

ACTION PLAN FOR PROMOTION OF BAMBOO IN NER



FINAL REPORT

**Submitted to
North Eastern Council,
Ministry of Development of the North Eastern Region (MoDoNER),
Government of India**



North Eastern Development Finance Corporation Ltd.

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Glossary

Glossary:

ABC	Activated Bamboo Charcoal
ADCs	Autonomous District Councils
AFP	Agro-Forestry Product
AIDC	Assam Industrial Development Corporation Ltd
ARCBR	Advanced Research Centre for Bamboo and Rattan
ARTFED	Assam Apex Weavers and Artisans Cooperative Federation Ltd.
BC	Bamboo Charcoal
BCDI	Bamboo and Cane Development Institute
BEF	Bamboo Entrepreneurs' Fund
BER	Bamboo Extraction Road
BIS	Bureau of Indian Standards
BPZ	Bamboo Processing Zone
BTSG	Bamboo Technology Support Group
CAGR	Compound Annual Growth Rate
CAMPA	Compensatory Afforestation Fund Management and Planning Authority
CBRI	Central Building Research Institute
CBTC	Cane and Bamboo Technology Centre
CIBERT	Centre for Indian Bamboo Resource and Technology
CPWD	Central Public Works Department
CSR	Corporate Social Responsibility
DBT	Direct Benefit Transfer
DFID	Department for International Development
DIA	Digital Image Analysis
DGFT	Directorate General of Foreign Trade
DPR	Detailed Project Report
DST	Department of Science and Technology
EU	European Union
FAO	Food and Agriculture Organization
FMCG	Fast Moving Consumer Goods
FPC	Farmer Producer Companies
FPO	Follow on Public Offer
FRA	Forests Rights Act
FSC	Forest Stewardship Council
GOI	Government of India
HOFF	Head of Forest Force
HSN	Harmonized System of Nomenclature
FIOR	Fixed Obligation to Income Ratio.
FRI	Forest Research Institute
ICIMOD	International Centre for Integrated Mountain Development
IFAD	International Fund for Agricultural Development
IIE	Indian Institute of Entrepreneurship
IIP	Indian Institute of Packaging
IIT	Indian Institute of Technology
IPIRTI	Indian Plywood Industries Research & Training Institute
INBAR	International Bamboo and Rattan Organization (INBAR)
ISFR	India State of Forest Report
ITC	India Tobacco Company Limited
JICA	Japan International Cooperation Agency
JLG	Joint Liability Group
M-DoNER	Ministry of Development of North Eastern Region
MFP	Minor Forest Produce
MIDH	Mission for Integrated Development of Horticulture
MIE	Meghalaya Institute of Entrepreneurship
MOEF&CC	Ministry of Environment and Forests and Climate Change
MUDRA	Micro Units Development and Refinance Agency Ltd

Glossary

NBM	National Bamboo Mission
NCHF	National Cooperative Housing Federation
NCDPD	National Centre for Design and Product Development
NEC	North East Council
NECBDC	North East Cane and Bamboo Development Council
NECTAR	North East Centre for Technology Application and Research
NEDFi	North Eastern Development Finance Corporation Limited
NEID	North East Industrial Development Scheme
NEHHDC	North Eastern Handicraft and Handloom Development Corporation
NER	North Eastern Region
NERCORMP	North East Rural Community Resource Management Project
NESAC	North East Space Application Centre
NORAD	Norwegian Agency for Development Cooperation
NIFT	National Institute of Fashion Technology
NINFET	National Institute of Natural Fibre and Engineering Technology
NITRA	Northern India Textile Research Association
NMBTTD	National Mission on Bamboo Technology and Trade Development
NRL	Numaligarh Refinery Limited
NRLM	National Rural Livelihood Mission
NRRS	N. Ranga Rao and Sons Pvt. Ltd
NTFP	Non - Timber Forest Products
PAN	Protected Area Network
PCCF	Principal Chief Conservator of Forest
PIB	Press Information Bureau
PIWTT	Protocol on Inland Water Transit and Trade
PMGSY	Pradhan Mantri Gram Sadak Yojana
PRFs	Proposed Reserve Forests
PWD	State Public Works Department
RBW	Reinforced Brick Work
R&D	Research and Development
RFRI	Rain Forest Research Institution
RF	Reserved Forests
RNBM	Restructured National Bamboo Mission
RuTAG	Rural Technology Action Group
SAMPADA	Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters
SFAC	Small Farmers' Agri-Business Consortium
SFURTI	Scheme of Fund for Regeneration of Traditional Industries
SLBC	State Level Bankers Committee
SME	Small and Medium Enterprises
SPV	Special Purpose Vehicle
SSR	State Schedule of Rates
TBM	Tripura Bamboo Mission
TC	Tissue Culture
TEDF	Techno Economic Development Fund
THHDC	Tripura Handloom & Handicrafts Development Corporation Ltd
TOF	Tree Outside Forest
TRIBAC	Tripura Bamboo and Cane Centre
TRIFED	Tribal Cooperative Marketing Development Federation of India Limited
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
USF	Un-classified State Forests
WBO	World Bamboo Organization

Content

Chapter No.	Chapter Name	Page No.
	Executive Summary	1
1	Introduction	22
2	Current Status of Bamboo Development	25
3	Existing Initiative for Bamboo Development	34
4	Policy and Regulatory Framework	39
5	Stakeholders' Discussion	44
6	SWOT Analysis	49
7	Priority Areas of Interventions	53
8	Vision, Goals and Implementation Strategies	57
9	Details of Strategies & Implementation Model	60
10	Summary of Financial Resource Requirement	164
11	Output and Outcome Plan	174
	Appendices	178

EXECUTIVE SUMMARY

1. Introduction

Bamboo is one of the most versatile plant species in the world. It has a wide variety of usages in today's world. In North Eastern India, local communities have traditionally used bamboo throughout their lives - from cutting the umbilical cord of new born babies to carrying the dead on their final journey. While it had been eclipsed by other materials after the advent of modernity, bamboo is enjoying a renaissance globally. Nearly two-fifths of the bamboo stock of India is concentrated in the North Eastern (NE) Region of the country. But, the contribution of bamboo towards the economic development of the NE states of India remains subdued.

The present study is an outcome of the decisions taken in the review meeting chaired by the Principal Advisor to the Hon'ble Prime Minister held on 22/09/2020 on major infrastructure projects, new initiatives and PMs announcements in respect of North Eastern Region, wherein it was decided that comprehensive sector-specific, state-specific holistic development operational Action Plans will be prepared for the sectors identified under new initiatives in NER. Accordingly, North Eastern Development Finance Corporation Ltd. (NEDFi) has been advised by the Ministry of DoNER to prepare a 5-year Action Plan on Promotion of Bamboo in North Eastern Region in association with the North Eastern Council (NEC) to exploit the emerging potential of north-eastern region in the global and domestic organic food market.

The potential role of bamboo in North Eastern economy has also been highlighted in several policy documents and forums such as North East Vision Document 2020, NITI Aayog etc. This Action Plan also aims to address the critical issues highlighted in such policy documents and forums.

Terms of Reference: The approved Terms of Reference of the present assignment are as follows:

(a) To assess the current status of the bamboo sector of NE region (NER) through stakeholders' consultation on challenges, prospects and recommendations for development and promotion of the sector;

(b) To identify priority areas for intervention with its implementation strategy; and

(c) To develop a 5-year holistic action plan including state(s) specific sub-plans, implementation mechanism, fund requirement, convergence with existing scheme/mission and formulation of new scheme, if required. The Scope of Work has been furnished at Appendix-2 of the report. This covers the above Terms of Reference in detail.

2. Current Status of Bamboo Development

Global Market Size: The global bamboo and bamboo products market size is about \$ 72.1 billion (2019) and it is projected to reach \$98.3 billion by 2025, after growing by about 5% per annum in the intervening years (Grand View Research). The robust growth of bamboo based markets is expected on account of factors like growing infrastructural development and the use of sustainable resources (like

EXECUTIVE SUMMARY

bamboo) in the manufacture of furniture and industrial products across the world. China is the leading nation in the production of bamboo and bamboo based items.

Market Segments: Chapter-2 gives the major segments of the global bamboo market as estimated by various organizations. It may be noted that the segments covering bamboo use for (a) pulp and paper, and (b) construction may account for over 70% of the global market. The other segments (industrial use, crafts, food use etc.) may be about \$ 20-22 billion in size in 2019. Of this, it has been estimated that non-traditional items like laminated furniture, flooring, panels etc. constitute over 45% (in 2017), while traditional products like handicrafts, traditional furniture, bamboo shoots, chopsticks and blinds will form the balance. It has been projected that the demand for bamboo for industrial use will grow more rapidly in the next few years as compared to its use for handicraft or food use.

International Trade: International trade remains a small part of the global output, as most of the output in the producing nations is sold in the domestic markets. The major exporters include China, European Union (EU), Indonesia, Vietnam, the USA, the Philippines and Thailand. The global trade of highly processed bamboo goods is growing, and these items (like flooring, panels, claddings, other highly processed industrial products, bamboo fibre etc.) constitute an ever-growing share of the global trade. However, traditional products such as furniture and woven items are also being traded. In fact, with \$ 380 million in exports, woven bamboo products still made the largest traded item in 2017 accounting for 21% of global exports (INBAR).

National Status: While it grows naturally almost throughout India except in the Kashmir region, bamboo occurs in abundance in the deciduous and semi-evergreen forests of the North Eastern region of the country and the tropical moist deciduous forests of Northern and Southern India. As per the India State of Forest Report (ISFR) 2019, an area of 160,037 km² has been described as 'bamboo bearing areas'.

In India, the demand for bamboo is estimated to be about 27 million MT, as reported by the National Cooperative Housing Federation of India's NCHF Bulletin in July 2017. This is needed for consumption by a range of users like the pulp and paper industry, construction sector, cottage industry and handlooms, food usage (bamboo shoots), fuel (charcoal), fodder (bamboo leaves) and medicines. As per the National Bamboo Mission, the annual harvest of bamboo is about 14.6 million MT (Operational Guidelines of NBM, revised in June 2019).

The bamboo market in India is estimated to be about Rs 23,942 crore (2019). There is no comprehensive data on India's bamboo market, as much of it is based on trade on an unorganized basis. The accurate estimation of bamboo export and import figures of India is difficult, as many of the bamboo products are internationally traded under same HSN code of timber. Data from few of the bamboo specific trade portals reveals that export figure of India in FY 2019-20 was USD 106 million and import figure stood at USD 170.39 million.

As per official records, India imported Rs. 290.07 crore of bamboo items in 2018-19 and Rs. 560.27 crore in 2019-20, which represented a surge of over 93% in the bamboo-based imports. India's exports have reduced by over 9% from Rs. 500.21 crore to Rs. 454.1 crore.

EXECUTIVE SUMMARY

Regional Status: The North Eastern states of India account for about one-third of India's area under bamboo, as well as 38% of the total bamboo stock of the country. Some of these states have skilled artisans who are very adept at working on bamboo based crafts. The availability of bamboo culms in the states of the NE Region has supported its use for diverse household purposes (utility items, furniture, tools etc.), application in bamboo-based crafts, construction of shelter and erection of fencing, use in farming etc. Further, analysis of the Forest Survey of India reveals that the region has limited "out of forest" bamboo stock which is harvestable. Also, with its wide use at the household level and sale in local markets, it has been reported that a significant proportion of the bamboo resources in the NE states have not been tapped adequately. So far, there have been low levels of investment in bamboo based industrial units in the NE Region.

3. Existing National Initiatives

India has the second largest bamboo stock of the world after China, with 136 species and 23 genera spread over 13.96 million hectares. However, the country's share in the global bamboo trade and commerce is only 4.5%. This is despite some noteworthy initiatives taken in the past in order to develop the bamboo sector in India. The Planning Commission had prepared a report on National Mission on Bamboo Technology and Trade Development (NMBTTD), which was presented to the Hon'ble Prime Minister in July, 2003. Accordingly, the Planning Commission allocated Rs. 2,600 crores for bamboo under the 10th Five Year Plan.

In October 2006, the Government of India (GOI) had launched the National Bamboo Mission (NBM) on the basis of the National Mission on Bamboo Technology and Trade Development Report, 2003. The NBM's key objective was to address issues relating to the development of the bamboo industry in the country, provide a new impetus and direction and enable the realisation of India's considerable potential in bamboo production. The Mission was largely limited to propagation and cultivation of bamboo, with limited investment in seasoning and treatment units and bamboo bazaars. The main weakness of the scheme had been the absence of a linkage between the producers (farmers) and the industry and a strong value addition component and also weak efforts in organizing bamboo farmers for aggregation through institutions such as cooperatives, SHGs, JLGs etc.

The National Bamboo Mission (NBM) was restructured in 2018. The Mission was launched as a natural corollary of the historic amendment of the Indian Forest Act in 2017, removing bamboo from the definition of trees. The main objective of the above Mission is to expand the area under bamboo plantation in non-forest Government and private lands in order to supplement farm incomes and contribute towards resilience to climate change as well as availability of quality raw material requirements of industries. In addition, the NBM has sought to address other aspects like post-harvest management, product development, industries, skills development, and import reduction.

Challenges & Action Points for Bamboo Development in NE Region: The major emphasis of the existing initiatives appears to be on the plantation of bamboo. The other aspects seem to be receiving less importance, especially a focus on market driven value addition. NBM has focussed upon 10 species of bamboos. However, there is a need to explore the commercial potential of all the other 126 species of

EXECUTIVE SUMMARY

bamboo available in India, as the introduction of new species into an area may be more challenging than the utilization of the existing bamboos.

While the major emphasis is on plantation, the productivity of Indian bamboo is very low. The existing productivity of Indian bamboo is 3-6 MT/Ha in comparison to China's 30-40 MT/Ha. In case of natural stock, productivity is even lower.

The manufacture of incense sticks is an important activity in India. However, there is a considerable generation of wastes. Similar challenge exists in case of the traditional craft clusters. Much of the bamboo culm is wasted while making bamboo sticks for use by Agarbatti units. Charcoal and activated bamboo charcoal may offer a way out. Other value added items may need to be developed to make maximum use of the bamboo raw materials, including wastes.

The bamboo sector of NER lacks reliable data on raw material and trade intelligence and has witnessed limited research and development with industrial application, inadequate credit linkage, lack of high value added product etc.

Much of the bamboo resources are located in remote areas that are not served by any roads. The sustainable extraction of bamboos (including replanting of utilized areas) is not possible in such a scenario. The other issues which confront the implementation of Government funded initiatives for bamboo development include: Multiplicity of institutions with overlapping mandates in the bamboo sector in NE India; late release of funding; as reported by State Bamboo Missions is impacting planting and other activities; and limited capacities at the state and district levels, especially with regard to bamboo trade and economics; technological innovations and manufacturing of bamboo products.

The following are the major points for Action Plan for bamboo development in the NE Region: increase productivity, ensure sustainably harvested raw material and develop uninterrupted and industry-specific supply chain, adoption of a market driven orientation; utilization of the full range of bamboos, with preference to the locally available species; research and development; Value Addition to the existing products; addressing the Logistic challenges; customized support mechanism especially developed for NER considering the inherent challenges of the region, capacity Development of Implementing Agencies; close inter-ministerial coordination and convergence. The above have emerged from an analysis of the existing challenges as discussed in this section. The present action plan will adopt the above points as its guiding axioms while developing the implementation strategies.

Other Recent Initiative: Another major bamboo initiative in North East is Assam Bio-Refinery- the first bamboo based bio-ethanol plant of NER. The unit is expected to consume 5 Lakh MT bamboo per year. Considering the low volume of "out of forest" bamboo in the region, the unit should look up for other channel of raw materials such as collaboration with State Forest Department for natural stock and own high yield captive plantation can be two options which the unit may explore.

4. Policy & Regulatory Framework

EXECUTIVE SUMMARY

Policy Framework: India does not have a National Bamboo Policy, despite the need for such an overarching document to guide the various agencies working for bamboo development in the country. However, the National Agro-forestry Policy had been announced in 2014 seeks to support agro-forestry, which has been defined as a land use system that integrates trees and shrubs on farmlands and rural landscapes to enhance productivity, profitability, diversity and ecosystem sustainability. The above policy intends to encourage and expand tree plantation in an integrated manner with crops and livestock to improve productivity, employment, income and livelihoods of rural households.

As mentioned earlier, the Government of India had launched a restructured National Bamboo Mission (NBM) in 2018, with its basic objectives of increasing the area under bamboo plantation in non-forest Government and private lands to supplement farm income and contribute towards resilience to climate change as well as availability of quality raw material requirements of industries.

Some of the NE Region have brought out State Bamboo Policies to promote bamboo (and other related items). These include Assam, Manipur (with the policy being at the draft stage), Nagaland, and Tripura. The salient points of the above state level policies have been furnished at Chapter-4. In addition, bamboo finds mention in the Socio-Economic Development Policy 2019 of Mizoram. In addition, the matter of bamboo development has also been mentioned in some of the other policies of the State Governments of the NE Region. These have been briefly mentioned in the above chapter.

