

# Harnessing the Market Potential of the Bamboo Industry in Central Luzon, Philippines: An Analysis of the Internal and External Environment

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## Abstract

The bamboo industry in Central Luzon holds significant promise for economic development and environmental sustainability. This study aims to analyze the internal and external factors influencing the bamboo industry in the region through SWOT and PESTLE analyses. Based on a focus group discussion involving key industry players, the study explores the industry's strengths, weaknesses, opportunities, and threats, as well as political, economic, social, technological, legal, and environmental factors. Findings reveal the importance of comprehensive strategies that address political stability, economic growth, consumer awareness, technological advancement, legal compliance, and environmental sustainability. Recommendations include capacity-building for production and marketing, the establishment of bamboo treatment facilities, and advocacy for supportive policies. By addressing these factors, the bamboo industry in Central Luzon can realize its potential for socio-economic development and environmental stewardship.

## Keywords

Bamboo, SWOT Analysis, PESTLE Analysis, Business Environment, Value Addition, Sustainability, Market Potential

## 1. Introduction

Bamboo, the fastest-growing and highest-yielding renewable resource, is found extensively in Africa, Asia, and South and Latin America, with numerous advantages over softs and hardwoods [1]. Its current economic and social benefits to its growers have positively impacted revenue returns on the people's liveli-

hood and employment for the youth in the geographical areas. According to the [2], there are over 1000 species of bamboo. It is a versatile material with countless uses, including construction, clothes, food, and fuel.

Bamboo plays a vital role socially, economically, and ecologically in areas where it occurs naturally and where it is planted. Bamboo, both highland and lowland, is a versatile resource with numerous applications. Bamboo is a highly versatile and rapidly renewable resource that offers various livelihood options and a pathway out of poverty. The recent rise of industrial bamboo products creates value chains that direct income to rural communities that manage bamboo forests. For instance, bamboo's light weight and ease of processing enable poor women to utilize their skills in traditional societies for a wide range of products like weaving, finishing, and dyeing [3]. It is indisputable that the Earth has been suffering for decades and even centuries. Bamboo is a great "green solution". As stated by [4] bamboo plants, with more than 40 million hectares around the world, are one of the most important plants for improving climate change due to their high bamboo biomass stocks and carbon storage. People have hailed bamboo as an environmental miracle crop due to its numerous benefits. It is noteworthy to emphasize the growing contribution of bamboo in the construction industry. Bamboo is one of the non-timber forest products (NTFPs) that have considerable potential as a wood substitute because of its high growth rate, good mechanical properties, and a broad range of applications, especially in industrial fields [5]. Furthermore, [6] noted that bamboo's strength and lightweight nature often allow for its use without the need for processing or finishing.

The growth of the bamboo industry is attributed to several factors, including the expansion of industrial and building activities in developed countries, the availability of bamboo in all tropical regions, and the rise in gardening activities. In the Philippines, bamboo is a vital domestic resource and a common building material. Consequently, the Department of Environment and Natural Resources (DENR) declaration that the nation is working to create a sustainable bamboo industry was highlighted in the article published by [7]. Of the 62 bamboo species found in the Philippines, 21 are thought to be native to the nation. In the Philippines, there are four different types of bamboo stands: publicly or state-owned, privately-owned, privately-owned natural, and privately-owned plantations [8].

According to a Department of Agriculture report (RFO 5), bamboo is becoming more and more in demand in the Philippines. The demand isn't currently being satisfied, though. For agroforestry farmers, producing bamboo is therefore a possible source of revenue. According to [9], the Philippines currently have a market for modified bamboo. While it is still in its infancy and plagued by a number of issues, it is also endowed with numerous strengths and has the ability to satisfy local clients' demands and possibly even take a piece of the worldwide market. Widespread use of bamboo products in food and drink production, textiles, energy, and the construction and furniture industries would be beneficial to the local economy.

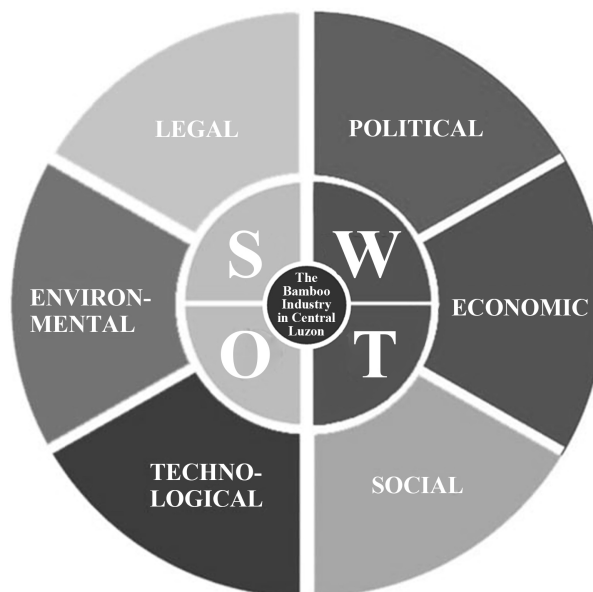
The government's support for bamboo production and utilization has been increasing recently. In accordance with the government's initiative to harness the bamboo sector's potential, a study focusing on the identification and analysis of the main internal and external factors that have an impact on the development of the bamboo industry in Region III was conducted. SWOT analysis was utilized to develop a profound understanding of the internal and external environment in which bamboo enterprises operate. Opportunities and threats pertain to environmental elements external to the company [10]. On the other hand, an analysis of the strengths and opportunities open to the industry will direct the actions it will take to improve the enterprise's performance.

To conduct a thorough analysis of the sector, the researcher utilized PESTLE analysis to provide a detailed description of the external factors that impact the operation of the bamboo enterprises. The importance of recognizing opportunities and threats was underlined by The Info Entrepreneurs [11]. They stated that identifying and avoiding common growth-related issues is essential for businesses to sustain their expansion and success. The findings of the study can greatly aid in the development of appropriate policies, strategies, and action plans to expand the bamboo industry and harness the potential of bamboo to provide positive social, economic, and environmental outcomes in the bamboo sector of Central Luzon.

