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Analysis of the potential bamboo and bamboo processing industry in Sumedang District, West Java, Indonesia

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Abstract. *Al'afifah JA, Sumardi I, Darwis A. 2025. Analysis of the potential bamboo and bamboo processing industry in Sumedang District, West Java, Indonesia. Asian J For 9: 24-33.* Bamboo production in Sumedang District in 2016 reached 1,599,056 culms. This relatively high production does not align with the popularity of its bamboo processing industry. In contrast, Tasikmalaya District, which has a similar level of bamboo productivity, has become one of the centers of the bamboo industry in West Java. Therefore, this research aims to identify the current potential of bamboo, identify the potential of the bamboo industry, and determine strategies for developing the bamboo industry in Sumedang District. The identification of the potential and availability of bamboo is conducted through mixed quantitative-qualitative method analysis obtained from interviews with Forestry Department Branch IX West Java, Indonesia. In contrast, the identification of the potential of the bamboo industry is done through qualitative descriptive analysis and value added analysis using the Hayami method based on data from interviews with bamboo industry players. Industry development strategies are determined using SWOT analysis. Findings indicate Sumedang has 126,210 bamboo culms, with 3,505 available for monthly harvest. Only 73% of the harvestable bamboo, or 2,565 culms monthly, is utilized. The local bamboo industry is predominantly home-based with minimal production capacity, using basic tools to create low-priced products. The added value ranges from 0-97%, with low profit margins, and competition from substitute products hinders market competitiveness. To develop the industry, intensive strategies are needed, including product diversification and innovation, market penetration, and accessing global markets.

Keywords: Added value, bamboo industry, bamboo potential, industry development, SWOT analysis

INTRODUCTION

Bamboo is one of the most significant non-timber forest products with immense potential for economic, environmental, and social benefits. As a renewable and versatile resource, bamboo plays a crucial role in various industries and contributes substantially to rural livelihoods and international trade. Economically, the export value of bamboo has shown a consistent upward trend, reflecting its growing demand in global markets. For instance, in Indonesia, bamboo exports increased significantly from 2017 to 2019, rising by USD 1.574 million, or 8.2% per year. This growth accelerated between 2019 and 2020, with an increase of USD 1.577 million, or 14.5% per year, as noted by Simatupang and Simagunsong (2022). These numbers underscore the increasing global recognition of bamboo's utility across a diverse range of applications.

The extensive utilization of bamboo stems from its unique properties and adaptability, which make it suitable for a wide array of products. Beyond its traditional use in furniture and construction, bamboo has become an essential raw material for innovative applications such as laminated bamboo, bamboo flooring, paper production, chopsticks, and various forms of weaving (Chaudhary et al. 2024). Its versatility is not only economically advantageous but also supports sustainable development goals, as bamboo is a fast-growing, renewable resource that can help combat deforestation and climate change.

In Indonesia, bamboo production aligns with its high utilization. According to the Central Bureau of Statistics (2022), Indonesia produced a remarkable 66,921,536 bamboo culms in 2022. Java Island, known for its fertile soils and favorable climate, is a significant contributor to this production. Within Java, bamboo cultivation is particularly prominent, with 66,861,182 bamboo culms planted in 2022. Specific districts such as Ciamis, Garut, Tasikmalaya, and Sumedang are notable for their high productivity. In 2016, Ciamis District led bamboo production in West Java, yielding 4,182,150 culms, followed by Garut with 2,072,130 culms, Tasikmalaya with 1,730,792 culms, and Sumedang with 1,599,056 culms (Open Data Jabar 2016). These figures highlight the region's significant contribution to the bamboo industry and its potential for further development.

Bamboo is derived from grass-like plants characterized by pipe-shaped stems, or culms, that taper in thickness and diameter from the base to the tip (Darwis et al. 2018). This structural uniqueness allows bamboo to be used in various engineering processes to enhance its value and utility. Techniques such as coloring (Al'Afifah et al. 2024) and advanced engineering processes (Sumardi et al. 2024) have further broadened its applications, making bamboo a competitive material in the global market. In addition to its technical and economic potential, bamboo also has cultural and artisanal significance in many regions, particularly in West Java, where traditional bamboo crafts thrive.

Sumedang District in West Java, despite not being the largest producer of bamboo crafts, has a rich tradition of bamboo utilization. Industries in Sumedang produce a range of bamboo products, including bamboo matting, baskets, containers, furniture, and other forms of weaving. These crafts not only support local economies but also preserve cultural heritage. Interestingly, while districts such as Tasikmalaya, Ciamis, Garut, and Cianjur are recognized as the primary hubs for bamboo crafts in West Java, the productivity of bamboo in Sumedang District is comparable to that of Tasikmalaya District (Open Data Jabar 2016). This highlights the untapped potential of Sumedang's bamboo industry, which, with strategic planning and investment, could emerge as a significant player in the regional and national bamboo sectors.