Legal & Regulatory Framework for Bamboo in India & the NE Region: As per the Constitution of India, 'Forest' is a subject under the concurrent list. Thus, both the Central Government and State Government can enact legislation on the subject, with the acts of the former having precedence in case of any conflict. In India, bamboo is primarily found in forests, whereby it is classified as a forest produce. Hence, it is subject to both Central and State laws.

The Indian Forest Act, 1927 had interpreted 'tree' to include bamboo. This meant that the felling of bamboo grown anywhere in the country was subject to restrictions applicable to 'timber'. The act not only constricted the livelihoods of forest communities, but restricted private growers too. In 2017, Section 2 (7) of the Indian Forest Act was amended to exempt bamboo grown in non-forest areas from the definition of 'tree'. Thereby, any bamboo grown in private or homestead land no longer requires a felling permission or transit permission from any State Forest Department. However, bamboo grown in forest lands will continue to be classified as tree and legal restrictions on cutting and transport of bamboo from such forest lands remains.

Under the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, popularly known as the Forests Rights Act (FRA), bamboo has been classified as a minor forest produce (MFP). This Act recognizes and vests individual forest-dwellers with forest rights to live in and cultivate forest land that was occupied before 13 December 2005 and grants community forest rights to manage, protect and regenerate the forest under section 3(1)(i), and to own and dispose minor forest products from forests where they had traditional access.

EXECUTIVE SUMMARY

As per Schedule VI of the Constitution of India, tribal communities inhabiting areas in some states of the NE Region, designated as autonomous districts, were granted special provisions for the protection of their traditional rights. Autonomous District Councils (ADCs) were established in such areas with powers over land and other resources including forests - excluding Reserved Forests (RF), Proposed Reserve Forests (PRFs) and Protected Area Network (PAN). Thus, under the FRA, 2006 as well as the powers vested with the ADCs, bamboo grown in forests (not being RF, PRF or PAN) can be utilized without any constraint. These forests are usually termed as Unclassified Forests or as Unclassified State Forests (USF) in the hill states of the NE Region. The de-facto control over such forests is exercised by the traditional authority.

5. Stakeholders' Discussions

International organizations such as World Bamboo Organization (WBO), International Bamboo and Rattan Organization (INBAR), Japan International Cooperation Agency (JICA) are working for Indian bamboo sector. Nationally, there are number of central ministries and agencies which are further supported by technical institutions such as NID Ahmedabad, Bengaluru & Jorhat, NIFT Shillong, Indian Institutes of Packaging Mumbai & Kolkata Indian Institute of Plywood Research and Training; IIT Guwahati, National Institute of Natural Fibre and Engineering Technology, Kolkata etc.

North East based stakeholder institutions are North East Cane and Bamboo Development Council (NECBDC), Rain Forest Research Institute (RFRI), Jorhat and its Advanced Research Centre for Bamboo and Rattan (ARCBR), Bamboo and Cane Development Institute (BCDI), Tripura Bamboo and Cane Centre (TRIBAC), North Eastern Space Application Centre,(NESAC), IITG Guwahati, North East Handicraft and Handloom Development Corporation (NEHHDC), North East Centre for Technology Application and Research (NECTAR) Indian Institute of Entrepreneurship (IIE), Bamboo Technology Park, Chaygaon, Kamrup, Assam, Bamboo Industrial Park, Dima Hasao, Assam, Numaligarh Refinery Limited (NRL) etc.

At state level there are- Department of Industries and Commerce, Department of Horticulture, Department of Soil Conservation, State Rural Livelihood Missions, State Bamboo Development Agency, State Handloom and Handicraft Development Corporations and the Autonomous District Councils etc.

A large number of stakeholders' consultations were organized (17 in all) as a part of the assignment. The stakeholders included participants from the Government, Entrepreneurs, Crafts Clusters, Institutions and Banks. The following summarizes the feedback received from the stakeholders. The details are available at Appendix-3. In addition, Appendix-1 gives the details of these stakeholders.

Government

Discussions were held with the senior officials of the National Bamboo Mission (NBM). They gave a background of their work, and the progress achieved till date. In addition, they furnished some

EXECUTIVE SUMMARY

suggestions for the bamboo sector of the NE Region, as well as their plans for the sector on a national basis.

Officers from the State Bamboo Missions of five states (Assam, Meghalaya, Mizoram, Nagaland, and Tripura) took part in discussions organized on two separate occasions. They gave an account of the progress of bamboo in their states, as well as the various interventions being undertaken for the sector in collaboration with various stakeholders along with implementation challenges.

Entrepreneurs & Industries

There were consultations with industrial units and entrepreneurs involved in the bamboo sector. These stakeholders gave their feedback on the issues challenging bamboo development across the value chain. These included issues with raw materials (in terms of quality and volumes), technology (need to upgrade tools and equipment), inadequate financing, logistics (high costs of transport), and market development. As many bamboo items were a novelty (files, panels, laminated furniture etc.), consumer confidence and tastes will take time to develop. The efforts of institutions and government initiatives need to reach the entrepreneurs, who are working for bamboo development.

Banks & Financial Institutions

Banks were of the opinion that currently there is limited high value bamboo products and they are manufactured mostly in the micro and small scale. The Government schemes along with MUDRA loans (collateral free loans) could be used by micro-level entrepreneurs. The bamboo eco-system needs to be developed on commercial basis, along with the ready availability of data. The importance of entrepreneur linked cluster development was also highlighted. Further, CSR funding could be used for bamboo plantations.

Institutions

The different institutions (both in the region as well as those located outside) shared their experience with the bamboo sector. They had undertaken several works for the sector, including in the NE region and are ready to support further growth of the sector in the NE Region.

International Practices on Bamboo

Experts from South Asian Countries such as Indonesia, Vietnam, Philippines- the countries which have established bamboo based economy participated, gave their suggestions and shared their willingness to work with NER. Expert group from Japan discussed the scope of collaboration for bamboo fibre extraction. Experts from African countries like Kenya and Tanzania who have identified bamboo as emerging economic area and a way to fight climate change participated and explained their models. Enterprise from Israel working in bamboo electric bicycle has also participated in the session.

6. SWOT Analysis

SWOT Analysis assesses the Strengths and Weaknesses of an entity, along with the Opportunities and Threats emanating from the environment around it. It gives a good starting point for planning a set of

EXECUTIVE SUMMARY

future activities related to the entity. In the present case, the concerned entity is the bamboo sector of all the NE states taken together. The SWOT analysis for the sector has been given below.

Strengths

- Availability of **sizeable stocks** of bamboos of various useful species
- Availability of considerable **wasteland areas** that are now unused (or less used) and which can be utilized for bamboo cultivation
- Availability of **traditionally skilled craftsmen** in several clusters in the NE states
- Existence of other **components of a bamboo eco-system** within the region like entrepreneurs, designers, institutions (working in parts of the bamboo value chain), government investment etc. apart from craftsmen.

Weaknesses

- Deficiencies in many parts of the **value chain**, which push up costs and reduce the market value of the items produced – including **lack of waste utilization**, use of non-treated bamboo, logistical weaknesses (transport and warehousing), sourcing issues, use of inappropriate copies of imported machinery by industrial units, low use of modern tools and equipment by artisans, limited market etc.
- **Lack of high value** product categories
- **Limited amount of non-forest bamboo** and its huge consumption on traditional industry.
- **Lack of Research and Development** and **limited understanding** of the bamboo as material for various industries
- Lack of thrust upon scientifically managed bamboo **plantations** in the NE states, with resources being mainly available from extraction of natural clumps and forest resources not under government control.
- **Low productivity** per Hectare of bamboo
- Inadequate **credit linkage** for entrepreneur and artisan based enterprises
- Limited use of modern **designs** and other **innovations** owing to the existence of a working level gap between the institutions and designers (on one hand) and the entrepreneurs and artisans (on the other hand)
- **Lack of marketing and forward logistics management skills amongst** the artisans of traditional craft clusters.
- Unavailability of **reliable data** on many segments of the bamboo sector in NE Region – resources outside forests, quantum of stock (species wise data), locally made products, supporting services etc. – all of which constrain informed decision making

Opportunities

- Increased appreciation of bamboo as **a sustainable alternative** to tropical wood, leading to rise in the global use of bamboo articles (both for industrially made items and artisanal creations) and their global trade (mainly exports from Asia to Europe and North America)
- **Focus of the Government** of India at the highest levels upon the bamboo sector in NE Region
- Significant opportunities to **substitute imports** of bamboo items with local alternatives on competitive basis

EXECUTIVE SUMMARY

- Possibility to **converge Government schemes** to develop the bamboo sector in NE Region
- Multilateral **agency's growing interest to work** for development of NE region.

Threats

- High level of **imports** in certain items (like round bamboo sticks for Agarbatti and bamboo fibre)
- Dependence on imported machines
- Competition from **well established players** in the global markets in case exports are attempted
- Absence of **large industrial units** based on bamboo (excluding shuttered paper mills of the public sector)

In addition, Chapte-6 discusses the measures proposed under the present Action Plan to address the identified Weaknesses and Threats of the bamboo sector.

7. Priority Areas for Intervention

The development of the bamboo sector in NE India will require a host of interventions across the eco-system. These have emerged from the previous chapters including the lessons from past initiatives, study of the policy and regulatory framework for bamboo, SWOT Analysis, stakeholders' consultations, field survey and secondary research etc. The key areas across the value chain that will need interventions under the present Action Plan include the following:

1. **Market Identification:** Understand the norms and needs of leading bamboo markets of the world and prepare the growers, entrepreneurs, technical support agencies and local governments of North East accordingly.
2. **Development of bamboo trade support tools:** To attract private investment in bamboo sectors of North East, bamboo sector needs more reliable and real-time information on availability of raw material availability - both in the form of species wise availability and location wise annually available stock of required grade.
3. **Improvement of Productivity:** Through scientific management of the bamboo plantations, the existing productivity of 3-6 MT/Ha of Indian bamboo needs to be improved to at least 8-10 MT within a specific time-line.
4. **Local Production of Planting Material:** For good quality planting material at low cost, the regions need to develop Tissue Culture Labs & hi- tech nurseries, large scale nurseries and small scale nurseries.
5. **Plantation:** In addition to existing plantation initiative of NBM in private land, implement a plan for bamboo plantation in wastelands and mechanism to extract forest based bamboo (excluding Reserve Forest and Protected Area Network);
6. **FSC FM Certification to Ensure Globally Compliant Raw Material:** Introduction of Forest Stewardship Council (FSC) Forest Management (FM) Certification at farmer group level and also under captive plantation of Forest Department which will ensure better price realization to growers and entrepreneurs due to compliance of import norms of developed countries.
7. **Inbound & Outbound Logistics:** Develop inbound logistics through the construction of Bamboo Extraction Roads to reach bamboo rich belts in remote areas; explore use of in-land waterway and railway;

EXECUTIVE SUMMARY

8. **Formation of Bamboo Sector FPO:** For organized supply chain and plantation management, and reduction of post-harvest wastage bamboo sector FPOs need to be formed which will act in the multi-modal supply chain mechanism.
9. **Dedicated Research and Development Institute for Bamboo Sector:** Promote industry anchored and market driven dedicated bamboo sector research and development through establishing National Institute of Bamboo Innovation and Technology (NIBIT) in NER.
10. **Bamboo Entrepreneurship Fund:** For bringing technological innovation to bamboo sector, connect the bamboo sector with startup revolution of India by introducing bamboo sector entrepreneurship fund for North East India.
11. **Value Addition and Waste Utilization:** Utilization of bamboo industry waste and value addition through development of high value by-products, innovation in traditional industry, introduce new products and reduce dependency on import of raw material.
12. **Bottom up approach of One Cluster One product** for traditional craft clusters.
13. **Indigenous Technology development:** Develop indigenous tools and machinery which suits the Indian bamboo species; set up Bamboo Machinery Centre of Excellence, organize machinery exhibition and explore setting up of machinery bank.
14. **Market Development:** Through investors meet, buyer-seller meet, exhibition, technology and skill transfer from bamboo sector leaders, collaboration with South East Asian Countries for technology transfer, skill upgradation and industry specific training.
15. **Policy Intervention-** Need of National Bamboo Policy, policy revision for ease of access to market, develop new market, promote innovation, increase productivity, ease of credit.
16. **Finance:** Easy credit, front ended subsidy considering challenges pertaining to North East,
17. **Implementation Model:** Strengthening of National Bamboo Mission through engagement of expert agency as Project Management Unit (PMU) and Inter-ministerial committee for monitoring. Alternatively, for a North East Specific Approach, a Special Purpose Vehicle (SPV) in the form of Society may be formed. The governing body of the SPV may have Joint Secretary of stakeholder ministry as members which may be chaired by Secretary, DoNER for greater synergy and convergence. The project may explore funding from the international agencies.

7.1. Setting the Priorities for Interventions

Following activities have to be undertaken in the indicated sequence:

Immediate Term:

- Form Project Management Unit under National Bamboo Mission and Inter-ministerial monitoring committee.
- Alternatively, form Special Purpose Vehicle "North East Regional Bamboo Development Project", formation of Governing body, Executive Committee, one (1) no. of Regional Project Management Unit and 8 nos. of State Project Management units
- Engage NESAC and RFRI for undertaking species wise bamboo stock estimation for the state of Arunachal Pradesh, Assam, Manipur, Mizoram, Nagaland, Sikkim and Tripura.

EXECUTIVE SUMMARY

- Development of target market wise market plan for Indian bamboo sector, understand country specific import norms and regulatory and compliance.
- Engage NESAC for Identification of potential waste land and organize awareness camps on community rights over wasteland bamboo cultivation.
- Formation of Bamboo Cell under State Forest Departments.
- Identification of FSC certification agency and finalize on modality of engagement
- Restructuring of NBM norms- cost of plantation, subsidy.
- Determination of Requirements of Bamboo (Quantity, Location, Species etc.) & Planting Materials
- Set up one pilot scale bamboo fibre unit in North East by using melt spinning technology.
- Scoping Study for identification of two clusters in each NER state for One Cluster One product initiative.
- Initiate Jiggat Plantation in convergence with various social forestry projects.
- Set up cluster level charcoal and activated charcoal units.
- Discussion with Ministry of Agriculture and Farmers Welfare for setting up National Institute of Bamboo Innovation and Technology in Guwahati, Assam
- Discussion with NITI Aayog and Startup India for Bamboo Entrepreneurship Fund
- Cross Country Dialogue, identification of partners for technology transfer.
- Expedite R&D of bamboo packaging under Indian Institute of Packaging
- Set up bamboo model multi-processing unit at Bamboo Industrial Park
- Feasibility study on bamboo extraction roads
- Discussion with DGFT for lift of export ban on charcoal and activated charcoal
- Initiate discussion with banks and financial institutions for Bamboo Finance Consortium
- Initiate discussion for Bamboo Credit Guarantee Scheme for NER

Short Term:

- Develop real-time information system on grower wise availability of annual stock including species, location etc.
- Initiate waste land cultivation of bamboo and captive plantation under State Forest Departments.
- Initiate construction of "Bamboo Extraction Road".
- Establish 3 nos. of Tissue culture labs.
- Establish hi-tech nurseries
- Formation and capacity building of Bamboo FPCs/FPOs in terms of multi model supply chain
- Initiate "one cluster one product" project.
- Finalize Bamboo Finance Consortium and Credit Guarantee Scheme
- DPR for setting up National Institute on Bamboo Innovation and Technology
- Set up Centre of Excellence for Bamboo Machinery
- Organize investors meet and buyer-seller meet
- Send NER entrepreneurs on international buyer-seller meets, expos etc.
- Identification of bamboo forest under Forest Department for Certification
- Funding of research project to CBRI, IWST for document properties of bamboo related to industrial utility.

EXECUTIVE SUMMARY

Medium Term:

- Establish large and small scale nurseries.
- Promote bamboo structures at prime locations at state capitals of NER states to create awareness.
- Set up machinery bank
- Establish large scale bamboo board and bamboo charcoal and activated charcoal unit.
- Establish large scale bamboo shoot units.
- Execute collaboration with South East Asian Countries for Skill Up-gradation of Artisans and Entrepreneurs
- Set up Bamboo Entrepreneurship Fund
- Initiate FSC Certification
- Administer bamboo entrepreneurship fund

7.2. Convergence with other Government Initiatives

Support may be obtained from different Government funded entities and schemes like:

- **National Bamboo Mission** –to fund relevant components of the action plan such as plantation, planting material infrastructure, enterprise development, market survey
- **Promotion of 10,000 FPO-** To form FPO/FPC for multi-model supply chain
- **Ministry of Skills Development** for skills up-gradation / development of craftsmen
- **DST:** For Research and Development component funding and machinery development
- **DBT:** For Research and Development Funding
- **SAMPADA:** For setting up of bamboo shoot based industry and other innovative food products
- **SFURTI Scheme of Ministry of MSME** for cluster level decentralized unit and cluster development
- **Amvedkar Hastshilpa Vikash Yojana (AHVY)** for bamboo craft cluster development project.
- MUDRA Loan Scheme operated for collateral free loans to small business
- Under **Agriculture Infrastructure Fund** for post-harvest infrastructure
- Under **North East Industrial Development Scheme (NEIDS) 2017** for transport incentive
- **PMGSY** for Bamboo Extraction Roads
- **Startup India and Atal Innovation Mission:** For Bamboo Entrepreneurship fund
- **Invest India:** for promotion of bamboo sector investment by other countries in North East.

