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Research Article

The Role of Bamboo in Promoting Sustainable Livelihoods in Mizoram, Eastern Extension of the Himalaya

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Abstract

Bamboo is one of the most important natural resources in tropical and subtropical regions that include among others Eastern Himalayas and Northeast India. Similarly, the state of Mizoram has abundant bamboo resources. The objective of this study was to examine the role of bamboo in promoting sustainable livelihoods in Mizoram, an eastern extension of the Himalaya. Data were collected from both secondary and primary sources. Secondary data were obtained from the Department of Environment, Forests, and Climate Change in Aizawl. For primary data collection, a case study of Tanhril village was conducted with the involvement of 35 households engaged in bamboo production and product marketing activities. Additionally, 20 shopkeepers of Chanmari market in Aizawl were interviewed to investigate the benefits of selling bamboo products. An observation method was also employed after field visits. The analysis revealed that bamboo has significant potential in enhancing the livelihoods of rural communities as it can be a subsidiary economic activity. The study findings indicated that the per capita income from bamboo product manufacturing is 11,000 INR (Indian Rupee.) per month, while the income from selling these products is 9,000 INR per capita and month. The key factors that affect bamboo production and utilization are underutilization of bamboo resources, deliberate burning of large bamboo culms and shifting cultivation in the study area. The study suggests that small-scale village-based bamboo industries can be established at the local level, with financial assistance from the state government to support artisans and enable them to sustain their livelihoods independently.

Keywords: Bamboo resource; Eco-system services; Small-scale bamboo industry; Climate change; Economic development

1 Introduction

Bamboo belongs to a subfamily of grasses and is widely distributed across tropical and subtropical regions. Bamboo forests cover a total area of 35 million hectares, representing approximately 1% of the global forest area (FAO, 2020). Bamboo is cultivated in Africa, Asia, and Central and South America (Buckingham et al., 2014). According to Liese and Kohl (2015), about 80% of the world's bamboo species and forests are located in tropical and subtropical Asia, particularly Southeast Asia. There are more than 1,663 species across 123 genera worldwide (Vorontsova et al., 2016; Wang et al., 2013). As an essential component of forest ecosystems, bamboo plays a significant role in environmental conservation and enhancing rural livelihoods.

Bamboo is a vital species for its native ecosystems, known for its high resilience, versatility, and unique properties. Bamboo forests provide habitats for biodiversity, reduce land degradation, stabilize slopes, produce oxygen, absorb heavy metals, and sequester carbon by removing it from the atmosphere. Additionally, bamboo releases 35% more oxygen than equivalent tree species (INBAR, 2019). Its root systems can purify water and have the capacity to recharge groundwater. With over 10,000 documented uses, bamboo serves as a sustainable alternative to plastics and is widely used for making paper and wood. It also provides housing, shade, and food for

millions of insect species, animals, and plants. Bamboo shoots are a popular vegetable, especially in Southeast Asia and Northeast India. As one of the fastest-growing plant species, bamboo can reach heights of up to 30 meters with a diameter of 30 cm and regenerates quickly after harvesting (Scurlock et al., 2000). Moreover, it is 100% biodegradable, making it an eco-friendly resource.

Bamboo is commonly known as the ”poor man’s timber” and serves as a major source of livelihood for rural communities, particularly those with limited alternative income options. Due to its growing economic and ecological significance, bamboo is now referred to as ”green gold.” Bamboo provides numerous ecological and economic benefits. On one hand, it contributes to ecological restoration and environmental conservation (Benzhi et al., 2015; Cai et al., 2021; Jiang et al., 2020; Zhu et al., 2021), controlling soil erosion and preventing landscape degradation. On the other hand, it provides food and shelter for both humans and animals. Additionally, bamboo serves as a significant carbon sink (P. Li et al., 2015; Venkatappa et al., 2020; Wang et al., 2013; Zhou et al., 2011) and plays a crucial role in climate change mitigation (Song et al., 2013) . Furthermore, bamboo-based industries, both large and small, generate income, create employment opportunities (Zhang et al., 2021) , and enhance rural livelihoods. Accurate mapping of bamboo forests can be valuable for resource planning, ecological protection, and economic development.

Bamboo, a primary source of livelihood, holds tremendous potential for sustaining rural economies as a natural raw material. It offers significant economic benefits by providing various tangible (Fig. 1) resources, including construction materials, handicrafts, fuelwood, and food (Nath et al., 2015; Partey et al., 2017) . Beyond its direct uses, bamboo is an integral component of rural farming systems, playing a crucial role in boosting local economies and enhancing rural livelihoods (Bajracharya et al., 2013; Dev et al., 2012) . It is considered one of the most valuable non-timber forest products (Hogarth & Belcher, 2013) . The bamboo industry has grown rapidly, contributing USD 60 billion in 2017 (INBAR, 2019) . In addition to its economic value, bamboo provides essential ecosystem services, including environmental conservation, soil erosion prevention, carbon sequestration, and the enhancement of scenic landscapes that support tourism (Liese, 2009) .

