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VALUE ADDITION, PROFITABILITY, AND STRATEGIC DEVELOPMENT OF THE SOUTH SULAWESI SAGO AGRO-INDUSTRY

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ABSTRACT

Sago is more than just a crop; it is a strategic asset for food security and a versatile industrial raw material. However, its true economic potential lies in agro-industrial transformation. This study examines how sago processing adds value and supports local livelihoods in North Luwu and Palopo, South Sulawesi. By combining the Hayami method for value-added analysis with partial budgeting and SWOT frameworks, we assessed the profitability of different processing stages and identified a path forward for the industry. Our findings reveal a sharp divide in economic outcomes. While wet and dry processing generate high value-added margins (over 40%), the milling stage remains below 15%. Interestingly, milling is actually the most efficient profit-maker, yielding a rate of 85.71%—far higher than drying or wet processing. This profitability extends to the people on the ground; with an R/C ratio of 1.6, sago processing is a highly viable business. However, a significant income gap persists, with loggers and processors earning roughly 25% more than the landowners who provide the raw material. To move the industry forward, the focus must shift toward farmer-led corporations and better land mapping. By establishing regional sago institutions and investing in infrastructure and human capital, South Sulawesi can move beyond basic milling into high-value derivative industries. These steps are essential to turning sago from a traditional staple into a modern industrial engine for the region.

Key words: Added value, agroindustry, Hayami method, partial budget, SWOT, sago.

INTRODUCTION

Sago, a versatile agricultural commodity, holds significant economic and cultural importance in Indonesia, particularly in regions like North Luwu and Palopo. It serves as a staple food source, a raw material for agro-industrial applications, and a potential driver of regional economic development. The sago agro-industry in these areas is deeply rooted in local livelihoods, with North Luwu and Luwu Districts recognized as key centers of sago production in South Sulawesi (Nisa’ *et al* 2023; Saruman *et al*., 2025). Despite its potential, the industry faces challenges related to value addition, profitability, and sustainable development strategies.

Efforts to enhance the sago value chain have revealed opportunities for increasing profitability through improved processing techniques. For instance, converting sago stems into sago flour generates significantly higher added value compared to wet sago, with value-added ratios of 69.09% and 39.17%, respectively (Hamidi & Elida, 2018). However, the industry is constrained by limited access to advanced processing technologies, inadequate infrastructure, and insufficient institutional support, which hinder its growth and competitiveness (Timisela *et al*., 2021; Girsang, 2018).

Government interventions have primarily focused on reducing the workload of sago farmers through training and equipment provision, but these efforts have had limited impact on other actors in the value chain (Nisa' *et al*., 2023). Additionally, marketing challenges, such as limited market capacity and low product prices, further restrict the industry's growth. Strategic interventions, including the adoption of e-commerce, infrastructure upgrades, and integrated farming systems, have been proposed to address these issues (Saruman *et al*., 2025).

The development of sago technoparks, such as the initiative in Palopo City, represents a promising approach to integrating education, technology, and business development. However, the realization of such projects requires stronger stakeholder collaboration and the establishment of effective management units (Nuryanti, *et al* 2020).

By addressing these challenges and leveraging its inherent strengths, the sago agro-industry has the potential to significantly contribute to regional economic development and food security. This study aims to explore the value-added potential, profitability, and strategic pathways for the sustainable development of the sago agro-industry in these regions.

MATERIALS AND METHODS

Research design and data collection

This study combine qualitative research design and descriptive one. The study was conducted from May to July 2023 in Luwu Regency and Palopo City, South Sulawesi Province, Indonesia. These locations were chosen because they are the center of sago-based local food and no such study has been undertaken to compare both area.

The type of data used was primary data in the form of cross section data, and secondary data in the form of time series data. Primary data were obtained through observation and interviews. Primary data collected were processing flow, price, processing cost, labor requirement, and labor cost. Data was collected through interviews with the management of sago agroindustry. In addition, direct observations were aspects that were taken into account in the value-added analysis. Determination of samples in primary data collection through interviews using questionnaires was carried out by purposive sampling.