## 2. Methodology

As illustrated in **Figure 1**, the Research Paradigm depicts the comprehensive approach of this study, aiming to analyze both the internal and external environment of the bamboo industry in Central Luzon.

This study utilized a quantitative-descriptive research design. The Business Research Methodology [12] states that the purpose of this type of research is to



**Figure 1.** Research paradigm.

provide a comprehensive understanding of current challenges or issues by collecting data that allows for a detailed explanation of the situation. The method of study was suitable due to the study's aim of providing a comprehensive description, evaluation, and analysis of the bamboo industry in Central Luzon through the utilization of SWOT and PESTLE analyses.

Enterprises must comprehend the macroenvironment to ensure that their strategy is in harmony with the influential factors of the bamboo industry landscape. [13] asserted that having a comprehensive grasp of PESTLE enables managers to steer clear of strategies that are likely to fail based on the prevailing environmental conditions. Pahwa [14] disclosed that only firms that identify opportunities at an early stage can exploit and profit from them.

The study was carried out in the provinces of Region III, namely Aurora, Bataan, Bulacan, Nueva Ecija, Pampanga, Tarlac, and Zambales. The participants of the study were proprietors of bamboo businesses, selected from the roster provided by DTI Region 3 within the Bamboo Industry Cluster as of December 2023. These firms are involved in the production and processing of various bamboo products, such as furniture, construction materials, handicrafts, engineered bamboo, bahay kubo, and poles. Bulacan currently has only one registered bamboo enterprise as a result of its recent involvement in the council.

## Respondents

As depicted in **Table 1**, the respondents of the study represent various bamboo enterprises from different provinces in Central Luzon. A combination of a discussion guide and a survey questionnaire was administered to analyze the bamboo industry's internal and external factors. Initially, the validation of the applicability in the regional setting of the results of the SWOT and PESTLE analyses through focus group discussions was conducted. This undertaking was facilitated using the discussion guide, which contained key questions based on related reports' readings.

**Table 1.** Registered bamboo enterprise in region III.

Registered Bamboo Enterprise in Region III	N
Aurora	2
Bataan	4
Bulacan	1
Nueva Ecija	2
Pampanga	7
Tarlac	14
Zambales	3
<b>Total</b>	<b>33</b>

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## 3. Results and Discussion

### 3.1. PESTLE Analysis

The Bamboo Industry in Central Luzon holds significant promise for economic development and environmental sustainability. However, numerous external factors shape its trajectory. The findings of the PESTLE Analysis are derived from a comprehensive focus group discussion involving key stakeholders within the bamboo industry.

#### 3.1.1. Political Factors

The bamboo industry in Central Luzon is governed by governmental regulations pertaining to trade agreements, environmental preservation, and land utilization. According to the viewpoints of the participants, policies that offer financial assistance for bamboo processing facilities, promote the establishment of bamboo plantations, and facilitate trade procedures for bamboo products have the potential to foster investment and growth in the industry. A pertinent investigation carried out by [15] examined the ramifications of governmental policies on the bamboo sector in the Philippines. Policies that provided incentives for the establishment of bamboo plantations were found to be instrumental in motivating proprietors to participate in bamboo cultivation, according to Dolom. Financial incentives and technical assistance were extended to landowners in the form of the Bamboo Development Act of 2009 and the National Greening Program (NGP), respectively, to encourage the establishment of bamboo plantations. In addition to encouraging reforestation, these incentives facilitated the accessibility of raw materials for the bamboo industry.

However, inconsistent regulations and policy ambiguities hindered the sustainability and competitiveness of Central Luzon's bamboo industry. Inadequate enforcement of environmental conservation measures and ambiguous land use regulations can generate barriers and uncertainties for industry participants. These incongruities have the potential to deter long-term investments, restrict entry into markets, and hinder the industry's capacity for expansion. The Department of Trade and Industry [16] conducted a study to analyze the effects of governmental policies on the bamboo sector in Central Luzon, Philippines. The report emphasized the significance of consistent and transparent policies in advancing sustainable development and industry competitiveness. Supportive policies, including the Philippine Bamboo Industry Development Plan and the National Greening Program, have contributed to the development and expansion of the bamboo industry in Central Luzon, according to the findings.

On the other hand, the research identified obstacles linked to inconsistent policy implementation and regulations. These obstacles comprised land tenure concerns, inadequate financial support for conservation endeavors, and barriers to trade. In summary, the examination highlights the pivotal significance of governmental policies in influencing the course of the bamboo sector in Central Luzon. To foster sustainable growth and strengthen competitiveness, it is imperative that policymakers give precedence to the formulation of policies that are

unambiguous, cohesive, and encouraging, while also addressing the distinctive requirements and obstacles of the industry. By cultivating a conducive policy milieu, Central Luzon has the capacity to maximize the utilization of its bamboo resources, thereby bolstering economic growth and sustainability while simultaneously advancing environmental objectives.

### **3.1.2. Economic Factors**

The expansion and sustainability of the bamboo sector are greatly influenced by increased employment rates and higher income levels. With the rise in employment prospects, there is a higher probability that more persons will pursue jobs in the bamboo industry, resulting in a workforce that is both skilled and diverse. Moreover, the presence of greater income levels among workers plays a significant role in boosting consumer spending on bamboo products, hence fueling demand and fostering additional growth in the business. A study undertaken by [17] examined the socioeconomic consequences of the bamboo business in rural communities. Numerous programs and interventions have been implemented to harness the social and environmental benefits of bamboo in development, as revealed by the study. The increased employment rates in firms associated to bamboo have played a significant role in reducing poverty and enhancing the living conditions of the local population. The presence of work opportunities in the industry resulted in a decrease in unemployment rates and a rise in household income levels. According to the findings of study [18], a significant majority (94%) of cooperative members highly appreciate their cooperative for its positive impact on their financial prosperity. Furthermore, the economic benefits provided by cooperatives are highly regarded. The primary motivations for joining a cooperative, as reported by the respondents, were access to loans and credit (chosen by 40% of participants), financial rewards such as earnings, dividends, and patronage (20%), and employment prospects (11%). Moreover, it has been disclosed that rural consumers are currently facing financial constraints. Products are not only contending with other brands, but also vying for consumer buying power. Therefore, it is crucial to increase customers' ability to purchase and their capacity to spend and consume.

