

Added Value Analysis and Development Strategy of Tobacco Stem Waste Treatment into Briquettes (Case Study at Jember Tobacco Research Center)

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ABSTRACT

Tobacco is one of the plantation commodities that has a strategic role in the national economy. Currently, tobacco stem waste is largely underutilized and inadequately managed at the farm level. Tobacco waste is processed into briquettes to achieve high economic value. Currently, tobacco briquettes are still rarely produced by the community; they are still produced by the Jember Tobacco Research Center. The objectives of this study are: (1) Analyzing the amount of added value produced in the processing of tobacco stem waste into briquettes at the Jember Tobacco Research Center. (2) Determine alternative strategies in the development of the briquette agro-industry at the Jember Tobacco Research Center. (3) Determine strategic priorities for the development of the briquette agro-industry at the Jember Tobacco Research Center. The data analysis methods used in this study are the Hayami method, SWOT analysis, and the AHP method. In this study, tools include questionnaires, laptops, cameras, and Microsoft Excel. Based on the Hayami value-added analysis, tobacco stem briquette processing yields an added-value ratio of 59%, indicating a high level of value addition. The results of the SWOT analysis indicate quadrant I, which means that the company is in a very favorable position. In addition to the AHP results, four alternative strategies were identified from the SWOT quadrant, each with four criteria equally connected to it. The results of the managerial implications obtained from the AHP method indicate that the priority of the resulting strategy is to collaborate with tobacco-based companies to ensure briquette products are ready for commercialization to the public, so they are widely known from farmers to entrepreneurs.

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1. Introduction

Indonesia is one of the major agricultural countries, where the agricultural sector plays a strategic role in national economic development. This sector not only absorbs a large proportion of the workforce but also contributes significantly to national income and foreign exchange earnings, highlighting its importance in driving economic growth (Irawan *et al.*, 2024). In addition to providing food and raw materials for various industries, agriculture supports the development of other economic sectors through market linkages that generate positive spillover effects (Nadzirah, 2020).

Tobacco is one of Indonesia's important plantation commodities and serves as a key

raw material for domestic industries. In East Java, tobacco production is concentrated in four main regions Jember, Probolinggo, Situbondo, and Bojonegoro, which together contributed approximately 2.01% to the regional gross added value, amounting to IDR27.321 billion during the 2016–2022 period (BPS-Statistics of Jawa Timur Province, 2023). Given its economic significance, maintaining the sustainability and efficiency of tobacco production systems is essential, including the management of post-harvest by-products (Mu'min *et al.*, 2018).

One major issue associated with tobacco production is the generation of substantial amounts of post-harvest biomass waste, particularly tobacco stems. At the farm level, tobacco stem waste is generally considered to have low economic value and is often left unmanaged, composted in limited quantities, or disposed of through open burning. In practice, farmers frequently burn tobacco stems in open fields as a quick disposal method. This practice represents inefficient resource use and poses environmental and health risks due to residual nicotine and particulate emissions released during combustion, which may harm human health (Najuda *et al.*, 2023).

The utilization of tobacco stem waste offers a promising opportunity to address both environmental and economic challenges. Converting tobacco stem waste into value-added products can reduce waste accumulation while generating additional income for farmers and rural communities (Slamet *et al.*, 2022). One potential use is the production of charcoal briquettes. Briquettes are solid fuels characterized by high carbon content, relatively high calorific value, and longer burning duration, making them suitable as alternative energy sources (Zainal *et al.*, 2021). Tobacco stem briquettes can be used for household cooking, small-scale commercial activities, outdoor activities such as camping, and as a substitute for traditional firewood, thereby supporting sustainable energy use and local economic development (Budi, 2017).

In general, biomass briquettes derived from agricultural waste, such as coconut shells and crop residues, have gained public acceptance as alternative fuels, particularly in areas facing rising energy costs (Adhitasari *et al.*, 2025; Santoso, 2022; Utami *et al.*, 2024). However, briquettes made from tobacco stem waste are still relatively unfamiliar to the general public. Limited awareness, lack of market exposure, and minimal promotion have constrained public acceptance, despite their technical potential and functional similarities to other biomass briquettes. This indicates the need for further evaluation and development to support wider adoption and commercialization (Yu *et al.*, 2022).

Although several studies have examined the utilization of agro-industrial waste into briquettes, most existing research has primarily focused on technical characteristics such as calorific value, combustion efficiency, and physical properties, or has analyzed economic feasibility using a single analytical approach. Studies on tobacco by-product utilization have largely emphasized composting, extraction, or basic briquette quality testing, with limited attention to comprehensive value-added assessment and strategic development planning (Purwono *et al.*, 2011; Pamujiati *et al.*, 2022; Mufarriyah *et al.*, 2021; Suciati & Djamali, 2022; Slamet *et al.*, 2022). Moreover, previous studies rarely integrate economic analysis with strategic decision-making tools, particularly within an institutional production context.

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comprehensive value-added assessment and strategic development planning (Purwono *et al.*, 2011; Pamujiati *et al.*, 2022; Mufarriyah *et al.*, 2021; Suciati & Djamali, 2022; Slamet *et al.*, 2022). Moreover, previous studies rarely integrate economic analysis with strategic decision-making tools, particularly within an institutional production context.