Secondary data was taken to support primary data collected and published by relevant institutions such as the Central Bureau of Statistics, Ministry of National Development Planning, Bank Indonesia, Ministry of Trade, and Comtrade. The secondary data needed were also obtained from the processing industry, such as data on raw material purchases, production, and product sales in each period.

Observation was carried out by directly observing the processing industry environment, the state of infrastructure, raw materials, and equipment used in processing and final products.
Interviews were conducted directly with the management of the processing industry such as business managers, production, processing and marketing departments related to value-added calculation data and value chains. Determination of samples in primary data collection through interviews was carried out by *purposive sampling,*

Observation was carried out by directly observing the processing industry environment, the state of infrastructure, raw materials, and equipment used in processing and final products.

Data analysis

Value added analysis

The data was first tabulated using the Microsoft Excel, then further analyzed using the value-added analysis of the Hayami model (Hayami *et al.*, 1987) to calculate the added value of sago processing, the value of output, profits, and labor rewards. The calculation of added value was done using cross section data. An overview of calculation analysis using the Hayami method can be seen in Table 1.

The overall collected data from observations, interviews, and literature studies were analyzed and interpreted. After calculating the added value, value-added testing was carried out according to Hubeis testing criteria (Hubeis, 1997). To determine the value-added ratio, 3 categories were used:

1. If the ratio was <15% then the added value was considered as low;
2. If the ratio was between 15-40% then the added value was moderate, and
3. If the ratio was >40%, then the added value was high.

Partial budget analysis

Analysis of revenue and business efficiency using a model from Soekartawi (2016). The elements taken into account consist of:

1. Revenue

Revenue is the result of multiplication between production and the selling price of output. Mathematically it is written as follows:

TR = Y. Py ………………… (1)

Where:

TR = Total revenue (Rp)

Y = Production number (Kg)

Py = Output price (Rp)

2. Total cost

Total cost is the total sum of fix cost and variable cost.

TC = FC + VC ……………… (2)

Where:

TC= Total cost (Rp)

FC= Fixed cost (Rp)

VC= Variable cost (Rp)

3. Income

Income is the difference between revenue and business expenses. Mathematically it is written as follows:

Pd = TR – TC ……………… (3)

Where :

Pd = Income (Rp)

TR = Total revenue (Rp)

TC = Total cost (Rp)

4. Business efficiency analysis

Business efficiency is calculated based on the ratio of revenue to cost or R/C ratio. Mathematically it is written as follows :

R/C = TR / TC ……………. (5)

Where:

R/C < 1 = the sago processing business is inefficient

R/C = 1 = the sago processing business is breakeven

R/C > 1 = the sago processing business is efficient

Strategy development for sago agroindustry

SWOT analysis was used to determine the strategy development of the sago agroindustry. Using a SWOT analysis, one can determine internal factors that contribute to competence, such as valuable resources or desired attributes under "Strengths," as well as internal factors that hinder success-critical competence, assets, or qualities listed under "Weakness." Under "Opportunity," we included external performance enhancers that can be investigated or utilized. Under "Treats," we also identified external performance impediments that could reduce success (Leigh, 2009). The SWOT matrix consists of four types of business development strategies (Puyt *et al*., 2023):

1. SO (*Strengths-Opportunities*) strategy: a strategy that maximizes the strengths of the internal environment to take advantage of the opportunities of the business' external environment.
2. WO (*Weakness-Opportunities*) strategy: a strategy that can improve the weaknesses of the internal environment by maximizing opportunities obtained from the business's external environment.
3. ST (*Strength-Threats*) strategy: a strategy that uses the strengths of the business to minimize the influence of threats from the business 's external environment.
4. WT (*Weakness-Threats*) strategy: a strategy in the form of defensive tactics to reduce the influence of internal environmental weaknesses and avoid threats from the external environment.