In addition, research conducted by [19] examined the correlation between income, social class, and consumer behavior in Developing Nations. Rural consumers are currently experiencing financial difficulties. Products not only compete with other brands, but also vie for consumer buying power. Therefore, it is crucial to increase customers' ability to purchase and their capacity to spend and consume.

The study uncovered a positive correlation between higher household earnings and an augmented allocation of funds towards bamboo-derived goods, including furniture, handicrafts, and construction materials. The increase in consumer demand greatly benefited local bamboo firms, leading to an increase in production and fueling economic growth. Furthermore, the cost is a major limitation when it comes to the mindful consumption of bamboo lifestyle goods

[20]. Higher income levels not only lead to more employment prospects within the bamboo sector, but also create favorable conditions for entrepreneurship in allied industries like as bamboo processing, marketing, and innovation. According to the article published by [21], the global market for items made from bamboo is expected to have significant growth between 2022 and 2031. The market is experiencing consistent growth in 2021, driven by the increasing implementation of strategies by major players. This trend is predicted to continue and result in more market expansion in the foreseeable future. Therefore, these opportunities would motivate ambitious businesses to invest in bamboo value-added goods, thus promoting innovation and diversity in the industry.

### 3.1.3. Social Factors

The bamboo sector in Central Luzon, Philippines, is currently at a crucial point, being influenced by a variety of factors including cultural perceptions, labor patterns, and consumer awareness. Comprehending these dynamics is crucial for individuals or groups who want to take advantage of the bamboo resources and prospective commercial opportunities in the region. The cultural perceptions of bamboo as a sustainable and environmentally benign material have a significant influence on consumer preferences and market demand in Central Luzon. Bamboo possesses profound cultural significance in Filipino society, frequently linked to qualities like as tenacity, adaptability, and environmental sustainability. Exploiting these favorable attitudes can act as a catalyst for greater adoption of bamboo in many sectors, such as construction, furniture, and crafts. Furthermore, advocating for the use of bamboo as a sustainable substitute for conventional materials is in accordance with the cultural values of the region, which prioritize the responsible management of the environment.

According to an article published by [22], it was stressed that bamboo has been an integral component of Philippine culture for numerous ages. It has been utilized for a diverse array of purposes, spanning from construction to handicrafts. Bamboo has been utilized in the Philippines since pre-colonial times for constructing houses, boats, and various other buildings. Moreover, the survey unveiled that corporations have begun to transition their marketing methods to enhance product value and boost sales using environmentally conscious approaches. Green advertising often aims to enhance customer knowledge of eco-friendly products. This can be attributed to the increasing environmental awareness and cultural values of customers.

A professional and skilled staff that is knowledgeable in bamboo planting, harvesting, processing, and product production is essential for the success of the bamboo sector in Central Luzon. Skilled labor not only improves manufacturing efficiency but also aids in the creation of high-quality bamboo goods that satisfy market needs. Nevertheless, the makeup of the workforce may undergo alterations because of urbanization, migration, and shifts in economic landscapes. With the younger population opting for non-traditional careers and the decline in traditional bamboo farming skills, the task of providing a consistent supply of com-



petent labor becomes more difficult. Research conducted by [23] emphasizes the significance of vocational training and skill development in improving labor capabilities and fostering innovation in firms related to bamboo. In addition, in an article published by [24], she explained the impact of changes in population characteristics on the evolution of the labor market. She states that populations worldwide suffer changes in age structure, fertility rates, and migration patterns, which in turn modify the dynamics of the labor. These changes can result in both advantageous and disadvantageous consequences for the job market, presenting difficulties and possibilities for individuals, corporations, and governments alike. Industry players are focused on addressing labor shortages and improving worker productivity to fully use the region's bamboo potential. Businesses can enhance production processes and maximize resource usage by implementing cutting-edge technologies, mechanization, and adopting best practices. To remain competitive in the global marketplace, it is crucial to embrace continual learning and adaptation as the industry advances.

The growing consciousness of environmental concerns and the importance of sustainability among consumers offers a favorable prospect for the Central Luzon bamboo industry. Due to mounting apprehensions over deforestation, climate change, and ecological deterioration, consumers are progressively oriented towards environmentally friendly and sustainable items. Bamboo is highly regarded for its fast growth, capacity to be renewed, and minimal influence on the environment. This makes it appealing to environmentally concerned consumers who are looking for ethical and eco-friendly options. By strategically implementing marketing initiatives, eco-labeling, and product certifications, it is possible to capitalize on consumer knowledge and drive demand for bamboo products, hence promoting market growth in Central Luzon. Research conducted by [25] emphasizes the increasing apprehension among consumers regarding the environment. Contemporary consumers prioritize products that are eco-friendly and recyclable.

#### **3.1.4. Technological Factors**

The bamboo sector in Central Luzon, Philippines, is currently undergoing significant changes because of advancements in cultivation and processing techniques, the integration of digital technology, and a strong focus on research and development (R&D). These elements collectively influence the overall structure of the sector, impacting how production is carried out, the level of competition in the market, and the implementation of sustainability efforts.

The book [26] showcased the most recent technological advancements in bamboo, with the goal of highlighting its sustainable advantages. In addition, the book includes global case studies that showcase the latest applications and advancements in using bamboo as a sustainable material. Over time, traditional agriculture has transformed into a more advanced form that provides more advantages for human existence, thanks to human cooperation and intervention [27]. Advancements in bamboo cultivation and processing are crucial for im-



proving productivity, enhancing product quality, and adding value to the Central Luzon bamboo sector.