Currently, tobacco stem briquettes are produced on a small scale by the Jember Tobacco Research Center and are not yet widely commercialized. The products are mainly distributed as souvenirs for visitors, rather than as market-oriented energy commodities. Consequently, there is limited empirical evidence on the added value generated by tobacco stem briquette processing and the strategic pathways required to support its commercialization. This gap highlights the need for a comprehensive analytical framework that not only evaluates economic value creation but also formulates development strategies and prioritizes actionable alternatives.

This study addresses these gaps by integrating the Hayami value-added analysis with SWOT and Analytical Hierarchy Process (AHP) methods to assess the economic performance, strategic positioning, and priority development strategies of tobacco stem briquettes. The novelty of this research lies in (1) the combined application of Hayami–SWOT–AHP analyses for tobacco stem briquette agroindustry development, and (2) the use of an institutional case study at the Jember Tobacco Research Center, which provides practical insights for scaling up agroindustrial waste utilization from research-based production to commercial application. Through this approach, the study contributes to both the theoretical literature on the valorization of agro-industrial waste and the practical development of sustainable energy products from tobacco by-products.

2. Methodology

The research was carried out at the Tobacco Research Center in Jember Regency, and research and data processing were conducted at the Laboratory of Agricultural Industrial Technology, University of Muhammadiyah Jember. From May to July in 2024. In this study, tools include questionnaires, laptops, stationery, cameras, and Microsoft Excel. The materials used in this study are primary data obtained from observations, interviews, and questionnaires with respondents, and secondary data sourced from scientific articles and from the Statistics Satisfaction Agency.

This study employed a mixed-methods research design with a quantitative dominant approach. Quantitative methods were used to analyze the economic feasibility and strategic priorities of tobacco stem briquette processing, while qualitative data supported the identification and interpretation of internal and external factors influencing agroindustry development. Quantitative analysis consisted of the Hayami value-added method to measure the economic value generated from processing tobacco stem waste into briquettes and the Analytical Hierarchy Process (AHP) to determine the priority of development strategies based on stakeholder assessments. These methods involve numerical calculations and structured decision-making procedures, allowing for objective evaluation of economic performance and strategic alternatives. Qualitative data were collected through observations, interviews, and questionnaires to identify strengths, weaknesses, opportunities, and threats (SWOT) related to the development of the tobacco stem briquette agroindustry. The qualitative findings were subsequently quantified through weighting and rating processes in the SWOT analysis to support strategic formulation. By integrating quantitative and qualitative approaches, this study provides a comprehensive assessment that combines measurable economic outcomes

with contextual strategic insights, ensuring methodological coherence with the research objectives and analytical tools employed.

The data analysis method in this study is the first value-added analysis of the hayami method, In the context of value-added analysis, there are three important supporting components: (1) Conversion factor, which shows the amount of output produced from one input unit, (2) Labor coefficient factor, which indicates the amount of labor required to process one input unit, and (3) Product value, which shows the output value/input unit (Ashari, 2019). The analysis technique of the hayami method can be described in the following table:

Table 1. Calculation Techniques of The Hayami Method

Variable	Value
I. Output, Input, and price	
1. Output (Kg)/production process	(1)
2. Input (Kg)/production process	(2)
3. Labor (Days of labor)/production process	(3)
4. Conversion factor	(4)= (1)/(2)
5. Labor coefficient (Days of labor/Kg)	(5)= (3)/(2)
6. Output price (IDR/Kg)	(6)
7. Direct labor wages (IDR/Days of labor)	(7)
II. Admissions and benefits	
8. Raw material price (IDR/Kg)	(8)
9. Other input contributions (IDR/Kg)	(9)
10. Output value (IDR/Kg)	(10)= (4) x (6)
11. a. Value Added (IDR/Kg)	(11a)= (10) – (9) x 100%
b. Value Added Ratio (%)	(12a)= (5) x (7)
12. a. Direct labor income (IDR/Kg)	(12a)= (5) x (7)
b. Labor share (%)	(12b)=(12a)/(11a)x 100%
13. a. Profit (IDR/Kg)	(13a)= (11a) – (12a)
b. Profit rate (%)	(13b)= 13a)/(11a) x 100%
III. Repay the services of the owners of the factors of production	
14. Margin (IDR/Kg)	(14) = (10 – (8)
a. Direct labor income (%)	(14a)= (12a)/(14) x 100%
b. Contribution of other inputs (%)	(14b)= (9)/(14) x 100%
c. Business owner's benefits (%)	(14c)= (13a)/(14) x 100%

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

The results of the calculation will be further analyzed using the value-added criterion indicator. According to Fadhilah *et al.* (2023) The added value is declared low if the added value ratio is < 15%, the added value is declared medium if the added value ratio ranges from 15% - 40%, The added value is declared high if the added value ratio is > 40%.

The SWOT matrix consists of four important types of business development strategies, namely:

1. SO (*Strengths-Opportunities*) Strategy: This strategy focuses on leveraging internal strengths to explore opportunities in the external environment.
2. WO (*Weakness-Opportunities*) Strategy: This strategy aims to address weaknesses in the internal environment while maximizing opportunities in the external environment.

3. ST (*Strength-Threats*) Strategy: This strategy leverages the company's strengths to mitigate threats from the external environment.
4. WT (*Weakness-Threats*) Strategy: This strategy is defensive, designed to minimize the impact of internal weaknesses while avoiding threats from the external environment.

By implementing these four strategies, companies can develop a more effective approach to addressing challenges and taking advantage of market opportunities. After determining the four alternative strategies, the next step is to choose the ones to be adopted using the SWOT quadrant.

