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Readiness and Strategic Constraints for Coconut Agroindustrial Downstreaming in North Kolaka Regency, Indonesia: Evidence from A Multi-Actor Cross-Sectional Survey

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Abstract: Coconut-producing districts in Indonesia face a recurring development challenge: raw-material availability does not automatically translate into deeper local processing, formal quality systems, or stable market integration. This study examined the readiness factors and strategic constraints associated with coconut agroindustrial downstreaming (hilirisasi) in North Kolaka Regency, Southeast Sulawesi, Indonesia. A cross-sectional multi-actor survey covered 100 respondents comprising 80 coconut farmers, 11 processors/small and medium enterprises, five traders/collectors, and four local-government representatives. A 53-item, five-point Likert instrument measured downstreaming performance (Y), eight readiness dimensions (X1–X8), perceived barriers (Z1), and development prospects (Z2). Descriptive statistics, Cronbach's alpha, Mann–Whitney U tests with rank-biserial effect sizes, and Spearman correlations were used. Aggregate readiness was moderate (mean 2.817/5; $\alpha=0.933$). Institutional collaboration had the highest readiness score (3.196), whereas infrastructure/logistics (2.450) and quality/legal compliance (2.482) were the weakest dimensions. Respondents using modern equipment ($n=61$) showed higher downstreaming performance than non-users (3.052 vs. 2.406; $p=0.012$; rank-biserial $r=0.298$) and higher aggregate readiness (2.971 vs. 2.575; $p=0.020$; $r=0.276$). Quality/legal compliance showed the strongest association with downstreaming performance (Spearman $\rho=0.867$), followed by policy support (ρ=0.787), institutional collaboration (ρ=0.783), and human resources/management (ρ=0.759). The highest perceived constraints were weak actor coordination (3.43), limited processed-product market access (3.22), and insufficient skills (3.17), all exceeding capital constraints (2.72). The findings indicate that equipment modernization is complementary rather than sufficient: district-level downstreaming requires coordinated improvements in standards, legal compliance, human capability, institutions, market linkage, and logistics.

Keywords: coconut; agroindustry; down streaming; value-chain upgrading; readiness; Indonesia

I. INTRODUCTION

Agri-food value chains are no longer simple channels connecting primary production to final consumption. In low- and middle-income economies, post-farm activities such as aggregation, processing, logistics, quality assurance, and distribution increasingly determine employment, technology transfer, value creation, and the capacity of rural regions to capture economic benefits from agricultural production [1,2]. For commodity-producing regions, this shift raises a practical policy question: how can abundant raw materials be converted into locally embedded processing capabilities rather than being sold mainly in primary or semi-processed form?

In Indonesia, the term hilirisasi is commonly used to describe this movement toward downstream processing and stronger linkage between primary production, agroindustry, and markets. In this article, coconut agroindustrial downstreaming refers to the transition from predominantly raw or basic product sales toward higher levels of processing, product diversification, formal quality and legal compliance, by-product use, and market integration. This definition is consistent with value-chain upgrading perspectives, which emphasize that technological change alone is insufficient when coordination, standards, and market relationships are weak [3,4].

Coconut is particularly relevant to such a transformation because almost every component of the fruit can enter an agroindustrial pathway. Technological surveillance of the coconut sector shows continuing innovation in food, oil, biomaterial, and by-product applications, but the ability to translate technical possibilities into local industrial development depends on supply-chain organization and investment in complementary capabilities [5]. Evidence from an Indonesian coconut supply chain in Riau Province similarly highlights market access, infrastructure, information, institutional support, and collective action as critical determinants of sustainability and resilience [6].

The literature on technology adoption reinforces this systemic view. A meta-analysis across developing-country agriculture found that adoption is frequently associated with education, land, credit, extension, tenure, and organizational membership, while the importance of individual determinants varies substantially across technologies and locations [7]. Complementary evidence from Ghana likewise shows that technology adoption is intertwined with broader socioeconomic changes and farmer capabilities [8]. Value-chain arrangements can also facilitate technology adoption by reducing market imperfections and transferring information, inputs, and incentives to producers [9,4]. Consequently, ownership of modern machinery should not be interpreted as a complete measure of upgrading readiness; it may instead be one component of a broader bundle of skills, formalization, market access, and institutional support.

