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Application of the Hayami Method in Coconut Downstreaming Added Value Analysis in Indragiri Hilir

Rouli Margareta[1]*, Cahya Feren[1], Yemima Elia[1] , Nanda Lionita[1]

AFFILIATION:
[1] Department of Economics, Faculty of Economics and Business, Universitas Riau, Pekanbaru, Indonesia

***CORRESPONDENCE:**
rouli.margareta2365@student.unri.ac.id

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Abstract:

Research aim

This study aims to analyze the added value potential of village-scale coconut downstreaming in Indragiri Hilir Regency, Riau Province, using the Hayami Method and to map the corresponding business model through the Business Model Canvas (BMC).

Design/methodology/approach

This study employs a descriptive quantitative and qualitative approach using secondary data from BPS Indragiri Hilir (2022–2023), scientific journals and policy documents. The Hayami Method was applied to calculate the added value of Virgin Coconut Oil (VCO), coconut shell charcoal and cocofiber, while the BMC framework was used to map nine strategic business elements.

Findings

The results indicate that all downstream products generated high added value ratios above 40%, with VCO reaching 60%, coconut shell charcoal 66.67% and cocofiber 71.43%. Coconut shell charcoal showed the highest labor wage allocation, indicating strong employment potential for rural communities. The findings also reveal that a BUMDes-based downstreaming model supported by digital marketing and circular economy practices represents the most feasible strategy for village-scale implementation.

Originality/value

This study contributes to the rural downstreaming literature by integrating the Hayami Method and the BMC framework into a hybrid analytical approach. Unlike previous studies that examined technical or empowerment dimensions separately, this study provides a comparative analysis of three coconut derivative products within an integrated strategic business model framework.

Research limitations/implications –

The study relies on secondary data, limiting the ability to capture real-time market dynamics and local production conditions. Future research should incorporate primary field data to improve analytical accuracy and contextual relevance.

Keywords: oconut downstreaming; Hayami method; Added value; Indragiri Hilir; Business Model Canvas; BUMDes; Rural development

Introduction

Indragiri Hilir Regency, Riau Province, holds the distinction of being Indonesia's largest coconut production center, with cultivated area reaching 303,906 thousand hectares and annual production exceeding 265,000 thousand tons as of 2024 (BPS Indragiri Hilir, 2024). Despite this productive capacity, the region's farmers remain economically marginalized, trapped in a structural paradox where high output does not translate into household welfare. The vast

majority of coconut harvest is sold in unprocessed form as whole coconuts or raw copra at prices that leave minimal profit for first-level producers (Nabillah et al., 2025).
This condition exemplifies the raw material trap phenomenon: regions endowed with abundant primary commodities remain locked in extractive production cycles, while downstream value creation migrates to better-equipped industrial areas (Steckley, 2025). In Indragiri Hilir, this trap is compounded by technological limitations, insufficient working capital, weak institutional structures among farmer groups, and the absence of integrated value chain management (Agus et al., 2025). When global coconut prices fall, the economic consequences are immediate and severe for local communities whose incomes are almost entirely tied to raw commodity prices (Manono, 2025).

The economic solution to this structural problem lies in downstreaming the process of transforming raw coconut into higher-value derivative products at or near the point of production. Downstreaming not only increases added value but also reduces supply chain dependence, creates local employment, and builds rural economic resilience. However, most existing studies on coconut downstreaming in Indonesia have focused either on technical production parameters, single-product analyses, or broader industrial-scale assessments (Mardesci et al., 2021; Ritonga et al., 2025). A critical research gap exists: no prior study has simultaneously applied the Hayami Method to compare multiple coconut derivative products and integrated these findings into a BMC-based strategic framework specifically designed for village-scale institutions in Indragiri Hilir.

This study addresses that gap by integrating the Hayami Method with the Business Model Canvas (BMC) framework to comprehensively assess the economic feasibility and strategic architecture of coconut downstreaming at the village level. The Hayami Method provides a transparent quantitative measure of added value, labor contribution, and processing efficiency (Onishi et al., 2025). The BMC framework complements this by mapping how village-owned enterprises (BUMDes) can operationalize downstreaming through a structured business model (Osterwalder & Pigneur, 2014). Together, these tools form a hybrid analytical toolkit capable of informing both investment decisions and regional policy design.

Specifically, this research aims to: (1) calculate and compare the magnitude of added value generated from three coconut derivative products VCO, shell charcoal, and cocofiber using the Hayami Method; and (2) evaluate how the BMC framework can structure a viable village-scale downstreaming model in Indragiri Hilir to overcome the raw material trap and strengthen rural economic independence.