Analytical Hierarchy Process (AHP), AHP calculation procedure according to Mario & Susandri (2013):

1. Criteria and sub-criteria

The steps that have been taken with the AHP procedure are:

- a. Make a pair comparison by comparing elements in pairs according to the criteria.
- b. Paired comparison matrices are filled using numbers to represent the relative importance of one element to another.

2. Synthesis

The things that have been done in this step are:

- a. Sum the values of each column in the matrix.
- b. Divide each value of a column by the total of the columns in question to obtain a matrix normalization.
- c. Summing the values of each row and dividing them by the number of elements to get the average value.

3. Measure consistency

The things that are done in this step are:

- a. Multiply each value in the first column by the relative priority of the first element, the value in the second column by the relative priority of the second element, and so on.
- b. Sum each row.
- c. The result of the row summing is divided by the relative priority element in question.
- d. The average value of the resulting quotients represents the maximum eigenvalue (λ_{max}), which is used to evaluate the consistency of the pairwise comparison matrix in the Analytical Hierarchy Process (AHP).

4. Calculate the index consistency (CI) with the formula: $(CI) = (\lambda_{max} - n) / n = \text{number of elements}$. This calculation is used to ensure that the consistency ratio (CR) value ≤ 0.1 . If it turns out that the CR value is greater than 0.1 then the paired comparison matrix must be corrected.

5. Calculate the consistency *ratio* (CR) with the formula:

$$CR = CI/IR.$$

CI = *Consistency index*.

IR = *Indek random consistency*.

6. Check the consistency of the hierarchy. If the value is more than 10%, then the data assessment must be improved. However, if the consistency ratio (CI/IR) is less than or equal to 0.1, then the calculation result can be declared correct.

3. Results and Discussion

3.1. Processing of Tobacco Stem Waste into Briquettes

Charcoal briquettes are solid fuel products obtained by pressing at a certain pressure from forest and plantation product waste.

1. Tobacco stalks are taken after the tobacco harvesting process in the field has been completed.
2. After the collection of tobacco stems, a drying process is carried out, which aims to remove the moisture content that is still stored in the tobacco stems. Drying the tobacco stems usually takes about 1 day until the tobacco stems are completely dry.
3. After the drying process continues in the coarse grinding process, the coarse grinding process aims to break the tobacco stem into small tobacco stem flakes to facilitate the smooth grinding process.
4. Furthermore, the process of re-drying is carried out in 1 day.
5. The next stage is drying using a tool, namely a Blower machine with a temperature of approximately ± 55 °C. The goal is for the tobacco sticks to turn black and to maximize the reduction in moisture content, which takes 6 hours.
6. The next process is fine grinding. Fine grinding is done using a grinding machine like a coffee grinder. This fine grinding aims to make the tobacco stalk flakes as fine as powder, which will later be molded into briquettes.
7. Weighing of tobacco stem charcoal powder as much as 1Kg.
8. The next stage is to make the adhesive using 100 grams of tapioca flour and 100 ml of boiling water. After the mixing is complete.
9. The next stage is the printing of briquettes using simple tools that have been prepared.
10. Entering the final stage, the printing results are dried in the sun for 1 day, in order for the adhesive material and tobacco stick powder to completely blend and dry.
11. Briquettes from tobacco sticks ready to use.

3.2. Analysis of the Added Value of the Hayami Method

Table 2. Analysis of the Added Value of Tobacco Stick Charcoal Briquettes on The Variables of Output, Input, Price

No	Variable	Value
I. Output, Input, Price		
1.	Output (Kg)/production process	50
2.	Input (Kg)/production process	35
3.	Labor (Days of labor)/production process	2
4.	Conversion factor	1.43
5.	Labor coefficient (Days of labor/Kg)	0.06
6.	Output price (IDR/Kg)	12,000
7.	Direct labor wage (IDR/Days of labor)	26,750

Table 2 shows that the briquette production process generates an output of 50 kg of tobacco stem charcoal briquettes from 35 kg of raw tobacco stem input in the production cycle, resulting in a conversion factor of 1.43. This indicates that each kilogram of raw tobacco stem produces 1.43 kg of briquette output, reflecting an efficient transformation of raw materials into value-added products. The relatively high conversion factor suggests minimal processing losses and highlights the strong potential of tobacco stem waste for economic

valorization, particularly through effective processing techniques and the contribution of binding materials during briquette formation. Furthermore, the labor coefficient of 0.06 IDR/kg indicates low labor intensity, implying that the production process can be efficiently managed at a small-scale agroindustrial level without requiring substantial labor input, thereby supporting the feasibility of scaling up production with controlled labor costs.

Table 3. Value-Added, Labor Income, And Profit Indicators of Tobacco Stem Charcoal Briquette Production

No	Variable	Value
II. Admissions and benefits		
8.	Raw material price (IDR/Kg)	2,000
9.	Other input contributions (IDR/Kg)	5,000
10.	Output value (IDR/Kg)	17,143
11.	a. Value Added (IDR/Kg)	10,143
	b. Value Added Ratio (%)	59
12.	a. Direct labor income (IDR/Kg)	1,529
	b. Labor share (%)	15
13	a. Profit (IDR/Kg)	8,614
	b. Profit rate (%)	85

Table 3 presents the value-added indicators of tobacco stem charcoal briquette production based on the Hayami method. The results show an added value of IDR10,143/Kg, with a value-added ratio of 59%, which is categorized as high (>40%). This finding indicates that processing tobacco stem waste into briquettes substantially increases the economic value of the raw material, transforming a low-value by-product into a commercially viable product. Compared with previous studies on agroindustrial waste briquettes, this added value ratio is higher than that reported for several other agricultural residues, such as pineapple processing waste and cassava-based agro-industries, which typically fall within the medium value-added category (Fadhilah *et al.*, 2023; Irawan *et al.*, 2024). The high added value can be attributed to the low cost of raw materials, the relatively simple processing technology, and the stable market price of briquette products.