The above is not an exhaustive list and indicates that many of the components can be funded partly from other sources

7.3. Vision, Goals & Implementation Strategies

Vision Statement

The Vision for the Promotion of bamboo in the North Eastern Region has been stated below:

EXECUTIVE SUMMARY

To promote sustainable and value added development of bamboo in the North Eastern states of India in order to make bamboo sector an organized sector of NER economy and place the region at the centre of global bamboo market.

The above vision will serve to guide the development of the goals and strategies under the present Action Plan. These have been given below.

Goals

The goals of the present action plan have been summarized below:

- **Goal-1: To ensure sustainable supply of raw material** to meet the present and future demand of the bamboo sector industry;
- **Goal-2: To make bamboo sector an organized sector” of the NER economy** from the existing “informal” form;
- **Goal-3: To develop a self-reliant value chain** of bamboo sector of North EAST India
- **Goal-4: To make North East India the centre of global bamboo industry.**

Table ES1: Goals & Implementation Strategies of the Action Plan for the Promotion of Bamboo in the NE Region

Goal	Implementation Strategy
To ensure sustainable supply of raw material to meet the present and future demand of the bamboo sector industry	Enhancement of productivity of North East to 10-12 MT/Ha from existing 3-6 MT/ha through Scientific Management of plantation and use of Farm input.
	Plan for commercial cultivation of bamboo to supplement the existing plantation initiative through- a)Plantation in wastelands b)Captive Plantation under State Forest Departments
	Revise cost norms of plantation under NBM for better care of plantation
	Forest Stewardship Council (FSC) Forest Management (FM) Certification to ensure sustainably harvested raw material that meets global compliance
	Local production of Planting Materials: Develop TC Labs & nurseries for increased availability of certified planting materials at low cost
To make bamboo sector an “organized sector” of the NER economy from the present “informal” form	Market Identification: Prepare the bamboo stakeholders of NER in accordance with the global need and market demand through understanding the norms and needs of leading bamboo markets of the world and implement country-wise market plan.
	Development of Bamboo Trade Support Tools: a) Assessment of Species Wise Resource Availability of bamboo in NER b) Tool for real-time database on annually harvestable bamboo of each state of NER
	Bamboo Extraction Road for easy logistics of raw material supply and extract natural stock of bamboo
	Form Bamboo FPC/FPO which will act under the mechanism of multi-modal supply chain to supply industry specific raw material and reduce post-harvest wastage.
	Use of In-land Water way and Railway to reduce the cost of out-

EXECUTIVE SUMMARY

Goal	Implementation Strategy
	<p>bound logistics</p> <p>Setting up of Bamboo Entrepreneurship Fund to promote bamboo based startups</p> <p>Revive the North East Incense stick industry through waste utilization to create high value by-product</p> <p>Introduce high value products such as bamboo fibre, industrial craft, activated charcoal, bamboo vinegar, bamboo shoot based pharmaceutical and nutraceutical product, high end bamboo construction at globally competitive cost, flat furniture, toothbrush, bio-plastic, bamboo as packaging material.</p> <p>Organized Craft industry at cluster level through “Bottom up one cluster one product” approach.</p> <p>Promote Inter-cropping for additional income of the growers</p> <p>Separate HSN code of bamboo products for more specific trade intelligence</p> <p>Lift the ban on export of bamboo charcoal and activated charcoal.</p> <p>Organize international buyer-seller meet, investors meet and expo</p>
<p>To develop a self-reliant value chain of bamboo sector of North East India</p>	<p>Promotion of Research and Development in Bamboo Sector through setting up of National Institute of Bamboo Innovation and Technology (NIBIT)- the first bamboo specific R&D institute of the Country</p> <p>Fund Research Project under CBRI, IWST to study industry specific various properties of bamboo.</p> <p>L Glutinosa plantation to reduce import of incense stick raw material</p> <p>Establish Centre of Excellence of bamboo machinery Organize atleast 5 nos. of international level Bamboo Technology Exhibition</p> <p>Establish Bamboo Financial Consortium</p> <p>Introduce “Bamboo Credit Guarantee Scheme for NER”</p>
<p>To make North East India the centre of global bamboo industry</p>	<p>For a North East Specific approach, form Special Purpose Vehicle in the form of Society under the aegis of Ministry of DoNER, Govt. of India titled “North East Regional Bamboo Development Project (NERBDP).</p> <p>Set up Governing body chaired by Secretary, Ministry of DoNER, and members with Joint Secretary of relevant ministries and principal secretary, planning department which will bring effective convergence</p> <p>Executive committee with central, state and industry representatives</p> <p>Setting up of RMPU in Guwahati and 8 nos., of SPMU, one each in every state</p> <p>Explore funding from international funding agencies</p> <p>Formulate National Bamboo Policy</p> <p>Collaboration with South East Asian Countries: For technology</p>

EXECUTIVE SUMMARY

Goal	Implementation Strategy
	transfer, skill and knowledge transfer

7.4. Fund Requirement

The total fund quantum proposed under the action plan is mentioned below-

Table ES2: Financial Resource Requirement of the Action Plan (in Rs. Cr.)

	Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	Market Identification Survey	2.00					2.00
2	Development of Bamboo Trade Support Tools						
	a. Assessment of Species Wise Resource Availability	3.72	3.72				7.44
	b. Real time database on annual species wise harvestable bamboo	5.00					5.00
3	Plan for productivity enhancement	273.42	203.49	206.99	211.19	216.22	1111.32
4	Plantation						
	a. Cost of 9746 Ha captive plantation under Forest Department	89.30	17.86	21.43	25.72	30.86	185.17
	b. Cost of cultivation of 50,000 ha wasteland	190	190	190	190	190	950.00
	c. Monitoring of Plantation	5.59	4.16	4.23	4.31	4.42	22.70
	d. Assessment of wasteland	0.50					0.50
	e. Bamboo Cell Under State Forest Department/Strengthening of Forest Development Corporation	16.00					16.00
5	FSC Certification						
	a. FSC FM Certification to 9746 ha of Captive plantation under Forest Department	0	0	0	0	0	1.69
	b. FSC FM for f 50,000 ha wasteland under Group	1.89	1.89	1.89	1.89	1.89	9.44
6	Planting Material						
	a. Tissue Culture Lab	0.00	13.62				13.62
	b. Hi tech nursery	9.00	13.00	15.00	0	0	37.00
	c. Large scale nursery	16.80	19.52	30.40	0.00	0.00	66.72
	d. Small scale nursery	14.80	18.00	18.00	23.60	0.00	74.40
7	Bamboo Extraction Road						
	a. Feasibility analysis of BER	1.7					1.70
	b. Construction of BER	0	28	40	60	80	208.00
8	Bamboo FPO Formation-Multi Model Supply Chain	5.25	6.3				11.55
9	Assessment of Inland water way and railway transport for bamboo	2					2.00
10	Setting up of National Institute of Bamboo Innovation and Technology						
	a. Project cost of NIBIT	48.18	54.32	59.76	70.68	69.70	302.63
	b. DPR preparation cost	3					3.00
	c. Research Project Funding at CBRI, IWST, FRI	10					10.00
11	Bamboo Entrepreneurship Fund	20	20	20	20	20	100.00
12	Value Addition						
	a. Incense Stick Industry	4.40	4.65	4.40	4.40	4.40	22.25

EXECUTIVE SUMMARY

	Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Total
	b. Charcoal & Activated charcoal	5.40	10.40	5.40	5.40	5.40	27.00
	c. Bamboo Fibre	25	63				88.00
	d. Bamboo Shoot	4.249	4.24				8.48
	e. Primary Treatment unit	0.62	0.62	0.62	0.62	0.31	2.79
	f. Bamboo Boards and furniture	25	50	50			125.00
	g. Industrialized Craft/Utility Products & Bioplastics	5.33	6.06	0.80	0.80	0.43	13.43
13	Improved Traditional craft through cluster approach	6	8	6	6	0	32.00
14	Machinery, Tools and Capacity Building						
	a. Centre of Excellence for Machinery	2.00					2.00
	b. Bamboo Technology Exhibition	0.4	0.4	0.4	0.4	0.4	2.00
	c. Feasibility of setting up bamboo machinery bank	0.4					0.40
15	Bamboo Market Development Fund						
	a. Buyer seller meet	0.8	0.8	0.8	0.8	0.8	4.00
	b. participation of entrepreneur in international buyer seller meet/exhibition	0.3	0.3	0.3	0.3	0.3	1.50
	c. New product development	0.4	0.4	0.4	0.4	0.4	2.00
	d. Tie up with international best practices	0.5	0.5	0.5	0.5	0.5	2.50
16	Subtotal						3475.22
17	Project Management Cost (2%)						69.50
18	Total Project Cost						3544.73

8. Implementation Arrangement

- a. The Action Plan may be implemented through existing initiative of National Bamboo Mission. The existing implementation arrangement may be suitably modified to engage expert professional agency as Project Management Unit (PMU) and Inter-Ministerial Mission Monitoring Committee.
- b. Alternatively, for a North East Specific approach, Special Purpose Vehicle **North East Regional Bamboo Development Society** may be formed with its Regional Project Management unit in Guwahati, Assam.
- c. The project may explore funding from international agencies such as IFAD, World Bank or ADB.
- d. Governing body may be formed with following members- Secretary, Ministry of DoNER as Chairman, Additional Secretary, National Bamboo Mission as Member Secretary, Joint Secretaries from Ministry of Industry and Commerce, Ministry of MSME, Ministry of Environment, Forest and Climate Change, Representative, NITI Aayog, Representative, Invest India, Principal Secretary, Planning Department, from all NER states as member.
- e. Executive Committee with following members- Government official in the rank of Joint Secretary as MD/CEO, Planning Advisor, North Eastern Council (NEC), Additional Commissioner, National Bamboo Mission; Representative of 2 NER states at the rank of Joint Secretary to be deputed by Chief Secretary (rotation in 2 years), Representative India Bamboo Forum as member. The chairman of the Executive Committee will also act as Managing Director/CEO of the Project
- f. 8 nos. of State Project Management Unit will be set up at state capitals of all the NER states.

9. Sources of Fund

Table ES3: Sources of Fund

	Particulars	Share	Govt. Funding	Bank Loan	Promoter's Contribution	Total	Convergence
1	Market Identification Survey	Govt-100%	2.00	0	0	2.00	NBM/TEDF
2	Development of Bamboo Trade Support Tools						
	a. Assessment of Species Wise Resource Availability	Govt-100%	7.44	0	0	7.44	NBM
	b. Real time database on annual species wise harvestable bamboo		5.00	0	0	5.00	Startup Missions
3	Plan for productivity enhancement	Govt. - 50%, Promoter-50%	555.66	0	555.66	1111.32	NBM/HMNEH
4	Plantation						
	a. Cost of 9746 Ha captive plantation under Forest Department	Govt-100%	185.17	0	0	185.17	NBM, CAMPA, JICA
	b. Cost of cultivation of 50,000 ha wasteland	Govt-100%	950.00	0	0	950.00	NBM, CAMPA, JICA
	c. Monitoring of Plantation	Govt-100%	22.70	0	0	22.70	Fresh Fund
	d. Assessment of wasteland	Govt-100%	0.50	0	0	0.50	NBM
	e. Bamboo Cell Under State Forest Department/Strengthening of Forest Development Corporation	Govt-100%	16.00	0	0	16.00	Fresh Fund
6	FSC Certification						

EXECUTIVE SUMMARY

	a. FSC FM Certification to 9746 ha of Captive plantation under Forest Department	Govt-100%	1.69	0	0	1.69	CAMPA
	b. FSC FM for f 50,000 ha wasteland under Group	Govt-100%	9.44	0	0	9.44	CAMPA
7	Planting Material						
	a. Tissue Culture Lab	Govt-100%	13.62	0.00	0.00	13.62	DST/DBT/NBM
	b. Hi tech nursery	Govt.- 50%, Bank Loan-40% Promoter-10%	18.50	14.80	3.70	37.00	NBM
	c. Large scale nursery	Govt.- 50%, Bank Loan-40% Promoter-10%	33.36	26.69	6.67	66.72	NBM
	d. Small scale nursery	Govt.- 50%, Bank Loan-40% Promoter-10%	37.20	29.76	7.44	74.40	NBM
8	Bamboo Extraction Road						
	a. Feasibility analysis of BER	Govt-100%	1.70	0	0	1.70	Fresh fund
	b. Construction of BER	Govt-100%	208.00	0	0	208.00	PMGSY
9	Bamboo FPO Formation-Multi Model Supply Chain	Govt-100%	11.55	0	0	11.55	Formation of 10,000 FPO
10	Assessment of Inland water way and railway transport for bamboo	Govt-100%	2.00	0	0	2.00	TEDF
11	Setting up of National Institute of Bamboo Innovation and Technology						Fresh Fund
	a. Project cost of NIBIT	Govt-100%	302.63	0	0	302.63	
	b. DPR preparation cost	Govt-100%	3.00	0	0	3.00	
	c. Research Project Funding at CBRI, IWST, FRI	Govt-100%	10.00	0	0	10.00	
12	Bamboo Entrepreneurship Fund	Govt-100%	100.00	0	0	100.00	Fresh Fund
13	Value Addition						
	a. Incense Stick Industry	Govt.- 50%, Bank Loan-40% Promoter-10%	11.13	8.90	2.23	22.25	NBM
	b. Charcoal & Activated charcoal	do	16.00	12.80	3.20	32.00	NBM
	c. Bamboo Fibre	do	44.00	35.20	8.80	88.00	NBM
	d. Bamboo Shoot	do	4.24	3.39	0.85	8.48	NBM/SAMP ADA
	e. Primary Treatment unit	do	1.40	1.12	0.28	2.79	NBM
	f. Bamboo Boards and furniture	do	62.50	50.00	12.50	125.00	NBM
	g. Industrialized Craft/Utility Products & Bioplastics	do	6.71	5.37	1.34	13.43	NBM
14	Improved Traditional craft through cluster approach	Govt-100%	32.00	0	0	32.00	SFURTI/AH VY
15	Machinery, Tools and Capacity Building						
	a. Centre of Excellence for Machinery	Govt-100%	2.00	0	0	2.00	Fresh Fund
	b. Bamboo Technology Exhibition	Govt-100%	2.00	0	0	2.00	Fresh Fund
	c. Feasibility of setting up bamboo machinery bank	Govt-100%	0.40	0	0	0.40	Fresh Fund
16	Bamboo Market Development Fund						Fresh Fund
	a. Buyer seller meet	Govt-100%	4.00	0	0	4.00	Fresh Fund

EXECUTIVE SUMMARY

	b. Participation of entrepreneur in international buyer seller meet/exhibition	Govt-100%	1.50	0	0	1.50	Fresh Fund
	c. New product development	Govt-100%	2.00	0	0	2.00	Fresh Fund
	d. Tie up with international best practices	Govt-100%	2.50	0	0	2.50	Fresh Fund
	Subtotal						
	Project Management Cost (2%)	Govt-100%	69.50	0	0	69.38	
	Total		2756.54	186.026	602.16	3544.73	

In addition to the above mentioned sources of fund, the project can also explore funding from international agencies such as World Bank, IFAD, Asian Development Bank etc.

10. Expected Output and Outcome of the Plan

Summary of expected Output and Outcome

Increase in Out of Forest Bamboo Stock: Although the region has country's 40% of the growing stock of bamboo, however extractable stock is significantly less. The action plan aims to increase bamboo cultivation area by 59,746 Ha, out of which 50,000 Ha is proposed to be developed on wasteland and 9,746 Ha will be under certified captive plantation of Forest Department.

Improve Productivity: For improved productivity through scientific management, it is proposed to revise the existing plantation cost norms under NBM with incorporation of additional components vital for plantation health.

Environmental Benefit: Bamboo has found growing interest amongst the global community due to its contribution towards fight against climate change through restoration of degraded land and wasteland. With this action plan 50,000 Ha of wasteland is expected to be restored. This will significantly contribute in India's commitment towards environment protection and will assist in achieving Bonn Target.

Production of Globally Standard Raw material: The proposed FSC certification in bamboo forestry management will ensure globally compliant raw material production. This will create new avenues for the entrepreneurs and growers for their products.

