development | Financing & Infrastructure | Risk Management | Stakeholder Coordination
↓
EXPECTED OUTCOMES
Improved practices + Reduced constraints + Stronger market access + Better stakeholder returns
↓
ULTIMATE OUTCOME
Enhanced, Competitive, Resilient, and Sustainable Cassava Value Chain in Pandan, Catanduanes

DISCUSSION

The findings indicate that the cassava industry in Pandan, Catanduanes has a relatively established operational foundation, although perceived efficiency varies across value-chain functions. Industry practices were highly practiced overall (WM = 3.37, SD = 0.69), with production techniques and farm management receiving the highest rating (WM = 3.47, SD = 0.63), followed by post-harvest processing and storage (WM = 3.43, SD = 0.67). The comparatively favorable assessments of these activities may reflect their direct connection to routine farm operations, accumulated local experience, and the need to preserve cassava quality after harvest. Such practices are important because production efficiency may be associated with appropriate input use and resource allocation (Fu et al., 2018;

Cahyaningsih et al., 2023), while timely drying, handling, and post-harvest management may contribute to reducing deterioration and maintaining product quality (Nainggolan et al., 2024; Chamorro et al., 2025). The findings therefore may suggest greater stakeholder familiarity with established production and post-harvest activities, although actual operational competencies were not independently assessed.

In contrast, technology and innovation adoption obtained the lowest practice rating (WM = 3.28, SD = 0.73), while marketing and distribution strategies also received a comparatively lower rating (WM = 3.30, SD = 0.74). Although both dimensions remained highly practiced, their comparatively lower ratings may indicate opportunities for technological modernization and market development. Technology adoption may be associated with capital availability, technical knowledge, reliable infrastructure, and operational capacity. Improved processing technologies may reduce losses and enhance product quality, although their utilization can depend on financial and technical resources (Olugbenga et al., 2020; Adaigho et al., 2025). Similarly, market-oriented practices may be influenced by price information, buyer relationships, transportation accessibility, and bargaining capacity. Thus, the observed differences may reflect varying resource and coordination requirements rather than inadequate stakeholder effort. However, the present study did not directly determine whether these factors explain the comparatively lower ratings, indicating the need for further investigation into the conditions associated with technology adoption and marketing practices.

The pattern of stakeholder challenges provides additional context for interpreting these differences. Challenges were rated as major overall (WM = 3.34, SD = 0.71), with limited access to capital and financing ranking first (WM = 3.39, SD = 0.70) and inadequate infrastructure and facilities ranking second (WM = 3.37, SD = 0.70). These constraints may be interconnected, as limited financing could restrict investments in equipment, facilities, and inputs, while inadequate infrastructure may increase processing, storage, and transportation difficulties. Evidence from agricultural value chains similarly identifies financial, infrastructural, and institutional constraints as important considerations in investment and coordination (Inegbedion et al., 2020; Nguyen, 2020; Olomu et al., 2020). Market price fluctuations and competition (WM = 3.31, SD = 0.72) and pest and disease management (WM = 3.29, SD = 0.72) were likewise perceived as major challenges. Price instability and production risks may contribute to uncertainty in operational planning and investment decisions, although their actual economic effects were not directly measured. Collectively, the findings suggest that stakeholders perceive substantial constraints despite reporting relatively established industry practices.

Despite these challenges, the cassava value chain was rated highly efficient overall (WM = 3.37, SD = 0.68), with production-to-processing linkages achieving the highest score (WM = 3.48, SD = 0.62). The coexistence of favorable efficiency assessments and major challenges may reflect differences between perceived operational performance and the difficulties encountered in sustaining or improving that performance. The relatively strong production-to-processing rating may indicate perceived advantages in stakeholder coordination, although geographical proximity and actual coordination mechanisms were not independently examined. This interpretation is broadly consistent with literature emphasizing value-chain integration and supply-chain relationships (Nattassha et al., 2020). Nevertheless, distribution and marketing channels recorded the lowest efficiency rating (WM = 3.32, SD = 0.71), while profit margins and stakeholder benefits were also comparatively lower (WM = 3.33, SD = 0.70). These findings may suggest that favorable production-related assessments do not necessarily extend equally to downstream commercial activities. Market information, transportation accessibility, and bargaining arrangements may be relevant considerations, although their specific

contributions remain untested. This pattern is consistent with the multidimensional nature of technical and commercial efficiency (Fu et al., 2018; Duangbootsee, 2024).

The relationship results provide further analytical support for these interpretations. Production and processing practices were significantly and positively associated with perceived value-chain efficiency ($r = 0.624$, $p < .001$), indicating that stakeholders reporting stronger practices generally also reported higher efficiency. This association may be consistent with potential advantages in resource utilization, product quality, and operational coordination, although these mechanisms were not directly tested. Conversely, challenges were significantly and negatively associated with efficiency ($r = -0.587$, $p < .001$), suggesting that respondents experiencing greater constraints tended to report lower efficiency. Industry practices were also negatively associated with challenges ($r = -0.472$, $p < .001$), indicating that stronger reported practices generally coincided with fewer perceived constraints. These associations may help explain why high aggregate ratings coexist with major challenges, as meaningful variation among respondents can remain despite similar categorical interpretations. However, the correlational design does not establish whether stronger practices reduce challenges, fewer challenges facilitate improved practices, or other unmeasured factors influence these relationships.

