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ARTICLE

Understanding Agribusiness Models in the Bamboo Sector: A Case From Central Luzon, Philippines

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ABSTRACT

The Philippine bamboo industry represents a significant economic and environmental sector, characterized by its versatility, rapid growth, and rising global demand. This research aims to define the bamboo industry in Central Luzon and evaluate the business models of 36 registered bamboo enterprises under the Department of Trade and Industry's (DTI) Bamboo Industry Cluster, utilising the Business Model Canvas (BMC) framework. A descriptive quantitative design was utilized, employing total population sampling and a structured questionnaire validated by domain experts. The findings indicate that the majority of enterprises operate on a micro-scale, depending on self-financing, backyard sourcing, and manual production techniques. Desirability is rooted in specific customer segments and value propositions that emphasize environmental sustainability and artistic expression. Feasibility is enhanced by informal networks, referrals, and cooperative partnerships; however, it is limited by restricted capital, automation challenges, and a consistent supply of bamboo. Viability is achieved through lean operations and income diversification, with numerous enterprises reporting modest profits and alternative revenue streams from farming, non-bamboo products, and machinery rentals. The results underscore the need to enhance innovation capacity, institutional support, market access, and value chain integration. Recommendations include strengthening procurement policies, semi-mechanization, IP protection, and shared service facilities. The study offers a strategic analysis of the potential for local bamboo enterprises to achieve sustainability, competitiveness, and social inclu-

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sivity as catalysts for rural development and ecological resilience.

Keywords: Bamboo Enterprises; Business Model Canvas; Enterprise Models; Innovation Practices; Supply Chain Development

1. Introduction

The bamboo industry in the Philippines is a strategic sector poised for growth due to its ecological importance, diverse applications, and increasing global demand. The Philippine Bamboo Industry Development Roadmap [1] emphasizes that bamboo pole production and bamboo processing are the primary pillars of this industry. The country is home to 70 native bamboo species, comprising 53 erect and 17 ascending species, while approximately 30 more species have been introduced from China and are being cultivated in provinces such as Benguet [2, 3]. With over 100 species now present, excluding ornamental varieties, the Philippines ranks among the most bamboo-rich countries in Southeast Asia.

From building materials and furniture to food, handicrafts, musical instruments, and bioenergy, bamboo's adaptability is seen in its many end uses. With its premium, export-ready furniture, its multifarious utility has earned the nation the moniker "Milan of Asia", mentioned at the Philippine Bamboo Industry Development Roadmap [1] and the Official Gazette [4], requiring the use of bamboo for public school and government furnishings, has formalized attempts to mainstream bamboo production. Tasked with increasing bamboo-based research and supporting micro, small, and medium-sized businesses (MSMEs) via financing sources including SETUP and TAPI, the Department of Science and Technology (DOST) Complementary roles from the League of Municipalities of the Philippines (LMP) and the Department of Environment and Natural Resources (DENR) help to further highlight the integrated growth of the bamboo sector.

As demonstrated by the efforts of the CS 1st Agroindustrial Development Corporation, the Bamboo Technology and Development Park, Inc., and the Guevara Investment and Development Corporation Inc., private sector engagement is also increasing. Reflecting a cross-sectoral commitment to the industry's expansion, financial institutions, including Land Bank and Development Bank of the Philippines have set aside money for bamboo plantation development.

Bamboo is gaining recognition worldwide as a sustainable alternative to lumber. With great potential for landscape restoration and climate mitigation, economists and agronomists consider it "green gold" and a good replacement for tropical hardwoods [5, 6]. Driven mostly by rising demand in Asia-Pacific for bamboo furniture and sustainable materials, reports by Future Market Insights [7] anticipate that the worldwide bamboo market to rise greatly, with values reaching over US$ 110 billion by 2026. Although promising, the Philippine market nonetheless faces difficulty in satisfying its own rising domestic demand [8]. Domestically, bamboo is still essential for rural life; it is frequently utilized in daily cooking activities, household goods, and farm buildings [9]. Reiterating its dedication to building a sustainable bamboo sector, DENR [10], though still young, the country's engineered bamboo sector marks a move toward using high-value applications Department of Science and Technology - Forest Products Research and Development Institute (DOST- FPRDI) [11]. Though attempts are under way to modernize the industry, especially in important areas like Central Luzon, a strategic and comprehensive knowledge of business operations remains lacking.