Emphasis on Indigenous Technology Development: The turn-around of Indian bamboo sector depends upon its emphasis on research and development. The proposed National Institute of Bamboo Innovation Technology is expected to give the much needed impetus to the industrial application oriented bamboo sector research and development.

Reduce Import Dependence: By introducing enterprise in the entire value chain of bamboo and focusing on waste utilization, it is expected that the Indian bamboo and raw material of bamboo based products will become cheaper than their import substitute.

EXECUTIVE SUMMARY

Connectivity Improvement: Bamboo sector of the region suffers logistical challenge with poor road connectivity, especially in the growing belt. This reduces cost competitiveness of the Indian products. The proposed action plan aims to improve connectivity from source till market. With the proposed 520 kms. of Bamboo Extraction Road, emphasis is given on ease of sustainable extraction of the natural stock. Further it is also proposed to explore more cost effective inland water and railway route for raw material and finished goods transportation.

Bamboo Trade Intelligence: The glaring absence in the current ecosystem is that of reliable data on bamboo. The proposed species wise stock survey and development of portal for real time data of annually harvestable stock details will address this issue to a great length.

Entrepreneurship Development: In addition to supplement the NBM initiative of bamboo entrepreneurship development, it is proposed to capitalize on the startup movement of the country by launching Bamboo Entrepreneurship Development Fund. Startups can also help to tackle the bamboo sector challenges with newer and innovative approach.

Revival of Traditional Industry: The once glorious Agarbatti industry of India is today facing challenge from other countries in terms of cheaper raw material. The action plan seeks to address the root cause of such debacle through action in terms of waste utilization and introducing high value supplementary products such as charcoal and activated charcoal.

Accelerate India's Race to Global Bamboo Market: Sector specific time bound and outcome oriented action is required to regain the global market. The action plan outlines several such critical gaps which need to be immediately addressed. Many of the existing research projects which aims to introduce new product development such as bamboo fibre, etc. need to be expedited. Further through the proposed Bamboo Market Development Fund, it is proposed to develop Indian bamboo products which is at par with global standard through improved machinery, increased investment and global market linkage.

Global Skill and Skill Knowledge Transfer to NER: The NER region has strong artisanal skills. This can be further improved in terms of design, finishing etc. with support from experts or master artisans from South East Asian countries.

Improved Package of Practice for Harvesting: Through formation of 77 nos. of FPOs with multi-model supply chain orientation, there will be improved harvesting practice, reduction in wastage and increase in farmers' income.

Strengthening existing stakeholder: Through setting up of Bamboo Cell/Division under each Forest Department of NER states; strengthening of State Forest Development Corporations; setting up of Centre of Excellence for Bamboo Machinery at NECBDC- dedicated bamboo specific initiative from the existing stakeholder institution is expected to increase.

EXECUTIVE SUMMARY

Improving Credit Flow: The action plan understands the challenges of central sector scheme implementation in the region. Institutional credit is inadequate for the bamboo ecosystem of NER. The action plan makes specific suggestion to improve credit flow to the entrepreneur through revision of existing NBM norms of funding and suggesting new financial products such as Bamboo Credit Guarantee Scheme etc.

Expected Socio-Economic Impact

On implementation, it is expected that there will generation of 47,000 nos. of direct employment and 1, 63,672 nos. of indirect employment. Detailed sector wise employment generation is given under the relevant chapter. In addition to this, there will be an earning of Rs. 4.04 Cr in the form of GST by the government on establishment of the proposed value addition units. Break up is given in relevant section

Further, it will also help in increasing farmer's income, contribute towards the mission of doubling farmers' income, bring economic opportunity to rural women thereby reducing poverty.

1. Introduction



1.1. Background

Bamboo is one of the most versatile plant species in the world. It has a wide variety of usages in today's world that have elevated the plant to the status of a modern '*Kalpa Vriksha*' (a wish-fulfilling plant). In North Eastern India, local communities have traditionally used bamboo throughout their lives - from cutting the umbilical cord of new born babies to carrying the dead on their final journey. While it had been eclipsed by other materials after the advent of modernity, bamboo is enjoying a renaissance globally. This has mainly been on account of the initiatives of various East Asian and South East Asian nations. Appendix-1 gives additional information about bamboo and its usages in today's world.

India is reported to have an area of 16 million hectares (Ha) under bamboo (India State of Forest Report, 2019). So far, the existing challenges have been constraining its role in the national economy. About 40% of bamboo is reportedly being used in the construction sector and in rural households without much value addition. On the other hand, much of the value added segments of the domestic market are dominated by imports. Nearly two-fifths of the bamboo stock of India is concentrated in the North Eastern (NE) Region of the country. But, the contribution of bamboo towards the economic development of the NE states of India remains subdued. This is despite the various initiatives taken up in the recent past for the development of bamboo in the region.

The present study is an outcome of the decisions taken in the review meeting chaired by the Principal Advisor to the Hon'ble Prime Minister held on 22/09/2020 on major infrastructure projects, new initiatives and PMs announcements in respect of North Eastern Region, wherein it was decided that comprehensive sector-specific, state-specific holistic development operational Action Plans will be prepared for the sectors identified under new initiatives in NER. Accordingly, North Eastern Development Finance Corporation Ltd. (NEDFi) has been advised by the Ministry of DoNER to prepare a 5-year Action Plan on Promotion of Bamboo in North Eastern Region in association with the North Eastern Council (NEC) to exploit the emerging potential of north-eastern region in the global and domestic organic food market.

The potential role of bamboo in North Eastern economy has also been highlighted in several policy documents and forums such as North East Vision Document 2020, NITI Aayog etc. This Action Plan also aims to address the critical issues highlighted in such policy documents and forums.

1.2. Terms of Reference

The approved Terms of Reference of the present assignment are as follows:

- a) To assess the current status of the bamboo sector of NE region(NER) through stakeholders' consultation on challenges, prospects and recommendations for development and promotion of the sector;
- b) To identify priority areas for intervention with its implementation strategy; and

INTRODUCTION

- c) To develop a 5-year holistic Action Plan including state(s) specific sub-plans, implementation mechanism, fund requirement, convergence with existing scheme/mission and formulation of new scheme, if required.

1.3. Approach & Methodology

The basic approach adopted for the Preparation of this Action Plan has combined the following measures:

- Preparation of Data Requirements for the work, based on the Terms of Reference (TOR) and Scope of Study;
- Analysis of documents and information available from the Internet and other secondary sources;
- Determination of Data Gaps;
- Collection of Data through Video-Conferences and Telephone calls with stakeholders like Government of India, State Governments, Industry, Businesses, Institutions etc.;
- Expert Inputs obtained from the Consultants engaged by NEDFi for the work; and
- Consolidation of information from the above sources to cover the Scope of Work.

It may be noted that the collection of primary data through detailed ground surveys was not taken up in view of the scope of work, time available for its completion, and the prevailing travel restrictions on account of the COVID-19 situation. Stakeholders' discussions were evolved as a way to collect the desired information in lieu of detailed ground surveys. State Governments of the region had shared their experiences regarding bamboo development, as well as the possibilities for bamboo-based activities in their states. In addition, over 50 institutions involved in the bamboo eco-system were consulted as a part of the work carried out. The inputs obtained from various sources have formed the basis for the formulation of the present Action Plan.

1.4. About this Document

The economic potential of bamboo for the North Eastern region had been recognized in many of the policy documents. The growing bamboo demand of the country in various industries vis a vis available stock in NER has been highlighted in North East Vision Document 2020. The vision document emphasized on need of scientific harvesting, skilled manpower and adequate infrastructure for large scale manufacturing. Similarly, the NITI Aayog has also identified bamboo as one of the focused area for shaping the economy of North East India. This Action Plan takes cognizance of such policy road maps and priority areas of bamboo sector intervention has been identified in terms of vision, goal, objectives, action plan, implementation arrangement, fiscal and non-fiscal incentives and convergence required.

This document has been drafted in accordance with the approved TOR described earlier and the Scope of Work, which has been detailed at Appendix-2. It gives an Action Plan for the development of

INTRODUCTION

bamboo based activities in the states of the NE Region. The main intent of the work is to benefit the regional stakeholders like growers, artisans and entrepreneurs. This is being sought to be done by facilitating the conversion of bamboo into a major segment of the organized economy of these states.

The chapters and sections of the report have been organized to cover the TOR and Scope of Work. The Action Plan devolves into specific road-maps covering viable segments like incense sticks, activated bamboo charcoal, bamboo applications in construction, bamboo fibre, bamboo board and bamboo furniture etc. These segments form the basis of the state-specific plans depending upon the suitability for the concerned state. In addition, the investments and incentives required to implement the Action Plan have also been spelt out.

2. Current Status of Bamboo Development



2.1. Global Status

Global Market Size: The global bamboo and bamboo products market size is about \$ 72.1 billion (2019) and it is projected to reach \$98.3 billion by 2025, after growing by about 5% per annum in the intervening years (Grand View Research). The robust growth of bamboo based markets is expected on account of factors like growing infrastructural development and the use of sustainable resources (like bamboo) in the manufacture of furniture and industrial products across the world. These are being boosted by the general perception that bamboo is a sustainable resource with a low carbon foot-print that offers multiple environmental, social, and economical benefits if it is used in lieu of other materials like timber.

Market Segments: The following table gives the major segments of the global bamboo market as estimated by various organizations. It may be noted that the segments covering bamboo use for (a) pulp and paper, and (b) construction may account for over 70% of the global market. The other segments (industrial use, crafts, food use etc.) may be about \$ 20-22 billion in size (in 2019).

Table-2.1: Global Bamboo Market

Segment	Market Estimate & Year for Estimate	Source
Pulp & Paper	40% market share (2019)	Future Market Insights
Construction	About 30% share (2019)	-Do-
Furniture	\$ 5,600 million (Projections for 2017)	Projections for 2017 based on 'Demand, Competitiveness, and Impact – Bamboo and other Sectors in the Mekong'
Woven Bamboo & Cane Products	\$ 4,200 million (Projections for 2017)	
Panels	\$ 2,200 million (Projections for 2017)	
Bamboo Shoots	\$ 1,700 million (Projections for 2017)	
Bamboo Flooring	\$ 1,160 million (2019)	FIOR Markets
	\$ 1,200 million (Projections for 2017)	Demand, Competitiveness, and Impact – Bamboo and other Sectors in the Mekong'
Bamboo Blinds	\$ 1,200 million (Projections for 2017)	
Charcoal	\$ 130 million (Projections for 2017)	
Activated Charcoal	\$ 170 million (Projections for 2017)	

Sources: As cited at above

It has been estimated that non-traditional items like laminated furniture, flooring, panels etc. constitute over 45% of the global bamboo markets (in 2017), while traditional products like handicrafts, traditional furniture, bamboo shoots, chopsticks and blinds will form the balance. ('Demand, Competitiveness, and Impact – Bamboo and other Sectors in the Mekong', The Mekong Bamboo Consortium Project). The above shares exclude use of bamboo in paper and pulp, and in construction (e.g. housing, scaffolding), both of which form a big part of the global market as estimated earlier.

CURRENT STATUS OF BAMBOO DEVELOPMENT

Till 2025, it has been projected that the demand for bamboo for industrial use will grow more rapidly compared with its use for handicraft or food use. This has been attributed to the growing demand for bamboos in diversified applications such as flooring, plywood, fuel, pulp, and paper etc.

Regional Status: As a region, the Asia-Pacific region accounted for 63% of the global market, with domestic furniture driving the growth in these nations. China is the leading nation in the production of bamboo and bamboo based items. Its output has been estimated to be \$ 39 billion (2018) as per the International Bamboo & Rattan Organization (INBAR).

International Trade: International trade remains a small part of the global output, as most of the output in the producing nations is sold in the domestic markets. For example, China exported \$2.2 billion in 2018, which formed just 5.6% of its output. The other major exporters include European Union (EU), Indonesia, Vietnam, the USA, the Philippines and Thailand.

It may be noted that the global trade of highly processed bamboo goods is growing, and these items (like flooring, panels, claddings, other highly processed industrial products etc.) constitute an ever-growing share of the global trade. However, traditional products are also being traded such as furniture and woven items. In fact, with \$ 380 million in exports, woven bamboo products still made the largest traded item in 2017 accounting for 21% of global exports (INBAR).

As per the 'Value Chain Analysis and Market Assessment of Bamboo Products in Kenya' (2018), over a three-year period from 2014 to 2016, 'preserved bamboo shoots are the most exported item (20.4%), followed by bamboo flooring (19.4%), bamboo basketry (14.2%) and bamboo and rattan furniture (10.3%)'.

Table-2.2: Global Exports of Bamboo & Cane (2017)

	Item	Value (\$) million	As a %	Remarks
1	Woven Bamboo Products	380	22	Bamboo plaits, baskets, mats etc.
2	Industrial Bamboo Products	362	21	Bamboo flooring, panels etc.
3	Bamboo Shoots	323	19	---
4	Bamboo & Cane Furniture	266	16	---
5	Woven Cane Products	172	10	Cane plaits, baskets, mats etc.
6	Raw Bamboo	101	6	---
7	Bamboo Charcoal	57	3	
8	Bamboo Paper & Pulp	26	2	
9	Raw Cane	17	1	
	Total	1,704	100	

Source: 'Trade Overview 2017', INBAR (prepared in November 2019) citing UNCOMTRADE data

NOTE: As per INBAR 'Due to their resemblance to wood products, it is likely that a large amount of the international trade in bamboo and rattan products is wrongly classified under the UN's Harmonized Commodity Description and Coding Systems (HS). Countries with a wider range of appropriate codes, and an increased capacity to identify bamboo and rattan products, show that the real figure may be

CURRENT STATUS OF BAMBOO DEVELOPMENT

much higher: data provided by China Customs alone adds over USD 1 billion more to the total export of bamboo and rattan products, putting the global export value in 2017 at over USD 2.7 billion.'

Major Exporters & Importers: The major exporters and importers of bamboo and cane items have been tabulated below, along with the monetary values of their exports and imports. This has been done for 2017, which is the latest year when UN COMTRADE data was available when the concerned source report was prepared by INBAR.

Table-2.3: Major Exporters & Importers of Bamboo & Cane (2017)

Exporter	Value (\$ million)	Importer	Value (\$ million)
China	1,184	European Union	536
European Union	151	USA	349
Indonesia	134	Japan	209
Vietnam	88	India	34
USA	27	Singapore	33
Philippines	22	China	33
Thailand	20	Korea	32

Source: 'Trade Overview 2017', INBAR (prepared in November 2019) citing UNCOMTRADE data

NOTE: As per INBAR 'Due to their resemblance to wood products, it is likely that a large amount of the international trade in bamboo and rattan products is wrongly classified under the UN's Harmonized Commodity Description and Coding Systems (HS). Countries with a wider range of appropriate codes, and an increased capacity to identify bamboo and rattan products, show that the real figure may be much higher: data provided by China Customs alone adds over USD 1 billion more to the total export of bamboo and rattan products, putting the global export value in 2017 at over USD 2.7 billion.'

On an average, the EU imported nearly 28% of the global imports in between 2014-16, while the US imported over 20%. These entities constituted for nearly half of the global imports. China is the significant exporter, as it contributed over 70% of the global imports in the above period. ('Value Chain Analysis and Market Assessment of Bamboo Products in Kenya', 2018)

2.2. National Status

Area under Bamboo: India is reportedly home to about 125 indigenous and 11 exotic species of bamboo from 23 genera. While it grows naturally almost throughout India except in the Kashmir region, bamboo occurs in abundance in the deciduous and semi-evergreen forests of the North Eastern region of the country and the tropical moist deciduous forests of Northern and Southern India. The North Eastern States and West Bengal account for more than 50% of the bamboo resources of the country. Other bamboo rich areas of the country are the Andaman & Nicobar Islands, Chhattisgarh, Madhya Pradesh and the Western Ghats.

CURRENT STATUS OF BAMBOO DEVELOPMENT

As per the India State of Forest Report (ISFR) 2019, an area of 160,037 km² has been described as 'bamboo bearing areas'. The following table provides additional details regarding the area under bamboo in India.

Table-2.4: Area under Bamboo in India

Class of Bamboo bearing Area →	Pure Bamboo	Dense	Scattered	Bamboo Present but Clumps completely hacked	Regeneration Crop	Total
Area (km ²)	4,332	30,575	1,02,139	8,260	14,731	160,037
As a % of the Total →	3	19	64	5	9	100

Source: India State of Forest Report 2019

It is seen that only 3% of the bamboo area consists of 'pure bamboo' and another 19% of 'dense bamboo'. Nearly two-thirds of the bamboo areas are covered by scattered clumps.