RESULTS AND DISCUSSION

Existing conditions

1. Harvesting and Extraction Process

Sago flour processing is primarily conducted as a cottage industry through two distinct operational models: mobile processing, which utilizes portable shredders directly within sago stands, and stationary processing, which is established at fixed locations determined by water availability. Following tree felling, leaf clearing, trunk sectioning, and transport, the sago extraction workflow consists of four key stages. First, workers peel the rough outer bark from the sectioned logs right at the extraction site to expose the starch-rich core. Next, mechanical shredders slice these log cores into a fine mash, which is then manually trampled and continuously doused with water to flush the raw starch out of the fibrous pulp. This starch-heavy runoff is then filtered to isolate the fine extract from residual fibers and left undisturbed to sediment. Finally, the dense, wet starch is scraped out and packed into traditional tumang containers (Figure 1). Tumang is a traditional container made of woven sago leaves that is used to accommodate and precipitate sago essence before drying (Manilet, 2026). Tumang sago is usually preferred by the local community, and is considered more durable than plastic packaging sago or sacks (Kamal *et al*., 2026).

2. Marketing and Retail Formats

The final product is distributed through traditional markets in Palopo City. It is primarily sold in bulk as wet sago flour (measured by the *bunch* or volumetric liters) or processed further into packaged, sun-dried sago flour. Thus, expanding the range of sago-based products, including liquid sugar, bioethanol, and gluten-free foods, can open new markets (Dewayani *et al*., 2024; Abidin *et al*., 2024). Furthermore, implementing dynamic pricing, customer segmentation, and cross-channel marketing can optimize revenue and market reach (Ernestivita *et al*., 2026). The sago market in Indonesia often operates under oligopsonistic and oligopolistic structures, where a few large traders dominate, limiting competition and farmer bargaining power (Saediman *et al*., 2021; Saruman *et al*., 2026).

Barriers to entry for sago marketing include capital requirements, economies of scale, and networking challenges (Saediman *et al*., 2021).

3. Socio-Institutional Framework and Resource Constraints

Sago production centers operate under unique traditional tenure systems and local wisdom:

- Fragmented Ownership: A single contiguous sago stand is frequently owned by multiple individuals, and land ownership does not automatically grant ownership rights to the sago clumps growing upon it.
- Community Organization: Local owners within a hamlet form cohesive farmer groups, which interface with specialized, independent groups of loggers and wet-sago processors.

Despite this cultural framework, local actors face severe resource constraints. The workforce is characterized by low secondary-school educational attainment, reliance on rudimentary processing tools, and substandard water infrastructure that compromises the hygiene and quality of the final starch output. To sum up, there is a need to improve the economic institutional structure of farmers and business actors to enhance marketing and production efficiency (Saruman, 2025).

Value added analysis

Value-added arises when a commodity undergoes processing, transport, and storage within a production line (Siregar, 2012). Here, a single sago tree provided 900 kg of raw input, yielding 600 kg of wet sago. Further processing produced 420 kg of dry sago and a final output of 336 kg of milled sago flour. These inputs and outputs establish correction factors of 0.67 for wet processing, 0.70 for drying, and 0.80 for milling. Thus, every kilogram of input at each respective stage yields 0.67 kg of wet sago, 0.70 kg of dry sago, and 0.80 kg of milled sago.

As shown in Table 2, wet starch processing recorded the highest value-added ratio at 92.0%, followed by drying (52.0%) and milling (13.0%). The high value-added in wet processing stems from the margins between output prices and the costs of raw materials and equipment. Unit prices increase with advanced processing: milled sago commands Rp 8,000/kg, dry sago Rp 4,200/kg, and wet sago Rp 1,667/kg. While wet and dry processing generate high value-added percentages (> 40%) and milling remains low (< 15%), the final milling stage secures the highest net profit rate at 85.71%, vastly outperforming drying (63.64%) and wet processing (47.83%).

According to Dewayani *et al*. (2024), traditional processing methods result in low yields and significant waste, with around 6 million tons of dry starch lost annually.

Sago economic analysis

The detail ofof revenue and income of sago wet logger/processing farmers per hectare is explained in Table 3. One sago trunk yields 10 to 11 sacks (50 kg each), priced at Rp 130,000 per sack (approximately Rp 3,000/kg). Based on a per-hectare yield of 30,350 kg, logger-farmers generate a gross income of Rp 91.05 million exclusively from wet sago sales. Land-owning farmers generate an income of Rp 8.75 million per hectare by selling raw sago logs at Rp 150,000–Rp 200,000 per tree (Rampasela, 2019). Meanwhile, logger-farmers process these logs into wet starch through a labor-intensive chain of felling, clearing, sectioning, grating, and washing.