Globally valued at US$72 billion in 2019, bamboo-based businesses have rich prospects for business growth, particularly in high-yield sectors [12]. Capture of this value depends critically on business model innovation. Originally developed by Osterwalder, the Business Model Canvas (BMC) provides a visual and strategic guide for evaluating corporate viability, desirability, and feasibility [13, 14]. Customer segments, value proposition, channels, customer relationships, income sources, cost structure, key resources, key activities, and key partners are nine linked blocks that the BMC framework splits

apart business dynamics [15, 16]. Given the growing potential of bamboo as a sustainable economic driver, it is necessary to assess how local bamboo businesses in Central Luzon run, especially in relation to their market orientation and structural initiatives. Although national and international statistics show a positive picture, knowledge of the ground-level application of business strategies that could enable local producers to scale efficiently still lags.

This study, therefore, aims to characterize the Central Luzon bamboo sector in terms of supply, demand, bamboo species, and market sectors. Moreover, it seeks to evaluate the strategic elements implemented by bamboo businesses using the BMC components, more specifically, desirability, feasibility. and viability. By doing this, our study adds to the larger discussion on how the Philippines may use creative ideas and organized business models to establish bamboo as a highly valuable sector both here and abroad.

2. Materials and Methods

This research utilized the BMC framework within a quantitative descriptive design to systematically characterize and assess bamboo enterprises in Central Luzon. The BMC was chosen for its comprehensive and adaptable framework, which facilitates the analysis of entrepreneurial dynamics through nine components: value propositions, customer segments, channels, customer relationships, key resources, key activities, key partnerships, revenue streams, and cost structures [15, 16]. The scattered and mostly informal framework of the bamboo industry in the Philippines required the BMC for strategic visualization of business operations, enabling insights at both macro and micro levels of enterprise management. The objective of this study is to record the real-time traits, practices, and operational choices of bamboo entrepreneurs, using a descriptive design.Descriptive research is regarded suitable for developing an accurate profile of people, events, or groups, so it acts as a useful tool for evaluating business activities inside the bamboo value chain [17].

The study covered all 36 registered bamboo enterprises linked to the Department of Trade and Industry (DTI) Bamboo Industry Cluster across the seven provinces of Region III: Aurora, Bataan, Bulacan, Nueva Ecija, Pampanga, Tarlac, and Zambales. These enterprises, classified as micro, small, or medium-sized, engage in activities ranging from bamboo pole processing to the manufacture of value-added products. A total population sampling method was used, including all active enterprises as of October 2022. This ensured full sector representation and minimized sampling bias given the small and well-defined population. Data were collected through a structured questionnaire with three parts: (1) enterprise profile, (2) strategic analysis based on the BMC, and (3) support mechanisms and perceived challenges.

Every item was designed to be particular and relevant for the bamboo sector, using different response strategies to enable more thorough and richer data collection. Content validation and reliability testing were done on the instrument before full deployment. Four domain experts, specifically those with expertise in agribusiness, cooperative development, and rural enterprise management, reviewed the questionnaire. Ten qualified bamboo-based businesses outside of Region III were pilot-tested to confirm the clarity, relevance, and usefulness of the changes. Cronbach's alpha was used to evaluate the instrument's internal consistency; the score obtained was higher than 0.7, indicating appropriate dependability for a quantitative study.

Depending on respondent accessibility and connectivity, data collection combined online questionnaires, phone interviews, and face-to-face field data gathering. This multimodal approach addressed the varying degrees of digital readiness among the participating companies and achieved high response rates. To support cross-verification of responses, secondary data were examined from the DTI, the DENR, the DOST, and the Department of Agriculture (DA).

Using three strategic criteria —desirability, feasibility, and viability —descriptive statistics, including frequency counts, percentages, and basic accounting formulas, were employed to assess enterprise strategies [18]. The three models provided a disciplined framework for combining the BMC components into meaningful interpretations on the scalability and sustainability of the ob-

served bamboo business models. The combination of primary and secondary data enhanced the dependability of the research, and the focus on BMC guaranteed conformity with globally accepted criteria in the analysis of innovation-driven entrepreneurship.

3. Results

3.1. The Status of the Bamboo Industry in Central Luzon

As of 2022, Central Luzon recorded a total bamboo plantation area of 3,875.67 hectares, encompassing both government-assisted sites and natural stands. This reflects the region's significant contribution to the country's bamboo resources and its potential for further industry development.

3.1.1. Demand

Bamboo matures in 3–5 years, making it a fast-growing alternative to hardwood. Returns are quicker, making it attractive for smallholder farmers. Central Luzon produces three types of bamboo products: processed bamboo, seedlings, and poles. As illustrated in **Figure 1**, the most commonly produced commodities include bahay kubo, sawali, handicrafts, and various manufactured goods.