Quality and legal compliance represent another critical dimension. Entry into higher-value markets usually increases requirements for documented processes, product specifications, labels, traceability, and food-safety compliance. Research on Indonesian vegetable chains demonstrates that stronger vertical and horizontal coordination can improve the ability of producers to comply with quality and safety requirements, particularly when producer organizations complement buyer coordination [10]. At the same time, smallholders' sustained participation in higher-value markets depends strongly on predictable market conditions and workable relationships with buyers and cooperatives [11]. These findings imply that local agroindustrial upgrading is simultaneously a technical, institutional, and market-governance problem.

Despite this growing literature, district-level evidence is still often fragmented across technology, finance, market access, or institutions. A policy intervention can therefore target the most visible constraint—frequently machinery or credit—without establishing whether that constraint is the weakest capability, the strongest correlate of downstreaming performance, or merely one element in an interdependent system. A more useful diagnostic distinguishes (i) the current level of readiness in each capability dimension, (ii) the perceived hierarchy of operational barriers, (iii) differences between technology users and non-users, and (iv) the strength of empirical associations between readiness dimensions and downstreaming performance.

This study addresses that need in North Kolaka Regency, Southeast Sulawesi, Indonesia. The objective was to identify and analyze economic, technological, institutional, policy, and social factors associated with coconut agroindustrial downstreaming. Specifically, the study assessed eight readiness dimensions, compared actors using modern equipment with those who did not, ranked the principal constraints reported by respondents, and estimated monotonic associations between readiness dimensions, downstreaming performance, and development prospects. Because the data are cross-sectional and perception-based, the analysis is deliberately framed in terms of strategic determinants and empirical associations rather than causal effects.

II. MATERIALS AND METHODS

A. Study design and setting

The study used a cross-sectional, descriptive-analytical design in North Kolaka Regency, Southeast Sulawesi, Indonesia. The analytical focus was the local coconut value chain and the readiness of actors to deepen processing and market integration. The study combined respondent-level perception data with role-based information from actors positioned at production, processing, trading, and local-government levels. The present article reports the quantitative component corresponding to the dissertation objective on factors associated with agroindustrial downstreaming.

B. Participants and sampling

The analytical sample comprised 100 respondents selected to represent major roles in the coconut value chain: 80 coconut farmers, 11 processors/small and medium enterprises (SMEs), five traders/collectors, and four representatives of local agencies responsible for plantation/agriculture/industry-related functions. A stratified-purposive approach was used because a complete, unified sampling frame covering all actors across the district value chain was not available. Accordingly, the sample was designed for multi-actor diagnosis rather than estimation of district-wide population prevalence. All 100 records contained complete responses for the 53 core Likert items used in the analysis.

Table 1. Composition of respondents and equipment-use status

Category	n	%
Coconut farmers	80	80.0
Processors/SMEs	11	11.0
Traders/collectors	5	5.0
Local-government representatives	4	4.0
Total	100	100.0
Uses modern equipment	61	61.0
Does not use modern equipment	39	39.0

Source: Primary survey data, processed in 2026. Equipment-use status corresponds to META5 (Yes = modern equipment; No = not using modern equipment).

C. Instrument and construct operationalization

The structured instrument contained 53 statements rated on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Six items (F01–F06) measured downstreaming performance (Y): processing, product diversification, branding/labeling, cross-area marketing, by-product utilization, and the share of sales in processed form. Eight readiness dimensions were measured by 36 items: technology and processing (X1; F07–F11), human resources and business management (X2; F12–F16), market access and marketing (X3; F17–F21), quality standards and legal compliance (X4; F22–F25), capital and inputs (X5; F26–F29), institutions and collaboration (X6; F30–F34), infrastructure and logistics (X7; F35–F38), and policy support (X8; F39–F42). Six items measured development barriers (Z1; F43–F48), and five items measured downstreaming prospects (Z2; F49–F53).