The regression findings further demonstrate the statistical relevance of these relationships. Industry practices and challenges jointly predicted perceived value-chain efficiency, $F(2,137) = 71.35$, $p < .001$, with $R = 0.714$ and $R^2 = 0.510$. Thus, the predictors accounted for 51.0% of the observed variance in reported efficiency, indicating substantial explanatory capacity within the statistical model rather than establishing causal effects. Industry practices were positively associated with efficiency after accounting for challenges ($B = 0.418$, $p < .001$), whereas challenges demonstrated a negative association after accounting for practices ($B = -0.382$, $p < .001$). These coefficients indicate associations in opposite directions; however, their unstandardized magnitudes should not be interpreted as directly comparable measures of predictor importance. The findings may support consideration of a combined approach involving operational improvement and constraint management, although the effectiveness of such interventions cannot be inferred from the regression results alone. Furthermore, the unexplained 49.0% of variance suggests that additional factors may warrant investigation.

Taken together, the findings provide an empirical basis for proposing a strategic intervention framework that builds on existing strengths while addressing comparatively weaker performance areas. Potential priorities may include sustaining established production and post-harvest practices, facilitating appropriate technology adoption, improving market access, and addressing perceived financing and infrastructure limitations. Stakeholder coordination may also represent a relevant intervention area, although its independent contribution to efficiency was not directly estimated in the present model. Local government units, agricultural agencies, industry organizations, and educational institutions could explore collaborative initiatives involving financing facilitation, infrastructure support, technical training, market linkages, technology demonstrations, and monitoring. The proposed framework should therefore be regarded as a research-informed set of potential interventions rather than a validated model of causal improvement. Its practical relevance lies in identifying priorities for stakeholder consultation, feasibility assessment, implementation, and subsequent evaluation. Future research incorporating objective efficiency indicators and longitudinal or intervention-based designs would help determine whether these proposed measures produce measurable and sustainable improvements.

Conclusion. The study concludes that cassava stakeholders in Pandan, Catanduanes reported highly practiced industry activities and high

perceived value-chain efficiency despite experiencing major financial, infrastructural, production-related, and market challenges. Production and post-harvest practices received comparatively stronger assessments, whereas technology adoption, marketing, and distribution presented relatively greater opportunities for improvement. Industry practices were significantly and positively associated with perceived efficiency, while stakeholder challenges demonstrated significant negative associations. Together, these predictors accounted for 51.0% of the variance in reported efficiency. The coexistence of favorable performance ratings and major challenges may reflect stakeholders' ability to maintain existing operations despite persistent constraints, although this explanation was not directly tested. The findings establish statistically significant relationships without demonstrating causality and provide an empirical foundation for developing context-responsive strategies to strengthen cassava value-chain performance and sustainability.

Recommendations. Based on the findings, the following recommendations are proposed:

1. ***Production and Processing Enhancement.*** Agricultural agencies and stakeholder organizations may sustain established production and post-harvest practices through technical assistance, quality improvement initiatives, and appropriate capacity-building programs.

2. ***Technology and Innovation Adoption.*** Local government units, cooperatives, and educational institutions may facilitate technology demonstrations, technical training, and access to affordable processing equipment to address comparatively lower adoption ratings.

3. ***Marketing and Value Addition.*** Stakeholders may explore collective marketing, market information systems, buyer partnerships, product diversification, and value-adding activities to strengthen downstream value-chain functions.

4. ***Financing and Infrastructure Support.*** Concerned agencies may assess financing accessibility, shared processing facilities, storage requirements, and transportation infrastructure to identify feasible support mechanisms for addressing major stakeholder challenges.

5. ***Stakeholder Coordination and Risk Management.*** Farmers, processors, traders, and institutional partners may establish collaborative planning and monitoring arrangements to address production risks, market fluctuations, and operational concerns.

6. ***Future Research and Framework Evaluation.*** Subsequent studies should incorporate objective productivity, processing costs, profitability, and market performance indicators, alongside longitudinal or intervention-based research designs, to evaluate proposed strategies and clarify potential causal relationships.

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Author contributions. Mac Andrew S. Bonifacio: Conceptualization, Data curation, Writing-original draft, Funding acquisition (Personally Funded), Investigation, Project administration, Resources, Validation | Pedrito Jose V. Bermudo: Conceptualization, Formal analysis, Writing-original draft, Investigation, Methodology, Supervision, Visualization | Johnmar F. Cordial: Software, Formal analysis, Writing-review & editing, Methodology, Visualization | Alan T. Sapanta: Formal analysis, Supervision

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