Bamboo has diverse applications, ranging from the production of high-value goods to climate solutions, carbon sequestration, and soil erosion control. Various bamboo-based products include toothbrushes, paper towels, sponges, single-use plates and cutlery, reusable water bottles, and coffee cups. In Northeast India, tribal communities use bamboo utensils for cooking rice and serve traditional wine in bamboo glasses. Bamboo is highly adaptable to different climates and soil conditions. It’s hard stems enable it to withstand and recover from severe calamities or damage. The shoots and culms of bamboo emerge from its dense rhizome root system, allowing for rapid regeneration and sustainable harvesting.

India is the world’s largest producer of bamboo, covering 11.4 million hectares, followed by China (5.4 million ha), Indonesia (2 million ha), and the Lao People’s Democratic Republic (1.6 million ha) (Y. Li & Feng, 2019; Yang et al., 2010) . India is home to 136 species of bamboo, whereas China has 39 species (Sun et al., 2015) . Despite being the largest producer, India’s share in the global bamboo trade is only 1% (UN, 2020). In India, the state of Mizoram ranks second in bamboo density and occurrence and 11th in overall bamboo production. It is often referred to as the ”Bamboo Queen” of the country. Bamboo forests in Mizoram are primarily concentrated in the five northern districts, whereas in the eastern (Champhai) and southern districts, bamboo distribution is relatively sparse due to higher altitudes. Bamboo is commonly found along riverbanks and abandoned jhum lands. Homestead bamboo cultivation is primarily practiced on non-arable land, though in some areas, it is also grown on arable land. Among Mizoram’s districts, Kolasib, Mamit, and Lunglei have the highest bamboo forest coverage.

Mizoram is home to abundant bamboo forests, hosting a rich diversity of species, including Melocanna baccifera (Roxb.) Kurz., Phyllostachys bambusoides Sieb., Schizostachyum dullooa Gamble, Teinostachyum wightii Beddome, and two unidentified species, locally known as Chingwa and Khupri. A significant portion of the population relies on bamboo-based products for their livelihoods. Bamboo is widely used for house construction, household items, kitchen utensils, agricultural implements, fishing devices, and as a food source in the form of bamboo shoots. Mizoram has a thriving small-scale bamboo industry, producing bamboo chips, ply boards, tiles, charcoal, and vinegar. Bamboo forests cover approximately 9,245 km², accounting for 44% of the state’s total geographical area (FSI, 2019). The region hosts a total of 35 bamboo species, of which 20 are indigenous and 15 have been introduced from outside (Sati, 2017) .

Bamboo in Mizoram has rich social and cultural significance. It is used in several fairs and festivals. Chapchar Kut, a festival, is celebrated in February every year. In this festival, the bamboo dance is performed in a large playground by hundreds of people in groups. The bamboo dance is also performed on various occasions. Bamboo shoots are another important food item and a staple in the diet of the people of Mizoram. Mizoram plays a significant role in India’s bamboo stock, contributing 125.8 lakh tonnes, which accounts for 3.1% of the country’s total bamboo area. Furthermore, it has an estimated 2,205 million bamboo culms out of India’s total of 23,297 million (FSI, 2019) . In Mizoram, bamboo grows mainly below 500. According to the Economic Survey of Mizoram (2023–24), bamboo-related activities generated a revenue of 1,304,160. Bamboo is deeply integrated into the daily lives and cultural traditions of the people of Mizoram. The famous Cheraw Dance, also known as the bamboo dance, showcases its cultural significance. Beyond tradition, bamboo plays a vital role in driving the socio-economic advancement of modern Mizoram.

Extensive literature on bamboo resources is available in publications by the (FAO, 2001, 2002, 2006; Londono, 2001; Pabuayon & Espanto, 1997). In India, the Department of Environment, Forests, and Climate Change has made significant contributions to bamboo research. However, studies specifically focusing on bamboo resources and their impact on sustainable livelihoods in Mizoram remain limited. This paper examines the role of bamboo in promoting sustainable livelihoods in Mizoram, the eastern extension of the Himalayas. The central research question is: How can bamboo resources be ef-

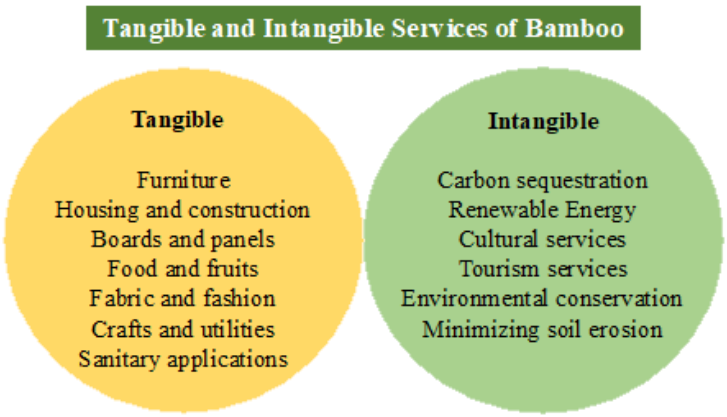

Figure 1: Tangible and intangible services of bamboo in Mizoram (Sati, 2023)

fectively utilized for sustainable livelihood development? The study analyses the potential of bamboo in terms of its distribution, area coverage, and species diversity. Additionally, it explores the dependency of local communities on bamboo-based products and their role in sustaining livelihoods through case studies. People's perceptions of the bamboo industry's contribution to livelihood sustainability were collected and analyzed. Finally, the paper offers recommendations on optimizing bamboo resources to enhance livelihoods. The study is guided by the hypothesis: "Optimal utilization of bamboo resources can significantly enhance livelihood opportunities."