For each multi-item construct, the respondent score was calculated as the arithmetic mean of its component items. Aggregate readiness (READINESS) was calculated as the equal-weight mean of X1–X8. Higher scores therefore represent stronger perceived readiness. Descriptive categories were defined as 1.00–1.80 = very low, 1.81–2.60 = low, 2.61–3.40 = moderate, 3.41–4.20 = high, and 4.21–5.00 = very high. Equipment modernization (META5) was coded 1 for respondents using modern equipment and 0 for respondents not using modern equipment.

D. Reliability assessment

Internal consistency was assessed using Cronbach's alpha. Alpha values of at least 0.70 were treated as adequate for primary interpretation. Values between 0.60 and 0.69 were retained for exploratory interpretation, whereas dimensions below 0.60 were treated descriptively and were not presented as strongly validated latent measures. This distinction is important because several subdimensions were heterogeneous, while the aggregate READINESS index showed high internal consistency ($\alpha=0.933$). The inferential discussion therefore gives greatest weight to Y, X4, X8, Z1, Z2, and READINESS, while treating results for lower-alpha subdimensions as exploratory signals.

E. Statistical analysis

Descriptive statistics included frequencies, percentages, means, standard deviations, minima, and maxima. The Mann–Whitney U test compared respondents using modern equipment (n=61) with those not using modern equipment (n=39). A nonparametric test was selected because the outcomes were derived from Likert-type composites and group sizes were unequal. Rank-biserial correlation was reported as an effect-size measure, with emphasis on magnitude rather than dichotomous significance alone.

Spearman's rank correlation (ρ) was used to evaluate monotonic associations between each readiness dimension and two focal outcomes: downstreaming performance (Y) and downstreaming prospects (Z2). Statistical significance was assessed at $\alpha=0.05$. Because multiple relationships were examined and the study was exploratory, p-values are reported without implying confirmatory causal inference; interpretation emphasizes effect magnitude, consistency across indicators, and substantive plausibility. All analyses used the 100 complete respondent records.

III. RESULTS AND DISCUSSION

A. Readiness profile and measurement reliability

Overall downstreaming performance was moderate (Y mean=2.800, SD=1.352), as was aggregate readiness (mean=2.817, SD=0.802). Downstreaming prospects were comparatively favorable (Z2 mean=3.490, SD=1.165). The readiness profile was uneven. Institutions and collaboration achieved the highest mean (X6=3.196), followed by human resources/management (X2=3.020) and market access/marketing (X3=2.988). The weakest dimensions were infrastructure/logistics (X7=2.450) and quality standards/legal compliance (X4=2.482).

The reliability results also showed an important distinction between the aggregate readiness concept and its component dimensions. Y (α=0.894), X4 (0.838), X8 (0.854), Z1 (0.918), Z2 (0.711), and READINESS (0.933) showed adequate internal consistency. X2, X3, and X7 were exploratory (α=0.605–0.640), while X1, X5, and X6 were below 0.60. The latter dimensions are therefore used primarily to characterize operational conditions rather than to support strong latent-construct claims.

Table 2. Descriptive statistics and internal consistency of study constructs

Code	Construct	Items	Mean	SD	Cronbach α	Interpretation
Y	Downstreaming performance	6	2.800	1.352	0.894	Adequate
X1	Technology/processing	5	2.918	0.835	0.529	Descriptive
X2	HR/business management	5	3.020	0.922	0.605	Exploratory
X3	Market access/marketing	5	2.988	0.947	0.611	Exploratory
X4	Quality/legal compliance	4	2.482	1.146	0.838	Adequate
X5	Capital/inputs	4	2.860	0.946	0.579	Descriptive
X6	Institutions/collaboration	5	3.196	0.910	0.512	Descriptive
X7	Infrastructure/logistics	4	2.450	0.883	0.640	Exploratory
X8	Policy support	4	2.620	1.172	0.854	Adequate
Z1	Development barriers	6	3.028	1.410	0.918	Adequate
Z2	Downstreaming prospects	5	3.490	1.165	0.711	Adequate
READINESS	Aggregate readiness	36	2.817	0.802	0.933	Adequate

Source: Primary survey data, processed in 2026. Interpretations below α=0.70 are explicitly exploratory/descriptive.