This study seeks to explore the current potential of bamboo in Sumedang District, focusing on its production capacity, existing industries, and the challenges they face. By identifying the strengths and weaknesses of the bamboo industry in Sumedang, this research aims to propose actionable strategies for its development. Additionally, the study examines the added value of bamboo products processed in Sumedang District, offering insights into how these industries can improve their competitiveness and contribution to the local economy. By addressing these objectives, the study not only sheds light on the potential of Sumedang's bamboo industry but also contributes to the broader discourse on sustainable resource management and rural development.

MATERIALS AND METHODS

Study area

The research was conducted in Sumedang District, West Java, Indonesia (Figure 1), involving several subjects from the bamboo processing industry. The subjects were selected using a snowball sampling method by first obtaining recommendations from the Head of the Industry Division of Sumedang District, and then requesting further recommendations from the interviewed bamboo industry players.

Methods and data collection techniques

The research method combines qualitative and quantitative data collection and analysis. The data simulateneously and independently collected, followed by integrating and comparing the findings to provide a comprehensive understanding of the research problem from multiple perspectives (Adhikari and Timsina 2024). This research gathers information about the phenomenon through interviews with participants, posing broad and general questions (Muurlink and Thomsen 2024). Two types of data are required, i.e.: primary and secondary data. Primary data are obtained through interviews and observations. Interviews aim to gather information from participants to understand their feelings, perceptions, and thoughts (Cheong et al. 2023). This study uses semi-structured interviews to enrich the information regarding respondents' perceptions and thoughts while maintaining control over the questions and issues raised, resulting in a lower dross rate or less irrelevant information (Cheong et al. 2023). Interviews were conducted with 10 bamboo industry entrepreneurs in Sumedang. The data obtained from only 10 respondents is already saturated. Therefore, no additional respondents are needed. Respondents have given their consent to provide the information. Observations involve all human senses based on empirical facts (Cisielska et al. 2018). Secondary data are obtained through literature studies from related books and articles, national statistical data, and interviews with the Forestry Department Branch IX West Java, which cover Sumedang and Indramayu Sub-district, and the Department of Cooperative Small and Medium Enterprises Trade and Industry of Sumedang District.

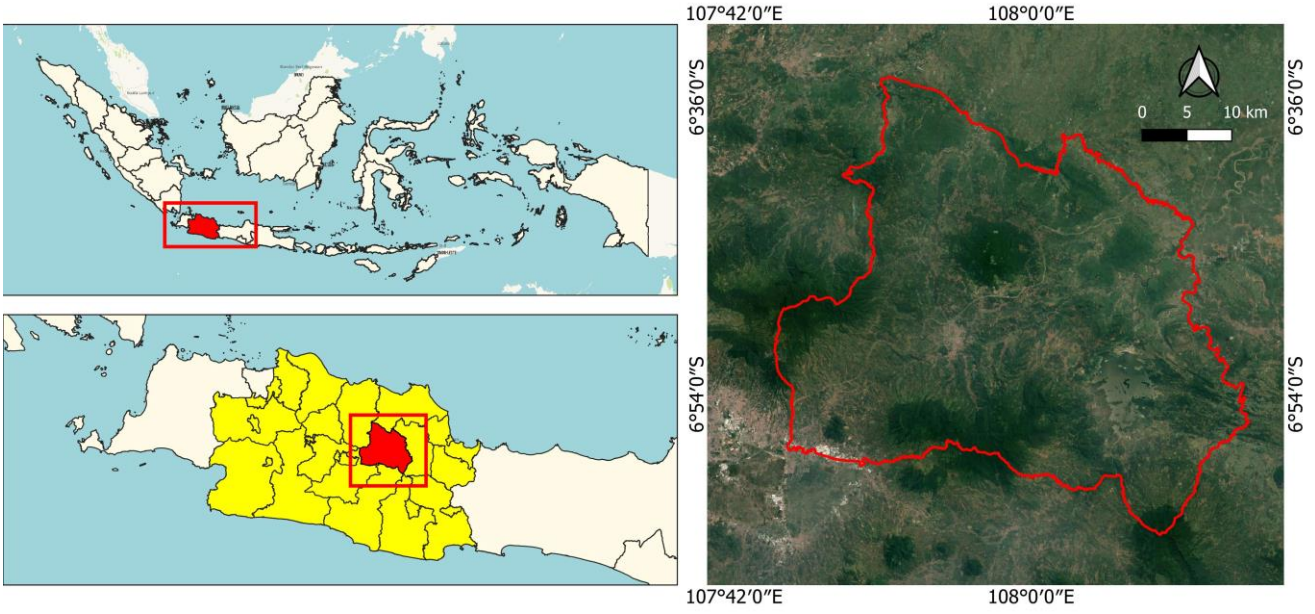

Figure 1. Research sites in Sumedang District, West Java, Indonesia

Data analysis

The data obtained was processed using Microsoft Excel. Data analysis determine the added value of bamboo for each type of product using the Hayami method. Additionally, the analysis assessed the availability of bamboo. Bamboo availability is identified by evaluating productivity, which is determined by the number of bamboo culms and their usage rates. The internal and external conditions of the bamboo industry were analyzed using SWOT analysis to understand the potential and development strategies for the bamboo industry in Sumedang District.