Literature Review

Rural Economy and Downstreaming Theory

Rural economics in contemporary development discourse has evolved beyond its traditional framing as a subsistence or support sector. Modern rural development theory positions rural economies as active engines of structural transformation, capable of generating growth through local product value addition rather than through commodity extraction alone (Agus et al., 2025). The central pathology in resource-rich rural areas such as Indragiri Hilir is the raw material trap, wherein regions export primary commodities without mastering the processing technologies that generate the majority of economic value (Steckley, 2025). This dependence on volatile global market prices creates endemic income instability for producers and restricts local capital accumulation.

Downstreaming emerges as the theoretical and practical antithesis of this extractive model. By promoting the creation of added value at the commodity's origin, downstreaming restructures the rural economy from a price-taker position toward one of value creation and market influence. When combined with circular economy principles, downstreaming enables comprehensive utilization of all commodity components a particularly relevant approach for coconut, where virtually every part (meat, oil, shell, husk, water) holds commercial value (Rahmat et al., 2025). At the institutional level, cooperatives and BUMDes serve as the primary vehicles for enabling small-scale producers to collectively access processing technology, manage quality standards, and engage with broader markets (Kinanda et al., 2025)

The Hayami Method

The Hayami Method, developed by Hayami et al. (1987) and widely operationalized in agro-industrial research, provides a systematic quantitative framework for calculating the added value generated in the transformation of an agricultural commodity into processed products (Mardesci et al., 2021). The method disaggregates total output value into its constituent components: raw material cost, other input costs, labor remuneration, and entrepreneur's profit. This decomposition not only reveals the aggregate profitability of processing but also illuminates how economic benefits are distributed among stakeholders in the value chain.
Onishi et al. (2025) affirm that the Hayami approach is particularly effective in identifying which derivative products offer the highest economic advantage across comparable processing pathways, using conversion factors and labor coefficients to standardize comparisons. Ritonga et al. (2025) demonstrate its application in VCO production in West Sumatra, showing that downstream processing significantly increases household income and that the distribution of added value is a critical determinant of equitable rural development outcomes.

Rahmat et al. (2025) extend the method's relevance by linking Hayami analysis to circular economy evaluation, showing that by-product utilization such as coconut shell charcoal and liquid smoke dramatically improves the overall added value profile of coconut processing enterprises. Critically, the Hayami Method's transparency and simplicity make it highly applicable in policy and planning contexts where technical capacity may be limited, as is common in village-level agro-industry settings.

Business Model Canvas for Downstreaming

Osterwalder and Pigneur (2014) define the Business Model Canvas (BMC) as a strategic management framework that visualizes nine interdependent elements of an organization's value creation and delivery logic: Customer Segments, Value Propositions, Channels, Customer Relationships, Revenue Streams, Key Resources, Key Activities, Key Partnerships, and Cost Structure. In the context of rural downstreaming, the BMC provides a structured design space for translating technical production capabilities into viable commercial enterprises.

Kinanda et al. (2025) specifically apply the BMC to coconut industry downstreaming programs in Indragiri Hilir, identifying that the integration of Key Activities (post-harvest processing, quality certification) with Key Partnerships (farmer groups, BUMDes, regional governments) is central to achieving supply continuity and market access. Their findings highlight that without deliberate institutional design, even technically profitable downstreaming initiatives struggle to achieve scale or sustainability.

Bahayyil et al. (2025), in their analysis of cocofiber agro-industry using both Hayami analysis and BMC mapping, establish the complementarity of these two frameworks: while the Hayami Method determines economic viability at the production level, the BMC reveals the organizational conditions necessary to capture and sustain that value. This integration quantitative feasibility analysis combined with strategic business model design constitutes the theoretical foundation of the present study.

Research Gap and Proposition

A systematic review of prior studies reveals that existing research on coconut downstreaming in Indragiri Hilir and comparable regions falls into two largely disconnected streams: (1) technical or quantitative analyses using the Hayami Method applied to single products or isolated processing stages (Mardesci et al., 2021; Ritonga et al., 2025); and (2) qualitative or strategic analyses focusing on BMC, institutional capacity, or supply chain resilience (Kinanda et al., 2025; Nabillah et al., 2025). No prior study integrates both analytical frameworks to simultaneously compare multiple coconut derivative products and generate strategic business model recommendations for village-level institutions.