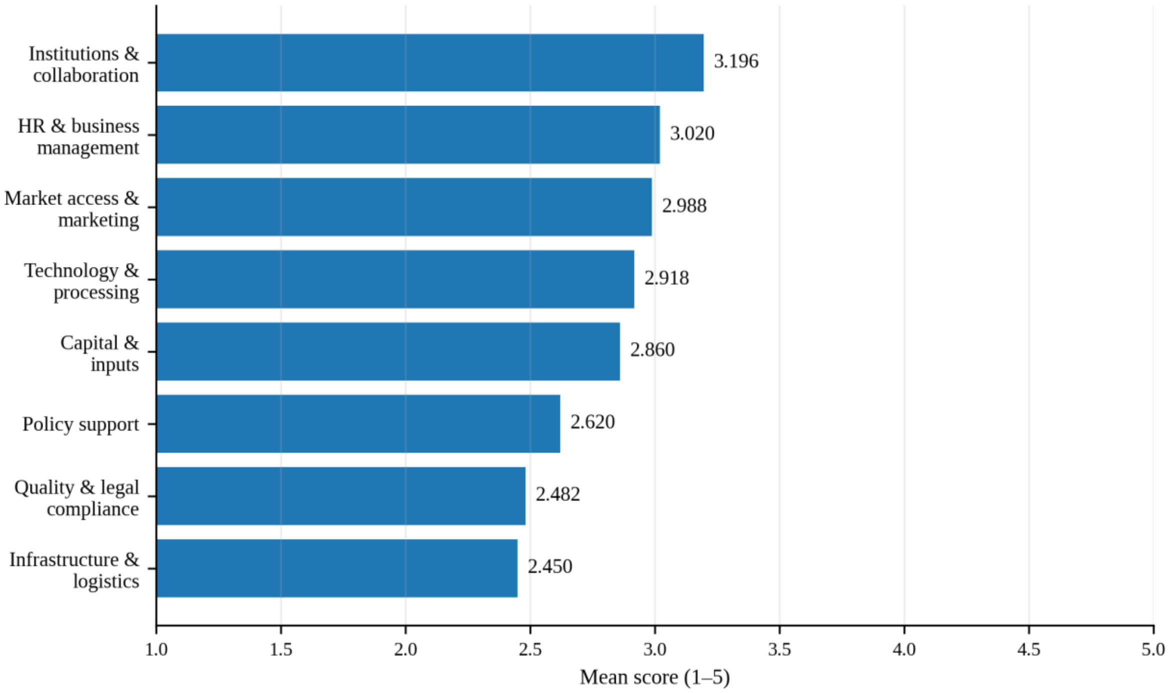

Figure 1. Mean scores of the eight downstreaming readiness dimensions.

Source: Primary survey data, processed in 2026. Scale: 1–5; higher scores indicate stronger readiness.

B. Modern equipment use and downstreaming readiness

Sixty-one respondents reported using modern equipment and 39 reported not using modern equipment. The modern-equipment group had significantly higher downstreaming performance (3.052 vs. 2.406; p=0.012; rank-biserial r=0.298) and higher aggregate readiness (2.971 vs. 2.575; p=0.020; r=0.276). Significant differences also occurred for human resources/management, quality/legal compliance, and policy support. In contrast, the technology-dimension score itself (X1) did not differ significantly at the 5% level (3.033 vs. 2.738; p=0.098). This pattern suggests that the observed modernization gap is not reducible to machinery alone; users of modern equipment also tend to be embedded in stronger complementary capabilities.

The modern-equipment group also reported higher perceived barriers (Z1: 3.311 vs. 2.585; p=0.018). This result should not be interpreted as evidence that modern equipment causes additional constraints. A more plausible cross-sectional interpretation is that actors who engage more intensively in downstream processing encounter and recognize quality, market, coordination, logistics, and financing requirements more directly.