The 85% profit rate indicates that a substantial proportion of the value added is retained as business profit, suggesting strong economic incentives for agro-industry actors. This finding implies that tobacco stem briquette production is not only technically feasible but also financially attractive. Similar patterns of high profit distribution have been reported in studies on biomass briquette production from agricultural waste, where low raw material costs significantly increase profitability (Ashari, 2019). However, the dominance of profit over labor income also highlights the need for equitable benefit distribution, particularly if the industry is scaled up at the farmer level.

Table 4. Analysis of the Added Value of Tobacco Charcoal Briquettes on The Variable of Remuneration of Owners of Production Factors

No	Variable	Value
III. Repay the services of the owners of the factors of production		
	Marjin (IDR/Kg)	15,143
14.	a. Direct labor income (%)	10
	b. Contribution of other inputs (%)	33
	c. Business owner's benefits (%)	57

Table 4 illustrates the distribution of the production margin among the factors of production, showing that 57% is allocated to capital owner profit, 33% to other input contributions, and 10% to direct labor income. The dominance of capital owner profit indicates that tobacco stem briquette production offers strong financial returns, which is a positive signal for business sustainability and long-term investment viability. High profitability enhances producers' ability to reinvest in production facilities, improve technology, and absorb potential market risks.

However, the relatively small share allocated to labor income suggests limited direct financial incentives for workers. While low labor intensity supports production efficiency, insufficient labor compensation may reduce motivation and limit the attractiveness of this agro-industry for broader community participation, particularly if production is scaled up. Therefore, balancing profit retention with fair labor remuneration is essential to ensure sustainable workforce engagement.

From a scalability perspective, the current margin structure supports capital-driven expansion, as retained profits can finance increased production capacity and technological upgrading. These findings directly inform managerial decision-making by highlighting the importance of allocating a portion of profits toward labor development, training, and incentive mechanisms. Such adjustments can enhance productivity and social sustainability, aligning economic efficiency with inclusive agribusiness development strategies

3.3. Formulation of Alternative Strategies for the Development of Agro-Industry Briquettes from Tobacco Sticks with SWOT Analysis

3.3.1 *Internal Strategi Factors Analysis Summary (IFAS)*

The weighting and rating of internal factors in the IFAS matrix were determined through expert judgment involving key stakeholders, including researchers and practitioners from the Jember Tobacco Research Center, as well as academics with expertise in agroindustrial development. Weights reflect the relative importance of each internal factor in influencing the development of the tobacco stem briquette agroindustry, with the total weight summing to 1.00. Ratings were assigned on a scale of 1 to 4, where higher values indicate stronger strengths or more critical weaknesses. The weighted score was calculated by multiplying each assigned weight by its corresponding rating, enabling a systematic evaluation of internal strategic conditions.

Table 5. Weighting of internal factors

No	Internal Strategy Factors	Weight	Rating	Score
Strengths				
1	Availability of tobacco stem briquettes as a renewable alternative energy source	0.08	4	0.30
2	Environmentally friendly production process with waste reduction benefits	0.09	4	0.33
3	Efficient storage and handling due to compact briquette form	0.07	4	0.25
4	High availability and continuity of tobacco stem raw materials	0.08	4	0.28
5	Low-cost raw material derived from underutilized tobacco stem waste	0.09	4	0.32
6	Simple and low technology processing suitable for small-scale agroindustry	0.09	4	0.38
7	Low level of direct market competition for tobacco-based briquettes	0.09	3	0.29
Total		0.59		2.13
Weakness				
1	Lower calorific value compared to coconut shell briquettes	0.07	2	0.15
2	Limited product maturity and market experience	0.09	2	0.16
3	Lack of digital marketing and promotional channels	0.07	2	0.12
4	Low consumer awareness and information dissemination	0.09	2	0.15
5	Limited market penetration and consumer acceptance	0.09	1	0.11
Total		0.41		0.69
Overall total		1.00		2.82

The overall value of internal factors, including strengths and weaknesses, was 2.82. According to Wicaksono *et al*, (2021), although various factors are included in the IFAS matrix, the weighted total score can range from 1.0 (the lowest) to 4.0 (the highest), with an average of 2.5. If the weighted total score is well below 2.5, it indicates that the company has internal weaknesses. On the contrary, a score well above 2.5 indicates that the company's internal position is quite strong. Then it can be concluded that a company can leverage existing strengths by minimizing the potential losses from weaknesses; in other words, companies tend to have strong internal factors.