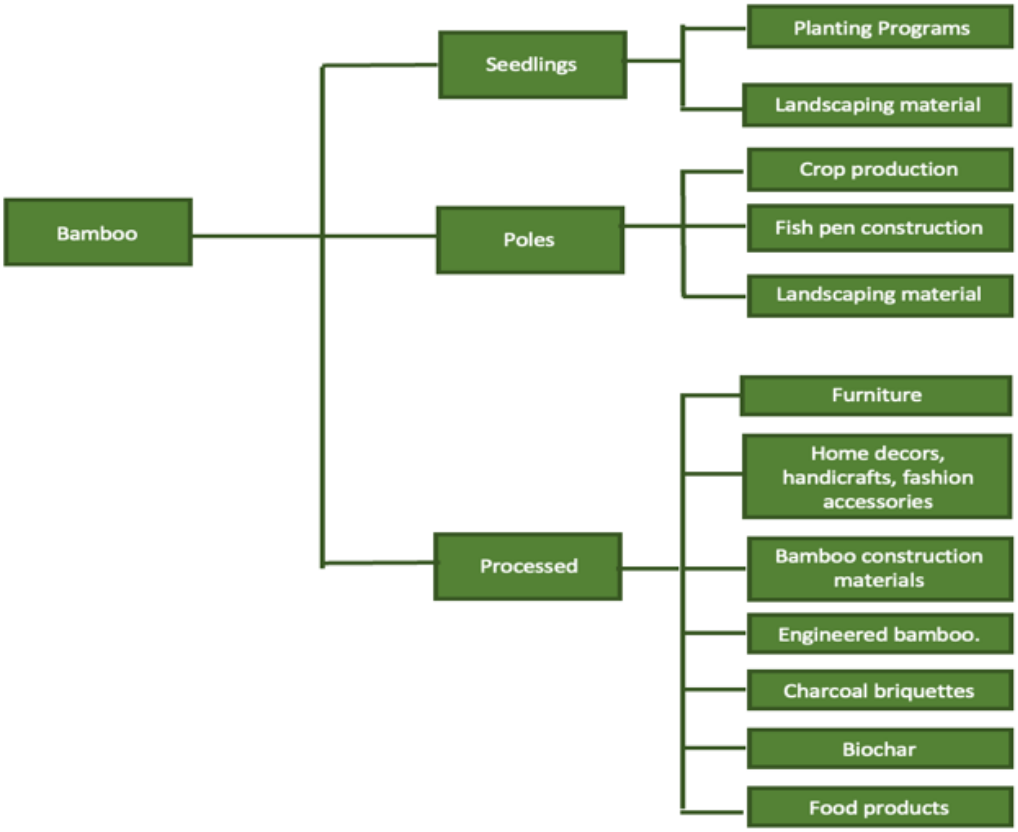

Figure 1. Product Formats.

3.1.2. Bamboo Species

Table 1 presents the various bamboo species cultivated in Central Luzon, highlighting Bayog and Kawayang Tinik as the most dominant species used for agriculture, aquaculture, and food products across the provinces. This result was gathered based on stakeholder consultations with bamboo industry players, as reported by the Department of Trade and Industry – Region III [19].

Table 1. Bamboo Species in the Region.

Province	Bayog	Tinik	Giant Bamboo	Kiling	Tsina	Bohong	Iron Bamboo	Botong
Aurora	■	■	■	■	■	■		
Bataan	■	■		■				■
Bulacan	■	■	■					
Nueva Ecija	■	■	■		■		■	
Pampanga	■	■	■	■	■	■	■	
Tarlac	■	■	■	■	■	■	■	
Zambales	■	■		■				

Legend: ■ Available specie in the province.

3.1.3. Market Segments

The bamboo value chain is divided into pole and processed production.

Figure 2 illustrates the bamboo value chain in Central Luzon, segmented into pole and processed product pathways. It outlines the flow from input provision to final sale, identifying key players such as input providers, farmers, processors, business enterprises, and consumers in both local and institutional markets.