Number of Culms (ISFR 2019): The total number of culms at the national level has been estimated 39,454 million out of which the percentage of green sound, dry sound and decayed culms has been observed as 74.41%, 17.14% and 8.45% respectively. Size class 2-5 cm has contributed maximum number of culms (38.67%). The total number of culms has increased by 11,351 million as compared to the estimates of ISFR 2017. [Source: India State of Forest Report (ISFR) 2019]

Green Weight of Bamboo Resources: The total estimated green weight of bamboo culms at the national level is 278 million MT of which green sound bamboos contribute 65 % and dry sound bamboos contribute remaining 35 %. As compared to the estimate of ISFR 2017, there is an increase of about 88 million MT equivalent green weight of bamboo has been observed in the assessment carried out for ISFR 2019. [Source: India State of Forest Report (ISFR) 2019]

Demand & Supply of Bamboo: In India, the demand for bamboo is estimated to be about 27 million MT, as per the National Cooperative Housing Federation of India (as reported in the NCHF Bulletin in July 2017). This is needed for consumption by a range of users like the pulp and paper industry, construction sector, cottage industry and handlooms, food usage (bamboo shoots), fuel (charcoal), fodder (bamboo leaves) and medicines. As per the National Bamboo Mission, the annual harvest of bamboo is about 14.6 million MT (Operational Guidelines of NBM, revised in June 2019). This indicates a large supply gap of around 54% as compared with the national requirements of bamboo at present. The position has remained unchanged for quite some time. Prior to 2016, the Niti Aayog had estimated that India's bamboo output could meet only half of its needs. ('Business Standard' news item dated April 8, 2016 titled 'Need to address supply-demand gap in bamboo sector: Govt.')

Market Size: The Operational Guidelines of NBM has stated that the size of India's cane and bamboo output was about Rs. 26,000 crores. In view of the fact that the global output of bamboo and bamboo items was about \$72.1 billion (in 2019) and India's share was about 4.5% (as per the 'State of India's Environment 2018 in Figures'), the bamboo market in India is estimated to be about Rs. 23,942 crores

CURRENT STATUS OF BAMBOO DEVELOPMENT

(2019), assuming \$ 1 = Rs. 73.79 and an unchanged market share. There is no comprehensive data on India's bamboo market, as much of it is based on trade in an unorganized basis.

Imports & Exports: The table at overleaf gives the import and export data for bamboo items. It is seen that India imported Rs. 290.07 crore of bamboo items in 2018-19 and Rs. 560.27 crore in 2019-20, which represented a surge of over 93% in the bamboo-based imports. India's exports have reduced by over 9% from Rs. 500.21 crore to Rs. 454.1 crore.

India's major import consists of bamboo sticks for *agarbatti*. This product formed over three-quarters of the national imports of bamboo items in 2019-20. India's exports mainly included 'other bamboo articles', which formed over 80% of its exports in 2019-20. The country enjoyed a negative trade balance in bamboo-based products in 2019-20 as per the official data. In that year, imports were higher than exports by almost Rs. 106 crores for bamboo items. In the previous year (2018-19), exports were substantially higher than imports for bamboo related products.

India's Agarbatti Industry

Till a decade back, India was exporting bamboo and bamboo products, thereby earning revenues where major contribution was from agarbatti (incense stick) exports. Today, India is importing large volumes of round bamboo sticks for Agarbatti from China and Vietnam. This is being done as imports are cheaper by 40-45% as compared to the sticks made from Indian bamboo. In addition; *jiggat*, the mix that is rolled over the sticks, is also being sourced from China. Further, India is importing unperfumed *agarbatti* sticks from Vietnam and China. Some of these are being exported after minimal value addition like addition of perfume and simple packaging. However, this business model has been impacted by the rapid increase in the import duties on bamboo and bamboo products enacted recently. The incense stick industry has been discussed subsequently in this report.

CURRENT STATUS OF BAMBOO DEVELOPMENT

Table-2.5: India's Imports & Exports of Bamboo Items (All Figures are Rs.in Lakh)

HS Code	Commodity	IMPORTS			EXPORTS		
		FY 2018-19	FY 2019-20	Change (%)	FY 2018-19	FY 2019-20	Change (%)
140110	Bamboos	21368.70	43929.96	105.58	480.74	311.35	-35.24
200591	Bamboo Shoots	77.39	39.08	-49.50	7.48	0.00	-100.00
440210	Bamboo Charcoal	263.66	322.44	22.29	15.39	25.42	65.17
440921	Bamboo Flooring	596.26	373.63	-37.34	234.62	183.22	-21.91
441210	Bamboo Plywood	218.65	224.32	2.59	76.50	106.09	38.68
460121	Bamboo Mats, Matting & Screens	270.58	306.22	13.17	55.74	112.25	101.38
460192	Bamboo Plaits, Plaited Mats	38.13	68.36	79.28	7.88	3.70	-53.05
460211	Bamboo Basketwork	834.66	671.87	-19.50	322.87	377.74	16.99
470630	Bamboo Pulp	656.91	421.19	-35.88	30.69	0.00	-100.00
940152	Bamboo Seats	8.07	7.47	-7.43	11.87	5.82	-50.97
940382	Bamboo Furniture	116.82	128.46	9.96	45.89	112.27	144.65
441873	Assembled Bamboo Floor Panels	18.49	19.21	3.89	0.00	0.00	---
441891	Bamboo Construction Items	81.90	29.81	-63.60	0.16	38.60	24025.00
441911	Bamboo Bread Boards, Cutting Boards	454.35	686.51	51.10	365.00	572.91	56.96
441912	Bamboo Chopsticks	41.31	12.75	-69.14	0.06	1.46	2333.33
441919	Bamboo Tableware & Kitchenware	821.39	972.65	18.42	4262.98	6046.23	41.83
442191	Other Bamboo Articles	3139.64	7813.18	148.86	44103.37	37534.24	-14.89
	TOTAL (OF ABOVE COMMODITIES)	29006.91	56027.11	93.15	50021.24	45431.30	-9.18

Source: Department of Commerce, Govt. of India ('SYSTEM ON INDIA'S MONTHLY TRADE')
[\[https://tradedstat.commerce.gov.in/meidb/com.asp?ie=e\]](https://tradedstat.commerce.gov.in/meidb/com.asp?ie=e)

CURRENT STATUS OF BAMBOO DEVELOPMENT

2.3. Regional Status

The North Eastern states of India account for about one-third of India's area under bamboo, as well as 38% of the total bamboo stock of the country. Some of these states have skilled artisans who are very adept at working on bamboo based crafts.

Area under Bamboo: As per the latest India State of Forest Report (ISFR) of 2019; the bamboo bearing areas of the NE states is as follows.

Table-2.6: Bamboo bearing Areas in NE Region

State	Area as per Class of Bamboo Bearing Area (km ²) (*)					Total Bamboo Bearing Area (km ²)
	Pure Bamboo	Dense	Scattered	Bamboo Present but Clumps completely hacked	Regeneration Crop	
Arunachal Pradesh	417	3,389	10,904	0	271	14,981
Assam	204	2,350	7,664	0	307	10,525
Manipur	0	1,383	6,862	995	663	9,903
Meghalaya	140	467	4,803	0	0	5,410
Mizoram	0	1,370	2,106	0	0	3,476
Nagaland	227	1,137	2,730	75	115	4,284
Sikkim	141	94	894	0	47	1,176
Tripura	20	617	3,146	0	0	3,783
Total – NER	1,149	10,807	39,109	1,070	1,403	53,538
Total – India	4,332	30,575	102,139	8,260	14,731	160,037
NER to India (%)	27	35	38	13	10	33

Source: India State of Forest Report 2019

(*) All figures are in km², but the ratio of NER to India (last row) is given as a percentage

The NE Region covers about 8% of India's geographical area; and it has over 33% of India's bamboo bearing areas.

Number of Culms: The number of bamboo culms in India has been estimated for the Recorded Forest area by the India State of Forest Reports (ISFRs) prepared on a biennial basis. As per the ISFR 2019, the position of bamboo bearing culms in such areas has been given as follows.

Table-2.7: Number of Bamboo Culms in Recorded Forest Area

State	Number of Bamboo Culms (in Millions)			
	Green Sound	Dry Sound	Decayed	Total
Arunachal Pradesh	4,869	512	388	5,769
Assam	3,082	466	281	3,829
Manipur	843	205	78	1,126
Meghalaya	1,148	188	185	1,521
Mizoram	863	134	77	1,074
Nagaland	2,289	98	157	2,544
Sikkim	963	88	59	1,110
Tripura	197	12	9	218
Total – NER	14254	1703	1234	17191
Total – India	29358	6761	3335	39454
NER to India (%)	49	25	37	44

Source: India State of Forest Report 2019

(*) All figures are in numbers in millions, but the ratio of NER to India (last row) is given as a percentage

CURRENT STATUS OF BAMBOO DEVELOPMENT

With just over 33% of India's bamboo bearing areas, the NE states have about 44% of the number of bamboo culms found in the recorded forest areas of the country. It may be noted that Arunachal Pradesh and Assam have the maximum number of bamboo culms found in such areas in the country.

Bamboo Stock: The equivalent green weight of bamboo culms in the recorded forest area of the different NE states has been tabulated below.

Table-2.8: Equivalent Green Weight of Bamboo Culms in Recorded Forest Area

State	Equivalent Green Weight in Thousand MT		
	Green Culms	Dry Culms	Total
Arunachal Pradesh	22,601	5,331	27,932
Assam	17,226	6,838	24,064
Manipur	4,664	3,090	7,754
Meghalaya	8,770	3,553	12,323
Mizoram	6,475	2,337	8,812
Nagaland	18,678	1,869	20,547
Sikkim	365	64	429
Tripura	5,053	1,242	6,295
Total – NER	83,832	24,324	1,08,156
Total – India	1,81,646	95,941	2,77,587
NER to India (%)	46	25	39

Source: India State of Forest Report 2019

(*) All figures are in thousand MT, but the ratio of NER to India (last row) is given as a percentage

NOTE: Bamboo culms are classified into three categories, namely green sound, dry sound and decayed. The estimated number of culms is converted into equivalent green weight using appropriate weight factors.

The NE region has 39% of the nation's equivalent green weight of bamboo culms found in the recorded forest areas, including 46% of the weight of green culms. It may be noted that the weight of green culms is maximum in India in Arunachal Pradesh (22.6 m tonnes), followed by Nagaland (18.6 m tonnes) and Assam (17.2 m tonnes).

Another fact is that 78% of the total bamboo stock of the NE region in recorded forest areas consists of green culms, as per the above report. The proportion of dry (usable) culms is lower.

Bamboo Resources in Tree Outside Forest (TOF) Areas: In ISFR 2019, the state wise number of culms and their equivalent green weight could not be estimated anywhere in India. This is due to the fact that in several states, adequate number of TOF plots having bamboo could not be found during the period of current assessment i.e. 2016 to 2018 and therefore, the estimate of state wise bamboo could not be generated. However, the numbers of plots having bamboo have been found sufficient to generate national level estimate. As per ISFR 2019, the equivalent green weight of bamboo in TOF areas is 19.7 million MT.

However, the availability of dry usable culms in TOF areas in the NE Region may not be adequate to support the industrial scale production of bamboo items (floor tiles, panels, laminated bamboo furniture etc.) after providing for the household use, traditional applications in the crafts sector, and other commercial use.

CURRENT STATUS OF BAMBOO DEVELOPMENT

In addition, the establishment of a bio-refinery in Numaligarh (in Assam) is expected to require 0.50 million MT of bamboo per annum for producing bio-ethanol.

Utilization of Bamboo Resources in NE Region: The availability of bamboo culms in the states of the NE Region has supported its use for diverse household purposes (utility items, furniture, tools etc.), application in bamboo-based crafts, construction of shelter and erection of fencing, use in farming etc. In fact, bamboo is interwoven with the culture and traditions of the region.

Despite its wide use at the household level and sale in local markets, it has been reported that a significant proportion of the bamboo resources in the NE states have not been tapped adequately. Further, the assured availability of bamboo (till the recent years) has deterred its cultivation as a plantation crop in the region. Only now, initiatives are being taken up in the NE states to encourage the plantation of bamboo. This is being done as a part of the recent national efforts to support bamboo development across India.

Despite the abundance of bamboo resources in the NE Region, and the sudden growth of industrial level production of bamboo based items (like tiles, panels, bamboo fibre etc.); there has been low levels of investment in bamboo based industrial units in the NE Region. Some of the existing bamboo-based industrial concerns include the following:

- Industrial production of **window blinds, floor mats, and place mats** has a combined annual capacity of 670,000 m².
- The annual production of **bamboo flooring** is 150,000 m², that of bamboo particleboard is 6,000 MT, and mat boards and bamboo mat corrugated roofing sheets amounts to 240,000 units.
- **Paper** is being produced by a private player in Assam using bamboo as the resource. Two large scale paper making plants in the public sector in Assam and one newsprint unit in Nagaland have been shut down after operating for some time.
- **Bamboo shoot** industry of India is highly unorganized. Approximate harvestable bamboo shoot of the region is 5885 MT worth Rs. 26.96 Million.
- The first-of-its-kind **bio-refinery** in Assam will be powered entirely by renewable energy and will primarily use bamboo biomass as the feed stock in production of ethanol.

Hence, it is seen that the industrial scale utilization of bamboo in the NE Region has been quite limited till date.

3. Existing Initiatives for Bamboo Development >>>

3.1. Past Initiatives & Learnings

India is the world's second largest cultivator of bamboo after China, with 136 species and 23 genera spread over 13.96 million hectares. According to the Union Ministry of Agriculture and Farmers' Welfare, India's annual bamboo production is estimated at 3.23 million tonnes. However, the country's share in the global bamboo trade and commerce is only 4%. This is despite some noteworthy initiatives taken in the past in order to develop the bamboo sector in India.

The Planning Commission had prepared a report on National Mission on Bamboo Technology and Trade Development (NMBTTD), which was presented to the Hon'ble Prime Minister in July, 2003. In India, the usage of bamboo was then (prior to 2003) about Rs. 2,043 crores. The report pointed out that there was considerable scope to increase the size of the industry by at least 2.2 times. Over the next two years the projected rate of growth could be as high as 20% per year, as envisaged. Accordingly, the Planning Commission allocated Rs. 2,600 crores for bamboo under the 10th Five Year Plan.

National Bamboo Mission (Previous): In October 2006, the Government of India (GoI) had launched the National Bamboo Mission (NBM) on the basis of the National Mission on Bamboo Technology and Trade Development Report, 2003. The NBM's key objective was to address issues relating to the development of the bamboo industry in the country, to provide a new impetus and direction and enable the realisation of India's considerable potential in bamboo production.

The NBM was launched as a Centrally Sponsored Scheme in 2006-07 and was subsumed under Mission for Integrated Development of Horticulture (MIDH) during 2014-15 and continued till 2015-16. Funds were released thereafter only for maintenance of bamboo plantations raised earlier under NBM. The Mission was largely limited to propagation and cultivation of bamboo, with limited investment in seasoning and treatment units and bamboo bazaars. The significant achievements under NBM are given as follows-

- 1466 Nurseries and 3 Tissue Culture units were set up/rehabilitated;
- Bamboo plantations were taken up in about 2.37 lakh ha in forest areas and about 1.25 lakh ha in non-forest areas;
- Existing bamboo stocks of 0.91 lakh ha were treated for productivity improvement;
- Pest & disease management was taken up in about 0.86 lakh ha in non-forest areas;
- 39 bamboo wholesale markets, 40 bamboo bazaars and 29 retail outlets were established;
- Employment generation was a concomitant outcome/ benefit of the various activities promoted under the Mission; and
- Bamboo raw material was also made available for development of Bamboo Industries.

Though NBM contributed significantly towards enhancing bamboo areas both in forest and non-forest areas, the main weakness of the scheme had been the **absence of a linkage between the producers**

EXISTING INITIATIVES FOR BAMBOO DEVELOPMENT

(farmers) and the industry and a strong value addition component and also weak efforts in **organizing bamboo farmers for aggregation** through institutions such as cooperatives, SHGs, JLGs etc.

In addition, the **plantation on non-forest land** involving farmers and private landowners has not gained complete momentum. The transfer of technology through training and demonstrations formed an integral part of the NBM. But, the **quality of the training** needed to be further upgraded to improve the practical knowledge and skills of the stakeholders.

3.2. National Bamboo Mission (Restructured)

The National Bamboo Mission (NBM) was restructured in 2018. The Mission was launched as a natural corollary of the historic amendment of the Indian Forest Act in 2017, removing bamboo from the definition of trees, hence bamboo grown outside forests no longer need felling and transit permissions.

The Mission envisages promoting holistic growth of bamboo sector by adopting area-based, regionally differentiated strategy and to increase the area under bamboo cultivation and marketing. Under the Mission, steps have been taken to increase the availability of quality planting material by supporting the setting up of new nurseries and strengthening of existing ones. To address forward integration, the Mission is taking steps to strengthen marketing of bamboo products, especially those of handicraft items.