Table 3. Mann–Whitney comparisons by modern-equipment use

Variable	Modern mean (n=61)	Nonmodern mean (n=39)	U	p	Rank-biserial r
Y: downstreaming performance	3.052	2.406	1544.5	0.0115	0.298
X1: technology/ processing	3.033	2.738	1465.0	0.0977	0.196
X2: HR/business management	3.187	2.759	1488.0	0.0336	0.251

Variable	Modern mean (n=61)	Nonmodern mean (n=39)	U	p	Rank-biserial r
X4: quality/legal compliance	2.709	2.128	1513.0	0.0161	0.272
X8: policy support	2.832	2.288	1481.0	0.0359	0.245
Z1: perceived barriers	3.311	2.585	1523.0	0.0177	0.279
READINESS: aggregate readiness	2.971	2.575	1518.0	0.0201	0.276

Source: Primary survey data, processed in 2026. Rank-biserial values are reported as effect-size magnitudes.

C. Hierarchy of perceived constraints

The most prominent constraint was weak coordination among actors (mean=3.43), followed by limited access to markets for processed coconut products (3.22) and insufficient human-resource skills for producing quality products (3.17). Limited processing technology (2.83) and logistics/transport costs (2.80) ranked above capital limitation (2.72). Thus, respondents did not identify finance as the dominant bottleneck. Instead, the constraint profile emphasized coordination, market linkage, and capability formation.

Table 4. Ranking of perceived barriers to coconut agroindustrial downstreaming

Rank	Item	Barrier	Mean
1	F47	Coordination among business actors is not yet optimal	3.43
2	F46	Access to markets for processed coconut products is limited	3.22
3	F45	Human-resource skills for producing quality products are insufficient	3.17
4	F44	Processing technology remains limited	2.83
5	F48	Logistics/transport costs are a serious constraint	2.80
6	F43	Limited capital constrains coconut downstreaming	2.72

Source: Primary survey data, processed in 2026. Scale: 1–5.

D. Associations between readiness dimensions and downstreaming outcomes

All eight readiness dimensions were positively associated with downstreaming performance (Y). The strongest relationship was observed for quality standards/legal compliance (X4; ρ=0.867), followed by policy support (X8; ρ=0.787), institutions/collaboration (X6; ρ=0.783), and human resources/management (X2; ρ=0.759). Aggregate READINESS was also strongly related to Y (ρ=0.777). These relationships were statistically significant at $p<0.001$.

Associations with downstreaming prospects (Z2) showed a similar but not identical ordering. Policy support had the strongest correlation (X8; ρ=0.806), followed by institutions/collaboration (X6; ρ=0.780), aggregate readiness (ρ=0.743), market access/marketing (X3; ρ=0.736), and quality/legal compliance (X4; ρ=0.715). Capital/inputs had the weakest association with prospects (X5; ρ=0.226; p=0.023). The contrast between the low mean of X4 (2.482) and its very high correlation with Y (ρ=0.867) identifies a particularly important leverage mismatch: the dimension that is least developed is also the one most closely associated with current downstreaming performance.

Table 5. Spearman correlations of readiness dimensions with downstreaming performance and prospects

Code	Readiness dimension	ρ with Y	p(Y)	ρ with Z2	p(Z2)
X1	Technology/processing	0.448	<0.001	0.582	<0.001
X2	HR/business management	0.759	<0.001	0.684	<0.001
X3	Market access/marketing	0.527	<0.001	0.736	<0.001
X4	Quality/legal compliance	0.867	<0.001	0.715	<0.001
X5	Capital/inputs	0.367	<0.001	0.226	0.023
X6	Institutions/collaboration	0.783	<0.001	0.780	<0.001
X7	Infrastructure/logistics	0.515	<0.001	0.506	<0.001
X8	Policy support	0.787	<0.001	0.806	<0.001
READINESS	Aggregate readiness	0.777	<0.001	0.743	<0.001

Source: Primary survey data, processed in 2026. Y = downstreaming performance; Z2 = downstreaming prospects. Correlations for lower-reliability subdimensions should be interpreted exploratorily.