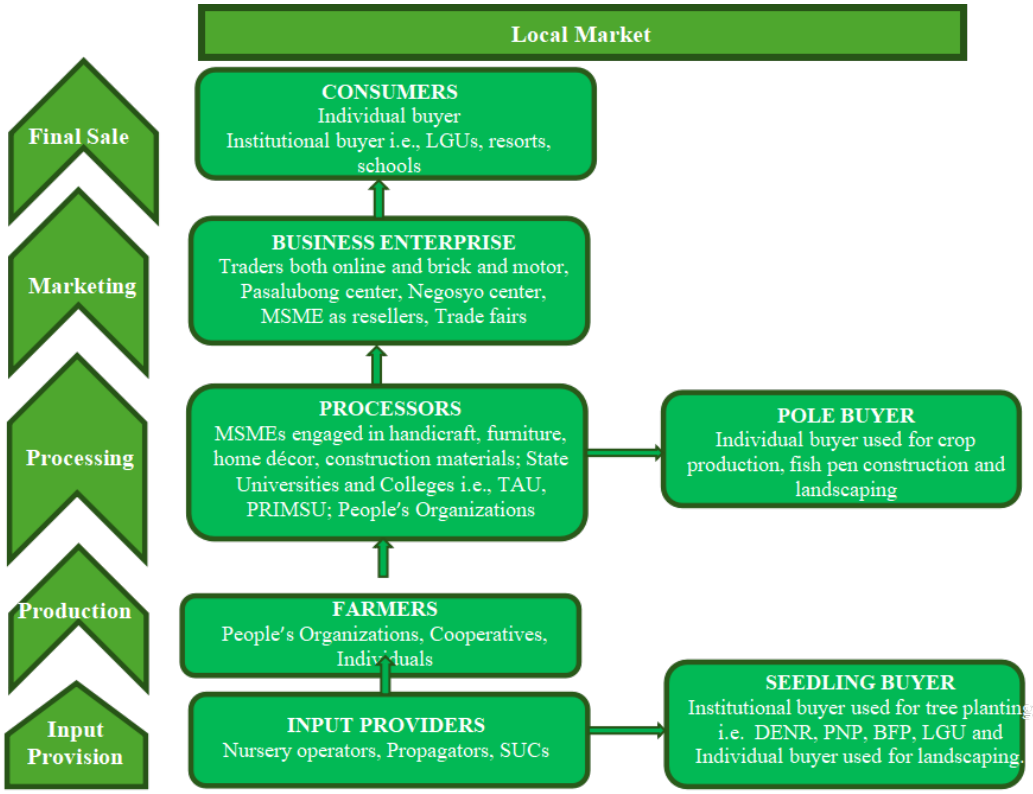

Figure 2. Marketing Segments of the Bamboo Industry in Central Luzon.

3.2. Desirability: Strategic Factors Based on the Business Model Canvas (BMC)

This section presents the strategic desirability factors implemented by bamboo enterprises in Central Luzon using the BMC framework.

Table 2 presents strategic desirability factors of bamboo enterprises based on the BMC. The data reflect a strong local market orientation, with most customers being individuals within the same municipality and purchasing for personal use. Customer engagement remains informal, mainly relying on basic feedback mechanisms and occasional after-sales support. Training investments and digital payment adoption are limited, suggesting low operational formalization.

Table 2. Desirability Factors.

Category	Response Option	Frequency	Percentage
Customer Segments			
Type of Buyers	Individuals	36	100%
	Institutions	20	56%
Location of Buyers	Within the municipality	30	83%
	Within the province	22	61%
	Within the region	18	50%
	Outside the region	8	22%
	Metro Manila	3	8%
Purpose of Buyers	For personal use	30	83%
	For business use	17	47%
	For donation/giveaway	14	39%
Customer Relationships			
After-sale Service	Assistance (e.g., installation)	13	36%
	Assurance (e.g., warranty)	11	31%
	Support (online/offline)	10	28%
	Usage guidance	7	19%
	Education/training	6	17%
	None	5	14%
Feedback Collection	Text/Chat	20	56%
	Online Review	18	50%
	Follow-up Emails	8	22%
	Repeat Purchase	3	8%
	Suggestion Box	0	0%
Employee Training	Product Development	14	39%
	Skills Management	7	19%
	Personality/Customer Service	2	6%
	None	16	44%
Channels			
Market Outlet	Production site	19	53%
	Home-based	9	25%
	Specialty store	9	25%
	Online stores	8	22%
	Public market/Shopping mall	6	17%
	Along the highway	4	11%
Mode of Delivery	Pick-up	27	75%
	Delivery with charge	12	33%
	Courier services	8	22%
	Meet-up	3	8%
Mode of Payment	Cash	36	100%
	Check	9	25%
	Online payment	8	22%
	Consignment	7	19%
	Cash on delivery	1	3%
Distribution Channel	Direct selling	25	69%
	Dual distribution	11	31%
	Intermediaries only	3	8%
Value Proposition			
Value-added Services	Artistic design	13	36%
	Customization	8	22%
	Free installation	2	6%
	None	12	33%
Market Perception	Reasonable	24	67%
	Environment-friendly	15	42%
	Durable	7	19%
	Sustainable	6	17%
	Unique/Credible	2	6%

Table 2. *Cont.*

Category	Response Option	Frequency	Percentage
Business Objective	Profit earning	22	61%
	Employment generation	15	42%
	Waste reduction	11	31%
	Climate change mitigation	11	31%
	Introduce innovation	9	25%

Distribution is characterized by direct, face-to-face selling, aligning with the grassroots nature of these enterprises. Value propositions center on artistic appeal and perceived affordability, reinforcing the dual economic and social motivations behind their offerings.