Objectives: The main objective of the above Mission is to expand the area under bamboo plantation in non-forest Government and private lands in order to supplement farm incomes and contribute towards resilience to climate change as well as availability of quality raw material requirements of industries. In addition, the NBM has sought to address other aspects like post-harvest management, product development, industries, skills development, and import reduction.

Accordingly, the NBM aims to increase nurseries and plantations of commercial species, establish bamboo treatment and seasoning plants, carbonization plants, enterprise incubators, and processing units for value addition and conversion of bamboo waste into products. In addition, the mission aims to promote more handicrafts in cottage industries, common facility centres, bamboo board /mat/corrugated sheets /floor tiles making units, biomass-to-energy units, activated carbon product units, bamboo depots and bamboo markets (physical and inline).

Enabling Provisions: The NBM has enabling provisions such as: including bamboo in the Schedule of Rates of Central Public Works Department (CPWD); adoption of "BIS certified and energy efficient" bamboo mat based products in projects/ construction works in all the hilly areas and sloped roofs; clarification on requirement of licenses for primary processing of bamboo units; royalty on home grown bamboo and transit permit on finished bamboo products; exemption of units exclusively using bamboo as raw material from obtaining license/NoCs from Forest Departments; and relaxation/removal of regulatory barriers in production, transit, marketing and processing of bamboo across the country.

Structure: The NBM has provisions for the constitution of Executive Committees at the national and state levels, apart from the formation of State Bamboo Development Agency to implement the Mission at

EXISTING INITIATIVES FOR BAMBOO DEVELOPMENT

the state level. At the districts, the District Level Agency is to be formed for all activities of the Mission in non-forest lands.

Activities under NBM: The NBM has the following categories of activities:

- Propagation & Cultivation (Nursery, Plantation & Maintenance);
- Bamboo Treatment & Preservation;
- Product Development & Processing;
- Promotion & Development of Infrastructure for Bamboo Markets;
- Development of Tools, Equipment & Machinery
- Skill Development & Awareness Campaign (up to 5% of allocation)
- Research & Development (up to 10% of allocation)
- Project Management (up to 5% of allocation)

[Source: Analysis of Annual Action Plans of National Bamboo Mission]

The key outputs envisaged under NBM are: (i) Coverage of 105,000 ha area under bamboo over a period of two years by ensuring adequate stocks of selected genetically superior quality planting material; (ii) Promotion and diversification of bamboo products through establishment of micro, small, medium & large processing units and development of value chain in bamboo; (iii) Setting up and strengthening of bamboo mandi/bazaars/rural haats, including promoting online trade; (iv) Enhanced cooperation within the country related to research, technology, product development, machinery, trade information and knowledge sharing platform particularly for NE States to give a boost to the low key bamboo based industry in the country. (NBM Operational Guidelines)

Achievements: The Mission is being implemented in a hub (industry) and spoke model, with the main goal of connecting farmers to markets so as to enable farmer producers to get a ready market for the bamboo grown and to increase supply of appropriate raw material to domestic industry. The bamboo ecosystem has been energized with 23 States being assisted, including all the 8 States of North East. 10 most important species which are required by industry have been identified and quality planting material is being made available to farmers for plantations.

In September 2022, 22 bamboo clusters were inaugurated in 9 States (Gujarat, MP, Maharashtra, Odisha, Assam, Nagaland, Tripura, Uttarakhand and Karnataka). A logo for the National Bamboo Mission was also released. [PIB Press Release 8th September 2020]

3.3. Challenges & Action Points

Some of the challenges faced by the development of the bamboo sector in the NE Region are discussed below. These have emerged from stakeholder consultations as well as from a review of secondary information.

- **Orientation of Existing Initiatives:** The major emphasis of the existing initiatives appears to be upon the plantation of bamboo. The other aspects seem to be receiving less importance, especially a focus on market driven value addition. There seems to be an absence of a mechanism to promote marketable products such as bamboo tiles and panels, bamboo fibre, composite bamboo

EXISTING INITIATIVES FOR BAMBOO DEVELOPMENT

furniture and activated bamboo charcoal. The export potential of items like bamboo shoots and bamboo craft items seems to have been overlooked.

- **Utilization of the Full Range of Species:** NBM has focussed upon 10 species of bamboos. However, there is a need to explore the commercial potential of all the other 128 species of bamboo available in India, as the introduction of new species into an area may be more challenging than the utilization of the existing bamboos. In fact, with the appropriate technology and developing markets, all species of bamboo can become commercially viable. The initiative of the Nagaland Bamboo Mission to produce activated bamboo charcoal has shown how a state can utilize all species of bamboo found within its territory.
- **Development of By-products to reduce Waste:** The manufacture of incense sticks is an important activity in India. However, there is a considerable generation of wastes which is currently not utilized. This reduces the cost competitiveness of the raw material of Indian Agarbatti industry. In the 1st Executive Meeting of the NBM, the State Mission Director of Tripura had pointed out the need for waste management for making the ventures (like agarbatti making) cost effective. This is on account of the fact that much of the bamboo culm is wasted while making bamboo sticks for use by agarbatti units. Activated bamboo charcoal may offer a way out. Other value added items may need to be developed to make fuller use of the bamboo raw materials.
- **Logistical Challenges:** Much of the bamboo resources are located in remote areas that are not served by any roads. The sustainable extraction of bamboos (including replanting of utilized areas) is not possible in such a scenario. In addition, the transport of bamboo involves high transport costs owing to its bulky size. Inter-state transport is faced with non-uniform rules with the obtaining of forest permits and transit passes being a cumbersome process.
- **Other Implementation Challenges:** Other issues which confront the implementation of Government funded initiatives for bamboo development include:
 - **Multiplicity of institutions** with overlapping mandates in the bamboo sector in NE India;
 - **Late release of funding**, as reported by State Bamboo Missions, impacting planting and other activities; and
 - **Limited capacities** at the state and district levels, especially with regard to bamboo trade and economics; technological innovations and manufacturing of bamboo products.

Action Points

The following are the major points for any Action Plan for bamboo development in the NE Region:

- ✓ Adoption of a **market driven** orientation;
- ✓ Utilization of the **full range of bamboos**, with preference to the **locally available species**;
- ✓ **Value Addition** to the existing products;

EXISTING INITIATIVES FOR BAMBOO DEVELOPMENT

- ✓ **Ease of** financial closure for entrepreneurs;
- ✓ **Revision** of plantation cost norms;
- ✓ **Revision** of subsidy norms factoring in NER challenges;
- ✓ Addressing the **Logistic challenges**;
- ✓ **Capacity Development** of Implementing Agencies;

The above have emerged from an analysis of the existing challenges as discussed in this section. The present action plan will adopt the above points as its guiding axioms while developing the implementation strategies.

Initiative for Bamboo Based Bio-fuel- Assam Bio-Refinery Limited: Under the aegis of Numaligarh Refinery Limited (NRL), North East will have the first bamboo based biofuel refinery in the country. The unit is estimated to consume around 5 lakh MT of raw bamboo procured from the North- Eastern States. Numaligarh Refinery Limited would be blending the bioethanol, with petrol as per the Indian Government rules and regulations (that allows for blending of petrol up to 10 per cent with ethanol). This refinery is a Joint Venture between the Indian PSU Numaligarh Refinery Limited and two other companies namely, Chempolis Oy of Finland and Fortum B.V. of Netherlands. The project is going to utilize a huge bamboo stock of the region. Considering the low amount of extractable “Out of Forest” bamboo, the venture need to ensure availability of raw material which is also cost effective. Mechanism to extract forest based bamboo can be one viable option for the unit. Further, it also need to come up with its own captive plantation, and preferably through wasteland cultivation.

4. Policy & Regulatory Framework



4.1. Bamboo Policy

Till today, there is no National Bamboo Policy for India. Such document is the need of the hour to guide the various agencies working for development of bamboo industry in the country.

However, the **National Agro-forestry Policy** had been announced in 2014. It seeks to support agro-forestry, which has been defined as a land use system which integrate trees and shrubs on farmlands and rural landscapes to enhance productivity, profitability, diversity and ecosystem sustainability. The above policy intends to encourage and expand tree plantation in an integrated manner with crops and livestock to improve productivity, employment, income and livelihoods of rural households, especially the small holder farmers. The policy also aims to meet the raw material requirements of wood based industries and reduce import of wood and wood products to save foreign exchange; apart from supplementing the availability of agro-forestry products (AFPs), such as the fuel-wood, fodder, non-timber forest produce and small timber of the rural and tribal populations, thereby reducing the pressure on existing forests.

As mentioned previously, the Government of India has launched a restructured **National Bamboo Mission** (NBM) in 2018. The basic objective of the above initiative is to increase the area under bamboo plantation in non-forest Government and private lands to supplement farm income and contribute towards resilience to climate change as well as availability of quality raw material requirements of industries. The NBM also seeks to address other areas like post-harvest management, product development, industries, skills development, and import reduction.

State Bamboo Policies in NE India: Some of the states of the NE Region have brought out policies to promote bamboo (and other related items). These include Assam, Manipur (with the policy being at the draft stage), Nagaland, and Tripura. The following briefly highlights the salient points of the above state level policies.

- **Assam Bamboo & Cane Policy 2019:** The policy aims at sustainable development and utilization of bamboo and cane resources in the state of Assam through scientific management and stakeholders' participation. In addition, the policy intends to achieve the protection and conservation of biodiversity, enhancement of resources and improvement of productivity, promotion of traditional and modern bamboo based industries, enhancing employment opportunity and livelihood security for the local people and development of effective marketing for bamboo and cane.
- **Manipur Bamboo Policy (Draft):** The policy seeks to harness the economic, social and environmental potential of the Bamboo resources of Manipur. It seeks to develop the economy of the State and provide employment and income generating activities to the farmers, rural poor and unemployed youths of the State. A market led, community owned sustainable development model for bamboo shall lead to an increase in quantity and quality of bamboo resources and enterprises

POLICY & REGULATORY FRAMEWORK

to meet the current and future requirements of not just the State and Country but also the larger international market.

- **Nagaland Bamboo Policy 2004:** This policy sought to develop bamboo in the state, both at enterprise and resource levels. The Nagaland Bamboo Development Agency was established to implement the above policy.
- **Tripura Non Timber Forest Product Policy, 2020:** In May 2020, the Government of Tripura has approved a Non Timber Forest Product Policy to boost livelihood opportunities of tribal communities dependent on forest produce. The policy aims at funding the cultivation of bamboo, cardamom, broomstick flowers, among other things using scientific methods.

In addition, bamboo finds mention in **the Socio-Economic Development Policy 2019** of **Mizoram**. This policy aims at bringing self-sufficiency in food items, improving social life, bringing happiness and peace to people.

Other Policies of the NE States: In addition, the matter of bamboo development has found mention in some of the other policies of the State Governments of the NE Region. These have been briefly mentioned below.

Table-4.1: Bamboo Development in Policies of NE States (Excluding State Bamboo Policies)

State	Policy & Year	Provisions planned for Bamboo Development
Arunachal Pradesh	Arunachal Pradesh State Industrial & Investment Policy 2020	'The following areas have been identified as key thrust areas which have huge potential for growth in the state: Industries based on non-timber forest produce e.g. bamboo, cane, medicinal plants / herbs, aromatic grass' [under 2(3) Thrust Areas]
Assam	Industrial & Investment Policy of Assam 2019	Under 3.10 'Bamboo': Assam has ample scope for bamboo-based industries such as paper manufacturing. The objective of the Government of Assam is to promote bamboo as a substitute for wood and make it the timber of the 21st century. Under 6.0 Thrust Areas: Government of Assam has identified certain activities as thrust areas for both the Manufacturing and Services sector activities. These are as follows: (i) Manufacturing – 6. Bamboo Industries
	Agriculture Policy of Assam	The Agriculture Department in association with National Bamboo Mission, Ministry of Environment and Forest, Govt. of India shall take steps for massive plantation of anti-erosion crops like Broom Grass, Bamboo, Banana, Vetiver and other medicinal and aromatic crops along the erosion prone areas (under 'Policies on Land') The floral wealth of Assam-seasonal, annual, perennial, ornamental trees, orchids, greens and ferns, hedge plants, ornamental bamboos, grasses, climbers, foliages, crotons and various wild beauties-is not yet documented in a comprehensive way which need immediate attention of all stake holders

POLICY & REGULATORY FRAMEWORK

State	Policy & Year	Provisions planned for Bamboo Development
	Assam Forest Policy 2004	<p>(under 'Flowers' as a part of policy on Horticultural Crops)</p> <p>2.1 The basic objectives that govern the Assam Forest Policy, 2004 are (inter alia) Meeting the bona-fide livelihood needs of fuel wood, fodder, bamboo, canes, small timbers and other N.T.F.Ps of the rural poor and the tribals in particular, with due regard to the carrying capacity of the forests</p> <p>3.6 Trade of bamboo and other N.T.F.Ps after adequate value addition and development of market facilities would be actively promoted.</p>
	Assam Forest Policy 2004 [Continued]	<p>Surplus raw materials could also be exported after meeting local needs, within the limit of sustainable production.</p> <p>Management of Bamboo and Canes:</p> <p>4.5.1 Bamboo being a multipurpose, eco-friendly crop abundantly available, yet an under-utilized natural resource, needs to be managed and exploited for sustainable use. Bamboo is conceived as the thrust area in the industrial development of Assam and for economic and ecological security of people. This precious resource needs to be fully tapped as an industrial raw material, as substitute for wood in rural/urban housing, engineering works, handicrafts, furniture through appropriate value addition aimed at meeting national and international markets. Undoubtedly bamboo can revolutionise the economy of the State ensuring employment opportunities to a large number of people, Extension and awareness about bamboo sector development will be given renewed thrust.</p> <p>4.5.2 Conversion of bamboo diversity, germ-plasm, sustainable management and use of dedicated bamboo forest and promoting bamboo cultivation in homesteads are the key-trust areas of Bamboo Policy of Assam.</p> <p>4.5.3 To enhance the productivity in bamboo sector, improved planting stock would be developed through application and extension of modern techniques both within the Forest Department and to the communities.</p> <p>4.5.4 Forward and backward linkages between bamboo growers and bamboo enterprise, industry and craft centres should be established to boost bamboo trade, industry and marketing within and outside the State.</p> <p>4.5.5 Harvesting of bamboo for paper mills would be properly monitored and silvicultural practices would be strictly followed. Such industries would be asked to procure at least half of their requirement from village communities, which will encourage them to grow more bamboo and also help their economic uplift. For all industrial use, the pricing would be done judiciously.</p> <p>4.5.6 Appropriate interventions and association with NGOs working in the sector for introducing modern technology catering to the current market</p>

POLICY & REGULATORY FRAMEWORK

State	Policy & Year	Provisions planned for Bamboo Development
		requirements and imparting necessary training to the local people of the State for optimum utilization of the returns from this invaluable resource of Assam.
Manipur	Industrial & Investment Policy of Manipur 2017	Under '5. Industrial activities identified as Thrust Areas' Manipur is a predominantly bamboo growing state with more than 20 different varieties. Building materials and furniture manufactured from bamboo give classy look and are more resistant to rain. Therefore, demand for such products has been increasing. Bamboo Park for industrial production of building materials and furniture shall be set up and units will be encouraged to manufacture building materials with bamboo.
Manipur	Industrial & Investment Policy of Manipur 2017 [Continued]	Varied bamboo products including extraction of ethanol is planned and being explored in collaboration with Oil companies. Besides, units for processing of bamboo shoots, a processed food which is sought after not only in Manipur but in entire South East Asian countries, will be encouraged.
Meghalaya	Meghalaya Industrial & Investment Policy 2012	This Policy thrust will be on Horticulture & Agro based post-harvest management, tourism related service activities, optimum utilization of Bamboo Resources, Pharmaceutical & Food processing activities including Honey processing. Under E Potential Areas: The following areas have been declared as potential area in the promotion of industrial activities in the state of Meghalaya: 9. Bamboo/Reclaimed Wood based & Products: The State government will encourage setting up of Bamboo/Reclaimed Wood based Industries in rural areas to encourage local entrepreneurs at the village level
Mizoram	Mizoram Industrial Policy 2012	Under '3. Identification of Thrust areas' Forest-based Industries: The vast bamboo and other forest resources of Mizoram will be optimally harvested for setting up of Industry for manufacturing of various high value bamboo and other forest based products. The process of value addition for maximum utility of Forest resources will be encouraged while restricting the out flow of forest resources without value addition. Entrepreneurs will be encouraged to utilize waste materials of bamboo in paper/pulp industry and also as feedstock (pulverized briquette) in biomass gasifier for power generation.
Tripura	Bamboo Vision Document	The Government of Tripura launched Tripura Bamboo Mission (TBM) in 2006 with the vision to strengthen the Bamboo sector in the state with a specific focus on livelihood generation and ensuring the integrated development of the bamboo value chain. TBM has adopted a farm to market approach with strategic interventions to develop various focus sub-sectors.