3.3.2 External Strategy Factors Analysis Summary (EFAS)

Table 6. Weighting of External Factors

No.	External Strategy Factors.	Weight	Rating	Score
<i>Opportunities</i>				
1.	Growing demand for renewable and alternative energy sources	0.11	4	0.43
2.	Low entry barriers for small-scale briquette production	0.10	3	0.33
3.	Increasing policy and societal pressure for agroindustrial waste reduction	0.12	4	0.45
4.	Institutional support through training and technology dissemination	0.11	4	0.41
5.	Untapped market potential for tobacco-based biomass briquettes	0.11	4	0.41
6.	Opportunities for income diversification for tobacco farmers	0.10	4	0.36
Total		0.64		2.40
<i>Threats</i>				
1.	Labor migration toward higher-income non-agricultural sectors	0.10	2	0.14
2.	Increasing competition from alternative biomass briquette producers	0.09	2	0.15
3.	Strong market dominance of coconut shell briquettes	0.09	2	0.16
4.	Substitution competition from other agroindustrial waste-based energy products	0.09	1	0.12
Total		0.36		0.58
Overall total		1.00		2.98

The external factor analysis highlights that the development of the tobacco stem briquette agro-industry is closely linked to broader dynamics in the renewable energy market and in the utilization of agro-industrial waste. Increasing demand for alternative energy sources and growing environmental awareness create favorable conditions for biomass-based briquettes, including those derived from tobacco stems. Limited market availability further indicates an opportunity for early market entry and product differentiation.

However, the industry also faces significant external threats, particularly from established biomass briquettes such as coconut shell briquettes, which dominate the market due to higher calorific value and stronger consumer recognition. In addition, competition from other agro-industrial waste-based briquettes intensifies substitution pressure in the alternative energy market. Labor migration toward non-agricultural sectors may also constrain workforce availability if the industry fails to offer competitive economic incentives. These findings emphasize the importance of strategic positioning, market differentiation, and institutional collaboration to enhance competitiveness and resilience in an increasingly competitive renewable energy landscape.

When viewed as a total score, the highest is 4.0, and the lowest is probably 1.0. The average total score is 2.5. With this, it can be said that the company's strategies effectively

leverage existing opportunities and minimize the potential adverse effects of external threats. If a total score of 1.0 is obtained, it indicates that the company's strategy neither takes advantage of opportunities nor avoids external threats. Therefore, it can be concluded that the Jember Tobacco Research Center is well positioned to capitalize on existing opportunities while minimizing the potential adverse effects from external threats (Wicaksono *et al.* 2021).

3.3.3 Determination of Alternative Strategies

According to Yaqin's (2021) research, to determine the coordinate points in the SWOT analysis diagram based on the results of IFAS and EFAS analyses, we need to calculate the total factor score. First, the total score for internal factors is obtained by subtracting the strength value from the weakness value. Furthermore, the total score for external factors is calculated by subtracting the threat value from the opportunity value.

The following calculations from external factors and internal factors obtained are as follows:

1. External factors = (chance-threat)
 - = 2.40 – 0.58
 - y = 1.82
2. Faktor internal = (strength-debilitation)
 - = 2.13 – 0.69
 - X = 1.44

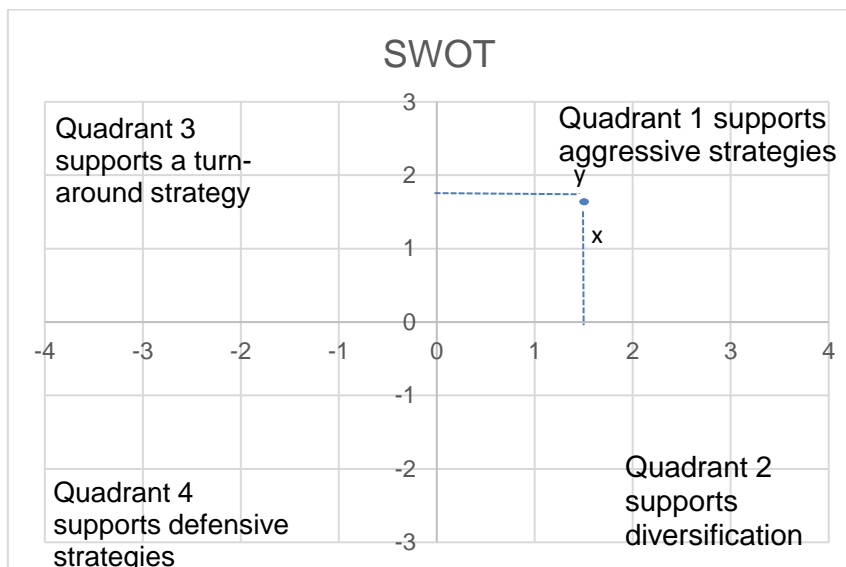


Figure 1. SWOT quadrant chart

The position of the tobacco stem briquette agro-industry in the SWOT quadrant chart is determined based on the difference between strength and weakness scores (X-axis) and the difference between opportunity and threat scores (Y-axis). Based on the IFAS analysis, the total strength score (2.13) exceeds the total weakness score (0.69), resulting in an X-axis value of +1.44. Meanwhile, the EFAS analysis shows that the opportunity score (2.40) is higher than the threat score (0.58), producing a Y-axis value of +1.82. These positive values place the agro-industry in Quadrant I of the SWOT matrix.