The highest operating costs are from refinery construction and extraction processing (Rp 42.0 million), followed by machinery procurement (Rp 7.0 million), resulting in a total production expenditure of Rp 56.6 million. By subtracting these total costs from the gross revenue, logger-farmers secure a net profit of Rp 34.5 million. The resulting revenue-cost (R/C) ratio of 1.6 demonstrates that sago logging and processing cooperatives are economically viable. Ultimately, a 25.38% income gap exists between land-owning farmers and sago processors, highlighting the economic advantages of processing over raw material sales.

Sago markets in eastern Indonesia, such as South Sulawesi and Southeast Sulawesi, are characterized by oligopsonistic and oligopolistic structures. Farmers often face unfair pricing due to the dominance of wholesalers and traders, leading to inefficiencies and low profit margins for producers (Saruman *et al*., 2026; Saediman *et al*., 2021). Barriers to entry in sago marketing include limited technical skills, capital requirements, and lack of product differentiation, which hinder competition and market efficiency (Saediman *et al*., 2021).

Analysis of sago agro industry development

The strategic SWOT matrix (Table 4) demonstrates that transforming sago sector requires reconciling deep-seated structural vulnerabilities with emerging global macroeconomic opportunities across land governance, nutritional economics, and institutional networks.

Spatial Governance and Institutional Anchors

Institutional frameworks dictate the viability of sustainable sago development. North Luwu Regional Regulation No. 11/2017 provides a critical legal shield (S1) against agricultural land-use conversion pressures (T3) from lucrative monocultures like oil palm. Utilizing an ST strategy, this mandate enables municipal spatial planning to zone vulnerable sago habitats into sustainable production forests. However, policy presence does not equal policy efficacy. To move beyond passive conservation, a strategic WO shift must elevate sago to a national strategic food commodity status—on par with rice and corn—securing synchronized federal and regional infrastructure funding. Farmers often rely on traditional methods, which are less efficient and yield lower-quality products (Timisela *et al*., 2021).

Environmental concerns, such as the unsustainable harvesting of sago forests, threaten long-term industry viability. For instance, in Maluku, sago trees are being cut at unsustainable rates, necessitating better forest management practices (Girsang, 2018).

Rebranding via the Functional Food Paradigm

Sago faces a socio-cultural paradox: it holds profound regional heritage value (S5) yet suffers from an external consumer stigma as an inferior "poor man's" food (T2). This barrier can be dismantled by aligning sago’s biochemical profile with modern epidemiological demands. The global rise in metabolic disorders has escalated the niche market demand for low-glycemic index (GI), gluten-free alternatives (S4, O4). Shifting the narrative from a subsistence crop to a high-value functional food allows the regional economy to capture health-conscious demographics. This requires a defensive WT strategy: combining Triple Helix academic publications to validate sago's health benefits with marketing campaigns to decouple the starch from its historical poverty stigma (Moshawih *et al*., 2025)

Rectifying Upstream Bottlenecks and the Quality Gap

Favorable downstream industrial starch demand (O2) is heavily constrained by severe upstream supply chain bottlenecks (Bushtanul *et al*., 2025). Conventional cultivation (W2), unidentified cultivars (W3), and a lack of breeding initiatives (W5) cause structural inefficiencies. Furthermore, immediate smallholder cash-flow needs drive premature logging (W1), threatening biophysical sustainability. This is compounded by an acute environmental and health hazard: the illicit use of urea fertilizer as a bleaching agent (T1) to compensate for low starch quality caused by poor processing water (W4). Limited access to modern processing technology and infrastructure is a major bottleneck in sago agroindustry development. Farmers often rely on traditional methods, which are less efficient and yield lower-quality products (Timisela *et al*., 2021). Transitioning to integrated farming systems and utilizing drylands for sago cultivation, with appropriate nutrient management, can address land scarcity and environmental concerns(Rampisela et ., 2018) Policies promoting local food preservation, infrastructure development, and community participation are essential for sustainable growth (Kadri *et al*., 2026). For example, in Maluku, community-driven initiatives to organize sago forests into sustainable gardens have shown promise (Timisela et ., 2022). SO pathways must organize smallholders into formal agricultural cooperatives (koperasi tani) to pool capital, map land, and invest in centralized, clean-water processing infrastructure.