Added value analysis

To determine the value added by bamboo, the value added analysis using the Hayami method is used. This is widely used method for calculating the value added. Based on Hayami (1987), value added is the difference between output value and input value due to the production process. The purpose of value added analysis is to understand the remuneration of production factors and to identify employment opportunities due to increased utility. Several variables used in value added analysis include production output, raw materials, labor, raw material prices, product prices, labor wages, and other inputs. The bamboo processing industry produces products in unit product units. The calculation of bamboo value added analysis using the Hayami method is outlined in Table 1.

In calculating the value added analysis of bamboo using the Hayami method, several assumptions are necessary: (i) Value added is calculated over one month of production, (ii) The output generated represents the average production within one month, measured in units of products, (iii) The unit of input used in each bamboo culm, (iv) The prices used are based on primary data obtained from interviews.

SWOT analysis

To determine the development strategy for the bamboo industry in Sumedang, one of the methods that can be used is SWOT analysis. According to Teoli et al. (2019) and Puyt et al. (2023), SWOT analysis consists of internal factors and external factors. Internal factors encompass strengths and weaknesses within a business, including human resources, financial aspects, marketing, production capabilities, raw materials, and management. External factors affect decision-making and business success, such as government policies, socio-cultural factors, competitive landscape, and technological advancements (David et al. 2019).

Based on the data of strengths, weaknesses, opportunities, and threats identified, strengths and weaknesses (internal factors) are structured into an Internal Factor Evaluation (IFE) matrix. In contrast, opportunities and threats (external factors) are structured into an External Factor Evaluation (EFE) matrix. Each factor is rated on a scale from 1 (very poor) to 4 (very good) relative to the business conditions. The weight of each factor is calculated by dividing its rating by the total ratings as calculated in Eq (1). Scores are then computed by multiplying weights by ratings as calculated in Eq (2), and the total scores are summed up as calculated in Eq (3) (Amirshenava and Osanloo 2022):

$$Weight = \frac{Rating}{Total\ rating} \quad \ldots\ldots (1)$$

$$Score = Weight \times Rating \quad \ldots\ldots (2)$$

$$Grand\ total\ score = \sum_{j=1}^{m} (Weight \times Rating) \quad \ldots\ldots (3)$$

The next step is to plot the total scores of each IFE and EFE matrix into an IE matrix as follows (Figure 2).

The IE Matrix is used to determine the current strategic position of the bamboo industry in Sumedang. The IE Matrix plots the total scores of internal and external factors simultaneously in one matrix. Internal factors are represented on the horizontal axis, while external factors are represented on the vertical axis. Each quadrant in the IE Matrix indicates a different type of strategy, as described in Table 2.

Table 1. The Hayami method of value added analysis

Variable	Unit	Formula
Output, input, price		
Output	Unit	A
Input	Unit	B
Labor	No. of workers	C
Conversion factor		D=A/B
Labor coefficient	No. of workers	E=C/B
Output price	Rp/unit	F
Labor wages	Rp/no. of workers	G
Income		
Raw material prices	Rp/unit	H
Other input contribution	Rp/unit	I
Output value	Rp/unit	J=D x F
Value added	Rp/unit	K = J - I - H
Add value ratio	%	L = (K/J) x 100%
Direct labor income	Rp/unit	M = E x G
Share of labor	%	N = (M/K) x 100%
Advantages	Rp/unit	O = K - M
Profit rate	%	P = (O/J) x 100%

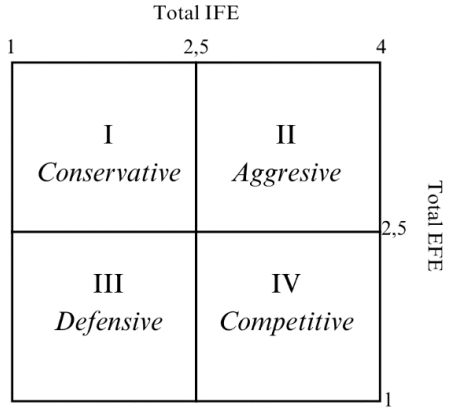

Figure 2. IE matrix (Ardeshir et al. 2016)

To formulate the strategies that can be implemented, the internal and external factors can be plotted in the following Table 3, resulting in four types of strategies: S-O (Strength-Opportunity), W-O (Weakness-Opportunity), S-T (Strength-Threat), and W-T (Weakness-Threat).