A Quadrant I position indicates a highly favorable strategic condition, where strong internal capabilities are supported by attractive external opportunities. In this context, the

tobacco stem briquette agro-industry possesses sufficient internal strengths. such as abundant raw materials. efficient production. and high value-added potential. while operating within a growing alternative energy market with relatively low competition. Therefore. an aggressive growth strategy is appropriate. emphasizing expansion. commercialization. and strategic partnerships to fully exploit existing opportunities and strengthen market positioning. The SWOT analysis places the tobacco stem briquette agroindustry in Quadrant I. indicating a favorable strategic position characterized by strong internal capabilities and promising external opportunities. This position suggests that the industry is well-suited for growth-oriented strategies that leverage internal strengths to capture emerging opportunities. Similar findings have been reported in agroindustrial development studies where abundant raw materials and limited market competition support expansion strategies (Wicaksono *et al.* 2021). However. despite this favorable position. limited market awareness and promotion remain critical challenges that must be addressed to ensure successful commercialization.

3.3.4 Matrix SWOT

The SWOT matrix is an effective tool to identify and compile the strategic factors of a company. At this stage. this matrix can provide a clear picture of the company's internal strengths and weaknesses. so that it can be linked to opportunities and threats that exist in the external environment (Yaqin. 2021).

Table 7. SWOT Matrix

	IFAS	Strengths 1. Availability of tobacco stem briquettes as a renewable alternative energy source 2. Environmentally friendly production process with waste reduction benefits 3. Efficient storage and handling due to compact briquette form 4. High availability and continuity of tobacco stem raw materials 5. Low-cost raw material derived from underutilized tobacco stem waste 6. Simple and low-technology processing suitable for small-scale agroindustry 7. Low level of direct market competition for tobacco-based briquettes	Weakness 1. Lower calorific value compared to coconut shell briquettes 2. Limited product maturity and market experience 3. Lack of digital marketing and promotional channels 4. Low consumer awareness and information dissemination 5. Limited market penetration and consumer acceptance
	EFAS	Opportunities 1. Growing demand for renewable and alternative energy sources 2. Low entry barriers for small-scale briquette production 3. Increasing policy and societal pressure for agroindustrial waste reduction	Strategy SO 1. Increasing farmers' knowledge of waste that is still unutilized so that it can provide economic value to farmers. 2. Maximizing production infrastructure and technology. 3. Briquette products are prepared for commercialization. 4. Collaborate with tobacco-based companies.

4. Institutional support through training and technology dissemination		4. Creating attractive marketing media (e-commerce).
5. Untapped market potential for tobacco-based biomass briquettes		
6. Opportunities for income diversification for tobacco farmers		
Threats	Strategy ST	Strategy WT
1. Labor migration toward higher income non-agricultural sectors	1. Positioning products by providing tobacco characteristics.	1. Improving product marketing through online media.
2. Increasing competition from alternative biomass briquette producers	2. Expanding product marketing areas through campaigns in events such as bazaars.	2. Improve product quality.
3. Strong market dominance of coconut shell briquettes		
4. Substitution competition from other agroindustrial waste-based energy products		

Table 7 presents the SWOT Matrix, a strategic framework for generating alternative development strategies by integrating internal and external factors. It is important to note that this matrix is not used to prioritize strategies; rather, it identifies feasible strategic options for the tobacco stem briquette agroindustry. Strategy prioritization is subsequently conducted using the Analytical Hierarchy Process (AHP).

The Strength–Opportunity (SO) strategies focus on leveraging strong internal capabilities such as abundant raw materials, efficient production processes, and high value-added potential to capitalize on favorable external conditions, including growing demand for alternative energy and limited market competition. These strategies emphasize commercialization readiness, infrastructure optimization, and collaboration with tobacco-based industries to accelerate market expansion.

The Weakness–Opportunity (WO) strategies aim to overcome internal limitations, particularly low market awareness and limited promotion, by exploiting external opportunities such as institutional support and increasing interest in renewable energy. These strategies highlight the importance of market segmentation, community outreach, training programs, and the use of digital marketing platforms to enhance product visibility and consumer acceptance.

The Strength–Threat (ST) strategies utilize existing strengths to mitigate external risks, especially competition from established biomass briquettes and substitute energy products. Product differentiation through tobacco-specific characteristics and targeted promotional activities is central to these strategies, enabling the agro-industry to maintain competitiveness in a crowded alternative energy market.

The Weakness–Threat (WT) strategies are defensive in nature and focus on minimizing vulnerabilities while avoiding external pressures. These strategies prioritize improvements in product quality and marketing efficiency to reduce competitive disadvantages and strengthen the industry’s resilience against market uncertainty.

Based on the position obtained in quadrant I, Strategy priorities are focused on strength-opportunity strategies, which refer to the utilization of internal forces to make the best use of

external opportunities. Formulation of a core strategy that can be used as a strategy for the development of tobacco stem waste into charcoal briquettes.

1. Increasing farmers' knowledge of waste that is still unutilized so that it can provide economic value to farmers.

A lot of agroindustrial waste on tobacco stems is still left when the harvest season arrives. Many farmers still do not think about how to process it or the impact on tobacco stick waste if left unchecked. Processing tobacco stem waste into briquettes is one solution to reduce post-harvest waste pollution. Tobacco briquettes are also able to compete with other briquettes. This is seen from how much calorific value contained in tobacco briquettes (Purwono *et al.*, 2011) shows longer combustion resistance even though it is still below the same level as coconut shell briquettes (Suryaman *et al.*, 2026).