2 Materials and method

2.1 Description of study area

Mizoram, a small state in the Republic of India, is located in the extreme south of Northeast India and is often referred to as the eastern extension of the Himalaya. It shares international borders with Myanmar to the east and south and Bangladesh to the west, making it the Indian state with the longest international boundary. Domestically, it is bordered by Tripura to the northwest, Assam to the north, and Manipur to the northeast, making it a landlocked state (Figure 2). Mizoram is part of the Indo-Myanmar biodiversity hotspot and is known for its rich ecological diversity. Of its total geographical area (21,087 km²), approximately 86% is forested, with bamboo forests covering around 40% of the total forest area.

The state's diverse landforms, including river valleys, floodplains, and rolling hills, contribute to its scenic beauty, earning it the titles "The Nightingale of India" and "The Land of Rolling Hills." Additionally, due to the prevalence of hilltop settlements, Mizoram is often referred to as "The Land of Highlanders." With a population density of just 52 persons per square kilometer (Census of India, 2011), Mizoram's population is sparsely distributed, with the majority concentrated in urban centers such as Aizawl and Lunglei. The state's economy is primarily agrarian, with more than 70% of the population engaged in agriculture. However, shifting cultivation (locally known as Jhuming) dominates agricultural practices, covering more than 50% of the arable land. Farmers engaged in this practice, known as Jhumias, often struggle with low crop production and productivity, which is insufficient to meet the needs of the growing population. Despite these challenges, Mizoram is endowed with abundant natural capital, including vast forests, rich bamboo resources, a pleasant climate, and ample water availability. Given the state's substantial bamboo reserves, marginal farmers have the potential to significantly improve their livelihoods by optimizing bamboo resource utilization.

2.2 Data Collection and Analysis

This study employed mainly qualitative approach, whereas some data were quantified. Data were gathered both from secondary and primary sources. The secondary data were gathered from the Department of Environment, Forest, and Climate Change, Aizawl. These data included district-wise total area, area under bamboo forests, bamboo types and their distribution, percentage of bamboo forests in each district, percentage of bamboo forests relative to the total forested area, and the distribution of bamboo forests across different forest divisions in Mizoram. Additionally, district-wise data on the number of culms, growing bamboo stock, estimated culms based on soundness in recorded forests, and key bamboo clusters in the Aizawl district were collected. For primary data collection, a case study of Tanhril village was conducted, surveying 35 households engaged in bamboo product-making. Additionally, 20 shopkeepers from Chanmari market in Aizawl were interviewed to assess the benefits of selling bamboo products. Data were also gathered through the participatory observation method during the field visits.

Sellers of bamboo products in Chanmari, Aizawl city, were interviewed regarding their monthly income and the benefits of selling bamboo. The study also analyzed people's perceptions of the role of bamboo in enhancing rural livelihoods and the challenges faced in developing small-scale bamboo industries. The collected data were further analyzed using the percentile method, descriptive statistical, correlation, and graphical representations. A map illustrating the distribution of bamboo in Mizoram was developed. Additionally, diagrams were created to depict the tangible and intangible benefits of bamboo.

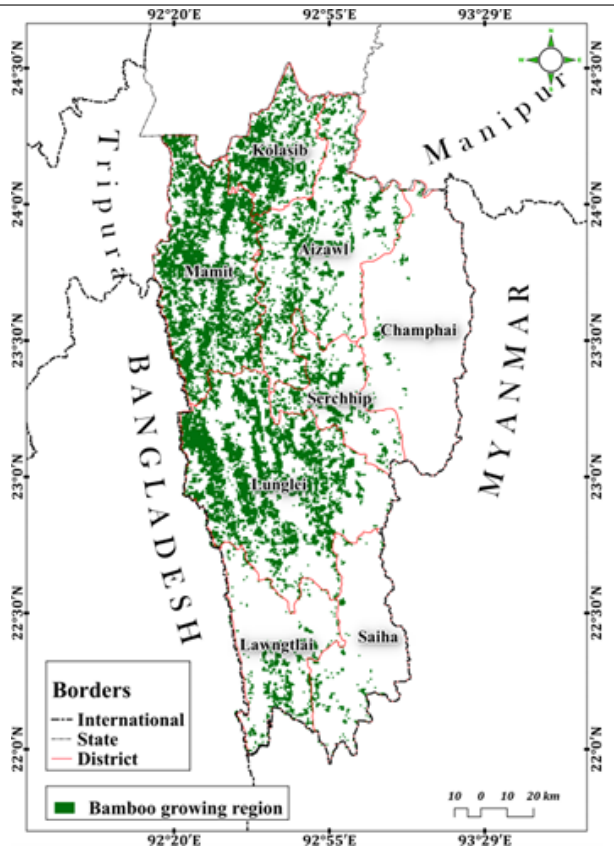

Figure 2: Distribution of bamboo in Mizoram, covering a large area of the state.

3 Results

3.1 Status of Bamboo Forests in Mizoram

Types of Bamboo and Area under Each Type

Mizoram has five types of bamboo: regenerated bamboo, bamboo without clumps, pure bamboo, scattered bamboo, and dense bamboo (Fig. 3). Dense bamboo covers the largest area, accounting for 66.15%, followed by scattered bamboo at 29.82%. Pure bamboo constitutes 2.44%, while bamboo without clumps covers 1.12%. Regenerated bamboo occupies less than 1% of the total bamboo area.