3.3. Feasibility: Strategic Factors Based on the Business Model Canvas (BMC)

Table 3 presents feasibility-related strategies of bamboo enterprises based on the BMC framework. A large majority are self-financed (83%), with minimal dependence on financial institutions (19%) or government grants (17%). Most enterprises source bamboo from owned land (64%), indicating a localized and self-reliant supply system.

Table 3. Feasibility Factors.

Category	Frequency	Percentage
Sources of Capital		
Fully financed by the owner	30	83%
Financial Institutions	7	19%
Grant from the Government	6	17%
Membership's share	3	8%
Family members	1	3%
Others	0	0%
Sources of Bamboo Poles		
Owned-produced	23	64%
Private institution	16	44%
Government	6	17%
Type of Production		
Purely Manual	27	75%
Partial Automation	12	33%
Full Automation	0	0%
Promotional Activities		
Referrals	29	81%
Trade fair participation	25	69%
Information dissemination	14	39%
Advertising	8	22%
Key Partnerships		
Information sharing	26	72%
Procurement of supply	12	33%
Competition	9	25%
Quality control	7	19%
Collective bargaining	4	11%
None	2	6%

Production is largely manual (75%), with no reported full automation, reflecting limited technological adoption. Promotion is driven by referrals (81%) and trade fair participation (69%), underscoring a community-based, low-cost marketing approach.

Key partnerships are mostly limited to informal information sharing (72%), while more structured collaborations like collective bargaining (11%) and quality control (19%) remain underutilized, signaling opportunities for improved coordination and scaling.

3.4. Viability: Strategic Factors Based on the Business Model Canvas (BMC)

This section discusses the cost structure and revenue streams of the bamboo enterprises in Central Luzon. These financial dimensions provide insight into the sustainability and scalability of operations, as well as diversification strategies employed to maintain profitability.

Table 4 presents the monthly income statement for a bamboo handicraft enterprise. From a gross sales revenue of ₱250,000, a 3% sales discount reduces the net sales to ₱242,500. The most significant expense component is direct labor (32%), followed by operating expenses (25%), direct materials (24%), and overhead (19%). Total expenses amount to ₱185,833.33, resulting in a net income before tax of ₱56,666.67 and a 30% return on expenses, indicating moderate profitability and cost efficiency.

Table 4. Monthly Income Statement – Handicrafts Production.

Particulars	Amount (₱)	Percent Share
Sales		
Sales Revenue	250,000.00	
Less: Sales Discount (3%)	7,500.00	
Net Sales	242,500.00	
Expenses		
Direct Materials	45,000.00	24%
Direct Labor	60,000.00	32%
Overhead	35,000.00	19%
Operating Expenses	45,833.33	25%
Total Expenses	185,833.33	
Net Income Before Tax	56,666.67	
Return on Expenses		30%

Table 5 shows the additional income sources of bamboo enterprises. Half of the respondents (50%) reported earnings from the sale of non-bamboo products, while 47% also engaged in farming as a secondary source of revenue. Other sources, such as income from waste materials (17%), tractor rentals (14%), and honoraria as speakers/trainers (8%), were less common. Notably, 33% of enterprises reported no other revenue source, reflecting varying levels of diversification across the sector.

Table 5. Other Sources of Revenue.

Other Sources of Revenue	Frequency	Percentage of Cases
Sale of non-bamboo products	18	50%
Farming	17	47%
Waste materials	6	17%
Rentals of tractors	5	14%
Honorarium as speaker/trainer	3	8%
Recreation fee	1	3%
None	12	33%
Multiple response; n=36		

4. Discussion

4.1. The Status of the Bamboo Industry in Central Luzon

Central Luzon presents considerable and strategic potential for the development of bamboo-based enterprises. This potential stems not only from the region's geographic centrality and accessibility but also from its well-established agricultural infrastructure and growing institutional ecosystem that collectively create favorable enabling conditions for a thriving bamboo economy. Such findings corroborate prior studies that emphasize the region's high suitability for bamboo propagation, cultivation, and subsequent market expansion [10]. Nonetheless, the region continues to encounter persistent constraints, which limit the full realization of its bamboo sector. Among these issues are inconsistent or poorly enforced quality standards, limited mechanization of production and processing systems, and fragmented logistical systems that hinder value chain inte-

gration. These ongoing challenges support observations raised in the Philippine Bamboo Industry Roadmap, which stressed the pressing need for stronger institutional coordination, inter-agency partnerships, and enhanced private sector involvement to scale up bamboo industry development across multiple nodes.