2. Maximizing production infrastructure and technology.

Infrastructure development plays an important role in achieving development goals aimed at creating social justice and community welfare. Agricultural infrastructure comprises physical and non-physical facilities needed to support agricultural activities. Agricultural infrastructure includes various elements, such as irrigation, storage facilities, and processing of agricultural products. Agricultural infrastructure is very important in increasing productivity, quality, and quantity of agricultural products (Jakatikta *et al.*, 2023). Considering that the waste treatment at the Jember Tobacco Research Center is still on a small scale and still uses simple tools and technology so that it can take a long time and the product yield is not so much.

3. Briquette products are prepared for commercialization.

In a dynamic and competitive business world, innovation and the development of new products are key to helping companies achieve success and customer satisfaction. Both companies, whether providing services or goods, share the same goal: to generate profits while satisfying consumers through quality products. Consumer satisfaction is not only a measure of success but also a key indicator of a company's competitiveness and market leadership. Therefore, companies are required to continue innovating, developing new products and services, and expanding their market share (Hananto *et al.*, 2024). The development of new products is essential for the company's survival. New product development efforts and effective strategies are often the determining factors in a company's survival. This is a problem companies face when developing new products. The main consideration is the suitability of the product to be produced to meet the market's needs and desires. A company must be able to place exactly where their products are positioned in the midst of market competition. The company must be able to develop new products and implement effective strategies to ensure its survival (Dimitrakaki, 2020).

4. Collaborate with tobacco-based companies.

By implementing this strategy, the market can be expanded, which will also impact product development later. Cooperation is very important to improve, as it plays a big role in the industry's progress and provides long-term success for both companies and the products they market (Christofer *et al.*, 2019).

3.4. Determining the Priority of the Agroindustry Development Strategy of Waste in Tobacco Stems into Briquettes using AHP

Subsequently, the Analytical Hierarchy Process (AHP) method was applied to determine the priority strategies for the development of tobacco stem waste processing into briquettes. This decision-making or problem-solving process can be simplified and made more efficient by combining AHP techniques with appropriate applications or software (Syaifullah *et al.* 2024). The analysis uses AHP to determine strategy priorities starting by formulating criteria and subcriteria that will be used to compare each alternative strategy (Saaty, 2008). The hierarchical arrangement in determining the strategy is compared to the 4 criteria that have been set to find alternative strategies that have the highest value. The alternative strategy that has the highest value is the priority of the strategy that was selected as an alternative strategy in the development of waste treatment on tobacco sticks into briquettes.

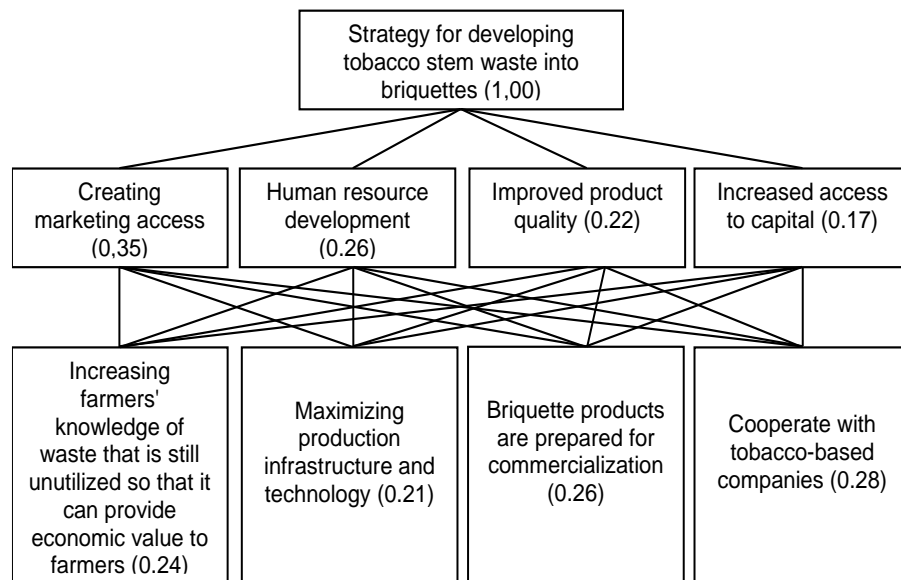


Figure 2. Hierarchical Structure

Figure 2 illustrates the hierarchical structure of the Analytical Hierarchy Process (AHP), developed to determine priority strategies for the development of the tobacco stem briquette agroindustry. The hierarchy consists of three main levels: the goal, the criteria, and the alternative strategies. The goal at the top level is to identify the most appropriate development strategy for the commercialization of tobacco stem briquettes. The second level comprises four criteria: market access, human resource development, product quality improvement, and access to capital, which were selected to reflect key agribusiness development priorities, including market competitiveness, production capacity, product sustainability, and financial feasibility.

These criteria capture the critical dimensions for scaling up agro-industrial activities, particularly those based on the utilization of agricultural waste. Market access refers to the ability to penetrate and sustain demand in the alternative energy market, while human resource development underscores the importance of skills and knowledge in maintaining production efficiency. Product quality improvement ensures competitiveness against

substitute briquette products. and access to capital supports investment in technology and expansion of production. The third level of the hierarchy consists of alternative strategies generated from the SWOT analysis. which are evaluated against each criterion through pairwise comparisons.

The weighting results derived from this hierarchical evaluation are presented in Table 8. which shows the relative priority of each alternative strategy. Thus. Figure 2 provides the logical framework for the AHP analysis. while Table 8 presents the quantitative outcomes of the decision-making process. ensuring transparency and coherence between the analytical structure and the final strategic recommendations.