E. Downstreaming readiness is a capability bundle, not a machinery variable

The central finding is that coconut agroindustrial downstreaming in North Kolaka is associated with a bundle of complementary capabilities rather than with machinery alone. Modern-equipment users displayed higher downstreaming performance and aggregate readiness, but the specific technology-readiness dimension (X1) did not differ significantly between modern and nonmodern groups at the 5% level. This distinction matters. A binary indicator of equipment use captures the presence of modern assets, whereas X1 also captures maintenance, standard operating procedures, capacity scalability, and energy availability. The results therefore suggest that purchasing equipment and building a functioning technological system are not the same development process.

This finding is consistent with evidence that technology adoption in developing-country agriculture depends on institutional, informational, educational, financial, and organizational conditions rather than a single input [7]. Value chains can help overcome these constraints through coordinated transfer of knowledge, inputs, incentives, and market information [4]. In India's dairy sector, value-chain participation was linked with technology adoption through chain-level mechanisms rather than isolated asset ownership [9]. The North Kolaka results extend this logic to coconut processing: hardware modernization appears most productive when accompanied by management capacity, formal quality practices, policy access, and market linkage.

The higher barrier score among modern-equipment users reinforces this interpretation. Actors engaging more deeply in processing are exposed to requirements that may remain invisible to actors selling less-processed products: maintaining machinery, securing packaging, meeting product standards, obtaining permits, guaranteeing consistent volume, financing working capital, and satisfying buyers. Their greater perception of constraints may thus reflect deeper participation in the downstream value chain rather than failure of modernization.

F. Quality and legal compliance emerge as the highest-leverage bottleneck

The most policy-relevant result is the combination of a low quality/legal-compliance mean (2.482) and the strongest correlation with downstreaming performance (ρ=0.867). The underlying items show why this dimension is weak: product labeling/composition/shelf-life standards and business/product legality both averaged only 2.21, while routine quality control reached 2.61. This gap indicates that processing activity is developing faster than formalization and quality-assurance systems.

For higher-value agroindustrial chains, formal quality systems are not simply administrative additions; they shape who can sell to whom, at what specification, and with what degree of repeatability. In Indonesian vegetable chains, Widadie et al. [10] found that quality and safety compliance was closely linked to the alignment of vertical buyer coordination and horizontal producer-organization support. Stronger coordination enabled monitoring, knowledge sharing, certification support, and more efficient compliance. Although coconut products differ technically from fresh vegetables, the governance mechanism is relevant: small processors are more likely to meet standards when quality requirements, technical assistance, organizational support, and buyer expectations are connected rather than fragmented.

This has a direct implication for district-level coconut programs. Investments in oil extraction, VCO processing, drying, or packaging should be bundled with standard operating procedures, labeling requirements, legal registration, hygiene routines, storage protocols, and quality monitoring. For VCO and branded coconut oil in particular, a failure to formalize these functions can prevent technically capable processors from accessing stable higher-value markets. Coconut innovation literature likewise emphasizes that new products require not only processing technologies but also integrated supply-chain and product-development capabilities [5].

G. Institutions and policy support are central to coordination and expectations

Institutional collaboration had the highest descriptive readiness score (3.196), while policy support showed strong correlations with both current downstreaming performance (ρ=0.787) and future prospects (ρ=0.806). Yet actor coordination was simultaneously the highest perceived barrier (3.43). This apparent tension is informative rather than contradictory. Respondents may recognize the presence and potential role of groups, cooperatives, and inter-actor relationships while still experiencing weak operational coordination in day-to-day transactions.

Value-chain governance theory predicts that the complexity of transactions, the ability to codify requirements, and supplier capabilities influence the form of coordination required between actors [3]. In smallholder settings, horizontal organizations can aggregate supply and reduce transaction costs, whereas vertical arrangements with buyers can communicate specifications and create market incentives. Widadie et al. [10] show that these two forms of coordination can complement one another. The North Kolaka evidence points in the same strategic direction: institutional structures should be evaluated not by their formal existence but by whether they perform concrete economic functions such as aggregating raw material, sharing price information, managing common facilities, coordinating quality, and linking processors with buyers.