District-wise Area of Bamboo Forests

District-wise bamboo coverage as a proportion of the total area was analyzed and presented (Fig. 4). The highest bamboo-covered area was observed in Lunglei district, covering 1,956.59 km², followed by Mamit district (1,598 km²) and Aizawl district (927.69 km²). The remaining districts had less than 800 km² of bamboo coverage. The lowest bamboo-covered area was recorded in Champhai district, followed by Saiha and Serchhip. In terms of total forest area, Lunglei district had the largest coverage (4,538 km²), followed by Aizawl (3,576.31 km²), Champhai (3,185.83 km²), and Mamit (3,025.75 km²). The other districts had less than 3,000 km² of forest area.

District-wise Area Percentage of Bamboo Forests

This section presents the percentage of bamboo-covered area relative to the total area of each district, as well as the percentage of bamboo area out of the total bamboo coverage in Mizoram (Fig. 5).

Percentage of Bamboo Area to the District Area

Mamit district had the highest percentage of bamboo-covered area relative to its total district area (52.81%), followed by Kolasib (47.87%) and Lunglei (43.12%). The lowest bamboo coverage was recorded in Champhai district at 10.85%. Aizawl district had 25.94% bamboo coverage, while Lawngtlai had 28.58%. Saiha and Serchhip districts had nearly equal bamboo coverage, approximately 30

Percentage of Bamboo Area Out of Total Bamboo Area

The district-wise bamboo area as a percentage of the total bamboo-covered area was analyzed. Lunglei district had the highest proportion of bamboo forests (27.59%), followed by Mamit district

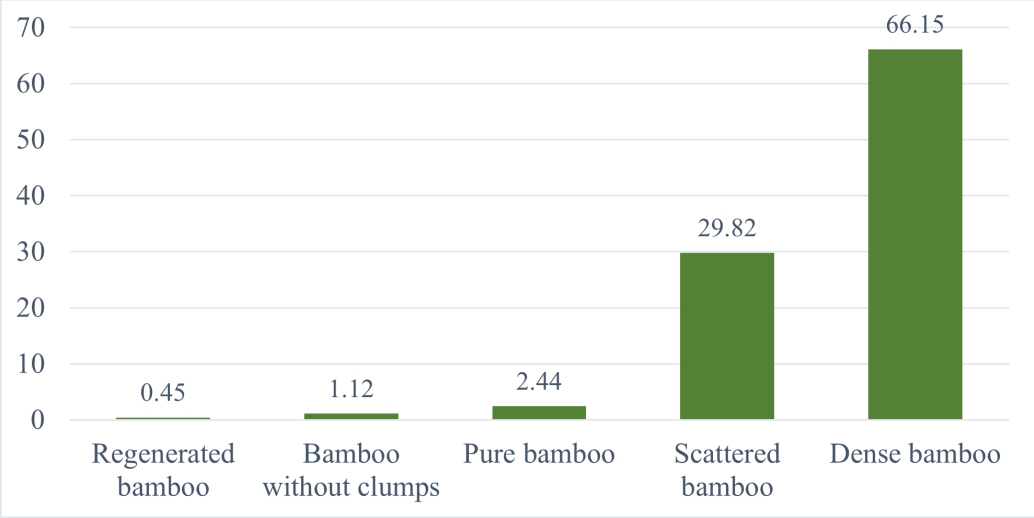

Figure 3: Type of bamboo forests and the area (%) under each type

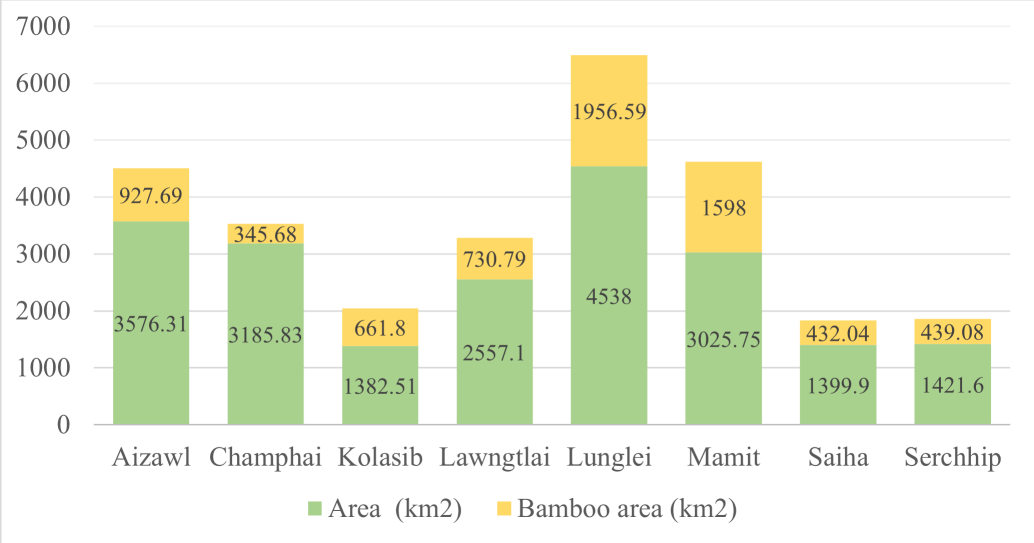

Figure 4: District wise bamboo area out of the total area of each district.

