



Growth in area and production of bamboo in North Eastern Region of India

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ABSTRACT

The present study was carried out based on secondary data on area and production of bamboo in India with the objective to analyze the growth in area and production from 2011 to 2021. Compound Annual Growth Rate (CAGR) and Cuddy Della Valle instability Index was calculated using time series data on export of bamboo and its products from (2009 -2020). The results showed a positive growth in area (7.07%) and production (128.94%) of bamboo resources of the country. North Eastern Region occupies 35.79 per cent of total bamboo area of 14.94 million hectares and 45.62 per cent of production of 53336 million bamboo culms and the production was highest in the state of Arunachal Pradesh (8824 million) followed by Assam (5656 million) and Nagaland (2705 million) during 2021. The CAGR of export was significant at 31.25 per cent in terms of quantity and 7.66 per cent in value terms. There was high instability in net quantity exported than the trade value. The growth in the bamboo resources implies the potential of the region in exporting of bamboo and its products by involving rural youth in the sector which would increase employment generation and income.

1. Introduction

North Eastern Region (NER) of India is the easternmost part of the country. Total geographical area of the region covering eight states of the country is 2,62,230 square kilometres which is almost eight per cent of that of India. Bamboo is one of the important NTFP providing income and livelihood to millions of people in the region from ancient time (INBAR, 2019). There are diverse uses of bamboo by the people like construction, scaffolding, handicrafts, agricultural implements, basket, fishing equipments, musical instruments, support to crop, fuel and also as food (Yuming *et al.*, 2004; Hossain *et al.*, 2015; Kaminski *et al.*, 2016; Coyle *et al.*, 2019; Emamverdian *et al.*, 2020). Bamboo plantation also helps in maintaining ecological balance through carbon sequestration and by enhancing the available agriculture land by preventing soil erosion, minimizing floods and landslides (Sharma *et al.*, 2018). There are more than 36 genera and 136 species of

bamboo found in India (FSI,2017). Bamboo has been traditionally harvested from forest lands in India and the homesteads which may have a few clumps of one of the many species of bamboo for household use but very little intervention in terms of purposive planting has been done in the past (Kumar and Tanya, 2015). The major bamboo producing countries in Asia were India and China; they together account approximately 70 per cent of the bamboo in Asia (Mera and Xu, 2014). India has 30 per cent of the world's bamboo resources (FSI, 2017) with a growing area of 14.94 million hectares and is producing a total of 53,336 million culms with equivalent weight of 402 MT (FSI, 2021). During 2019, the total global bamboo exports was USD 3.054 billion where India stands at 7th position in world export by exporting 67 USD million (2 % of world exports) (INBAR, 2021). The major importers of bamboo products from India were Bhutan, Bangladesh, USA, UAE and Nepal (Gogoi,

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2020). There are total eighteen bamboo products with Harmonized Commodity Description and Coding Systems (HS) codes given by INBAR for world trade under ten categories which are namely, bamboo raw materials, bamboo shoots, charcoal, bamboo-based panels, bamboo panels for construction, pulp and paper article, bamboo furniture, woven bamboo products, bamboo articles of daily use and bamboo tableware and kitchenware (INBAR, 2021). The north-eastern hilly states of India harbour nearly 90 species of bamboos, 41 of which are endemic to that region (Loushambam *et al.*, 2017). The area under bamboo in NER is 5.35 million hectares with a production of 24,330 million culms (179 MT) (FSI, 2021). Despite the efforts of a wide range of stakeholders at various levels, the bamboo industry in the region has made only limited growth due to lack of coordination, financial facilities, skill development and proper extension (INBAR, 2016). Therefore, the study was conducted to get an overview of growth in area, production of bamboo resources of the NER and trend in export of bamboo products from India.

2. Materials and Methods

The present study was based on secondary data on area and production of bamboo, collected from Indian Forest Survey Report (IFSR), GoI, for the year 2011 to 2021. Tabular analysis was applied to obtain the results. Time series data on export of bamboo and its products from 2009 -2020 was collected from United Nations Comtrade Database (2022) for calculating growth trend in export. Compound Annual Growth Rate and Cuddy Della Valle instability Index were calculated using the following formula.