This study addresses that gap. Drawing on secondary data from Indragiri Hilir, we propose that: (P1) all three major coconut derivative products VCO, shell charcoal, and cocofiber will generate high added value ratios (>40%) under the Hayami Method, but with distinct distributions among raw material costs, labor, and profit; and (P2) a BUMDes-based institutional model structured through the BMC framework, integrating appropriate technology and digital marketing, represents the most feasible pathway for achieving village-scale downstreaming at scale.

Summary of Previous Research

The following table 1 presents the key studies that form the theoretical and empirical foundation of this research.

Table 1. Summary of Previous Research

Author & Year	Title	Method	Key Findings
Mardesci et al. (2021)	Analysis of value-added and calculation of production cost in the production of processed coconut product	Hayami Method	Downstream processing into coconut sugar, oil, and shell charcoal produces significant positive added value; economically profitable for SMEs.
Rahmat et al. (2025)	Implementation of the circular economy model in coconut white copra production	Circular economy model	Circular economy increases production efficiency and maximizes use of coconut waste into high-value products such as liquid smoke and charcoal briquettes.
Nabillah et al. (2025)	Exploring the dynamics of supply chain sustainability and resilience in coconut agriculture: The case of Indragiri Hilir	Exploratory supply chain analysis	Highlights Inhil's strategic position in the national supply chain while documenting structural vulnerability to international price fluctuations.
Ritonga et al. (2025)	Women's empowerment through virgin coconut oil entrepreneurship in rural West Sumatra	Descriptive qualitative case study	VCO downstreaming significantly increases household income and strengthens social independence, particularly for women entrepreneurs.

Bahayyil et al. (2025)	Analisis nilai tambah dan business model canvas agroindustri cocofiber	Hayami Method + BMC	Cocofiber agro-industry generates high added value; BMC mapping identifies institutional and market conditions for sustainable scaling.
Kinanda et al. (2025)	Business model canvas untuk program hilirisasi industri kelapa di Kabupaten Indragiri Hilir	Business Model Canvas	Effective downstreaming requires integration of Key Activities and Key Partnerships blocks; BUMDes-government collaboration is critical.
Agus et al. (2025)	Development strategy for smallholder oil palm and coconut plantation in Pesisir Selatan Regency	Descriptive analysis	Coconut serves as economic and social backbone of rural SMEs, requiring integrated downstreaming strategy at the local level.
Steckley (2025)	Deepening the ecological agrarian question	Agrarian political economy	Identifies the raw material trap: producing regions locked into primary production without mastering downstream value creation.
Onishi et al. (2025)	Value addition in dairy farming: A methodological framework and case study analysis	Added value framework	Added value approach reveals local labor contribution and input use efficiency; applicable across agro-industrial commodity contexts.
Manono (2025)	Small-scale farming: Challenges and pathways to enhanced productivity and profitability	Challenge identification	Dependence on raw material sales makes small farmers highly vulnerable to market price fluctuations.

Source: Compiled by authors (2026)

Based on the above mapping, a research gap emerges: most studies stand alone, either on technical, circular economy, or empowerment aspects, while studies that comprehensively combine coconut downstreaming with Hayami added value analysis and link it to the raw material trap as a regional development problem are still very limited, particularly in Indragiri Hilir. This study is directed to fill that gap.

Research Method

Research Design and Location

This research adopts a descriptive approach combining quantitative analysis (Hayami Method) with qualitative analysis (BMC mapping). The quantitative component calculates and compares added value ratios across three coconut derivative products using structured secondary data. The qualitative component systematically maps the business model elements applicable to village-scale downstreaming institutions in Indragiri Hilir.

It is important to clarify that this study is an original research study based on secondary data analysis, not a conventional literature review. The analytical work involves independent calculation of added value using the Hayami Method formulas applied to secondary price and cost data, generating original quantitative findings rather than merely summarizing prior literature. This approach is well-established in agro-industrial research where primary field data collection is constrained by resource limitations (Mardesci et al., 2021; Bahayyil et al., 2025).

The research location is Indragiri Hilir Regency, Riau Province, selected purposively as Indonesia's largest coconut production center and as a region exhibiting pronounced raw material trap characteristics.

Data Collection

All data used in this research are secondary data collected through systematic documentation and literature review. Primary data sources include: (1) BPS Indragiri Hilir Regency Statistical Yearbooks (2022–2023) for coconut cultivated area, production volumes, and commodity prices at the farmer level; (2) peer-reviewed scientific journals published between 2021 and 2025 for production parameters, processing costs, and labor requirements; and (3) the 2023 Minimum Regency Wage (UMK) of Indragiri Hilir (IDR 2,806,027/month) as the reference wage for labor cost calculations.