4.1.1. Supply

Based on data cited from the Department of Environment and Natural Resources – Region III [10], bamboo plantations in Central Luzon collectively cover a total land area of approximately 3,875.67 hectares. These include a combination of natural bamboo stands and plantations supported by government-initiated programs. Notably, provinces such as Zambales and Pampanga stand out for their higher bamboo production volumes, primarily attributed to long-standing agroforestry practices in upland and marginal areas. In support of ecosystem restoration goals, the DENR actively promotes bamboo planting, particularly in environmentally sensitive and degraded landscapes such as coastal zones and riverbanks, as a climate-resilient and regenerative intervention [20]. Concurrently, several local government units (LGUs) in Central Luzon have incorporated bamboo development into their localized climate adaptation and livelihood programs. However, despite these efforts, actual adoption rates among smallholder farmers remain low. Many farmers express reservations, driven by concerns about market volatility, limited awareness of technical protocols, prolonged maturity of bamboo stands, and insufficient capital investment for scaling.

Nursery Operation

Propagation activities in Central Luzon are primarily led by cooperatives and state universities and colleges (SUCs), notably those cited in Pampanga State Agricultural University (PSAU) [21], President Ramon Magsaysay State University (PRMSU) [22], and Tarlac Agricultural University (TAU) [23]. These organizations typically rely on basic propagation methods such as branch cuttings and nodal segmentation, which are aligned with low-cost, community-managed production systems. While accessible, this approach is largely dependent on funding support from government programs, such as the National Greening Program (NGP), raising concerns about its long-term viability and sustainability. Without the presence of secure off-take agreements or committed buyers, nursery operators often experience uncertainty regarding the future marketability of their planting materials. Furthermore, the lack of formalized systems for quality assurance, performance monitoring, and consistent data collection hinders the capacity of nurseries to scale their operations effectively. Addressing these gaps through the institutionalization of nursery networks, the standardization of protocols, and the implementation of incentive mechanisms remains a critical pathway for expanding bamboo supply sustainably.

4.1.2. Demand

The demand side of the bamboo value chain in Central Luzon is characterized by its diversity in product types and applications. The region is known not only for producing raw poles and planting materials, but also for a wide variety of semi-processed and fully processed bamboo products. These include traditional housing materials such as bahay kubo panels and sawali, as well as household and kitchenware like bamboo cutlery and décor, along with emerging green products like bamboo charcoal and biochar. Demand for these products varies considerably depending on the bamboo species, the diameter and age of the culms, and their moisture content. However, the majority of these transactions remain highly localized and seasonal, often occurring through informal networks. Cash transactions remain the dominant form of payment, highlighting the absence of credit mechanisms or digital payment systems. These findings reinforce the notion of a demand-driven but informally structured market with minimal price standardization, which was similarly noted by the Department of Trade and Industry. The limited visibility of market signals and the lack of coordinated pricing strategies contribute to inefficiencies and income instability among bamboo producers and traders.

4.1.3. Bamboo Species

Bayog and Kawayang Tinik remain the dominant bamboo species cultivated and utilized across most provinces in Central Luzon. Their continued prevalence is largely due to their multi-functional utility across various rural and urban applications, particularly in food preparation, housing construction, and handicrafts such

as woven furniture and decorative items. These species are highly adaptable to local agro-climatic conditions, making them preferable for farmers and artisans alike. In recent years, however, there has been a noticeable shift towards introducing newer and more specialized species into the market. For instance, Iron Bamboo, valued for its straightness and tensile strength, is being promoted for industrial uses such as engineered bamboo and construction-grade materials. Similarly, ornamental and speciality variants like Buho and Kiling are gradually gaining traction in landscaping, eco-tourism zones, and artisanal production. These species diversification trends are consistent with findings from Mishra and Kanchan [24], who observed an emerging shift in product differentiation strategies among bamboo stakeholders aiming to address niche markets and value-added applications.

4.1.4. Market Segments

The bamboo value chain in Central Luzon caters to a broad yet unevenly served set of market players, including individual consumers, LGUs, schools, cooperatives, and small to medium-sized enterprises (SMEs). Individual buyers remain the primary customer base for furniture, home accessories, and small construction needs, while institutional markets occasionally procure bamboo products through public greening programs and eco-facility improvements. SUCs and LGUs play catalytic roles in generating localized demand, often by integrating bamboo in climate resilience, construction, and community livelihood initiatives. However, the overall market landscape remains fragmented, with no unified distribution system or cooperative-led aggregation model to streamline supply and match demand. This condition creates bottlenecks for producers who struggle to reach broader or more lucrative markets.