The government's assistance in the cultivation and exploitation of bamboo has been steadily increasing in recent times. The recently drafted Philippine Bamboo Industry Roadmap highlighted the following S&T Interventions: 1) Advancement of cost-effective techniques for drying and preservation; 2) Innovation in product development and processing of underutilized bamboo species; 3) Advancement in processing tools, equipment, and machinery; 4) Utilization of field and mill residues; 5) Production of rayon from bamboo (cellulose derivatives); 6) Advancement in the development of engineered bamboo products. Therefore, it is imperative to prioritize science and technology activities to facilitate the growth of the Philippine Bamboo Industry [8].

By incorporating inventive methods into the cultivation and processing procedures, the bamboo industry in Central Luzon can discover fresh prospects for expansion and diversification. In a previous study (reference [25]), it was discovered that digital transformation has a positive effect on the economic growth of both companies and societies. This is achieved by using resources more efficiently and reducing waste, which in turn allows for simplification and optimization of business processes, resulting in lower costs. Additionally, [28] highlighted the significance of digital marketing as the leading aspect of any marketing strategy in all industries. Organizations have consistently emphasized the importance of enhancing their brand's productivity, expanding their client base, and achieving more revenue through the implementation of efficient digital marketing tactics. Adopting digital technologies promotes creativity, adaptability, and durability in the bamboo business, positioning players in Central Luzon for sustainable growth in the digital age.

Research and development (R & D) is essential for fostering innovation within ecosystems. Organizations engage in activities to create new products, services, or processes that can improve their competitive advantage and contribute to the general growth of the ecosystem [29]. By giving priority to research and development agendas and promoting a culture of innovation, the bamboo industry in Central Luzon has the potential to unleash undiscovered opportunities, improve competitiveness, and make a positive contribution to sustainable development goals.

To summarize, the combination of advancements in bamboo farming and processing, digital technologies, and research and development highlight the significant impact that the Central Luzon bamboo sector may have. By adopting technological advancements, cultivating collaborative collaborations, and investing in knowledge creation, stakeholders may effectively manage changing market dynamics, seize emerging possibilities, and drive the region towards a more robust and environmentally friendly bamboo economy.

### **3.1.5. Legal Factors**

The bamboo industry in Central Luzon operates under a regulatory framework

that is shaped by environmental rules and labor legislation. Comprehending the consequences of these legal and regulatory frameworks is essential for industry stakeholders to navigate compliance obligations and promote sustainable expansion. Environmental rules are crucial in determining how bamboo resources in Central Luzon are sustainably managed and utilized. Bamboo harvesting, processing, and trade activities are regulated by national and municipal environmental laws to protect biodiversity, prevent deforestation, and promote ecosystem conservation. Adhering to environmental impact assessment (EIA) methods, forest management protocols, and sustainable harvesting practices is crucial to guaranteeing the long-term sustainability of bamboo ecosystems and minimizing negative environmental effects. The EIA process in the Philippines is carried out by the Environmental Management Bureau (EMB) of the Department of Environment and Natural Resources (DENR). The method is formally referred to as the Philippine Environmental Impact Statement System (PEISS), which was established by PD 1586 on June 11, 1978.

Labor laws and regulations govern the Central Luzon bamboo industry, determining employment practices, working conditions, and labor rights. Ensuring adherence to minimum wage regulations, occupational safety measures, and labor contracts is crucial for advancing social justice, safeguarding the well-being of workers in the bamboo business, and protecting their human rights. Effectively addressing inclusion and diversity concerns is a crucial component of organizational management. Efficient handling of these matters is crucial for fostering a favorable work environment, enhancing employee morale and productivity, and guaranteeing adherence to legal and ethical norms [30].

Overall, environmental restrictions, intellectual property rights, and labor laws are important factors that influence the regulatory framework of the bamboo industry in Central Luzon. Industry stakeholders can promote responsible and inclusive development of bamboo enterprises in the region by adopting sustainable practices, respecting intellectual property rights, and upholding labor standards. This will not only contribute to environmental conservation, economic resilience, and social equity but also foster a sense of responsibility among the stakeholders.

### **3.1.6. Environmental Factors**

Environmental factors, specifically climate change, biodiversity preservation, and water resource management, drive complex difficulties and opportunities in the bamboo sector in Central Luzon. Comprehending the interaction between these factors is crucial for maintaining the industry's expansion and adaptability in the face of changing environmental conditions. Climate change has a substantial effect on the development patterns of bamboo, rendering them vulnerable to pests, diseases, and the degradation of their habitat in Central Luzon. The essay produced by Bamboo Vision affirms that bamboo is renowned for its versatility, although it can still face obstacles due to shifting climate patterns. Bamboo growth

can be affected by extreme weather events, droughts, and fluctuating temperatures.

Protection activities are crucial in safeguarding the natural bamboo habitats and advancing biodiversity protection in Central Luzon. DENR Communications Development Officer Joshua Rei Ubaldo (2024) identifies climate change as a major catalyst for the decline of biodiversity. He stated that both animals and plants are migrating towards the poles, either moving northward towards the North Pole or southward towards the South Pole to avoid the high temperatures.

Due to climate change, a significant number of plant and animal species are experiencing mortality. Immediate implementation of cost-effective solutions and practical approaches is crucial to prevent the irreversible degradation of the remaining major biodiversity regions and essential habitats due to ongoing threats. The report by [31] underscored the significance of mainstreaming as a cost-effective strategy to safeguard the remaining KBAs and ensure sustainable management of the production systems in the surrounding area. This approach distributes responsibility among other significant participants, ensuring favorable outcomes. Ultimately, it is crucial to prioritize the mitigation of climate change effects, the preservation of biodiversity, and the improvement of water resource management as essential elements of sustainable bamboo sector growth in Central Luzon. Using ecological ideas, getting the community involved, and flexible management techniques are important for creating strong bamboo ecosystems, encouraging people to be responsible with the environment, and maintaining the industry's social and economic importance when the environment is uncertain.