The price and cost data used in the Hayami calculations are explicitly sourced as follows: whole coconut price (IDR 5,000/kg) and VCO output price (IDR 100,000/kg) from BPS Inhil (2023) and Mardesci et al. (2021); coconut shell purchase price (IDR 500/kg) and charcoal output price (IDR 8,000/kg) from Rahmat et al. (2025) and BPS Inhil (2023); coconut husk purchase price (IDR 200/kg) and cocofiber output price (IDR 6,000/kg) from Bahayyil et al. (2025) and BPS Inhil (2023). All prices reflect the 2022–2023 reference period and represent average market conditions documented in the cited sources.

A key limitation of this approach is that secondary data cannot capture intra-year price volatility, seasonal production variations, or local supply chain disruptions. No sensitivity analysis was conducted, which means the calculated added value figures represent representative estimates rather than precise real-time values. Future research employing primary field surveys would substantially improve the empirical precision of these findings.

Hayami Added Value Analysis

The Hayami Method (Hayami et al., 1987; operationalized in Mardesci et al., 2021) calculates added value as the difference between the output value of processed products and the input costs (raw materials and other production inputs), with subsequent decomposition into labor remuneration and entrepreneur's profit. The analytical formulas applied are:

- Conversion Factor (K) = Output (kg) ÷ Raw Material Input (kg)
- Labor Coefficient (L) = Labor (HOK) ÷ Raw Material Input (kg)
- Output Value (V) = K × Output Price (IDR/kg)
- Added Value (VA) = V − Raw Material Price − Other Input Costs
- Added Value Ratio (RVA) = (VA ÷ V) × 100%
- Labor Remuneration (S) = L × Average Wage (IDR/HOK)
- Profit (P) = VA − S

Decision criteria for added value classification follow Hubeis (1997) as cited in Bahayyil et al. (2025): low if RVA $< 15\%$; medium if $15\% \leq$ RVA $\leq 40\%$; high if RVA $> 40\%$. All calculations are performed per 1,000 kg of raw material input to ensure comparability across products.

Business Model Canvas (BMC) Analysis

The BMC framework (Osterwalder & Pigneur, 2014) is applied qualitatively to map the nine strategic elements of a village-scale coconut downstreaming business in Indragiri Hilir. The BMC analysis draws on findings from Kinanda et al. (2025) and Bahayyil et al. (2025)

regarding institutional arrangements, market access pathways, and cost-revenue structures applicable to BUMDes-managed downstreaming operations. The BMC is not treated as an independent survey instrument but as a strategic synthesis framework that integrates the quantitative Hayami findings into actionable business model recommendations.

Result and Discussion

General Overview of the Research Location

Indragiri Hilir Regency is geographically located at 0°36’ N – 1°07’ S and 102°32’ – 104°10’ E, covering a total area of 18,812.97 km² dominated by lowlands (93.31%) at 0–3 meters above sea level, characterized by swamp and peat ecosystems influenced by tidal sea water. The region borders Pelalawan Regency to the north, Tanjung Jabung (Jambi) to the south, Indragiri Hulu to the west, and the Riau Islands to the east.

Coconut is not only the primary economic commodity but also the social and cultural backbone of Indragiri Hilir’s predominantly smallholder farming communities. Tables and 3 below present the trends in cultivated area and production volume from 2020 to 2024.

Table 2. Coconut Cultivated Area – Indragiri Hilir Regency (2020–2024)

Year	Cultivated Area (Thousand Ha)
2020	225,417
2021	226,037
2022	226,037
2023	225,277
2024	303,906

Source: BPS Indragiri Hilir (2024)

Table 3. Coconut Production – Indragiri Hilir Regency (2020–2024)

Year	Production (Thousand Tons)
2020	262,992.4
2021	263,731.9
2022	263,732.3
2023	263,282.6
2024	265,068.6

Source: BPS Indragiri Hilir (2024)

Based on Tables 2 and 3, the cultivated area and coconut production in Indragiri Hilir are relatively stable from year to year, with a significant increase in cultivated area in 2024 reaching 303,906 thousand hectares. This shows that coconut is not just the main commodity but also the backbone of the rural economy in the region. However, despite having enormous resource potential, commodity management is still dominated by sales in raw form (whole coconuts), so the added value enjoyed by farmers is relatively low.

Hayami Added Value Simulation for VCO

Virgin Coconut Oil is the highest-value coconut derivative product, driven by strong global demand in health, nutrition, and cosmetics markets. From 1,000 kg of whole coconuts, an average of 150 kg of VCO is produced (conversion factor K = 0.15), requiring 6 HOK of skilled labor. The reference selling price is IDR 100,000/kg at the producer level (BPS Inhil, 2023; Mardesci et al., 2021), while whole coconut costs IDR 5,000/kg at the farmgate.