Table 2. IE matrix description

Quadrant	Strategic position	Description	Appropriate type of strategy
I	Conservative	IFE Score<2.5 and EFE score≥2.5	Conservative strategies (WO)
II	Aggressive	IFE Score≥2.5 and EFE Score≥2.5	Aggressive Strategies (SO)
III	Defensive	IFE Score<2.5 and EFE Score<2.5	Defensive Strategies (WT)
IV	Competitive	IFE Score≥2.5 and EFE Score<2.5	Competitive Strategies (ST)

Table 3. SWOT strategy analysis (Teoli et al. 2019)

Internal / External	Strength (S)	Weakness (W)
Opportunity (O)	**S-O Strategy** Use S by utilizing O	**W-O Strategy** Overcome W by utilizing O
Threat (T)	**S-T Strategy** Use S to avoid O	**W-T Strategy** Minimize W to avoid T

RESULTS AND DISCUSSION

Distribution and availability of bamboo in Sumedang

The availability of bamboo in Sumedang District is spread across 23 out of 26 subdistricts (Forestry Department Branch IX, personal communication, 2024). The subdistrict with the highest bamboo production is Rancakalong, which produces 65,100 bamboo culms, followed by North Sumedang Sub-district and Pamulihan Sub-district produces 15,000 bamboo culms each, and Jatinunggal Sub-district produces 11,399 bamboo culms. Generally, the distribution of bamboo plant potential in each sub-district is shown in Figure 3.

Bamboo distribution is evenly spread across each subdistrict, with the *tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz) variety dominating over other types. Another bamboo type found in Sumedang District is greater giant bamboo (*Gigantochloa pseudoarundinacea* (Steud.) Widjaja), which accounts for 3.1% of the total bamboo population and is distributed only in Sukasari Sub-district, Cisitu Sub-district, Cimalaka Sub-district, Tanjungsari Sub-district, and Situraja Sub-district. Additionally, *betung bamboo* (*Dendrocalamus asper* (Schult. f.) Backer ex K.Heyne)), comprising 0.43% of the total, grows only in Buahdua Sub-district and Tomo Sub-district. The overall distribution numbers for bamboo can be seen in Table 4.

Table 4. Bamboo distribution in Sumedang District February 2024 (Forestry Department Branch IX West Jawa, 2024)

Sub-district	Bamboo types	No. of bamboo (culms)
Sukasari	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz), Greater giant bamboo (*Gigantochloa pseudoarundinacea* (Steud.) Widjaja)	1050
Ganeas	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz)	2700
Pamulihan	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz)	15000
Buahdua	*Betung bamboo* (*Dendrocalamus asper* (Schult. f.) Backer ex K.Heyne)	500
Jatinunggal	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz)	11399
Rancakalong	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz)	65100
Cimanggung	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz)	1675
Conggeang	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz)	1350
Tomo	*Betung bamboo* (*Dendrocalamus asper* (Schult. f.) Backer ex K.Heyne)	45
Ujung Jaya	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz)	126
Cisitu	Greater giant bamboo (*Gigantochloa pseudoarundinacea*)	900
Paseh	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz)	100
Wado	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz)	4500
Sumedang Utara	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz)	15000
Cimalaka	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz), Greater giant bamboo (*Gigantochloa pseudoarundinacea* (Steud.) Widjaja)	1100
Sumedang Selatan	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz)	305
Tanjungkerta	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz)	100
Tanjungmedar	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz)	2850
Tanjungsari	Greater giant bamboo (*Gigantochloa pseudoarundinacea*)	600
Cibugel	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz)	25
Surian	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz)	20
Jatigede	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz)	15
Situraja	*Tali bamboo* (*Gigantochloa apus* (J.A. & J.H. Schultes) Kurz), Greater giant bamboo (*Gigantochloa pseudoarundinacea* (Steud.) Widjaja)	1750
Total		126,210
Total bamboo that can be harvested each month		3,505

Source: Forestry Department Branch IX West Java, Indonesia (pers. comm. 2024)