Trend analysis

The Compound Annual Growth Rate (CAGR) of the export of bamboo was calculated.

$$Y = ab^t e$$

Where,

Y = Dependent variable

a = Intercept

b = Slope

t = Time (independent variable)

e = Residual term or error term

The CAGR derived from the logarithmic form of the equation as

$$\ln y = \ln a + t \ln b$$

The percent CAGR was estimated using the following relationship

$$\text{CAGR} = (\text{Anti log of } b - 1) \times 100$$

Cuddy Della Valle Instability index

The coefficient of variation was computed using the following formula

$$\text{CV} = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100$$

The formula used to compute the degree of variation around the trend using the instability index given by Cuddy and Valle(1978). High instability in export is indicated by a high value of this index and vice-versa:

$$\text{Instability Index} = \text{CV} \times \sqrt{1 - R^2}$$

C.V = Coefficient of variation (in percent)

R² = Adjusted Coefficient of determination

3. Results and discussion

Area and production scenario of bamboo in the North East Region

The total area under bamboo in India was 14.94 million hectares during the year 2021. The share of NER to India was 35.79 per cent that occupied 5,348.50 thousand hectares of area in 2021 and showed increasing trend from the previous year 2019. The area under bamboo over the decade (2011-2021) showed positive change (7.04 %) all over India while in the North Eastern Region it was decreased by 4.48 per cent (Table 1). In states of Assam (47.26%), Meghalaya (4.46%) and Tripura (29.42%) positive decadal growth in area was observed which was due to effective implementation of the National Bamboo Mission, which provided funds after 2015-16 for maintenance of the bamboo plantations raised earlier under the mission (GoI, 2018). The highest negative growth was in Mizoram with 50.67 per cent reduction in bamboo bearing area followed by Nagaland (19.48%) and Sikkim (15.83%) and Manipur (9.95%). There was negligible decline in the state of Arunachal Pradesh (2.14%). The decline in bamboo bearing area was due to exclusion of no bamboo area in the inventory from the total bearing area. Density along with other factors can also be a good indicator of the disturbance and degradation of vegetation (INBAR, 2016).

The production of culms including both dry and green were having high positive growth over the decade (Table 2). The total number of estimated culms was found to be 53,336 million during the year 2021 which has increased over the decade at 128.94 per cent. Similarly, the NER production of culms was 24330 contributing 45.62 per cent to total of India in 2021. It showed a positive decadal growth 82.27 per cent. The state of Mizoram and Manipur were having negative growth of bamboo production from 2011 to 2021. But it was observed that from the year 2017 there was positive growth of production in these two states. The highest decadal growth in production was in Arunachal Pradesh (196.11%) followed by Assam (141.61%), Nagaland (122.45%) and Tripura (88.19%). Meghalaya had a positive decadal growth of 75.78 per cent while the lowest was observed in the state of Sikkim (42.98%). The increase in production of bamboo in the states from the year 2017 to 2021 was observed due to successful implementation and

Table 1. State wise bamboo bearing area of the NER of India (000' hectare)

| States | 2011 | 2017 | 2019 | 2021 | Decadal change from 2011 to 2021 (%) |
|-------------------|--------------------|--------------------|--------------------|--------------------|--|
| Arunachal Pradesh | 1608.30 | 1512.50 | 1498.10 | 1573.90 | -2.14 |
| Assam | 723.80 | 895.50 | 1052.50 | 1065.90 | 47.26 |
| Manipur | 930.30 | 1068.70 | 990.30 | 837.70 | -9.95 |
| Meghalaya | 479.30 | 594.30 | 541.00 | 500.70 | 4.46 |
| Mizoram | 924.50 | 326.70 | 347.60 | 456.10 | -50.67 |
| Nagaland | 490.20 | 602.50 | 428.40 | 394.70 | -19.48 |
| Sikkim | 118.10 | 55.30 | 117.60 | 99.40 | -15.83 |
| Tripura | 324.60 | 361.70 | 378.30 | 420.10 | 29.42 |
| Total (NER) | 5599.10 (40.11) | 5417.20 (34.55) | 5353.80 (33.45) | 5348.50 (35.79) | -4.48 |
| India | 13957.70 (100) | 15680.80 (100) | 16003.70 (100) | 14944.30 (100) | 7.07 |

Note: Figures in the parentheses indicate percentage to total

Source: (FSI, 2017,2019, 2021)

Base period-2011

Table 2. State wise number of estimated culms of bamboo of the NER of India (in million)

| States | 2011 | 2017 | 2019 | 2021 | Decadal change from 2011 to 2021 (%) |
|-------------------|------------------|------------------|------------------|------------------|--|
| Arunachal Pradesh | 2980 | 4048 | 5769 | 8824 | 196.11 |
| Assam | 2341 | 2452 | 3829 | 5656 | 141.61 |
| Manipur | 2297 | 2340 | 1126 | 1568 | -31.74 |
| Meghalaya | 1251 | 1323 | 1521 | 2199 | 75.78 |
| Mizoram | 2205 | 716 | 1074 | 1490 | -32.43 |
| Nagaland | 1216 | 1301 | 2544 | 2705 | 122.45 |
| Sikkim | 228 | 135 | 218 | 326 | 42.98 |
| Tripura | 830 | 797 | 1110 | 1562 | 88.19 |
| Total (NER) | 13348 (57.29) | 13112 (46.68) | 17191 (43.57) | 24330 (45.62) | 82.27 |
| India | 23297 (100) | 28092 (100) | 39454 (100) | 53336 (100) | 128.94 |

Note: Figures in the parentheses indicate percentage to total

Source: (FSI, 2017,2019, 2021)

Base period-2011

functioning of bamboo mission in the NER states providing financial assistance for growing of nursery to setting up of enterprises (GoI, 2022).