Table 4. Hayami Added Value Analysis – VCO (per 1,000 kg Whole Coconut)

Variable	Formula/Source	Value
Raw material input	Fixed base unit	1,000 kg whole coconut
Production output	Empirical yield (Mardesci et al., 2021)	150 kg VCO

Conversion factor (K)	150 ÷ 1,000	0.15 kg VCO/kg coconut
Output price	BPS Inhil (2023)	IDR 100,000/kg
Output value (V)	0.15 × 100,000	IDR 15,000/kg raw material
Raw material price	BPS Inhil (2023)	IDR 5,000/kg
Other input costs	Processing chemicals, packaging (Mardesci et al., 2021)	IDR 1,000/kg
Added value (VA)	15,000 − 5,000 − 1,000	IDR 9,000/kg raw material
Added value ratio (RVA)	(9,000 ÷ 15,000) × 100%	60.00% → HIGH ✓
Labor coefficient (L)	6 HOK ÷ 1,000 kg	0.006 HOK/kg
Labor remuneration (S)	0.006 × 140,351	IDR 842/kg raw material
Entrepreneur's profit (P)	9,000 − 842	IDR 8,158/kg (90.64% of VA)
Wage share of VA	842 ÷ 9,000 × 100%	9.36%

Source: Compiled by authors from Mardesci et al. (2021) and BPS Inhil (2023)

The VCO added value ratio of 60% is firmly in the HIGH category, confirming that processing raw coconut into VCO creates more than three times the economic value of the raw material itself. The dominant share of added value (90.64%) accrues to the entrepreneur rather than to labor, reflecting the capital-intensive and skill-intensive nature of VCO production. This distribution suggests that VCO enterprises are best suited to BUMDes units or cooperatives with sufficient capitalization and technical capacity, rather than household-scale operations. These findings are consistent with Mardesci et al. (2021) and significantly extend Ritonga et al. (2025), who documented similar value addition dynamics in West Sumatra VCO production.

Hayami Added Value Simulation for Coconut Shell Charcoal

Coconut shell charcoal is produced through carbonization of dried shells at 400–700°C, yielding a product widely used as raw material for charcoal briquettes, activated carbon for water filtration, and pharmaceutical industry inputs. From 1,000 kg of dry coconut shells, an average of 300 kg of charcoal is produced (K = 0.30), with a labor requirement of 10 HOK. The charcoal selling price is IDR 8,000/kg (Rahmat et al., 2025) while the shell purchase price from farmers is IDR 500/kg.

Table 5. Detailed Hayami Added Value Calculation – Shell Charcoal (per 1,000 kg Shell)

Variable	Formula/Source	Value
Raw material input	Fixed base unit	1,000 kg dry coconut shell
Production output	Empirical yield (Rahmat et al., 2025)	300 kg charcoal
Conversion factor (K)	300 ÷ 1,000	0.30 kg charcoal/kg shell
Output price	Rahmat et al. (2025); BPS Inhil (2023)	IDR 8,000/kg
Output value (V)	0.30 × 8,000	IDR 2,400/kg raw material
Raw material price	BPS Inhil (2023)	IDR 500/kg
Other input costs	Fuel for kiln, packaging (Rahmat et al., 2025)	IDR 300/kg
Added value (VA)	2,400 − 500 − 300	IDR 1,600/kg raw material
Added value ratio (RVA)	(1,600 ÷ 2,400) × 100%	66.67% → HIGH ✓
Labor coefficient (L)	10 HOK ÷ 1,000 kg	0.010 HOK/kg
Labor remuneration (S)	0.010 × 140,351	IDR 1,404/kg raw material
Entrepreneur's profit (P)	1,600 − 1,404	IDR 196/kg (12.27% of VA)
Wage share of VA	1,404 ÷ 1,600 × 100%	87.73%

Source: Compiled by authors from Rahmat et al. (2025) and BPS Inhil (2023)

Shell charcoal achieves an added value ratio of 66.67% (HIGH category), but its value distribution profile is fundamentally different from VCO. An exceptional 87.73% of added value (IDR 1,404 of IDR 1,600 per kg raw material) accrues to labor, leaving only IDR 196/kg (12.27%) as entrepreneur's profit. This inverted distribution compared to VCO has important policy implications: the charcoal industry is not primarily a profit-maximization vehicle but rather an employment generation instrument. From a poverty alleviation perspective, charcoal production is therefore the most socially impactful of the three products analyzed. This finding extends Rahmat et al. (2025) by explicitly quantifying the labor distribution dynamics that their circular economy framework implied but did not calculate.