(22.53%). Aizawl district accounted for 13.08% of the bamboo forests, while Lawngtlai district had 10.3%. The remaining districts had less than 10

3.2 Forest Division-wise Distribution of Bamboo Area in Mizoram

Mizoram has 14 forest divisions, which include national parks and wildlife sanctuaries. The total area and bamboo-covered area of each division vary, as do the total number of culms and the growing stock area. Among these, the Thenzawl, Mamit, and Lunglei forest divisions have the highest bamboo coverage. In terms of the percentage of bamboo forests relative to the total forest division area, Dampa Wildlife Sanctuary has the highest proportion, followed by the Kawrthah and Mamit forest divisions. Thenzawl, Lunglei, and Mamit forest divisions have the highest number of bamboo culms. Regarding total growing stock, the highest figures are recorded in the Thenzawl, Kolasib, Lunglei, Darlawn, and Mamit forest divisions.

Number of Culms and Growing Stocks

The number of culms and total growing stock were examined and presented (Fig. 6). The total number of culms (in millions) was highest in the Lunglei district (1,558 million), followed by the Mamit district (1,062 million) and the Aizawl district (1,021 million). The lowest number of culms was recorded in the Champhai district (297 million), Saiha district (355 million), and Serchhip district (438 million). The Kolasib and Lawngtlai districts had a moderate number of culms. In terms of district-wise growing stock, the highest volume was recorded in the Lunglei district (6,109 m3), followed by the Mamit district (4,164 m3) and the Aizawl district (4,004 m3). Three districts—Kolasib, Lawngtlai, and Serchhip—had growing stock ranging between 2,800 and 1,720 cubic

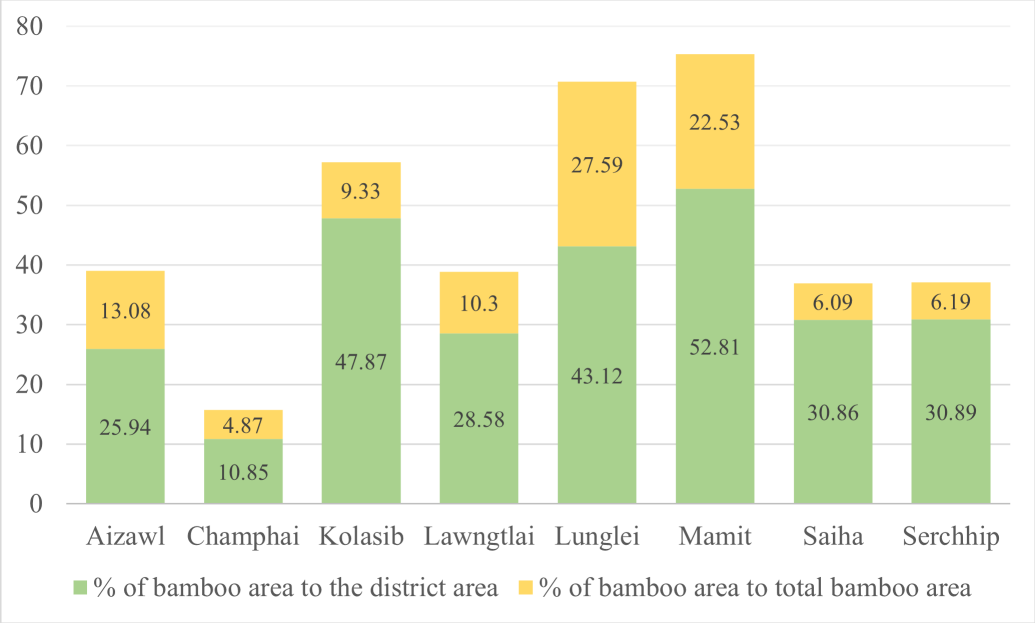

Figure 5: Percentage of Bamboo Area Relative to District Area and Total Bamboo Area. Source: EFCC (2023), Government of Mizoram.

meters. The Saiha and Champhai districts had the lowest growing stock.

Number of Estimated Culms by Soundness

There are three estimated types of culms based on soundness in the recorded forests of Mizoram—green culms, dry culms, and decayed culms (Table 1). Mizoram has 1,953 million green culms, 185 million dry culms, and 67 million decayed culms (FSI, 2019). Green culms have the highest quantity, accounting for 88.57%, followed by dry culms (8.39%). Decayed culms have the smallest quantity (3.04%).

3.3 Correlation Analyses

The bamboo area, total number of culms, and total growing stock were analyzed (Table 2). It was observed that the bamboo area is highly correlated (0.951) with both the total number of culms and the total growing stock. Furthermore, the total number of culms and the total growing stock exhibit a perfect correlation (1.000), indicating a direct proportional relationship.