### 3.2. SWOT Analysis

The focus group discussion allowed key stakeholders to identify the main strengths, weaknesses, opportunities, and threats of the bamboo enterprise in Central Luzon. The 33 enterprises enrolled in the Bamboo Industry Cluster in the region under DTI then rated these item statements.

#### 3.2.1 Strengths

Shown in **Table 2** are the strengths of the Bamboo Industry in the region.

Due to the vast diversity of its uses, the bamboo plant has been revered in the country for centuries. As a building material, bamboo is famous for its viability. Compared to mild steel, which has a tensile strength of 23,000 lb per square inch, bamboo has a tensile strength of 28,000 lb per square inch, making it one of the world's finest natural engineering materials and a crucial component of earthquake-resistant buildings [32]. Due to bamboo's hardness, lightness, flexibility, attractive look, and tensile strength, it can be a viable substitute for lumber and wood in numerous industries, including the furniture and building sectors. Additionally, bamboo is an excellent source of energy. The calorific value of bamboo-produced charcoal briquettes is superior to that of charcoal derived from other sources.

**Table 2.** Strengths of the bamboo industry.

Strengths	Weighted Mean	Verbal Interpretation	Verbal Description
Bamboo grows in various habitat in the Region.	3.69	Strongly Agree	The respondent viewed the statement as major strength.
Bamboo has short gestation period.	3.44	Strongly Agree	The respondent viewed the statement as major strength.
Bamboo is a versatile commodity.	3.39	Strongly Agree	The respondent viewed the statement as major strength.
Bamboo can produce a wide range of product.	3.22	Agree	The respondent viewed the statement as a strength.
There are Provincial Bamboo Industry Development Councils in each province of the region.	3.47	Strongly Agree	The respondent viewed the statement as major strength.
Inherent craftsmanship of bamboo processors.	3.25	Agree	The respondent viewed the statement as a strength.
<b>Overall Weighted Mean</b>	<b>3.43</b>	<b>Strongly Agree</b>	<b>Major Strengths</b>

Bamboo has a diverse number of applications. In Central Luzon, many enterprises create products that add value to bamboo poles. One of the most apparent uses of bamboo is as a wood substitute and composite material. Bamboo poles are utilized for fish pens, vegetable cultivation, and landscaping. Bamboo handicrafts and furniture consist of traditional products made of round or split bamboo and, more recently, “pack-flat, knockdown” furniture, which retains bamboo’s physical, environmental, and aesthetic qualities while addressing the disadvantages of variable quality, low productivity, and high labor and transport costs. Another emerging bamboo-based product is engineered bamboo. This product has numerous applications in the furniture, craft, and construction industries. Bamboo salt manufacturing is also targeted in the region, notably PRIMSU in Zambales. In addition, bamboo is used as a food product, such as labong, and as fuel like bamboo charcoal.

The issuance of EO 879, creating the Philippine Bamboo Industry Development Council (PBIDC), and later the issuance of MC 30, supporting the establishment of a bamboo industry development program, provide the basis for concerted efforts in industry development. The mandate of DepEd to procure 25% of its desks and chairs made of bamboo creates a big market for furniture manufacturers. Central Luzon has a considerable desire to revive the bamboo industry through its Provincial Bamboo Industry Development Council. Therefore, the province is conducting various bamboo-related plans and programs to revitalize the sector. LGUs have started to realize the importance of bamboo in the local economy, creating jobs and employment for residents.

Filipinos are highly artistic. The talent for bamboo craftsmanship was passed down from generation to generation by kin and neighbors. The artists also imparted their specialized knowledge and abilities to others in the community. The most experienced family members taught the rest the skills through an apprenticeship program. Therefore, familial ties have remained essential for the transmission of craft skills. Filipino artisanal talents are passed down through generations.

### 3.2.2. Weaknesses

Indicated in **Table 3** are the weaknesses of the bamboo industry.

The bamboo industry has yet to maximize its potential. These weaknesses are consistent with the responses of the bamboo enterprises in Central Luzon. According to the data, a significant area for improvement in the bamboo industry is the need for more supplies of treated bamboo to fulfill the needs of bamboo-based enterprises. Various companies are interested in entering the market for engineered bamboo, but there is a need for a greater supply of treated bamboo. According to the Tarlac processor, there is a demand for handicrafts, but they require assistance taking orders because of the lengthy lead time. Due to the length of time required to cure bamboo, the production of the final product is negatively impacted. He claimed that establishing a bamboo treatment facility would alleviate this weakness and help boost the industry.

**Table 3.** Weaknesses of the Bamboo Industry.

Weaknesses	Weighted Mean	Verbal Interpretation	Verbal Description
There is a low volume of bamboo supply.	3.64	Strongly Agree	The respondent viewed the statement as major weakness.
Inadequate supply of treated bamboo to meet the requirements of various bam-boo-based industries	3.61	Strongly Agree	The respondent viewed the statement as major weakness.
The bamboo industry has insufficient baseline data.	3.42	Strongly Agree	The respondent viewed the statement as major weakness.
There is no one institution that is dedicated to overseeing the development of the bamboo industry.	3.19	Agree	The respondent viewed the statement as a weakness.
Lack of access to machineries.	3.44	Strongly Agree	The respondent viewed the statement as major weakness.
There is a lack of natural resource management.	3.25	Agree	The respondent viewed the statement as a weakness.
<b>Overall Weighted Mean</b>	<b>3.43</b>	<b>Strongly Agree</b>	<b>Major Weakness</b>

There is a need for greater information and data on the industry, notably about the database of key players. These players comprise the industry, employment, domestic trade of bamboo and bamboo products, and economic contributions. According to DTI Region 3, the main reason for this lack of knowledge and statistics is that many transactions involving bamboo, particularly in rural areas, must be recorded in official documents. When a farmer cuts and sells a few culms, there are no receipts; when bamboo items are sold, there are no receipts of transactions. Exports and imports of bamboo goods include formal transactions and are consequently recorded and reflected in the official accounts of the Philippine Statistical Authority. Additional industry components for which very little data is available include the number of micro and small businesses engaged in the production and processing of bamboo, employment, local trade and sales, and contribution to the gross domestic product (GDP). Specifically, there needs to be more data regarding the usage pattern of bamboo; the lack of research on this crucial variable has led to inappropriate resource allocation procedures.