Policy support appears especially important for expectations about future downstreaming. This is plausible because local actors may depend on public services for licensing, technical extension, infrastructure, equipment programs, market promotion, and coordination across agencies. Hidayati et al. [12], studying sustainable agrifood value-chain transformation in Indonesia, identify stakeholder support, communication, certification motivation, and market expansion among the enabling factors for transformation. These parallels reinforce the need for policy packages that connect services rather than delivering isolated interventions.

H. Market access, logistics, and skills constrain conversion of potential into commercial upgrading

The barrier hierarchy further clarifies why a machinery-centered strategy would be incomplete. Limited market access (3.22) and skill deficits (3.17) were more prominent than capital constraints (2.72). Infrastructure/logistics was the lowest readiness dimension (2.450), with road/transport support averaging 2.19 and production/storage/water facilities 2.28. These findings describe a classic commercialization gap: local actors can perceive strong economic potential while lacking the market and logistical architecture needed to convert that potential into stable sales.

Smallholders' sustained participation in higher-value markets depends heavily on market attributes that reduce output uncertainty and create credible relationships with buyers [11]. The literature on transforming food systems likewise places growing importance on the midstream and downstream functions of storage, logistics, processing, and distribution [1,2]. In North Kolaka, the strong correlation between market access and downstreaming prospects (ρ=0.736) suggests that actors' expectations are closely tied to whether demand can be reached, not merely whether a product can be made.

Coconut-specific evidence from Riau Province strengthens this interpretation. Wahyudi et al. [6] identify marketing as a weak link and emphasize institutional capacity and collective action in building resilient coconut supply chains in remote Indonesian settings. For North Kolaka, this implies that downstreaming policy should connect processor selection to practical market arrangements: buyer mapping, product specifications, trial orders, aggregation schedules, transport planning, and information on prices and demand. Training should likewise be production- and market-specific rather than generic, combining technical operation, quality control, bookkeeping, costing, packaging, and customer management.

I. A district-level intervention logic

Taken together, the results support a sequenced intervention logic. First, strengthen quality and legal compliance because this dimension is both weak in level and strongly associated with downstreaming performance. Second, convert existing institutional potential into operational coordination through clear actor functions, shared facilities where economically justified, and transparent market information. Third, develop skills and management alongside any equipment program. Fourth, anchor processing expansion in real market relationships and logistics solutions. Fifth, use finance as an enabling instrument within these packages rather than as a stand-alone solution.

This approach reflects the broader literature on value-chain transformation, which emphasizes simultaneous changes in governance, value addition, and sustainability rather than isolated technical interventions [12]. It also fits the coconut sector's technological diversity: kopra upgrading, coconut oil processing, and VCO development impose different requirements for raw-material quality, process control, packaging, and market positioning [5]. District policy should therefore differentiate support by the readiness of actors and the specific product pathway rather than distributing identical assets across locations and enterprises.

J. Study limitations

Several limitations must guide interpretation. First, the study is cross-sectional; correlations and group differences do not identify causal effects. Second, the stratified-purposive sample was designed to capture multiple value-chain roles but does not constitute a probability sample of all coconut actors in the regency. Third, the main measures are self-reported and may share common-method variance. Fourth, internal consistency was below 0.70 for several subdimensions, especially X1, X5, and X6; those results should therefore be treated as exploratory or descriptive rather than as evidence from fully validated latent constructs. Fifth, the equipment indicator is binary and does not measure machine type, age, utilization rate, productivity, or capital intensity. Finally, the study does not include longitudinal sales, cost, certification, or product-quality data that would allow causal evaluation of upgrading outcomes. Future research should validate the measurement structure in a larger sample, incorporate objective enterprise performance indicators, and evaluate staged downstreaming interventions over time.