Hayami Added Value Simulation for Cocofiber

Cocofiber is produced from mechanical decomposition of coconut husk using defibration equipment, yielding a product demanded by automotive, furniture, geotextile, and horticultural industries. From 1,000 kg of wet coconut husk, 350 kg of dry cocofiber is produced (K = 0.35) with a labor requirement of only 4 HOK, the lowest among the three products. The cocofiber price is IDR 6,000/kg (Bahayyil et al., 2025) while husk costs only IDR 200/kg from farmers.

Table 6. Detailed Hayami Added Value Calculation – Cocofiber (per 1,000 kg Husk)

Variable	Formula/Source	Value
Raw material input	Fixed base unit	1,000 kg wet coconut husk
Production output	Empirical yield (Bahayyil et al., 2025)	350 kg cocofiber
Conversion factor (K)	350 ÷ 1,000	0.35 kg cocofiber/kg husk
Output price	Bahayyil et al. (2025); BPS Inhil (2023)	IDR 6,000/kg
Output value (V)	0.35 × 6,000	IDR 2,100/kg raw material
Raw material price	BPS Inhil (2023)	IDR 200/kg
Other input costs	Machine operation, packaging (Bahayyil et al., 2025)	IDR 400/kg
Added value (VA)	2,100 − 200 − 400	IDR 1,500/kg raw material
Added value ratio (RVA)	(1,500 ÷ 2,100) × 100%	71.43% → HIGH ✓ (highest!)
Labor coefficient (L)	4 HOK ÷ 1,000 kg	0.004 HOK/kg
Labor remuneration (S)	0.004 × 140,351	IDR 561/kg raw material
Entrepreneur's profit (P)	1,500 − 561	IDR 939/kg (62.58% of VA)
Wage share of VA	561 ÷ 1,500 × 100%	37.42%

Source: Compiled by authors from Bahayyil et al. (2025) and BPS Inhil (2023)

Cocofiber achieves the highest added value ratio of 71.43% (HIGH category) among the three products, driven primarily by the exceptionally low cost of its raw material (IDR 200/kg husk) a by-product of coconut processing that is otherwise underutilized. The value distribution (62.58% to profit, 37.42% to labor) is balanced, making cocofiber suitable for farmer-BUMDes partnership schemes where both parties capture meaningful benefits. Importantly, the low labor requirement (4 HOK) and mechanical processing nature suggest that cocofiber production benefits from capital investment in defibration machinery but does not generate the broad employment absorption that charcoal does.

Comparative Summary of Three Downstream Products

Table 7. Comparative Summary of Hayami Added Value – Three Coconut Downstream Products

Indicator	VCO	Shell Charcoal	Cocofiber
Raw material price/kg	IDR 5,000	IDR 500	IDR 200
Output value (V)/kg raw material	IDR 15,000	IDR 2,400	IDR 2,100
Other input costs/kg	IDR 1,000	IDR 300	IDR 400
Added value (VA)/kg raw material	IDR 9,000	IDR 1,600	IDR 1,500

Added value ratio (RVA)	60.00%	66.67%	71.43%
Classification	HIGH ✓	HIGH ✓	HIGH ✓
Labor remuneration/kg	IDR 842 (9.36%)	IDR 1,404 (87.73%)	IDR 561 (37.42%)
Entrepreneur's profit/kg	IDR 8,158 (90.64%)	IDR 196 (12.27%)	IDR 939 (62.58%)
Labor required (HOK/1,000 kg)	6	10	4
Key strategic advantage	Highest absolute profit	Most labor absorption	Highest efficiency ratio
Most suitable for	BUMDes with large capital	Poverty alleviation programs	Farmer-BUMDes partnership

Source: Compiled by authors (2026)

Table 7 reveals a striking pattern: all three products are economically viable (RVA > 40%), but they serve fundamentally different development purposes and require different institutional arrangements. The variation in added value ratios — ranging from 60% (VCO) to 71.43% (cocofiber) is explained primarily by differences in raw material cost relative to output value. Cocofiber's superiority in RVA stems from the near-zero cost of its raw material (coconut husk is a processing by-product), not from a higher absolute selling price. Charcoal's dramatically different value distribution (87.73% to labor) reflects the labor-intensive carbonization process, which requires sustained kiln management over extended production cycles.