Relative to this, there is currently no institution committed to overseeing the growth of the bamboo sector. Even though a substantial amount of technical and research-based knowledge is accessible through DTI, DENR, DOST, DA, and other implementing agencies, interviews with various respondents reveal that technical information must be efficiently transmitted throughout the bamboo industry. Multiple organizations simultaneously promote the bamboo sector both nationally and regionally. Owing to a lack of coordination, concerns involving raw resources and enterprise growth still need to be addressed. This also applies to institutions for training and research. Bamboo sector development is one of their many responsibilities, although it has a lower priority and is provided with fewer resources. Implementers must be more specialized to solve the complications involved with bamboo sector development, considering their many responsibilities. In addition, there needs to be more collaborative development due to a lack of communication among implementers, researchers, policymakers, and institutions.

Finally, the respondents firmly agree that the lack of access to machinery for processing bamboo is a problem. Existing machinery is present in the region, but only certain institutions have access to it. A bamboo processor in Tarlac claims that due to the machinery's importation and high cost, most processors need assistance to access it. In addition, the machine's operation would necessitate significant knowledge and ability, which would impede accessibility.

Moreover, the limited research and development concerning innovation and the lack of natural resource management have been identified as weaknesses. Universities still need to enhance their research and development capabilities, and they must match the high level of industrial demand with the quantity and quality of relevant publications. The bamboo industry also views the need for natural resource management as a weakness. This lack of natural resource man-

agement, according to DENR, will have a lasting effect on the availability of raw materials. Insufficient harvesting and management procedures ultimately limit the system's capacity to produce high-quality handicrafts. Continuous innovation in product, technology, market, organizational, and institutional innovation is required to upgrade the bamboo industry in Central Luzon.

### 3.2.3. Opportunities

Listed in **Table 4** are the opportunities for the bamboo industry in Central Luzon.

Bamboo has tremendous potential to contribute to current timber resource limitations and satisfy rising demand. As confirmed by respondents, the expanding market potential of bamboo for value addition and as a wood substitute is a clear opportunity for the bamboo sector. The reduction of global and domestic wood resources has opened chances for bamboo to replace wood in various applications, particularly in construction. The global market enables the region to produce high-quality goods, particularly furniture and handicrafts, and expand its market share. Bamboo can be utilized as an alternative building material for rural housing, urban housing, ecotourism resorts, and interior and exterior design. The development of panels, boards, and composite materials for flooring, roofing, kitchen cabinets, interior décor, doors, windows, and positioning has been made possible by the advent of engineered bamboo. This would reduce reliance on wood, lower the import/foreign exchange load, and generate income and employment opportunities for smallholder farmers, semi-processors, and other companies. With the availability of traditional skill sets, suitable bamboo species, and promising domestic and international markets, the market for bamboo handicrafts and furniture is promising. There is also a growing need for household lifestyle products like lamp shades, flower vases, fruit vases, and wall-hanging decoration materials, all of which might be penetrated by the bamboo handicrafts sector.

The economic integration of ASEAN may be perceived as an opportunity. Although rival goods enter the country with zero or low tariffs, Philippine goods will enter the markets of other ASEAN nations under the same terms. Introducing items from rival nations will necessitate domestic manufacturers improving the quality of their goods. Competition inspires excellence in competitors. Research institutions in the area can and have been developing technology and procedures for the bamboo sector. The SUCs in the region are active industry participants, such as Tarlac Agricultural University, which primarily focuses on creating engineered bamboo, while the PSAU and PRIMSU are also focused on the propagation of bamboo species.

In a [33] article, 77% of respondents stated that plastic is the least environmentally friendly packaging material. Consumers are connecting with sustainable enterprises in previously neglected ways. Consumer satisfaction in developing and emerging economies is closely linked to climate change concerns, with



many consumers demanding firms commit to conserving nature and natural systems. This growing consumer interest presents excellent potential for bamboo-based products, as bamboo is known to be environmentally benign and contributes to climate change mitigation.

Another subsector that could introduce and elevate bamboo basketry or woven products is the tourism and packaging industry. Therefore, the Philippines' standing as a tourism destination has improved, as has Central Luzon. A robust tourism business boosts the local goods market among international and domestic travelers. We anticipate an increase in sales of bamboo-made handicrafts and works of art. According to the data, a small number of businesses in Central Luzon are already manufacturing high-end bamboo handicrafts. Establishing linkages and creating new markets in the horticultural, floricultural, and tourism subsectors is necessary to develop markets for these products. Additionally, we must focus our efforts on diversifying design, enhancing skills and capacity, improving tools and techniques, fostering cluster growth, providing handholding, and enhancing business development services. With continual, concentrated support and a specialized agency for promoting the handicraft subsector, it will be possible to serve both the large and developing home and export markets.

**Table 4.** Opportunities of the Bamboo Industry.

Opportunities	Weighted Mean	Verbal Interpretation	Verbal Description
The increasing market potential of bamboo for value-addition and as wood substitute.	3.58	Strongly Agree	The respondent viewed the statement as major opportunity.
ASEAN integration will promote innovation and efficiency in local bamboo industry in its bid to become competitive.	3.25	Agree	The respondent viewed the statement as an opportunity.
The existence of technology and innovations in the bamboo industry.	3.50	Strongly Agree	The respondent viewed the statement as major opportunity.
The availability of land for bamboo plantation.	3.56	Strongly Agree	The respondent viewed the statement as major opportunity.
The growing interest of market in consuming environment-friendly products.	3.22	Agree	The respondent viewed the statement as an opportunity.
The Philippines has improved its position as a tourist destination.	3.19	Agree	The respondent viewed the statement as an opportunity.
<b>Overall Weighted Mean</b>	<b>3.38</b>	<b>Strongly Agree</b>	<b>Major Opportunity</b>

### 3.2.4. Threats

Evident in **Table 5** are the threats of the bamboo industry in Central Luzon.