3.4 Area, Number of Culms, and Growing Stock of Bamboo

Mizoram has a total area of 21,087 km², of which 7,091.67 km² is covered by bamboo forests, representing 33.63% of the total area (Table 3). Across the eight districts of Mizoram, the mean bamboo forest area is 886.46 km², with a maximum of 1,956.59 km² and a minimum of 345.68 km². The highest percentage of bamboo forest area relative to the district's total area is 52.81%, while the lowest is 10.85%, with a mean of 33.86%. Similarly, the mean percentage of bamboo forest area relative to the total bamboo forest area is 12.50%, with a maximum of 27.59% and a minimum of 4.87%. These figures indicate the availability of sufficient bamboo forests as a raw material source, which can be utilized for making bamboo crafts and other articles, thereby enhancing livelihoods.

Mizoram is rich in bamboo culms and growing stock. It has a total of 6,123.74 million culms and a growing stock of 24,014 cubic meters (Table 4). Across the eight districts, the mean total number of culms is 765.47 million, while the mean growing stock is 3,001.77 cubic meters. The maximum values recorded are 1,557.85 million culms and 6,108.97 cubic meters of growing stock, whereas the minimum values are 296.64 million culms and 1,163.26 cubic meters, respectively.

3.5 Bamboo Clusters in Aizawl District

Mizoram has five bamboo clusters, each specializing in the production of bamboo products (Table 5). The highest number of artisans is in the Hnam cluster, followed by the Lengpui cluster, while the other three clusters have an equal number of artisans. These bamboo clusters produce a variety of bamboo crafts and sell them in major cities across Mizoram. The primary bamboo products include computer brooms, floor brooms, bamboo containers, flower vases, tea coasters, bamboo hangers, vases and plates, and basket-coiled bowls. Each cluster specializes in different bamboo products.

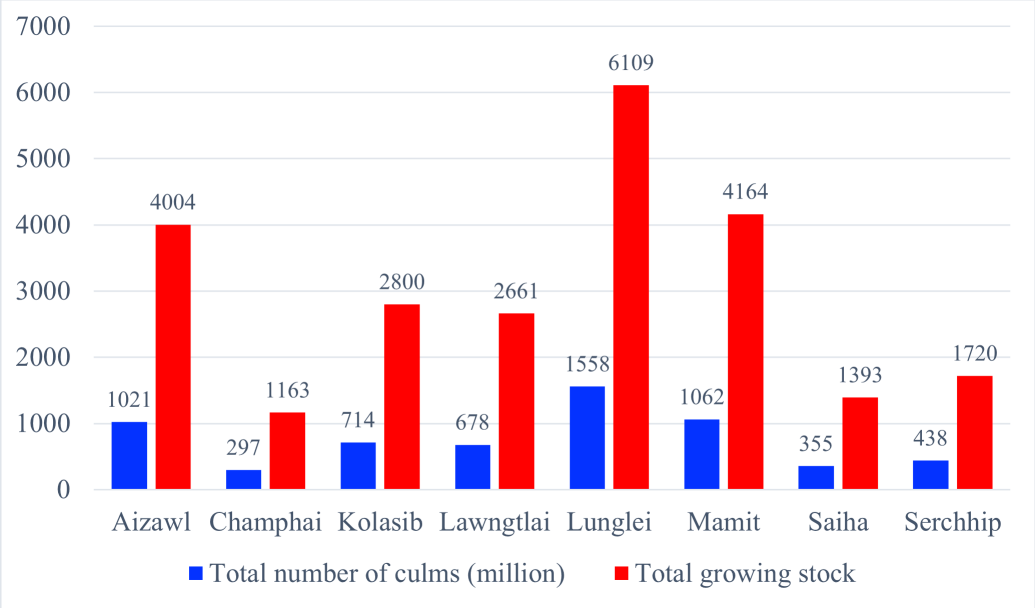

Figure 6: Total number of culms and the total growing stocks

Table 1: Number of estimated culms by soundness in recorded forests of Mizoram

S. No.	Estimated culms by soundness	Quantity (in m)	Quantity (%)
1	Green Culms	1953	88.57
2	Dry Culms	185	8.39
3	Decayed	67	3.04
4	Total	2205	100

Source: EFCC (2023), Government of Mizoram.

3.6 Economic Benefits of Bamboo Products

A case study was conducted involving 35 heads of households engaged in bamboo product manufacturing and 20 shopkeepers involved in selling these products (Table 6). The artisans produce bamboo items using traditional methods without modern technology and with limited facilities (Fig. 7). These products are sold in the local market, yielding modest profits. The study findings indicate that the per capita income from bamboo product manufacturing is INR 11,000 per month, while the income from selling these products is INR 9,000 per capita per month.

3.7 People's Perceptions of Bamboo Industry as an Option of Livelihoods

The perception of 60 households in Tanhril village regarding the bamboo industry and its role in livelihood enhancement was studied (Table 7). Several related questions were asked. About 16.7% of respondents were unaware of small-scale industries. Among the households, 58.3% were engaged in small-scale bamboo industries; however, only 41.7% were able to sustain their livelihoods through this work. Government subsidies are minimal, and market facilities are inadequate, though raw materials are readily available. Many respondents believe that small-scale bamboo industries can enhance livelihoods and that increased government support and subsidies could help make the bamboo industry more sustainable.