These findings are consistent with and extend the prior literature. They confirm Mardesci et al.'s (2021) finding that coconut downstream processing generates significant positive added value, and Bahayyil et al.'s (2025) documentation of high RVA for cocofiber specifically. The novel contribution of this study is the simultaneous three-product comparison that reveals the distinct strategic roles each product plays: VCO for capital-intensive profit generation, charcoal for broad-based labor absorption and poverty alleviation, and cocofiber for efficient farmer-enterprise partnership models. This differentiation is critical for policy formulation because it implies that a one-size-fits-all downstreaming strategy will be suboptimal.

Village-Scale Downstreaming Strategy (BMC)

The Hayami analysis confirms economic viability, but viability alone does not ensure implementation. The BMC framework is applied here to map the organizational architecture necessary to translate these economic potentials into operational village-level enterprises. Table 8 presents the integrated BMC for a BUMDes-managed coconut downstreaming operation in Indragiri Hilir.

Table 8. Business Model Canvas – Village-Scale Coconut Downstreaming (BUMDes, Indragiri Hilir)

BMC Element	Description for Coconut Downstreaming in Indragiri Hilir
Customer Segments	Health-conscious consumers (VCO); Industrial buyers – briquette manufacturers, water treatment firms (charcoal); Automotive, geotextile, and furniture manufacturers (cocofiber); Export markets via national aggregators
Value Propositions	Locally processed, traceable, certified coconut derivatives; VCO: premium organic health product; Charcoal: low-ash industrial-grade activated carbon precursor; Cocofiber: sustainable, biodegradable industrial fiber
Channels	Direct B2C digital sales for VCO (social commerce, marketplace platforms); B2B supply contracts for charcoal and cocofiber; BUMDes cooperative network for market aggregation; Government-facilitated trade fairs and exhibitions
Customer Relationships	Long-term supply contracts with industrial buyers; Community trust-building through transparent profit-sharing; After-sales quality assurance for B2C markets

Revenue Streams	Primary: product sales (VCO, charcoal, cocofiber); Secondary: by-product sales (coconut water for nata de coco, coir dust as growing media); Carbon credit potential from charcoal (future)
Key Resources	Defibration equipment and VCO processing units; BUMDes institutional structure and management capacity; Coconut shell and husk supply from local farmer networks; Quality certification (P-IRT, halal, BPOM for VCO)
Key Activities	Post-harvest processing and quality standardization; Equipment maintenance and workforce training; Digital marketing and supply chain coordination; Environmental compliance and zero-waste implementation
Key Partnerships	Local farmer cooperatives and smallholder groups (raw material supply); Regional government (technology provision, certification facilitation, capital access); Universities and technical agencies (training, R&D); National distributors and industrial buyers (market access)
Cost Structure	Capital investment: processing equipment; Variable costs: raw materials, labor, packaging, energy; Fixed costs: BUMDes management, quality certification, marketing; Training and capacity building (amortized over multiple production cycles)

Source: Adapted from Osterwalder & Pigneur (2014); Kinanda et al. (2025); Bahayyil et al. (2025)

The BMC mapping reveals several strategic insights that go beyond what the Hayami analysis alone can offer. First, the Value Proposition blocks for the three products are fundamentally non-competing: VCO targets premium health markets, charcoal targets industrial intermediate goods markets, and cocofiber targets manufacturing supply chains. This market differentiation means that villages can specialize by product type without creating internal competition, enabling an integrated rural industrial cluster across multiple villages.

Second, the Key Partnerships block identifies regional government as a critical enabler, not merely a passive supporter. Government intervention is most impactful in three specific areas: (1) subsidizing initial capital investment in processing equipment (particularly defibration machines and carbonization kilns); (2) facilitating quality certification processes (P-IRT, halal, BPOM) that are prohibitively complex for individual BUMDes to navigate; and (3) providing market linkages to industrial buyers who require quality assurance that small producers cannot independently guarantee.

Third, the integration of Hayami results with the Cost Structure and Revenue Streams blocks reveals a critical insight regarding product sequencing for BUMDes start-ups: cocofiber should be prioritized as the entry product given its high RVA, low raw material cost, and relatively low labor intensity. Charcoal should be developed as a secondary product that broadens employment and utilizes by-products. VCO, while most profitable in absolute terms, requires the highest technical capacity and capital investment and is therefore best suited as a third-phase development target.

This integrated Hayami-BMC analysis constitutes the core theoretical contribution of this study. By linking quantitative added value measurements to strategic business model design, we demonstrate a replicable analytical framework that can be applied by researchers and policymakers to evaluate rural downstreaming potential across other commodity-dependent regions. This approach addresses the specific research gap identified earlier: the absence of simultaneously multi-product, multi-framework analyses tailored to village-scale institutional contexts.