Source: Study of Secondary Information

4.2. Legal & Regulatory Framework for Bamboo in India & the NE Region

As per the Constitution of India, 'Forest' is a subject under the concurrent list. Thus, both the Central Government and State Government can enact legislation on the subject, with the acts of the former having precedence in case of any conflict. In India, bamboo is primarily found in forests, whereby it is classified as a forest produce. Hence, it is subjected to both Central and State laws.

The **Indian Forest Act, 1927** had interpreted 'tree' to include bamboos. This meant that the felling of bamboo grown anywhere in the country was subjected to restrictions applicable to 'timber'. The Act not only constricted the livelihoods of forest communities, but restricted private growers too. As per the above Act, the felling and transportation of bamboo from Reserve Forests or from Protected Forests was to be carried out only with the written permission of the Forest Officer. The transportation of bamboo from forests required a 'Transit Pass'.

In 2017, Section 2 (7) of the Indian Forest Act was amended to exempt bamboo grown in non-forest areas from the definition of 'tree'. Thereby, any bamboo grown in private or homestead land no longer requires a felling permission or transit permission from any State Forest Department. However, bamboo grown in forest lands will continue to be classified as tree and legal restrictions on cutting and transport of bamboo from such forest lands remain.

Under **The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006**, popularly known as the Forests Rights Act (FRA), bamboo has been classified as a minor forest produce (MFP). This Act recognizes and vests individual forest-dwellers with forest rights to live in and cultivate forest land that was occupied before 13 December 2005 and grants community forest rights to manage, protect and regenerate the forest under section 3(1)(i), and to own and dispose minor forest products from forests where they had traditional access. Section 3(1)(c) of the Forest Rights Act 2006 defines forest rights as inclusive of 'Right of ownership, access to collect, use and dispose of minor forest produce which have traditionally been collected within or outside village boundaries'. Individuals, communities and gram sabhas having rights under this particular section of the Act will not only have the rights to use but also rights of ownership over MFPs.

As per **Schedule VI of the Constitution of India**, tribal communities inhabiting areas in some states of the NE Region, designated as autonomous districts, were granted special provisions for the protection of their traditional rights. Autonomous District Councils (ADCs) were established in such areas with powers over land and other resources including forests - excluding Reserved Forests (RF), Proposed Reserve Forests (PRFs) and Protected Area Network (PAN) established for wildlife and biodiversity conservation. Laws enacted at the Union or State levels need the consent of the ADCs to be applicable in such areas.

Thus, under the FRA, 2006 as well as the powers vested with the ADCs, bamboo grown in forests (not being RF, PRF or PAN) can be utilized without any constraint. These forests are usually termed as Un-classified Forests or as Un-classified State Forests (USF) in the hill states of the NE Region. The de-facto control over such forests is exercised by the traditional authority.

5. Stakeholders' Discussions



5.1. Existing Stakeholders in the Bamboo Eco-system

The development of the bamboo sector involves a diverse set of stakeholders, viz. farmers, local communities, artisans, small scale and household producers, traders, NGOs, panchayat and district/block level officials; and policy makers, scientists and researchers. These stakeholders can be either organizations (government ministries or departments, companies or institutions) or individuals who belong to different ministries and government agencies, research institutions and academia, and the private sector.

National level Stakeholders: The stakeholders who are active in the bamboo sector at the national level are the Ministry of Environment, Forests and Climate Change; Ministry of Agriculture and Farmers' Welfare working through the National Bamboo Mission, Ministry of DoNER through North Eastern Council, North East Cane and Bamboo Development Council, North East Handicraft and Handloom Development Corporation, North Eastern Development Finance Corporation Limited and North Eastern Regional Agri-Marketing Corporation and National Mission for Sustainable Agriculture; Ministry of Micro, Small and Medium Enterprises, Ministry of Textiles (Development Commissioner – Handicrafts), Ministry of Rural Development through the National Rural Livelihood Mission (NRLM).

In addition to this, the development of Bamboo sector is dependent on concerted efforts of various other ministries which have direct or indirect role in the value chain and ecosystem. This includes- Ministry of Road Transport and Highway, Ministry of Food Processing Industries, Ministry of Tourism, Ministry of Science and Technology, Department of Biotechnology, National Disaster Management Authority, Ministry of Tribal Affairs, Ministry of Housing and Urban Affairs.

NITI Aayog: NITI Aayog, especially the NITI Forum for North East, have a significant role in emphasising the possibilities for bamboo development in the NE Region. NITI Forum for North East was constituted in February 2018, to identify various constraints in the way for accelerated, inclusive but sustainable economic growth in the North East Region of our country and also to recommend suitable interventions for addressing the identified constraints. The Three-Year Action Agenda prepared by NITI Aayog for India covering the period from 2017-18 to 2019-20 was silent on the role of bamboo at the national level, as well as on its role in the regional strategy for NE India. NITI Aayog has identified bamboo as one of the priority areas for the North Eastern Region.

Invest India: Invest India is the National Investment Promotion and Facilitation Agency of India and act as the first point of reference for Investment in India. Invest India has "North East Desk" for facilitating Investment to North East India. Countries such as Taiwan, Japan and other South East Asian countries who have been leader in the bamboo sector technology can be invited to invest in bamboo sector of North East India. In March 2021, Invest India has organized meeting with Taiwan on the subject of "Investment Opportunities in India's North East and Textile Sector".

STAKEHOLDERS' DISCUSSIONS

International Agency working in Bamboo Sector of India including NER: Some of the prominent international agency working in bamboo sector development of India are-

World Bamboo Organization: Established in 2005, WBO has its headquarter at Antwerp, Belgium, the organization consist of prominent bamboo sector specialist across the globe from various sub-sector.

International Bamboo and Rattan Organization (INBAR): Headquartered in China, INBAR is an intergovernmental organization with 47 members which was set up in 1997. It works towards policy advocacy for sustainable use of bamboo and rattan.

Japan International Cooperation Agency (JICA): JICA has identified sustainable forest development as one of its key area of intervention for India. In the state of Tripura, JICA has been working towards sustainable development of bamboo through setting up of CFC, capacity building of artisans and plantation management.

National Level Institutional Stakeholder- The national level institutional stakeholders of bamboo are- Design Institutes such as NID Ahmedabad, Bengaluru who are working through Centre of Bamboo Initiative & NID Jorhat, NIFT Shillong, Indian Institutes of Packaging Mumbai & Kolkata who are currently working on developing bamboo as packaging material, Indian Institute of Plywood Research and Training which is a Bamboo Technology Support Group of National Bamboo Mission, IIT Guwahati, National Institute of Natural Fibre and Engineering Technology, Kolkata which are exploring the scope of using bamboo as geo-textile.

India Bamboo Forum: Former Union Minister Suresh Prabhu has recently launched India Bamboo Forum- an independent forum with an aim to give boost to the bamboo sector by promoting entrepreneurship, research, and trade of high quality bamboo products in a sustainable manner. The forum aims to work in five priority areas of bamboo- development of a dedicated knowledge dissemination portal, improving technical standards, skill development, providing mentorship to bamboo startups and creation of a platform for facilitating buyer-seller linkages of bamboo products.

5.2. Institutional Stakeholders in the NE Region

Apart from the Government Departments and other stakeholders like industry, crafts sector, growers and individuals, the role of institutional stakeholders can be essential for the development of any economic activity. Some of the institutions working for bamboo development in the NE region and located within the region have been listed below.

- **North East Cane and Bamboo Development Council (NECBDC):** The erstwhile Cane & Bamboo Technology Centre (CBTC) under North Eastern Council was established by for training, technology sourcing, developing market linkages for the bamboo sector so that Indian bamboo products could be present in the global marketplace. ECBDC is one of the Bamboo Technology Support Group of National Bamboo Mission.

STAKEHOLDERS' DISCUSSIONS

- **The Rain Forest Research Institute (RFRI), Jorhat:** Rain Forest Research Institute is a Central Research institute situated in Jorhat in Assam. It works under the Indian Council of Forestry Research and Education of the Ministry of Environment, Forest and Climate Change, Government of India. Further, RFRI has the only government promoted tissue culture lab in the region which working in the field of bamboo tissue culture for planting material. They are also one of the Bamboo Technology Support Group of National Bamboo Mission. Under RFRI, **Advanced Research Centre for Bamboo and Rattan (ARCBR)** Mizoram provides support for development of the bamboo sector.
- **Bamboo and Cane Development Institute:** It was set up to cater to the changing design and technology needs of buyers and to provide support to artisans and craftsmen in these two aspects. The Institute conducts training programmes and workshops and acts as a resource Centre. The Centre also facilitates the participation of artisans and craftsmen in trade fairs.
- **Tripura Bamboo and Cane Centre (TRIBAC):** It is an organization under Centre for Indian Bamboo Research and Technology (CIBART) which provides local artisans with training and capacity building for bamboo product production and enterprise development.
- **North Eastern Space Application Centre (NESAC):** The North Eastern Space Applications Centre (NESAC), a joint initiative of Department of Space (DOS) and the North Eastern Council (NEC) is a society registered under the Meghalaya Societies Registration Act, 1983. It is an expert institution in the region which is involved in forest based resource mapping through satellite imagery. The institute has been involved with many of the NER state governments for resourcing mapping of bamboo
- **Indian Institute of Technology Guwahati (IITG)** is a public technical and research autonomous institute which conducts research to develop innovative bamboo products using new technologies that address practical issues. Department of Design, IIT Guwahati is setting up technical back up unit at IIT Guwahati for KVIC, Loom Development, Design Development and Branding of Shken Bamboo Products for Government of Meghalaya, Hand-tools development for Bamboo handicrafts, Setting up of Production Centre at Syntein Village, East Khasi Hills, Meghalaya, Crafts training program for nearly 500 Bamboo craftsperson in Assam and Meghalaya and Classroom projects in bamboo.
- **North East Handicraft and Handloom Development Corporation (NEHHDC):** Under the Ministry of DoNER, NEHHDC was created as an aggregator of craft products of North East. Bamboo Craft is one of its major product segment.
- **North East Centre for Technology Application and Research (NECTAR)** has created production capacities and technology capabilities, including skilled human resources in various product lines and bamboo applications, though the impact of these measures has been less.
- **Indian Institute of Entrepreneurship (IIE)** works with the North East Council (NEC), and its functions are to design and organize training and entrepreneurship research to improve efficiencies, effectiveness and delivery of development practitioners.

STAKEHOLDERS' DISCUSSIONS

- **Rural Technology Action Group (RuTAG)** aims at improving the rural economy in the NER through appropriate interventions in traditional methods of production. RuTAG aims to bring together groups or stakeholders to proactively work for the development of the region so that people were able to use research and development to upgrade rural systems in terms of efficiency/productivity. RuTAG is administered by IIT Guwahati.
- **Bamboo Technology Park, Chaygaon, Kamrup, Assam:** Promoted by Assam Industrial Development Corporation Ltd. (AIDC) as a SPV, the park provides infrastructure facilities to bamboo entrepreneurs against payment of user charge.
- **Bamboo Industrial Park, Dima Hasao, Assam:** Upon implementation, this will be the first ever bamboo technology industrial park of India. The project will be funded by the Ministry of DoNER which is expected to be completed by March 2021. It is set up in the major bamboo growing belt of the North East.
- **Numaligarh Refinery Limited (NRL):** NRL is coming up with the first ever bamboo based bio-ethanol project of NER which is currently under implementation.

State level Stakeholders: The state level stakeholders of bamboo sector are- Department of Industries and Commerce through their industrial policy and as implementation agency for State Bamboo Mission in few of the NER states, Department of Forest for forest based bamboo, Department of Horticulture through implementation of State Bamboo Mission in few NER states, Department of Soil Conservation for State Bamboo Missions in states such as Sikkim and Meghalaya and scope of horticulture inter-cropping, State Rural Livelihood Missions through bamboo craft clusters under the missions, State Bamboo Development Agency (Nagaland), State Handloom and Handicraft Development Corporation for bamboo craft sector interventions, the Autonomous District Councils for forest and community land based bamboo resource etc.

Other Stakeholders: National Level Enterprises which are procuring bamboo as raw material, semi-finished material and finished product from NER, NGOs, bamboo enterprises, business associations, bamboo cultivators, traders and designers.

5.3. Feedback from the Stakeholders Meetings

A large number of stakeholders' consultations were organized (15 in all) as a part of the assignment. The stakeholders included participants from the Government, Entrepreneurs, Crafts Clusters, Institutions and Banks. The following summarizes the feedback received from the stakeholders. The details are available at Appendix-3. In addition, Appendix- gives the details of these stakeholders.

Government

Discussions were held with the senior officials of the National Bamboo Mission (NBM). They gave a background of their work, and the progress achieved till date. In addition, they furnished some suggestions for the bamboo sector of the NE Region, as well as their plans for the sector on a national basis.

STAKEHOLDERS' DISCUSSIONS

Officers from the State Bamboo Missions of five states (Assam, Meghalaya, Mizoram, Nagaland, and Tripura) joined discussions organized on two separate occasions. They gave account of the progress of bamboo in their states, as well as the various interventions being undertaken for the sector in collaboration with various stakeholders along with implementation challenges.

Entrepreneurs & Industries

There were consultations with industrial units and entrepreneurs involved in the bamboo sector. These stakeholders gave their feedback on the issues challenging bamboo development across the value chain. These included issues with raw materials (in terms of quality and volumes), technology (need to upgrade tools and equipment), lack of financing, logistics (high costs of transport), and market development. As many bamboo items were a novelty (files, panels, laminated furniture etc.), consumer confidence and tastes will take time to develop. The efforts of institutions and government initiatives need to reach the entrepreneurs, who are working for bamboo development.

Banks & Financial Institutions

Banks were of the opinion that currently there is limited high value bamboo products and they are manufactured mostly in the micro and small scale. The Government schemes along with MUDRA loans (collateral free loans) could be used by micro-level entrepreneurs. The bamboo eco-system needs to be developed on commercial basis, along with the ready availability of data. The importance of entrepreneur linked cluster development was also highlighted. Further, CSR funding could be used for bamboo plantations.

Institutions

The different institutions (both in the region as well as those located outside) gave account of their experience with the bamboo sector. They had undertaken several works for the sector, including in the NE region. They are ready to support further growth of the sector in the NE Region.

International Practices on Bamboo

Experts from South Asian Countries such as Indonesia, Vietnam, Philippines- the countries which have established bamboo based economy participated, gave their suggestion and shared their willingness to work with NER. Expert group from Japan expressed their willingness to share bamboo fibre technology with India. Experts from African countries Kenya and Tanzania who has identified bamboo as emerging economic area and way to fight climate change participated and explained their models. Enterprise from Israel working in bamboo electric bicycle has also participated in the session.

Other Stakeholders

Discussions were held with other classes of stakeholders like international participants, organizations involved with craft clusters, and bamboo machinery suppliers. Their inputs (along with that of other stakeholders) have been used to draw up the strategies for bamboo development in the NE region under the present Action Plan.

6. SWOT Analysis



6.1. Analysis of Strengths, Weaknesses, Opportunities & Threats

SWOT Analysis assesses the Strengths and Weaknesses of an entity, along with the Opportunities and Threats emanating from the environment around it. It gives a good starting point for planning a set of future activities related to the entity. In the present case, the concerned entity is the bamboo sector of all the NE states taken together. The SWOT analysis for the sector has been given below.

In addition, the following section discusses the measures proposed under the present Action Plan to address the identified Weaknesses and Threats of the entity.

Strengths

- Availability of **sizeable stocks** of bamboos of various useful species
- Availability of considerable **wasteland areas** that are now unused (or less used) and which can be utilized for bamboo cultivation
- Availability of **traditionally skilled craftsmen** in several clusters in the NE states
- Existence of other **components of a bamboo eco-system** within the region like entrepreneurs, designers, institutions (working in parts of the bamboo value chain), government investment etc. apart from craftsmen

Weaknesses

- Deficiencies in many parts of the **value chain**, which push up costs and reduce the market value of the items produced – including **lack of waste utilization**, use of non-treated bamboo, logistical weaknesses (transport and warehousing), sourcing issues, use of inappropriate copies of imported machinery by industrial units, low use of modern tools and equipment by artisans, limited market etc.
- **Lack of high value** product categories
- **Limited amount of non-forest bamboo** and its huge consumption on traditional industry.
- **Lack of Research and Development** and **limited understanding** of the bamboo as material for various industries
- Lack of thrust upon scientifically managed **bamboo plantations** in the NE states, with resources being mainly available from extraction of natural clumps and forest resources not under government control.
- Weak **credit linkage** for entrepreneur and artisan based enterprises
- Limited use of modern **designs** and other **innovations** owing to the existence of a working level gap between the institutions and designers (on one hand) and the entrepreneurs and artisans (on the other hand)

SWOT ANALYSIS

- Unavailability of **reliable data** on many segments of the bamboo sector in NE Region – resources outside forests, quantum of stock (species wise data), locally made products, supporting services etc. – all of which constrain informed decision making

Opportunities

- Increased appreciation of bamboo as **a sustainable alternative** to tropical wood, leading to rise in the global use of bamboo articles (both for industrially made items and artisanal creations) and their global trade (mainly exports from Asia to Europe and North America)
- **Focus of the Government** of India at the highest levels upon the bamboo sector in NE Region
- Significant opportunities to **substitute imports** of bamboo items with local alternatives on competitive basis
- Possibility to **converge Government schemes** to develop the bamboo sector in NE Region

Threats

- High level of **imports** in certain items (like round bamboo sticks for agarbatti)
- Dependence on imported machines
- Competition from **well established players** in the global markets in case exports are attempted
- Absence of **large industrial units** based on bamboo (excluding shuttered paper mills of the public sector)

6.2. Addressing the Weaknesses & Threats under this Action Plan

This section discusses the steps proposed under this Action Plan to deal with the above mentioned Weaknesses and Threats of the bamboo sector in the NE Region. This has been done as follows.