4.2. Desirability: Strategic Factors Based on the Business Model Canvas (BMC)

Bamboo-based enterprises in Central Luzon exhibit high localization in terms of their client base, with 100% of businesses reporting that they cater primarily to individual or household buyers. Furthermore, 83% of these transactions occur within the same municipality or neighboring barangays, indicating limited geographic expansion. Commercial and institutional clients, such as corporations, resorts, or government contractors, are often underserved, with only 56% of enterprises consistently able to reach these segments. This signals a significant untapped opportunity to scale up operations and diversify the clientele through targeted marketing and value-added services. These patterns reinforce the findings of Cahiles-Magkilat [25], and Hassan et al. [26], Castillo [27], who underscored that most bamboo market activities in the Philippines remain hyper-localized due to barriers in logistics, brand recognition, and compliance with bulk procurement requirements.

4.2.1. Customer Relationships

Customer engagement in bamboo enterprises is predominantly informal, relying on word-of-mouth, repeat purchases, and basic communication channels. About 36% of businesses report offering after-sales services such as product repairs or replacements, while 56% collect customer feedback via text messages and 50% through online platforms like Facebook Messenger or community group chats. Despite these interactions, only 44% of enterprises provide structured or formal customer training or product orientation, which limits opportunities for deepening relationships. Nonetheless, these grassroots customer relations practices contribute to trust-building and incremental product improvements, as noted in studies by Chen [28] and Chron [29]. Enhancing these interactions with digital CRM tools or structured loyalty programs could unlock greater customer lifetime value and brand loyalty.

4.2.2. Channels

Distribution channels remain heavily reliant on direct, face-to-face transactions, with 69% of businesses conducting sales at production sites, roadside stalls, or their homes. Online selling platforms are slowly emerging, with 22% of respondents using them, although barriers remain in terms of digital literacy, logistics, and e-payment systems. Most deliveries are conducted via customer pick-up (75%), with minimal door-to-door delivery services offered. Cash payments are universal (100%), which limits opportunities for financing or installment-based sales. These grassroots approaches

mirror cost-sensitive business models rooted in community trust and familiarity, a trend similarly discussed in the study of Paychex[30] in their analysis of informal rural enterprise behavior.

4.2.3. Value Propositions

The core value propositions of bamboo enterprises in Central Luzon include artistic craftsmanship (36%), product customization to meet client-specific needs (22%), and eco-conscious production processes (42%) that appeal to sustainability-minded buyers. Enterprises often promote the renewable and biodegradable nature of bamboo as a selling point, aligning their messaging with environmental sustainability. Additionally, many operators pursue dual-purpose goals, with 61% identifying as profit-driven while 42% prioritize social objectives such as local employment generation, women's involvement, or community livelihood development. This blend of economic and social orientation reflects the hybrid mission framework discussed in Mishra and Kanchan[24] and Nurdiah[31], which recognizes the need for rural enterprises to balance income generation with broader developmental goals.

4.3. Feasibility: Strategic Factors Based on the BMC

4.3.1. Sources of Capital

A majority of bamboo enterprises (83%) report being self-financed, using personal savings or income from other livelihood activities to cover operational costs. Only a minority (19%) have accessed formal bank loans, often due to a lack of collateral, poor credit history, or unfamiliarity with lending procedures. Some businesses receive grants or assistance from government agencies such as the Department of Labor and Employment (DOLE), although these are often time-bound and project-specific. These findings support the conclusions of Gasingan[32], who noted that formal financial instruments, such as the LandBank's KAWAYAN program, have limited reach among micro and small bamboo enterprises due to eligibility and administrative barriers.

4.3.2. Bamboo Supply and Production

Raw materials are predominantly sourced from owned or community-managed bamboo stands, with 64% of enterprises relying on self-harvested supply. However, challenges persist, particularly in accessing processed bamboo such as treated poles or laminated boards, due to shortages, transportation issues, and limited post-harvest infrastructure[10]. Production is largely manual (75%), relying on hand tools and basic processing equipment. This limits volume and consistency, especially when fulfilling bulk or customized orders. Limited access to machinery is often attributed to capital constraints, lack of maintenance support, and insufficient technical training, reflecting broader challenges in achieving industrial-scale bamboo production.