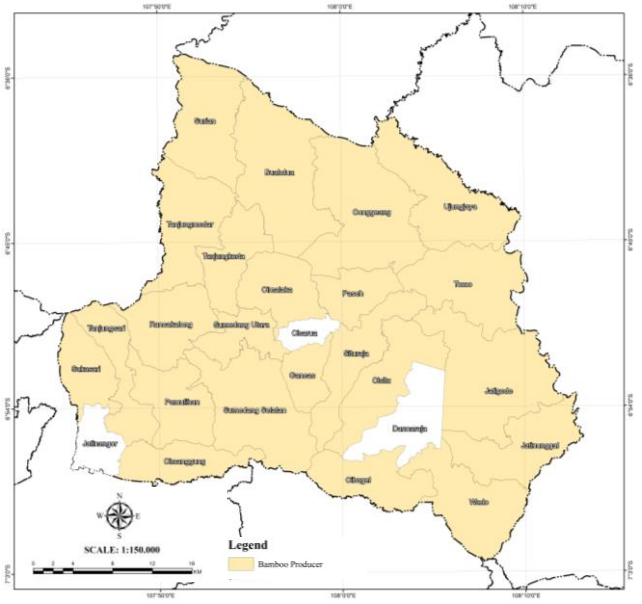

Figure 3. Distribution of bamboo producer in Sumedang District, West Java, Indonesia

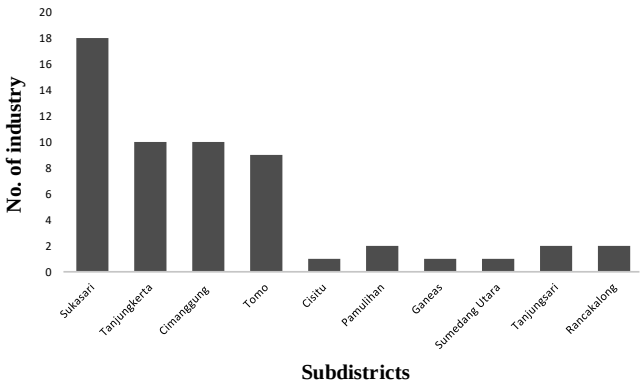

Figure 4. Number of bamboo industries in Sumedang District, West Java, Indonesia

The data in Table 4 is the result of processing potential data based on available resources. The processed involved measuring the area of bamboo groves and converting them into clump quantities. For bamboo types with large clump areas like *betung bamboo*, each clump has a wide radius of 30 meters. Meanwhile, bamboo types with smaller clump areas like *tali bamboo* and *surat bamboo* have a wide radius of 15 meters per clump. The number of clumps is then multiplied by the average number of bamboo culms per clump, which is between 90-100 culms (Forestry Department Branch IX West Jawa, personal communication, 2024)

According to this data collection method, the total number of bamboo culms in Sumedang District is 126,210, comprising a mix of young and old bamboo. According to Sutiyono and Wardani (2011), with proper clump management, one clump can have three different age generations of bamboo: 1-year-old, 2-year-old, and 3-year-old bamboo. The distribution of bamboo ages within a clump is equal, approximately 35.4, 33.8, and 30.8% for generations 1, 2, and 3 respectively. Considering that mature bamboo is typically used, based on the research mentioned above, it can be assumed that the total number of bamboo culms available can be harvested over a three years. It means that in one month, a total of 3,505 bamboo culms can be harvested.

Potential of bamboo industry in Sumedang District

Several sub-districts in Sumedang are known for bamboo processing, including Sukasari Sub-district, Tanjungkerta Sub-district, Cimanggung Sub-district, Tomo Sub-district, Cisitu Sub-district, Pamulihan Sub-district, Ganeas Sub-district, North Sumedang Sub-district, Tanjungsari Sub-district, and Rancakalong Sub-district. Each subdistrict specializes in different bamboo products. The number of industries in each subdistrict can be seen in Figure 4.

Sukasari Sub-district has the most bamboo industries in Sumedang District, followed by Tanjungkerta Sub-district and Cimanggung Sub-district. Industries in Sukasari Sub-district include *boboko*, spice racks, bamboo curtains, lampshades, coffee filters, tissue boxes, *giribig* (traditional processing rice), *bilik* (traditional wall), table and chair sets, sheepskin pads, *angklung* (traditional musical instrument), *calung* (traditional musical instrument), and various other woven products (Table 6). Tanjungkerta and Cimanggung Sub-districts also produce similar products, primarily woven items. Certain products are made exclusively in specific areas, such as *bongsang* (tofu baskets) produced only in the Ganeas and North Sumedang Sub-districts, and *giribig* (traditional processing rice) and *bilik* (traditional wall) produced in Sukasari and Tanjungsari Sub-districts.