Table 8. Final Weighting of The Selection of Alternative Strategies

Alternative strategies	Creating marketing access	Human resource development	Improved product quality	Increased access to capital	Priority
AS1	0.28	0.31	0.16	0.18	0.24
AS2	0.19	0.14	0.33	0.22	0.21
AS3	0.33	0.17	0.19	0.34	0.26
AS4	0.20	0.38	0.32	0.26	0.28

Information: AS1 = Increasing farmers' knowledge of waste that is still unutilized so that it can provide economic value to farmers; AS2 = Maximizing production infrastructure and technology; AS3 = Briquette products are prepared for commercialization; AS4 = Collaborate with tobacco-based companies.

Table 8 presents the final priority weights of alternative strategies derived from the AHP analysis. showing that AS4 (collaboration with tobacco-based companies) achieved the highest priority score (0.28). This result reflects AS4's strong performance across multiple criteria. particularly market access and human resource development. which are critical drivers of agro-industrial growth. Collaboration with established tobacco-based companies enables broader market penetration. enhances product credibility. and facilitates knowledge transfer. thereby addressing commercialization and capacity-building needs simultaneously. Consistent with previous studies. institutional partnerships play a crucial role in improving product legitimacy. distribution efficiency. and market reach for small-scale agroindustries (Farid *et al.*. 2018). In the context of tobacco stem briquettes. such collaboration is especially important for supporting the transition from research-based production to commercial-scale operations while reducing commercialization risks.

The relatively small differences in the priority scores. ranging from 0.21 to 0.28. indicate that all proposed strategies are relevant and complementary rather than mutually exclusive. For example. AS3 (preparation for commercialization) closely follows AS4 (0.26). suggesting that commercialization readiness is nearly as important as institutional collaboration. Meanwhile. AS1 (improving farmers' knowledge) and AS2 (enhancing infrastructure and technology) receive slightly lower but still substantial priority values. highlighting their supportive roles in strengthening long-term sustainability.

These trade-offs demonstrate decision sensitivity within the AHP framework. where strategies that address immediate market access and institutional linkage are prioritized. while capacity building and technological improvements serve as enabling strategies. This interpretation confirms that AS4 serves as a strategic entry point for development. supported by complementary actions represented by the other alternatives.

3.5. Managerial Implications

The results of the analysis using the AHP method indicate that the priority of the resulting strategy is to collaborate with tobacco-based companies to prepare briquette products for commercialization to the public, ensuring they are widely known from farmers to entrepreneurs. The development of farmers' knowledge needs to be improved because farmers play an important role, so that waste produced after harvest is not left to pollute the natural ecosystem, and to find innovations in processing tobacco stem waste into briquettes that generate economic value for farmers. This recommendation presents managerial implications for the Jember Tobacco Research Center regarding briquette production in Jember Regency. Managerial implications aim to review or discuss the conclusion of the final results of the study (Suriyanto *et al.*, 2014). The managerial implications of this research are to determine the priorities of the selected strategies, namely:

1. The Jember Tobacco Research Center can collaborate with tobacco-based companies (0.28). this collaboration is an effort to create marketing access obtained from the AHP analysis (0.35). So that the briquette products made do not face difficulties in marketing. Cooperation can be carried out with PTPN X, PT. bobin, and PT. Salt warehouse in Jember regency.
2. Briquette products are prepared for commercialization (0.26). Considering the value added in the high category, the Jember Tobacco Research Center prepares them in terms of capital, production costs, and production capacity to meet the demand in the agency described in point 1.
3. The Jember Tobacco Research Center can increase farmers' knowledge of unused waste so that it can provide economic value to farmers (0.24) by providing training/counseling on the manufacture of tobacco stem briquettes to maintain the sustainability of the product.
4. Maximizing infrastructure and production technology (0.21). Jember Tobacco Research Center Increases the Use of Production Technology to Make Briquette Production More Efficient.

4. Conclusion

The conclusion that can be drawn in this study is that the development of tobacco waste processing into briquettes is very important to implement. This is seen from the:

1. The value-added analysis shows that tobacco stem charcoal briquettes generate an added value of IDR 10.143, with an added value ratio of 59%, which is classified as high (>40%).
2. The results of the SWOT analysis indicate that the development of briquettes from tobacco stem waste falls in quadrant I, which indicates a very favorable situation. Based on the results of the SWOT analysis, four alternative strategies were identified that served as the basis for the development strategy for processing tobacco stem waste into briquettes, including the first, increasing farmers' knowledge of waste that is still underutilized so it can provide economic value to farmers; maximizing infrastructure and production technology; preparing briquette products for commercialization; and collaborating with tobacco-based companies.

3. Furthermore, the AHP analysis identified four criteria: creating access to marketing, developing human resources, improving product quality, and increasing access to capital. In the calculation of the AHP analysis, four alternative strategies were obtained from the SWOT analysis, namely, the first, increasing farmers' knowledge of waste that is still unused so that it can provide economic value to farmers (0.24), the second is Maximizing infrastructure and production technology (0.21), the third is briquette products are prepared for commercialization (0.26) and the last is collaborating with tobacco-based companies, (0.28). The strategy, based on the results of a questionnaire with 6 respondents, is to collaborate with tobacco-based companies to develop briquette products from tobacco stocks widely known to the public and entrepreneurs.

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