4.3.3. Promotion and Partnerships

Marketing strategies are primarily informal, with 81% of businesses relying on word-of-mouth referrals and 69% participating in local trade fairs, pasalubong centers, or community events. While these channels are cost-effective, they provide limited reach and brand visibility. Approximately 72% of enterprises benefit from informal partnerships, such as knowledge exchanges with peers or support from barangay officials. However, structured collaborations such as standardized quality assurance programs (19%) and collective bargaining or pricing arrangements (11%) remain rare. This affirms Efti's[33] assertion that rural MSMEs suffer from weak cooperative structures, leading to reduced negotiating power and inconsistent product standards.

4.4. Viability: Cost Structure and Return on Expenses

The cost structure of bamboo enterprises reflects a lean operational model. Labor costs account for 32% of total expenses, followed by operating costs (25%) such as transportation, raw materials, and utilities. Despite minimal use of automation and limited access to high-volume distribution, enterprises report an average return of 30% on expenses. This moderate level of profitability suggests that small-scale bamboo enterprises can sustain operations and generate income under conditions of prudent financial management. Such outcomes

underscore the viability of bamboo-based business models when grounded in local knowledge, efficient resource use, and community-driven demand.

4.4.1. Other Sources of Revenue

Diversification plays a crucial role in enhancing enterprise resilience. Half of the respondents (50%) report revenues from non-bamboo products such as furniture from mixed materials, food products, or retail goods. Meanwhile, 47% supplement their income through agricultural activities, such as rice or vegetable farming, and 17% earn from waste material repurposing. These alternative income streams reflect adaptive strategies commonly adopted in rural settings, enabling entrepreneurs to navigate periods of fluctuating bamboo demand and seasonal variations. Such practices also align with broader literature on rural livelihood diversification as a buffer against economic shocks and market volatility.

5. Conclusion

This study examined the state of bamboo enterprises in Central Luzon using the BMC framework. The findings highlight a resilient microenterprise sector that continues to thrive despite limitations in capital, equipment, and formal market access. Many of these enterprises rely on locally available resources such as backyard-grown bamboo and manual labor, and are able to maintain modest profitability. The ability of some to diversify their income through farming, rentals, and bamboo by-products, such as charcoal, reflects strong adaptability and creativity among rural entrepreneurs.

Financially, the sector shows promise, with an average return on expenses of 30%. This suggests that, even with limited means, many enterprises are managing their costs effectively. However, structural constraints such as a lack of investment in mechanization, limited access to treated materials, and weak links to formal markets continue to restrict growth and prevent enterprises from reaching higher-value markets. While interest in sustainable bamboo products is growing, the lack of coordinated innovation, infrastructure, and institutional support remains a significant hurdle to scaling and achieving impact. To move beyond subsistence-level operations, a more holistic and inclusive approach is needed. Strengthening the local innovation ecosystem should include helping producers protect their designs and indigenous knowledge through intellectual property services. Encouraging product development and supporting transitions to higher-value items, such as engineered furniture or biodegradable packaging, can also open up new market opportunities. Design-thinking workshops, prototyping assistance, and curated exposure to local and international buyers can help shape the next generation of bamboo products.

Access to appropriate semi-mechanized tools must also be improved. With the right technology, microenterprises can boost both the volume and quality of production. Training programs, especially those that support women, youth, and indigenous peoples, should be designed to build technical skills, enhance product quality, and improve enterprise management. Here, LGUs and state universities can take a leading role in community-based training and enterprise development. Policy enforcement also plays a critical role. Stronger implementation of existing procurement policies, such as Official Gazette[4], can help create steady demand for bamboo products, particularly in public institutions. Alongside this, documenting and sharing local success stories can inspire other communities and build trust in bamboo enterprise models.

Ultimately, addressing logistical and supply chain challenges requires stronger, multisectoral collaboration. Establishing shared-service hubs equipped with tools for bamboo treatment, shaping, and quality testing can significantly enhance productivity, especially in areas with high production density. When designed to be inclusive and community-led, such interventions have the potential to transform bamboo enterprises from subsistence-based operations into competitive and sustainable rural industries.

To build on these findings, future research may extend the analysis beyond Central Luzon through comparative studies with other regions exhibiting similar enterprise dynamics. Moreover, incorporating consumer perspectives, particularly regarding design preferences, sustainability perceptions, and willingness to pay, would provide valuable insights for market-driven product de-

velopment and strategic positioning.

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Institutional Review Board Statement

Ethical review and approval were waived as the study involved minimal risk and no sensitive personal data. Participation was voluntary, with informed consent implied through questionnaire completion. The study followed the principles of the Declaration of Helsinki.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study prior to the conduct of interviews and questionnaire administration.

Data Availability Statement

Data supporting the findings of this study are not publicly available.

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Conflicts of Interest

The author declares no conflict of interest.

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