Nearly all types of products produced in Sumedang District utilize *tali bamboo* as the raw material. According to industry players, *tali bamboo* is particularly suitable for weaving products because it is durable and less prone to breakage. Additionally, *tali bamboo* is widely used due to its abundant availability in almost every subdistrict in Sumedang District. It is because most of the bamboo products produced in Sumedang District are woven products that require highly flexibility raw materials. According to statements by Budiono (2024), *tali bamboo* is flexible and less prone to breakage, easy to shape, has long nodes, is more resistant to pests and weather, and has unique fibers that give a natural appearance. *Tali bamboo* also has better tensile strength than other bamboo species (Bahtiar et al. 2019). Meanwhile, bamboo varieties used for construction, which require high strength such as *betung bamboo*, are rarely found in Sumedang District due to their lesser usage. Regarding bamboo raw material requirements, Sumedang District requires approximately 2,567 culms of bamboo per month, as detailed in Table 5. Based on previous calculations, the monthly harvestable bamboo in Sumedang District amounts to approximately 3,505 culms. It indicates that bamboo availability in Sumedang meets the supply needs of all bamboo industries in the region, even exceeding the demand.

Value added of bamboo in Sumedang District

Value added is the difference between the output and input values resulting from the production process. The calculation in value added analysis includes calculating profits and income, and understanding the remuneration for production factors (Caruntu and Lapadusi 2012). Value added can also serve as an indicator of business sustainability. Three main criteria can be used as indicators of sustainability: value added ratio, labor share, and profitability (Tisakti et al. 2022). The value added in the industry from various products in Sumedang District ranges from 0-97%, depending on the level of difficulty, the raw materials and additional materials required, and the selling price of the products (Table 7). Furniture products such as table and chair sets, sheepskin pads, *angklung*, *calung*, and carved glasses have higher value added than woven products due to their higher selling prices and more complex manufacturing processes. Innovative products also have higher value added compared to non-innovative products. For example, sheepskin pads with name engravings have a value added of 64%, which is higher than regular sheepskin pads with a value added of 57%.

All bamboo industries in Sumedang are home-based industries operated without employees. Bamboo industry operators do not account for employees in their financial statements. Therefore, Table 7 includes the profit levels without employee wages and those with one employee. Generally, the profit levels without labor costs are high, with most of them above 50%. However, when labor costs are considered, the profit levels become smaller. The assumption used for labor cost calculation is a wage of Rp. 10,000 per product produced. In general, the profit levels with labor costs are low, with some being negative. It indicates that bamboo processing businesses generate very little profit or incur losses. Products that still have relatively high profit levels after accounting for labor costs are furniture products like table and chair sets, sheepskin pads, *angklung*, *calung*, and carved glasses. It is because furniture products typically have higher selling prices due to the more complex manufacturing process and the selection of higher-quality materials. As for the products with low or even negative profit margins, these are simple products with low selling prices that require a larger amount of raw materials.

Development strategy for the bamboo industry in Sumedang District

Developing strategies for the bamboo industry in Sumedang involves observing and evaluating the business environment. Business environment analysis is crucial as an organization is significantly influenced by its environment. This analysis is necessary to direct these influences positively, contributing to business success (Gunawan 2024). The business environment analysis is divided into two parts as shown in Table 8: internal and external analysis. Internal condition analysis provides a general overview of the organization's condition, including market availability and marketing, human resources, financial aspects, and technical operations. External condition analysis covers factors beyond the business's control that can influence decision-making, including government policies, competition levels, and socio-cultural factors.

Table 5. Raw materials needed in Sumedang District, West Java, Indonesia

Kind of bamboo industry	Raw material needed (culms/month)
Boboko (Rice basket)	256
Spice rack	16
Bamboo curtain	32
Lampshade	16
Coffee filter	8
Tissue box	7
Laundry basket	32
Fruit basket	16
Bongsang (Tofu basket)	200
Table and chair set	6
Nyiru (Winnowing basket)	80
Tolombong	256
Giribig	800
Bilik (Bamboo wall)	720
Sheepskin pads	20
Angklung	50
Calung	50
Carved glass	2
Total	2,567

Table 6. Examples of bamboo products in Sumedang District, West Java, Indonesia

Examples of bamboo products		Product uses
Boboko (Rice basket)		A container for storing rice. This product is often used in traditional households and during cultural events.
Nyiru		A bamboo tray for processing grains, mainly for rice
Bilik		A traditional wall or partition made of bamboo
Bongsang (Tofu basket)		A container for storing typical Sumedang tofu
Calung		A traditional musical instrument typical of West Java
Angklung		A traditional musical instrument typical of West Java

Table 7. Added-value and profit rate of the bamboo industry in Sumedang District, West Java, Indonesia

Products	Value added	Profit rate without calculating labor wages	Profit rate with calculating labor wages
Boboko (Rice basket)	79%	79%	69%
Spice rack	86%	86%	66%
Bamboo curtain	80%	80%	40%
Lampshade	77%	77%	43%
Coffee filter	93%	93%	83%
Tissue box	97%	97%	87%
Laundry basket	80%	80%	72%
Fruit basket	66%	66%	26%
Bongsang (Tofu basket)	78%	78%	-22%
Table and chair set	88%	88%	83%
Nyiru (Winnowing basket)	90%	90%	40%
Tolombong	63%	63%	-38%
Giribig (1.5 × 3 m^2)	50%	50%	0%
Bilik (Bamboo wall) (2 × 3 m^2)	0%	0%	-50%
Bilik batik (2 × 3 m^2)	20%	20%	7%
Sheepskin pads	57%	57%	53%
Sheepskin pads with name engraving	64%	64%	60%
Angklung	61%	61%	59%
Calung	83%	83%	80%
Carved glass	94%	94%	78%