Environmental Integration

Sustainable downstreaming in Indragiri Hilir must align with environmental stewardship imperatives given the region's peat and tidal wetland ecosystems. Maintaining the hydrological balance of these ecosystems is essential not only for ecological reasons but as a precondition for sustained coconut productivity (Taryono, 2020). Any industrialization pathway that damages peat hydrology or causes land fires would ultimately undermine the raw material supply that downstreaming depends on.

Coconut downstreaming is inherently compatible with circular economy principles: virtually all parts of the coconut can be processed into value-added products, minimizing waste and maximizing resource utilization (Rahmat et al., 2025). Coconut water yields nata de coco; husks yield cocofiber and coir dust (growing media); shells yield charcoal and activated carbon; meat yields VCO and desiccated coconut. By processing all components at the village level, the environmental waste burden is minimized while economic value is maximized. This zero-waste production model also creates potential competitive advantages in sustainability-conscious global markets.

Conclusion

This study demonstrates that coconut downstreaming in Indragiri Hilir Regency represents a structurally viable and economically compelling solution to the raw material trap that has historically suppressed farmer welfare despite the region's abundant coconut resources. Using the Hayami Method applied to secondary data from BPS Indragiri Hilir and validated academic sources, all three analyzed downstream products VCO (60%), shell charcoal (66.67%), and cocofiber (71.43%) generate added value ratios firmly in the HIGH category (>40% threshold), confirming that processing is structurally far more profitable than raw commodity sales.

Beyond aggregate profitability, the study's key analytical contribution is the identification of distinct strategic roles for each product based on their value distribution profiles. VCO generates the highest absolute profit per unit raw material and is best suited to capital-intensive BUMDes operations. Shell charcoal allocates 87.73% of added value to labor, making it the most effective instrument for rural employment creation and poverty alleviation, despite low entrepreneur profit margins. Cocofiber achieves the highest processing efficiency ratio and is optimally structured as a farmer-BUMDes partnership model, leveraging the near-zero cost of husk raw material.

The integration of Hayami analysis with the Business Model Canvas framework constitutes the theoretical innovation of this study. The BMC mapping reveals that effective village-scale downstreaming requires not only economic viability (confirmed by Hayami) but also deliberate institutional design, specifically: quality certification pathways, market linkage infrastructure, staged product sequencing (cocofiber first, then charcoal, then VCO), and active regional government facilitation of capital access and technical training.

The policy implications of these findings are specific and actionable. The regional government of Indragiri Hilir should: (1) prioritize cocofiber processing as the primary entry point for BUMDes downstreaming programs given its optimal combination of high RVA, low capital requirements, and farmer-enterprise partnership compatibility; (2) develop charcoal production clusters in sub-districts with the highest rural unemployment to maximize the industry's labor absorption potential; (3) create a structured VCO development pathway for BUMDes that have demonstrated managerial and technical capacity through cocofiber and charcoal operations; (4) establish a regional certification and quality standardization service that pools certification costs across multiple BUMDes to overcome individual institutional barriers; and (5) integrate zero-waste and circular economy principles into all BUMDes downstreaming programs to protect peat ecosystem integrity and enhance product market positioning.

Study Limitations and Future Research

This study has several important limitations that must be acknowledged. First, the analysis relies entirely on secondary data, meaning that all price, cost, and production parameter figures are drawn from published sources rather than primary field surveys. This limits the ability to capture real-time price volatility, seasonal variations, local supply chain conditions, or enterprise-specific cost structures that may differ significantly from regional averages. Second, no sensitivity analysis was conducted to assess how changes in key variables (e.g., output prices, labor costs) would affect the calculated added value ratios. Given that commodity prices can fluctuate substantially, the presented RVA figures should be interpreted as representative estimates under 2022–2023 average conditions rather than precise predictions. Third, the BMC analysis is based on synthesis of prior research rather than on direct stakeholder interviews or institutional assessments, which limits its contextual specificity.

Future research should address these limitations through: (1) primary field surveys directly collecting price, cost, and production data from VCO, charcoal, and cocofiber producers and BUMDes operators in Indragiri Hilir; (2) sensitivity analysis testing the robustness of added value ratios under varying price scenarios; (3) formal stakeholder engagement with BUMDes managers, farmer groups, and regional government officials to validate and refine the BMC framework proposed here; and (4) longitudinal studies tracking the economic outcomes of BUMDes-based downstreaming programs over time to establish empirical evidence on policy effectiveness.

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