The bamboo industry in Central Luzon is not free from possible threats that may hinder its development. As evident from the result, the respondents acknowledged the multiple threats listed. Today, everything can be imported, including information and technology. Due to their low prices, China's bamboo items are flooding local markets and may effectively compete with local goods. Various materials and manufacturing techniques are being introduced to developing countries. This relates to one of the threats identified by the respondents, where bamboo industry workers are enticed to use another medium. Polymers, for instance, are gaining popularity as a material for home items. Substantial investments have been made in plastic manufacturing facilities, and plastic production is massive; as a result, the prices of the products are relatively low.

Government agencies support the business; however, policies incentivizing the construction of bamboo plants are required. If nothing is done, this will threaten the continuous supply of bamboo since it will limit the participation of farmers in production. Similarly, there are no product specifications that prevent bamboo use in high-level construction. Moreover, a recurrent threat to the sector is the stigma attached to bamboo products by customers. Local consumers' opinions of low quality are exacerbated by the low value and quality of products created by manufacturers who are incapable of producing superior products. This preconception makes buyers initially unaware of bamboo's characteristics and hesitant to acquire bamboo products as opposed to conventional wood products. People's perceptions of bamboo are shaped by their interactions with the material, *i.e.*, the present products and manufacturing processes. If this experience

**Table 5.** Threats of the Bamboo Industry.

Threats	Weighted Mean	Verbal Interpretation	Verbal Description
Bamboo products coming from China and neighboring countries at a low price.	3.69	Strongly Agree	The respondent viewed the statement as major threat.
The competition in modern quality and designs with other materials.	3.56	Strongly Agree	The respondent viewed the statement as major threat.
Bamboo industry workers are enticed to use another medium	3.47	Strongly Agree	The respondent viewed the statement as major threat.
There are no incentives to invest in bamboo plantation development or in pioneering industries.	3.42	Strongly Agree	The respondent viewed the statement as major threat.
No specifications for bamboo construction materials resulting in the non-use of bamboo in high-level constructions.	2.94	Agree	The respondent viewed the statement as a threat.

**Continued**

The consumers stigma on bamboo products.	3.28	Strongly Agree	The respondent viewed the statement as major threat.
<b>Overall Weighted Mean</b>	<b>3.39</b>	<b>Strongly Agree</b>	<b>Major Threat</b>

does not undergo a significant transformation, the stigma surrounding bamboo will persist, hence diminishing the performance of bamboo products.

Additionally, the shift in the political sector is determined as a threat by one respondent. He declared that local governments are crucial for leading or supporting the formulation of an economic development strategy. The shift in local dynamics may impact budget allocation, strategy implementation, and the prioritization of bamboo-related product execution.

#### 4. Recommendations

In light of the external forces impacting the bamboo industry in Central Luzon, it is imperative to formulate all-encompassing plans that take into account political, economic, social, technological, legal, and environmental aspects. First and foremost, it is crucial to establish political stability and implement supportive policies to promote sustainable practices. Furthermore, bolstering economic stability and improving access to financing will stimulate growth and entice investments. Furthermore, by increasing public knowledge about the environmental advantages of bamboo and confronting societal prejudices, it is possible to enhance the desire for bamboo products among consumers. Furthermore, allocating resources to technology and infrastructure will significantly improve the productivity of industries, particularly in geographically isolated regions. In addition, effectively managing legal intricacies through clear laws and strict enforcement would safeguard the interests of all parties involved. Ultimately, giving priority to sustainable practices will help reduce environmental dangers. The collaborative efforts are crucial for realizing the full potential of the bamboo industry in Central Luzon, promoting both environmental conservation and socio-economic progress.

Moreover, a notable area for development based on the strategic factors of the bamboo enterprise is production and marketing, as most enterprises rely significantly on manual labor for production and trade show participation for promotion. It is suggested that enterprises be capacitated to access machinery through training, skill development, and financial assistance. It is recommended to implement additional marketing strategies, such as partnerships with complementary stores, online marketing, and offering discounts and incentives. Furthermore, to address the industry's primary weakness, it is recommended that each province establish a bamboo treatment facility. This intervention will eliminate the extensive lead time of processors, which prevents them from accepting large orders from the client. Relatively, this will mitigate the most significant threat