Table 8. Added-value and profit rate of the bamboo industry in Sumedang District, West Java, Indonesia

Internal Factors	External Factors
Marketing The product sales chain involves direct sales to consumers, primarily to middlemen or traders. Prices are generally determined by middlemen, traders, or buyers, with few craftsmen setting their own prices. Sales are typically conducted directly, without using online shopping platforms, and promotions are minimal, relying mostly on word-of-mouth.	**Government Policies** There are no specific local government programs for developing the bamboo industry, as the local government prioritizes the food industry. However, general facilities like digital marketing training, partnerships with retail groups, annual exhibitions, and low-interest business loans are available but underutilized by bamboo craftsmen. The regional spatial plan includes developing cultural tourism and craft centers, presenting opportunities for bamboo industries to thrive in the cultural tourism sector.
Human Resources Bamboo industries in Sumedang are mostly small-scale home productions without employees. Craftsmen usually work alone or with family members. Their skills are inherited, without formal training. Most craftsmen are over 40 years old, and the youth rarely engage in bamboo weaving, preferring farming, especially since the government launched the Millennial Farmer program.	**Competition Levels** Competitors include other bamboo product producers from neighboring regions and substitute products like plastic baskets and modern household items. While Sumedang bamboo products are of higher quality, they lack innovation and face competition from more functional substitutes.
Financial Aspects According to calculations using the Hayami method (Table 7), the addition of bamboo product value is significant but has small profit margins. Craftsmen do not produce on a large scale, and they often need minimal initial capital from personal funds.	**Socio-cultural Factors** Bamboo crafting skills are inherited rather than formally taught, and there are no formal bamboo craft associations in Sumedang. Bamboo crafting is typically a side job, with farming or gardening as the main occupation.
Technical and Operation Aspects The production scale is small, home-based, and unstructured, with craftsmen producing bamboo products only when not farming. Production capacity is low, averaging one product per day. Simple tools are used, and production residues like bamboo dust and shavings are discarded without further processing	**Market Availability** Sumedang's bamboo products have a reasonably broad local market but haven't reached the global market. Demand remains stagnant or declining for products with substitutes.
	Raw Material Availability The primary raw material is bamboo tali, which is valued for its durability and ease of weaving. Sumedang has a sufficient supply of bamboo tali to meet local industry needs, though craftsmen sometimes source black bamboo from outside Sumedang for specific products

IFE, EFE, and IE matrices

Based on the business environment analysis, various strengths, weaknesses, opportunities, and threats are identified, as shown in Tables 9 and 10.

The IFE matrix shown in Table 8 shows that the highest strength score is attributed to the skillset inherited over generations. This indicates that this attribute is the most significant strength among the others. Meanwhile, the lowest weakness score is that bamboo products are impractical. The grand total of the IFE matrix is 2.733. According to David (2017), a score of 3 or close to 3 indicates that the bamboo industry in Sumedang has relatively small strengths.

Based on Table 10, the highest opportunity score is attributed to the availability and ease of obtaining raw materials. This indicates that this opportunity is the most significant among the others. The threats with the lowest scores are the presence of more functional substitute products and the lack of special attention from the government for the bamboo industry in Sumedang. The grand total score from the EFE matrix is 3.129, which is close to 3. According to David (2017), a score of 3 or close to 3 indicates that the bamboo industry in Sumedang has relatively small opportunities.

Based on the calculations in the IFE and EFE matrices plotted on the IE matrix (Figure 2), the bamboo industry in Sumedang occupies quadrant II, which is the aggressive strategic position. Based on this position, the suitable strategy type to apply includes intensive strategies such as market penetration, market development, product development, and diversification.

SWOT analysis

The appropriate strategy type for industries in quadrant II is the SO strategy in SWOT (Amirshenava and Osanloo 2022). Therefore, three main strategies are recommended based on the SO strategy, leveraging existing opportunities by utilizing the strengths (Benzaghta et al. 2021). The types of strategies are listed in Table 11.

The first strategy involves product diversification and innovation in existing products. This strategy leverages the strengths of the bamboo industry in Sumedang, including existing skills and opportunities such as access to soft loans and the availability and ease of bamboo raw materials. It falls under the category of related diversification strategy for bamboo processed products and product development strategy for innovating existing products. The initial step in implementing this strategy is establishing a Bamboo Craftsmen Association. This program aims to facilitate training, distribution of aid in bamboo processing, and other collective activities among bamboo craftsmen. The association serves as a platform to facilitate recommended programs.