Mizoram has 10 major bamboo-related institutions. These institutions play a crucial role in promoting bamboo industries for sustainable livelihoods. They collaborate with industries, banks, foreign agencies, enterprises, research organizations, and social forums. Many individuals are employed in these institutions, contributing to the growth and development of the bamboo industry. Principal bamboo institutions in Mizoram promoting bamboo products for enhancing rural livelihoods are:

1. Mizoram Bamboo Mission
2. Mizoram Bamboo Development Agency
3. Department of Commerce and Industry
4. NABARD
5. Mizoram State Rural Livelihood Promotion Society
6. Rural Self Employment Training Institutes (RSETI)
7. Foundation of Micro Small and Medium Enterprises (MSMEs) Clusters
8. Evangelical Social Action Forum (ESAF)
9. PRIMAX Corporation, Taiwan
10. Advanced Research Centre for Bamboo and Rattan, Aizawl

Table 2: Correlation among bamboo area, total number of culms, and the total growing stock

Variables	**Bamboo Area (km^2)**	**Total No. of Culms (million)**	**Total Growing Stock (m^3)**
Bamboo Area (km^2)	1.000	0.951	0.951
Total No. of Culms (million)	0.951	1.000	1.000
Total Growing Stock (m^3)	0.951	1.000	1.000

Source: EFCC (2023), Government of Mizoram; analysed by the author.

Table 3: Bamboo area to district area and total bamboo area (n=8)

Statistic	Area (km^2)	Bamboo area (km^2)	% of bamboo area to district area	% of bamboo area to total bamboo area
Mean	2635.88	886.46	33.86	12.50
Maximum	4538.00	1956.59	52.81	27.59
Minimum	1382.51	345.68	10.85	4.87
Standard Deviation	1167.18	588.82	13.52	8.30
Sum	21 087	7091.67	270.92	100

Source: EFCC (2023), Government of Mizoram; analysed by the author

4 Discussion

This study reveals that Mizoram has abundant bamboo resources, a high number of culms, and significant bamboo stock. However, these vast resources have not yet been utilized sustainably. Mizoram is among the Indian states where infrastructural facilities, such as transportation and markets, remain limited. Bamboo forests are located in remote areas with steep and inaccessible terrain. Additionally, rural settlements are sparsely distributed, and population density is low. Furthermore, shifting cultivation is widely practiced in Mizoram, leading to the annual burning and clearing of bamboo forests for crop cultivation. As a result, two key factors contribute to the underutilization of bamboo resources. First, bamboo forests remain unutilized and gradually degrade over time. Second, large portions of bamboo forests are deliberately burned to make way for shifting cultivation.

A small proportion of the population is engaged in making and selling bamboo products. However, due to inadequate market facilities, these products are primarily sold in local markets and consumed domestically. This study highlights that Mizoram has a diverse range of bamboo species, with dense bamboo being the most dominant. Three northern districts—Kolasib, Mamit, and Aizawl—have the largest bamboo-covered areas, while Champhai district has the least bamboo forest coverage. In terms of the percentage of bamboo forest relative to district area, Mamit, Kolasib, and Lunglei rank the highest, indicating strong potential for establishing small-scale bamboo industries. Additionally, an analysis of the proportion of bamboo forests to the total bamboo area reveals that Lunglei has the highest bamboo coverage, followed by Mamit and Aizawl. The data suggests that four districts—Kolasib, Mamit, Lunglei, and Aizawl—possess the highest bamboo forest cover across all measured categories, making them key regions for bamboo-based economic activities.

There are 14 forest divisions, including national parks and wildlife sanctuaries, spread across all eight districts of Mizoram. Five forest divisions—Thenzawl, Kolasib, Lunglei, Darlawn, and Mamit—have particularly high potential for establishing bamboo industries and promoting sustainable livelihoods. In terms of the number of bamboo culms, Mizoram holds a significant position in India. At the district level, Lunglei, Mamit, and Aizawl rank the highest. Similarly, these three districts have the largest total growing bamboo stocks, highlighting their strong potential for bamboo-based industries, which can play a crucial role in livelihood sustainability. To support this, the State Government has established bamboo clusters in various locations to produce bamboo products. This study selected five key bamboo clusters, where numerous artisans are engaged in crafting and selling bamboo products in the local market. Each cluster specializes in specific products. The Government of Mizoram actively promotes these clusters by providing financial aid to support their growth.

Table 4: Total number of culms and total growing stock in Mizoram

Statistical Measure	Total no of culms (million)	Total growing stock (cubic meter)
Mean	765.47	3001.77
Maximum	1557.85	6108.97
Minimum	296.64	1163.26
Standard Deviation	401.45	1574.91
Sum	6123.74	24 014.14

Source: EFCC (2023), Government of Mizoram

Table 5: Key bamboo clusters in Mizoram

Cluster	Artisan No.	Major Products	Specialization
Hnam Cluster	360+ Artisans	Computer broom, floor broom, bamboo container, flower vase & tea coaster	Bamboo brooms & containers
Lengpui Cluster	75+	Bamboo Hanger	Bamboo Hanger
Sesawng Cluster	50+	Basket Coiled Bowls, Vases & Plates	Basket Coiled Bowls, Vases & Plates
Edenthar Cluster	50+	Bamboo container, Flower vase & Tea Coaster	Flower vase & Tea Coaster
Chite Cluster	50+	Bamboo container, Flower vase & Tea Coaster	Bamboo container

Source: Cluster observatory – FMC, Aizawl.