The Triple Helix Innovation Model

The execution of these strategies relies on an integrated governance framework. WO and WT pathways converge on a Triple Helix model linking Local Government, Research Academics, and Agrarian Cooperatives. Academic institutions must catalog regional sago varieties (resolving W3) and disseminate high-yield, climate-resilient breeding technologies. Concurrently, the regional government must optimize the investment climate through targeted deregulation and infrastructure subsidies to attract private downstream processors. Without this synchronized institutional network, sago development will remain fragmented and vulnerable to market shifts.

CONCLUSION

In conclusion, while sago logging and processing remain highly viable livelihoods in South Sulawesi, a substantial socioeconomic gap exists between land-owning farmers and processors, with profitability heavily skewed toward sago milling (85.71%) over dry and wet processing. However, traditional processing methods yield low economic value and negligible food security benefits, whereas downstream wet and dry processing generate high added value (> 40%). Because raw sago inherently lacks high economic returns, technological innovation and product diversification are crucial to capturing higher value and driving meaningful multiplier effects. Therefore, to accelerate the regional economy and bolster national food security, South Sulawesi must transition toward a modernized agroindustry guided by a six-pronged strategy: establishing farmer-corporation-based sago areas, mapping sago lands, developing derivative industries, forming regional institutions, upgrading infrastructure, and enhancing local human resource capacity.

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Table 1. Components in the calculation of added value with the Hayami Method

No	Variable	Calculation
Input, Output, Price		
1.	Output (kg)	1
2.	Raw material input (kg)	2
3.	Labour input (hour/HOK)	3
4.	*Convertion factor*	1 : 2
5.	*Labor coefficient*	3 : 2
6.	Output price (Rp/kg)	6
7.	Product price (Rp/kg)	6
8.	*Wage rate* (Rp/kg)	7
Income and Outcome		
9.	Cost of raw material input (Rp/kg)	8
10.	Other cost of input (Rp/kg)	9
11.	Output (Rp/kg)	4 x 6
	a. Added value (Rp/kg)	10 – 8 – 9
	b. Added value ratio (%)	11a : 10
	c. Labor acceptance (Rp/kg)	5 x 7
	d. Labor percentage (%)	12a : 11a
	e. Processor *profit* (Rp/kg)	11a – 12a
	f. Profit level (%)	13a : 11a
Production factor service fee of the owner		
12.	Margin (Rp)	10 – 8

a. Ratio of labor income (%)	12a : 14
b. Other input percentage share (%)	9 : 14
c. Profit ratio of *owner* (%)	13a : 14

Source: (Hayami *et al*., 1987)

Table 2. Comparison of Added Value of Wet Processing of Sago Drying, and Milling

Description of Costs / Receipts / Advantages / Added Value	Wet Processing	Drying	Milling
Output, Input dan Price			
1. Output (kg) (1)	600	420	336
2. Input (kg) (2)	900	600	420
3. Labor (HOK) (3)	6	4	0.5
4. Conversion factor (4)	0.67	0.7	0.8
5. Labor coefficient (HOK/kg) (5)	0.007	0.007	0.001
6. Output price (IDR) (6)	2500	6000	10000
7. Average labor wage (IDR/HOK) suta(7)	120000	120000	120000
Income and Profit			
8. Raw material price (IDR/kg) (8)	133.33	2000	6000
9. Contribution of other inputs (IDR/kg) (9)	0	0	1000
10. Value of output (IDR/kg) (10)	1,667	4,200	8000
11. a.Value-added (IDR/kg) (11a)	1533	2200	1000
b. Value ratio plus (%) (11b) = (11a/10) x 100%	0.92	0.52	0.13
12. a. Labor income (IDR/kg) (12a)	800	800	143
b. Labor share (%) (12b) = (12a/11a) x 100%	52.17	36.36	14.29
13. a. Profit (IDR/kg) (13a) = 11a -12a	733	1400	857
b. Profit rate (%) (13b) = (13a/11a) x 100%	47.83	63.64	85.71
Remuneration for Factors of Production			
14. Margin (IDR/Kg) (14) = (10) - (8)	1,533	2,200	2000
Labor income (%) (14a) = (12a/14) x 100%	52.17	36.36	7.14
Contribution of other inputs (%) (14b) = (9/14) x 100%	0	0	50
Entrepreneur's profit (%) (14c) = (13a/14) x 100%	47.83	63.64	42.86