IV. CONCLUSION

Coconut agroindustrial downstreaming in North Kolaka is characterized by moderate overall readiness and a substantial mismatch between development potential and the capabilities required for commercial upgrading. Institutions and collaboration were perceived as the strongest readiness dimension, while infrastructure/logistics and quality/legal compliance were the weakest. Modern-equipment users displayed higher downstreaming performance and aggregate readiness, but the absence of a significant difference in the broader technology-readiness dimension indicates that machinery alone cannot explain upgrading. Quality and legal compliance was the strongest correlate of downstreaming performance, whereas policy support was the strongest correlate of future prospects. Coordination, market access, and skills ranked above capital as perceived constraints. The practical implication is clear: district-level downstreaming should be designed as a coordinated capability package linking equipment with standard operating procedures, legal compliance, quality control, skills, institutions, logistics, and market relationships. These findings provide an empirical basis for prioritizing interventions while avoiding the common assumption that asset provision by itself constitutes agroindustrial transformation.

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REFERENCES

[1] C. B. Barrett, T. Reardon, J. Swinnen, and D. Zilberman, "Agri-food value chain revolutions in low- and middle-income countries," Journal of Economic Literature, 60(4), 2022, pp. 1316–1377. https://doi.org/10.1257/jel.20201539

[2] T. Reardon, R. Echeverria, J. Berdegué, B. Minten, S. Liverpool-Tasie, D. Tschirley, and D. Zilberman, "Rapid transformation of food systems in developing regions: Highlighting the role of agricultural research and innovations," Agricultural Systems, 172, 2019, pp. 47–59. https://doi.org/10.1016/j.agsy.2018.01.022

[3] G. Gereffi, J. Humphrey, and T. Sturgeon, "The governance of global value chains," Review of International Political Economy, 12(1), 2005, pp. 78–104. https://doi.org/10.1080/09692290500049805

[4] J. Swinnen and R. Kuijpers, "Value chain innovations for technology transfer in developing and emerging economies: Conceptual issues, typology, and policy implications," Food Policy, 83, 2019, pp. 298–309. https://doi.org/10.1016/j.foodpol.2017.07.013

[5] J. F. Grass Ramírez, R. Camacho Muñoz, and J. W. Zartha Sossa, "Innovations and trends in the coconut agroindustry supply chain: A technological surveillance and foresight analysis," Frontiers in Sustainable Food Systems, 7, 2023, Article 1048450. https://doi.org/10.3389/fsufs.2023.1048450

[6] A. Wahyudi, I. K. Ardana, A. Aunillah, B. Rianto, U. K. Anggoro, A. M. Hasibuan, M. Mardiharini, C. Indrawanto, B. Wardono, Sujianto, Ermiati, B. Sudjarmoko, D. Listyati, and Y. Ferry, "Building sustainable and resilient coconut supply chains in remote areas: A study from Riau Province–Indonesia," Sustainable Futures, 9, 2025, Article 100709. https://doi.org/10.1016/j.sftr.2025.100709

[7] S. Ruzzante, R. Labarta, and A. Bilton, "Adoption of agricultural technology in the developing world: A meta-analysis of the empirical literature," World Development, 146, 2021, Article 105599. https://doi.org/10.1016/j.worlddev.2021.105599

[8] A. Adams, E. T. Jumpah, and L. D. Caesar, "The nexuses between technology adoption and socioeconomic changes among farmers in Ghana," Technological Forecasting and Social Change, 173, 2021, Article 121133. https://doi.org/10.1016/j.techfore.2021.121133

[9] E. Janssen and J. Swinnen, "Technology adoption and value chains in developing countries: Evidence from dairy in India," Food Policy, 83, 2019, pp. 327–336. https://doi.org/10.1016/j.foodpol.2017.08.005

[10] F. Widadie, J. Bijman, and J. Trienekens, "Alignment between vertical and horizontal coordination for food quality and safety in Indonesian vegetable chains," Agricultural and Food Economics, 10, 2022, Article 8. https://doi.org/10.1186/s40100-022-00215-w

[11] O. Ola and L. Menapace, "Smallholders' perceptions and preferences for market attributes promoting sustained participation in modern agricultural value chains," Food Policy, 97, 2020, Article 101962. https://doi.org/10.1016/j.foodpol.2020.101962

[12] D. R. Hidayati, E. Garnevska, and P. Childerhouse, "Enabling sustainable agrifood value chain transformation in developing countries," Journal of Cleaner Production, 395, 2023, Article 136300. https://doi.org/10.1016/j.jclepro.2023.136300