Table 6: Monthly income (INR) of people involved in making and selling bamboo products

Variables	Making ($n = 35$)	Selling ($n = 20$)
Input	35 000	540 000
Output	420 000	720 000
Net income	385 000	180 000
Per capita income	11 000	9000

Source: By author.

An input-output analysis of bamboo product manufacturing and sales reveals that small-scale bamboo industries can play a significant role in generating income, boosting the economy, and enhancing livelihoods, particularly in regions like Mizoram, where the economy primarily depends on traditional crop cultivation and the collection of non-timber forest products (NTFPs). However, this potential can only be realized if adequate market facilities and strong support from the State Government are provided. It has been observed that only a small proportion of the population in Mizoram is engaged in the bamboo industry, despite its substantial economic viability. Therefore, expanding participation in the bamboo sector could significantly improve livelihood sustainability. Public perception of the bamboo industry and its role in livelihood enhancement is generally positive. Although only a limited number of people are currently involved in the industry, they hold an optimistic view regarding the establishment of small-scale bamboo enterprises in rural areas. If adequate infrastructure, market facilities, and financial support from the State Government are ensured, bamboo could become an important source of sustainable livelihood in Mizoram.

Bamboo forests play a multifaceted role in generating income, boosting the economy, enhancing livelihoods, and conserving the environment. However, the economic condition of bamboo artisans remains poor, as they primarily belong to vulnerable communities. These artisans have limited ownership of and access to resources, markets, advanced production technologies, and insights into market trends. Most bamboo artisans are landless and do not own any farmland. As a result, their economic output remains low, with an estimated average monthly income of only INR 11,000, contributing to their continued financial hardship.

The bamboo industry presents both opportunities and challenges. The key opportunities include livelihood enhancement, revenue generation, entrepreneurship development, and sustainable growth. However, the industry also faces significant challenges, such as inadequate infrastructure, limited market access, and a lack of skill development. Government initiatives to establish bamboo industries and promote sustainable livelihoods remain limited. Some existing efforts include bamboo policies, financial assistance, research and development, skill development programs, infrastructure development, technology upgrades, market linkages, skill enhancement, and the promotion of sustainable practices. The Government of Mizoram has launched several measures for the promotion of bamboo industries in the state. However, frequent changes in government every five years disrupt these promotional efforts.

Only a few people in the state are involved in the promotion of bamboo-based industries. Most of them practice small-scale industries using traditional methods, without modern technology. As a result, the economic benefits are minimal. In comparison, other northeastern states of India have shown better performance in bamboo-based industries than Mizoram. However, there is considerable potential for developing small-scale industries in the state.

On the environmental front, the impact of bamboo depletion is severe. Large-scale cutting of bamboo on fragile slopes leads to significant soil erosion, which in turn reduces the fertility of the surface soil. In Mizoram, bamboo covers more than 50% of the total area, yet it remains largely underutilized. Additionally, bamboo is often cut and burned to prepare land for shifting cultivation. It was observed that shifting cultivation is mainly practiced in bamboo-covered areas, leading to serious environmental consequences.

Figure 7: (a) an old artisan is making bamboo basket (b) bamboo handicrafts are hanging at the shop in Chanmari, Aizawl

Table 7: People's perception of bamboo industry and its role in livelihood enhancement ($n = 60$ HHs)

Questions	**Yes (%)**	**No (%)**	**Don't know**
Do you know about small-scale bamboo industry?	83.3	16.7	
Is there any small-scale bamboo industry in your village?	83.3		16.7
Are you engaged in small-scale bamboo industry?	58.3	41.7	
Is it sufficient to carry your livelihood optimally?	41.7	58.3	
Is there any government support/subsidy to small-scale bamboo industry in your village?	50.0	50.0	
Is market facilities enough for bamboo industries?	33.3	66.7	
Is raw material enough and free to bamboo industries?	58.3	41.7	
Do you think that more small-scale bamboo based industries can enhance livelihoods in the village?	66.7	33.3	
Can government support/subsidy make bamboo industry sustainable?	66.7	33.3	

Note: HHs = Households; – indicates no responses.

5 Conclusion

Bamboo is a vital resource that plays a significant role in promoting sustainable livelihoods, particularly in regions where the rural population relies on traditional agriculture and forest resources. This study reveals that Mizoram has abundant bamboo resources, distributed across almost the entire state. The region possesses a vast number of bamboo culms and substantial bamboo stock. However, the utilization of bamboo remains minimal. Only a small portion of the population is engaged in the bamboo industry, and the income generated from it is insufficient. Rural communities in Mizoram face significant economic hardships, with most people being marginal farmers who rely on traditional agricultural practices, primarily shifting cultivation, which yields low output. Many also depend on forest-based resources for their livelihood. This study suggests that Mizoram has immense potential to develop its bamboo industry by producing bamboo articles, furniture, and crafts. Currently, only a few artisans are involved in crafting handicrafts and agricultural tools for domestic use, which is not sufficient to fully harness the state's bamboo resources. Establishing small-scale bamboo industries at the village level could provide economic opportunities for rural communities. Collaboration between government agencies and local communities is essential to support sustainable livelihoods. Training programs can be introduced to enhance artisans' skills, and more individuals can be encouraged to participate in the bamboo industry. Additionally, providing adequate infrastructure and market facilities will help boost bamboo-based enterprises. Implementing these measures will significantly contribute to strengthening sustainable rural livelihoods in Mizoram.

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