Table 3. Analysis of revenue and income of sago wet logger/processing farmers per Hectares for 2023

No.	Description	Unit	Price (IDR/unit)	Amount (IDR)
1.	Income			
	Sago starch production per Ha	30.350 Kg	3.000	91.050.000

2.	. Production Cost			
	a. Cutting, cleaning, cutting stems, grating then squeezing/ washing	150 people	280.000	42.000.000
	b. Gasoline and raw etc.	50 logs	87.000	4.350.000
		1 Package	7.000.000	7.000.000
	c. Chainsaw machines	1 Package	425.000	425.000
	d. Axes/crowbars / dodos	1 Package	1.200.000	1.200.000
		2 sheet	800.000	1.600.000
	e. Grated machines			
	f. Tarpaulin 8 x 6 m			
3.	Total Production Cost			56.575.000
4.	Profit			34.475.000
5.	(R/C) Ratio			1,6

Table 4. SWOT Matrix analysis

Internal Factors / External Factors	Strength (S)	Weakness (W)
	1. North Luwu Regional Regulation No. 11/2017 2. Strong stakeholder support for development 3. Long shelf-life of dried sago without specialized warehousing 4. High versatility for functional foods (high-carb, low-GI, gluten-free) 5. Deep-rooted cultural value in Luwu	1. Premature sago logging violating technical guidelines 2. Persistent conventional, non-modern cultivation systems 3. Unidentified/unknown cultivated sago varieties 4. Suboptimal starch quality due to low processing water quality 5. Complete lack of systematic sago breeding initiatives
Opportunities (O)	SO Strategies (Aggressive/Growth)	WO Strategies (Turnaround/Development)
1. Rising niche demand for exclusive health foods 2. Growing starch demand as industrial raw material 3. High potential as a complementary flour substitute 4. Expanding diabetic consumer base seeking low-	1. Establish localized sago production zones managed by farmers' cooperatives (koperasi tani) [S2, O1, O2] 2. Accelerate GIS mapping of existing and potential sago habitats [S1, O5] 3. Foster downstream industrial processing for high-	1. Lobby to establish sago as a national strategic food commodity on par with rice and corn [W2, O1] 2. Build cross-institutional synergy between regional and central government bodies [W4, O2] 3. Enforce rigorous, environmentally conscious quality control across integrated upstream-downstream

GI alternatives 5. Climate change resilience of sago over conventional crops	value sago starch derivatives [S4, O2, O3] 4. Codify legal frameworks to incentivize sago agricultural expansion [S1, O1] 5.Enhance local human capital and specialized production infrastructure [S2, O2]	industries [W4, O3]
Threats (T)	**ST Strategies (Diversification/Defense)**	**WT Strategies (Defensive/Survival)**
1. Illegal/unsafe use of urea fertilizer as a bleaching agent 2. Entrenched public perception of sago as an inferior "poor man's" food 3. Rapid agricultural land-use conversion pressure 4. Absence of modernized, consumer-ready sago foods in retail markets	1.Revise municipal spatial planning to designate vulnerable sago areas as sustainable production forests [S1, T3] 2. Scale up mid-to-large-scale modern food processing industries to squeeze out primitive bleaching practices [S4, T1] 3. Launch targeted public socialization and marketing campaigns highlighting sago-based food innovations [S5, T2]	1.Expand academic publications, clinical trials, and public education on sago's health benefits [W3, T2] 2.Pass strict statutory zoning laws guarding against industrial sago land conversion [W1, T3] 3. Streamline regional investment regulations to attract high-tech processing partners [W4, T4] 4.Form an institutional Triple Helix (Government–Academia–Research Institutes) to disseminate localized, culturally aligned tech innovations [W3, W5, T2, T4]

Figure 1. Tumang
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