Members of the Bamboo Craftsmen Association include a group of craftsmen along with local government representatives. Another program for implementing the diversification and innovation strategy involves training for developing new products and enhancing existing ones. Examples of new products that can be developed include plates, toothbrushes, combs, bookshelves, and other unconventional items made from bamboo. Enhancing existing products involves improving their quality through design, appearance, or functionality upgrades. An example of quality improvement is coloring *boboko* products or creating specific weaving patterns to enhance consumer appeal. These training programs can be provided through the Bamboo Craftsmen Association. Another implementation program involves providing technology assistance from the local government, which can be channeled through the Bamboo Craftsmen Association.

Table 9. IFE matrix

	Internal factors	Weight	Rating	Score
	Strength (S)			
S1	Skills are inherited and passed down through generations	0.259	3.75	0.970
S2	Non-woven products have a high profit margin	0.241	3.5	0.845
	Total	0.500		1.815
	Weakness (W)			
W1	No regular and continuous production schedule	0.138	2	0.276
W2	Most products are simple and lack innovation	0.121	1.75	0.211
W3	No organization or association of bamboo craftsmen	0.138	2	0.276
W4	Bamboo products are not practical to use	0.103	1.5	0.155
	Total	0.500		0.918
	Grand Total	1.000		2.733

Table 10. EFE matrix

	External factors	Weight	Rating	Score
	Opportunity (O)			
O1	The government provides soft loans	0.226	3.5	0.790
O2	Increasing consumer awareness of eco-friendly products	0.242	3.75	0.907
O3	Raw materials are always available and easy to obtain	0.258	4	1.032
	Total	0.726		2.730
	Threat (T)			
T1	Presence of more functional substitute products	0.081	1.25	0.101
T2	Competition from other producers making similar products	0.113	1.75	0.198
T3	No special attention from the government for the bamboo industry in Sumedang	0.081	1.25	0.101
	Total	0.212		0.399
	Grand total	1.000		3.129

Table 11. Alternative strategies

Strategy type	Strategies	Strategy implementation	PIC
Related diversification and product development	Diversification and existing product innovation	Establishing a bamboo craftsmen association	Bamboo craftsman and government
		Training for new product development and enhancement of existing products	Bamboo craftsmen association
		Providing technological assistance	Government
Market penetration	Market penetration	Educational campaigns	Bamboo craftsmen association
		Collaborating with communities or companies	Bamboo craftsmen association
		Organizing cultural exhibitions	Government
Market development	Open global market	Increasing production capacity	Bamboo craftsmen association
		Collaborating with international distributors	Bamboo craftsmen association
		Creating policies to facilitate exports	Government
		Developing an export information website and providing export consultations	Government

The second strategy involves market penetration to increase sales through various marketing methods. Some programs that can be implemented through the Bamboo Craftsmen Association include educational campaigns and collaborations with communities or businesses. Educational campaigns can include social media campaigns to raise awareness about bamboo processed products as environmentally friendly products, collaborating with influencers, creating educational videos about bamboo processed products, conducting workshops on making simple bamboo products for the general public, and more. Collaboration with communities or businesses can involve becoming a supplier to a company or organizing joint events with communities that can then increase sales or awareness of bamboo processed products. Another implementation by the government in the market penetration strategy the provision of cultural exhibitions.

The last strategy is to enter the global market, aiming to explore new markets that have not been tapped before, which falls under the category of market development strategy. Implementing this strategy involves increasing production scale to leverage existing opportunities, such as easy access to raw materials and soft loans from the local government. Production scale can be enhanced through the Bamboo Craftsmen Association acting as an aggregator to collectively market products. Furthermore, the association can collaborate with international distributors. Another implementation program by the government could include creating policies to facilitate exports and developing an export information website while providing export consultations. Facilitating exports might involve streamlining bureaucracy, offering low taxes, and subsidizing export costs, among other measures.

In conclusion, the bamboo craftsmanship industry in Sumedang District holds significant economic potential that has yet to be seriously developed. Only about 73% bamboos are utilized from the existing potential. Generally, the bamboo industry in Sumedang District is traditional and operates as home industry without employees, with very small production capacities. The production process uses simple tools and produces simple, traditional products without innovation, resulting in low-priced items. It is known that the profit margins are generally small, with some businesses even experiencing losses. Moreover, more functional substitute products make it difficult for bamboo products to compete with items that serve the same function. Intensive strategies and diversification are suitable approaches to develop the bamboo industry in Sumedang. These strategies include product diversification, product innovation, market penetration, and opening global markets.

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