**Table 6.** SWOT analysis matrix of the bamboo industry in Region III.

<b>Internal Environment</b>	<b>Strengths</b>	<b>Strategies to Build Strengths</b>
	<ul style="list-style-type: none"> <li>▪ Bamboo grows in various habitat in the Region.</li> <li>▪ Bamboo has short gestation period.</li> <li>▪ Bamboo is a versatile commodity.</li> <li>▪ Bamboo can produce a wide range of products.</li> <li>▪ There are Provincial Bamboo Industry Development Councils in each province of the region.</li> <li>▪ Inherent craftsmanship of bamboo manufacturers.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Invest in research and development to enhance bamboo cultivation techniques.</li> <li>▪ Foster collaborations between Provincial Bamboo Industry Development Councils to share best practices.</li> <li>▪ Provide training and incentives to further develop the craftsmanship of bamboo manufacturers.</li> <li>▪ Establish partnerships with technology providers to enhance bamboo processing capabilities.</li> </ul>
<b>Internal Environment</b>	<b>Weaknesses</b>	<b>Strategies to Eliminate/Lessen Weaknesses</b>
	<ul style="list-style-type: none"> <li>▪ There is a low volume of bamboo supply.</li> <li>▪ Inadequate supply of treated bamboo to meet the requirements of various bam-boo-based industries.</li> <li>▪ The bamboo industry has insufficient baseline data.</li> <li>▪ There is no one institution that is dedicated to overseeing the development of the bamboo industry.</li> <li>▪ Lack of access to machineries.</li> <li>▪ There is a lack of natural resource management.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Implement programs to increase bamboo supply through sustainable cultivation practices.</li> <li>▪ Develop infrastructure for treated bamboo production to meet industry demands.</li> <li>▪ Conduct comprehensive studies to gather baseline data for informed decision-making.</li> <li>▪ Advocate for the creation of a dedicated institution to oversee bamboo industry development.</li> <li>▪ Facilitate access to machinery through government support or partnerships with private sectors.</li> <li>▪ Implement effective natural resource management practices through community engagement and regulation.</li> </ul>
<b>External Environment</b>	<b>Opportunities</b>	<b>Strategies to Explore Opportunities</b>
	<ul style="list-style-type: none"> <li>▪ The increasing market potential of bamboo for value-addition and as a wood substitute.</li> <li>▪ ASEAN integration will promote innovation and efficiency in the local bamboo industry in its bid to become competitive.</li> <li>▪ The existence of technology and innovations in the bamboo industry.</li> <li>▪ The availability of land for bamboo plantation.</li> <li>▪ The growing interest of the market in consuming environment-friendly products.</li> <li>▪ The Philippines has improved its position as a tourist destination.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Capitalize on the increasing market potential by diversifying bamboo products and marketing them as sustainable alternatives.</li> <li>▪ Leverage ASEAN integration to adopt innovative practices and enhance competitiveness in the bamboo industry.</li> <li>▪ Invest in research and development to incorporate technology and innovations into bamboo production processes.</li> <li>▪ Identify and secure land for bamboo plantation expansion through partnerships with landowners and government agencies.</li> <li>▪ Develop marketing campaigns to promote the environmental benefits of bamboo products and capitalize on consumer interest.</li> </ul>

## Continued

External Environment	Threats	Strategies to Minimize Threats
	<ul style="list-style-type: none"> <li>▪ Bamboo products come from China and neighboring countries at a low price.</li> <li>▪ The competition in modern quality and designs with other materials.</li> <li>▪ Bamboo industry workers are enticed to use another medium.</li> <li>▪ There are no incentives to invest in bamboo plantation development or in pioneering industries.</li> <li>▪ No specifications for bamboo construction materials resulting in the non-use of bamboo in high-level constructions.</li> <li>▪ The consumers stigma on bamboo products.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Capitalize on the increasing market potential by diversifying bamboo products and marketing them as sustainable alternatives.</li> <li>▪ Leverage ASEAN integration to adopt innovative practices and enhance competitiveness in the bamboo industry.</li> <li>▪ Invest in research and development to incorporate technology and innovations into bamboo production processes.</li> <li>▪ Identify and secure land for bamboo plantation expansion through partnerships with landowners and government agencies.</li> <li>▪ Develop marketing campaigns to promote the environmental benefits of bamboo products and capitalize on consumer interest.</li> </ul>

posed by Chinese goods, as the business will be able to compete not only on price but also on quality.

Ultimately, the researcher developed strategic suggestions specifically designed to take advantage of strengths, address weaknesses, exploit opportunities, and mitigate threats identified within the industry after conducting a SWOT Analysis Matrix on the Bamboo Industry in Region III.

As shown in **Table 6**, the SWOT Analysis Matrix of the Bamboo Industry in Region III is presented along with corresponding strategies.

The development of the bamboo industry in Central Luzon is influenced by a combination of internal and external factors, each playing a crucial role in shaping its trajectory. Internal factors include the region's inherent strengths and weaknesses, such as the availability of bamboo in various habitats, its short gestation period, and the craftsmanship of local manufacturers. Additionally, the presence of Provincial Bamboo Industry Development Councils highlights local support and coordination efforts. However, challenges such as low bamboo supply volumes, inadequate treated bamboo availability, and a lack of baseline data hinder industry growth. Externally, opportunities arise from the increasing market potential of bamboo, driven by its versatility and eco-friendliness, as well as ASEAN integration promoting innovation and efficiency. The existence of technology and innovations in the bamboo industry, coupled with available land for bamboo plantation, further bolster prospects. Nevertheless, threats such as competition from cheaper imports, consumer stigma, and a lack of incentives for investment pose challenges. By addressing these internal and external factors strategically, the bamboo industry in Central Luzon can unlock its full potential for sustainable growth and socio-economic development.

## 5. Conclusion

Several internal and external factors ultimately determine the growth and development of the bamboo sector in Central Luzon, influencing its direction and capacity for expansion. In order to maximize its benefits and potential while minimizing its drawbacks and risks, it is essential to adopt an all-encompassing approach. Implementing strategies like committing resources to research and development, fostering partnerships, and addressing supply chain inefficiencies are crucial steps to improving the internal environment. Furthermore, the industry should capitalize on external opportunities by diversifying its product offerings, implementing technological advancements, and promoting sustainability. However, in order to effectively overcome challenges such as complex rules, competition in the market, and environmental risks, it is crucial to engage in collaborative efforts to advocate for favorable laws, enhance infrastructure, and foster community participation. By adopting a holistic approach to these factors and engaging in collaborative initiatives, the bamboo sector in Central Luzon can maximize its potential, thereby making substantial contributions to the region's economic progress, environmental conservation, and societal welfare. A comprehensive strategy involving cooperation among different players is necessary to resolve the supply chain inefficiencies in the bamboo business. Enhancing coordination and communication among individuals involved in the cultivation, processing, production, and distribution of bamboo is of utmost importance. Crucial measures include allocating resources to infrastructure and logistics, adopting technological innovations, and improving expertise and understanding throughout the supply chain. Facilitating supply chain optimization can be further enhanced by fostering relationships between the public and commercial sectors and leveraging government assistance and incentives. Through a collaborative effort to tackle these obstacles, the bamboo sector may surmount inefficiencies and unleash its complete capacity for economic advancement and ecological sustainability.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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