The total green equivalent weight includes both dry and green weight of the bamboo. The NER contributed 44.59 per cent to the total of India (4,02,000 thousand Tonnes) in 2021 which has been increased from the previous years. It was observed that, over the decade there was 137.43 per cent increase in the production of the bamboo weight (Table 3). North eastern region also contributed a recognizable amount with an increase of 141.37 per cent over the decade. Among the states, Nagaland decadal growth was highest (345.45%)

followed by Arunachal Pradesh (222.54%) and Meghalaya (230.33%). Assam had a positive growth of 214.41 per cent, while Tripura had 150.01 per cent decadal growth. The State of Manipur (17.59%), Mizoram (4.57%) and Sikkim (29.65%) was showing negative decadal growth but there was increasing growth with respect to the year 2019. The growth in the production of green equivalent weight was due to increasing number of culms production which was increasing from the year 2017 onwards. The role of National Bamboo Mission was one of the reasons for increasing production of the bamboo plants despite reduction in the bamboo bearing area (GoI, 2022).

Table 3. State wise green equivalent weight of bamboo of the NER of India ('000 tonnes)

| States | 2011 | 2017 | 2019 | 2021 | Decadal change from 2011 to 2021 (%) |
|-------------------|------------------|------------------|-------------------|-------------------|--|
| Arunachal Pradesh | 14431 | 18863 | 27932 | 46546 | 222.54 |
| Assam | 12286 | 14912 | 24064 | 38600 | 214.18 |
| Manipur | 13738 | 15469 | 7754 | 11321 | -17.59 |
| Meghalaya | 7491 | 11462 | 12323 | 24745 | 230.33 |
| Mizoram | 13187 | 6217 | 8812 | 12585 | -4.57 |
| Nagaland | 7274 | 11269 | 20547 | 32402 | 345.45 |
| Sikkim | 887 | 305 | 429 | 624 | -29.65 |
| Tripura | 4965 | 6494 | 6295 | 12413 | 150.01 |
| Total (NER) | 74259 (43.86) | 84991 (45.05) | 108156 (38.96) | 179236 (44.59) | 141.37 |
| India | 169312 (100) | 188680 (100) | 277587 (100) | 402000 (100) | 137.43 |

Note: Figures in the parentheses indicate percentage to total

Source: (FSI, 2017,2019, 2021)

Base period-2011

Growth and instability in export of bamboo products

The compound annual growth rate (CAGR) of bamboo export in terms of quantity (in kg) over the period from 2009 to 2020 was found to be positive at 31.25 per cent and significant (Table 4). But the instability index was very high with 90.97 per cent as there was fluctuations in export over the years. Similarly, in terms of export trade value (US\$) it was observed significant positive CAGR of 7.66 per cent. In comparison to the instability index in quantity terms the

value of trade was less fluctuating over the years signified by 31.35 per cent instability index. The instability in export might be due to demand for the products by the importing countries from other competing exporters from Asia. The Asia-Pacific region contributed to the largest share of worldwide bamboo trade, including traditional bamboo-producing countries such as China, the Philippines, Vietnam, and Indonesia serving as major exporters of bamboo products (INBAR,2021).

Table 4. Growth in export of bamboo products from India

| Year | Net Weight(in kg) | Trade Value (US\$) |
|-----------------------|-------------------|--------------------|
| 2009 | 2012940 | 707254 |
| 2010 | 238788 | 594183 |
| 2011 | 1487598 | 1514309 |
| 2012 | 1368832 | 2114754 |
| 2013 | 448374 | 1348249 |
| 2014 | 326224 | 1585595 |
| 2015 | 7438812 | 2599666 |
| 2016 | 1313900 | 1061768 |
| 2017 | 5674113 | 1290261 |
| 2018 | 17370793 | 1959182 |
| 2019 | 7271979 | 1680664 |
| 2020 | 8920629 | 2231865 |
| CAGR(%) | 31.25* | 7.66* |
| Instability index (%) | 90.97 | 31.35 |

*Significant at 10% probability level

Source: United Nations Comtrade Database, 2022

4. Conclusion

The growth in area and production of bamboo resources of the country over the decade along with the increasing growth in export is giving an indication of development of the sector. NER has the highest share in term of area and production to the total which implies the potential of the region in exporting of bamboo and its products. The instability in export of bamboo products need to be resolved with proper actions from the government. Therefore, the implemented programme such as National Bamboo Mission and the state governments need to give more emphasise on the production of value-added products which will provides employment opportunities to the youth in bamboo sector.

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