Table-6.1: Addressing the Weaknesses

Identified Weakness	Measures Proposed under Action Plan
Deficiencies in many parts of the value chain	<ul style="list-style-type: none"> • Setting up of industry across value chain which can address the issue of waste. • Develop Multi-model supply chain through formation of FPOs for grading and easy handling during transportation • Improvement of inward logistics through the concept of Bamboo Extraction Roads • Increase use of In-land waterway and railway • Use of improved designs • Lift DGFT ban on export of bamboo charcoal and activate charcoal • Explore feasibility of duty drawback rate of 7% to export • Mandatory procurement of bamboo procurement by government institutions
Lack of high value products	<ul style="list-style-type: none"> • Introduction of new products such as fibre, activated charcoal, industrial craft. • Catering to raw material needs of high end

SWOT ANALYSIS

Identified Weakness	Measures Proposed under Action Plan
	bamboo construction
<p>Limited amount of non-forest bamboo and its huge consumption on traditional industry.</p>	<ul style="list-style-type: none"> Action Plan proposes large scale plantations on (1) wastelands and (2) areas earmarked for development in forest lands (excluding RF and PAN) along with the development of nurseries / TC labs
<p>Lack of Research and Development and limited understanding of the bamboo as material for various industries</p>	<ul style="list-style-type: none"> Action Plan proposes setting up (1) National Institute of Bamboo Innovation and Technology (2) Centre of Excellence for Bamboo Machinery
<p>Lack of thrust upon scientifically managed bamboo plantations in the NE states, with resources being mainly available from extraction of natural clumps and forest resources not under government control.</p>	<ul style="list-style-type: none"> Scientific management of bamboo forests Introduction of FSC certification to bamboo plantation
<p>Weak credit linkage for entrepreneur and artisan based enterprises</p>	<ul style="list-style-type: none"> Bamboo Entrepreneurship Fund Front ended pro-rata basis subsidy Formation of bamboo financial consortium Low or interest free loan Convergence with existing Government schemes Engagement of dedicated agency for DPR preparation Loan guarantee in line of Covid Credit Guarantee scheme
<p>Limited use of modern designs and other innovations</p>	<ul style="list-style-type: none"> Encouraging designers in the NID and NIFT in NE Region to focus on the bamboo sector Engaging in a bigger way with designers in the rest of the country and other countries Thrust on innovations from institutions (IIT, NITs, and Engineering Colleges etc.) and others both in the region and elsewhere.
<p>Lack of marketing and forward logistics management skills amongst the artisans of traditional craft clusters.</p>	<ul style="list-style-type: none"> Bottom up approach for one cluster one product model Equal focus on training of unemployed youth marketing and forward logistics management at cluster level
<p>Unavailability of reliable data on many segments of the bamboo sector</p>	<p>Identification of bamboo resources (species wise) NESAC, tools for real time information on annual harvestable bamboo stock details, Building up a data base of artisans, capacities, products and other stakeholders of the eco-system</p>

Table-6.2: Addressing the Threats

Identified Threats	Measures Proposed under Action Plan
High level of imports in certain items	Cost and quality competitive domestic production , by utilization of wastes and other measures (round sticks for agarbatti)
Competition from well established players in the global markets	<p>Identifying less served niches as an entry strategy- focus on bamboo polyester substitute fibre instead of bamboo rayon. Focus on mechanical method of fibre extraction which produces more environmentally sustainable fibres than existing chemical treatment method</p> <p>Build up international reputation as reliable supplier of quality bamboo products – especially for high end construction sector and artisanal items</p> <p>Encourage international investors to come to NE Region to use the available resources and manpower</p>
Absence of large industrial units based on bamboo	<p>Encourage Indian and international investors to come to NE Region to use the available resources for making bamboo items for national and export markets</p> <p>Publicize the availability of incentives under NEIDS 2017 and other schemes, including that of State Governments</p>

7. Priority Areas for Interventions

7.1. Key Areas for Interventions

The development of the bamboo sector in NE India will require a host of interventions across the ecosystem. These have emerged from the previous chapters including the lessons from past initiatives, study of the policy and regulatory framework for bamboo, SWOT Analysis, stakeholders' consultations, secondary research etc. The key areas across the value chain that will need interventions under the present Action Plan include the following:

1. **Market Identification:** Understand the norms and needs of leading bamboo markets of the world and prepare the growers, entrepreneurs, technical support agencies and local governments of North East accordingly.
2. **Development of bamboo trade support tools:** To attract private investment in bamboo sectors of North East, bamboo sector needs more reliable and real-time information on raw material availability - both in the form of species wise availability and location wise annually available stock of required grade.
3. **Improvement of Productivity:** Through scientific management of the bamboo plantations, the existing productivity of 3-6 MT/Ha of Indian bamboo needs to be improved to at least 10-12 MT within a specific time-line.
4. **Planting Materials:** For good quality planting material at low cost, the regions need to develop Tissue Culture Labs & hi- tech nurseries, large scale nurseries and small scale nurseries.
5. **Plantation:** Implement a plan for bamboo plantation in wastelands and mechanism to extract forest based bamboo (excluding Reserve Forest and Protected Area Network).
6. **FSC FM:** Introduction of Forest Stewardship Council (FSC) Forest Management (FM) Certification at farmer group level and also under captive plantation of Forest Department which will ensure better price realization to growers and entrepreneurs due to compliance of import norms of developed countries.
7. **Inbound & Outbound Logistics:** Develop inbound logistics through the construction of Bamboo Extraction Roads to reach bamboo rich belts in remote areas; potential use of in-land waterway and railway.
8. **Formation of Bamboo Sector FPO:** For organized supply chain and plantation management, and reduction of post-harvest wastage bamboo sector FPOs need to be formed which will act in the multi-modal supply chain mechanism.
9. **Dedicated Research and Development Institute for Bamboo Sector:** Promote industry anchored and market driven dedicated bamboo sector research and development through establishing National Institute of Bamboo Innovation and Technology (NIBIT) in NER.

PRIORITY AREAS FOR INTERVENTIONS

10. **Bamboo Entrepreneurship Fund:** For bringing technological innovation to bamboo sector, connect the bamboo sector with startup revolution of India by introducing bamboo sector entrepreneurship fund for North East India.
11. **Value Addition and Waste Utilization:** Utilization of bamboo industry waste and value addition through development of high value by-products, innovation in traditional industry, introduce new products and reduce dependency on import of raw material.
12. **Bottom up** approach of One Cluster One product for traditional craft clusters.
13. **Indigenous Technology development:** Develop indigenous tools and machinery which suits the Indian bamboo species; set up bamboo machinery centre of excellence, machinery exhibition and set up machinery bank.
14. **Market Development:** Through investors meet, buyer-seller meet, exhibition, technology and skill transfer from best practice models, collaboration with South East Asian Countries for technology transfer, skill upgradation and industry specific training.
15. **Policy Intervention-** Need of National Bamboo Policy, policy revision for ease of access to market, develop new market, promote innovation, increase productivity, ease of credit.
16. **Finance:** Easy credit, front ended subsidy considering challenges pertaining to North East.
17. **Implementation Model:** Strengthening existing implementation mechanism of National Bamboo Mission through formation of Project Management Unit and Interministerial Mission Monitoring Committee. Alternatively, for a more North East specific approach, formation of Special Purpose Vehicle in the form of Society, implement North East Specific bamboo project, governing body with Joint Secretary of stakeholder ministry and chaired by Secretary, DoNER for greater synergy and convergence, international agency funding to be explored.

7.2. Setting the Priorities for Interventions

Based on the diagram given at the previous page, the following activities have to be undertaken in the indicated sequence:

Immediate Term:

- Formation of Special Purpose Vehicle "North East Regional Bamboo Development Project", formation of Governing body, Executive Committee and one (1) no. of Regional Project Management Unit and 8 nos. of State Project Management units
- Engagement of NESAC and RFRI for undertaking species wise bamboo stock estimation for the state of Arunachal Pradesh, Assam, Manipur, Mizoram, Nagaland, Sikkim and Tripura.
- Development of country-wise market plan for Indian bamboo sector, understand country specific import norms and regulatory and compliance.
- Engagement of NESAC for Identification of potential waste land and organize awareness camps on community rights over wasteland bamboo cultivation.
- Formation of Bamboo Cell under State Forest Departments.

PRIORITY AREAS FOR INTERVENTIONS

- Identification of FSC certification agency and finalize on modality of engagement
- Restructuring of NBM norms- cost of plantation, subsidy.
- Determination of Requirements of Bamboo (Quantity, Location, Species etc.) & Planting Materials
- Set up one pilot scale bamboo fibre unit in North East by using melt spinning technology.
- Scoping Study for identification of two clusters per NER state for One Cluster One product initiative.
- Initiate Jiggat Plantation in convergence with various social forestry projects.
- Setting up of cluster level charcoal and activated charcoal units.
- Discussion with Ministry of Agriculture and Farmers' Welfare for setting up National Institute of Bamboo Innovation and Technology in Guwahati, Assam
- Discussion with NITI Ayog and Startup India for Bamboo Entrepreneurship Fund
- Cross Country Dialogue, identification of partners for technology transfer.
- Expedite R&D of bamboo packaging under Indian Institute of Packaging
- Setting up of bamboo model multi-processing unit at Bamboo Industrial Park
- Feasibility study on bamboo extraction roads
- Discussion with DGFT for lift of export ban on charcoal and activated charcoal
- Initiate discussion with banks and financial institutions for Bamboo Finance Consortium
- Initiate discussion for Bamboo Credit Guarantee Scheme for NER

Short Term:

- Development of real-time information system on grower wise availability of annual stock including species, location etc.
- Initiate waste land cultivation of bamboo and captive plantation under State Forest Departments.
- Initiate construction of "Bamboo Extraction Road".
- Establishment of 3 nos. of Tissue culture labs.
- Establishment of hi-tech nurseries
- Formation and capacity building of Bamboo FPOs in terms of multi model supply chain
- Initiate "one cluster one product" project.
- Finalization of Bamboo Finance Consortium and Credit Guarantee Scheme
- DPR for setting up National Institute on Bamboo Innovation and Technology
- Setting up of Centre of Excellence for Bamboo Machinery
- Organizing investors meet, buyer-seller meet
- Sending NER entrepreneurs on international buyer-seller meets, expos etc.
- Identification of bamboo forest under Forest Department for Certification
- Funding of research project to CBRI, IWST for document properties of bamboo related to industrial utility.

Medium Term:

- Establishment of large and small scale nurseries.
- Explore Setting up of machinery bank
- Establishment of large scale bamboo board and bamboo charcoal and activated charcoal unit.
- Establishment of large scale bamboo shoot units.

PRIORITY AREAS FOR INTERVENTIONS

- Execution of collaboration with South East Asian Countries for Skills Up-gradation of Artisans and Entrepreneurs
- Promote bamboo based high end construction at premium locations of NER state capitals to create awareness
- Setting up of Bamboo Entrepreneurship Fund
- Initiate FSC Certification
- Administer bamboo entrepreneurship fund

7.3. Convergence with other Government Initiatives

Support may be obtained from different Government funded entities and schemes like:

- **National Bamboo Mission** -for establishment of nurseries and support for plantation, market research
- **Formation of 10,000 FPO Scheme-** For setting up FPO for multi-model supply chain
- **Ministry of Skills Development** for skills up-gradation / development of craftsmen
- **DST:** For Research and Development component funding and machinery development
- **DBT:** For Research and Development Funding
- **SAMPADA:** For setting up bamboo shoot based industry and other innovative food products
- **SFURTI Scheme of Ministry of MSME for cluster level decentralized unit and cluster development**
- **Amvedkar Hastshilpa Vikash Yojana (AHVY)** for bamboo craft cluster development project.
- MUDRA Loan Scheme operated for collateral free loans to small business
- Under **Agriculture Infrastructure Fund** for post-harvest infrastructure
- Under **North East Industrial Development Scheme (NEIDS) 2017** for transport incentive
- **PMGSY** for Bamboo Extraction Roads
- **Startup India and Atal Innovation Mission:** For Bamboo Entrepreneurship fund
- **Invest India:** for promotion of bamboo sector investment by other countries in North East.

The above is a partial list, which indicates that many of the components can be funded partly from other sources.

8. Vision, Goals & Implementation Strategies



8.1. Vision Statement

The Vision for the Promotion of bamboo in the North Eastern Region has been stated below:

To promote sustainable and value added development of bamboo in the North Eastern states of India in order to make bamboo sector an organized sector of NER economy and place the region at the centre of global bamboo market.

The above vision will serve the guide the development of the goals and strategies under the present Action Plan. These have been given below.

8.2. Goals

The goals of the present action plan have been summarized below:

- **Goal-1: To ensure sustainable supply of raw material** to meet the present and future demand of the bamboo sector industry;
- **Goal-2: To make bamboo sector an organized sector” of the NER economy** from the present “informal” form;
- **Goal-3: To develop a self-reliant value chain** of bamboo sector of North EAST India
- **Goal-4: To make North East India the centre of global bamboo industry.**

The above goals have been derived for the above Vision Statement for the development of bamboo in the NE states. These represent concrete aims of the Action Plan. The implementation strategies for the plan have been proposed in order to reach the above goals.

8.3. Implementation Strategies

Strategies represent the paths adopted in the Action Plan in order to reach the goals. The strategies have to be backed up by the following aspects, which will seek to answer some basic questions as given below:

- Rationale (**Why** are these steps being taken up)
- Action Points (**What** steps will be carried out)
- Methodology (**How** will these steps be undertaken)
- Coverage (**Where** will the steps be carried out)
- Implementing Agencies (**Who** will take up the steps)
- Time Lines (**When** will the steps be taken up)
- Resource Requirements (**How** much will these steps cost)

The detailed discussion of each of the implementation strategies has been taken up in the next chapter. The table at the next page gives the strategies set out against each of the above mentioned goals of the present Action Plan.

It may be noted that the Implementation Strategies seek to address the key areas for intervention that had been identified from an exercise including the lessons from past initiatives, study of the policy and regulatory framework for bamboo, SWOT Analysis, stakeholders' consultations, secondary research.

VISION, GOALS & IMPLEMENTATION STRATEGIES

Table-8.1: Goals & Implementation Strategies of the Action Plan for the Promotion of Bamboo in the NE Region

Goal	Implementation Strategy
<p>To ensure sustainable supply of raw material to meet the present and future demand of the bamboo sector industry</p>	<p>Enhancement of productivity of North East to 10-12 MT/Ha from existing 3-6 MT/ha through Scientific management of plantation and use of Farm input.</p>
	<p>Plan for commercial cultivation of bamboo to supplement the existing plantation initiative through- a)Plantation in wastelands b)Captive Plantation under State Forest Departments</p>
	<p>Revise cost norms of plantation under NBM for better care of plantation</p>
	<p>Forest Stewardship Council (FSC) Forest Management (FM) Certification to ensure sustainably harvested raw material that meets global compliance</p>
	<p>Planting Materials: Develop TC Labs & nurseries for increased availability of planting materials</p>
<p>To make bamboo sector an organized sector” of the NE economy from the present “informal” form</p>	<p>Market Identification: Prepare the bamboo stakeholders of NE in accordance to the global need and market demand through understanding the norms and needs of leading bamboo markets of the world and come up with country-wise market plan.</p>
	<p>Development of Bamboo Trade Support Tools: a) Assessment of Species Wise Resource Availability Develop digital and b) innovative tool for real-time database on annually harvestable bamboo of each state of NE</p>
	<p>Bamboo Extraction Road for easy logistics of raw material supply and extract natural stock of bamboo</p>
	<p>Bamboo FPC/FPO which will act under the mechanism of multi-modal supply chain to supply chain industry specific raw material and reduce post-harvest wastage.</p>
	<p>Use of In-land Water way and Railway for out-bound logistics</p>
	<p>Set up Bamboo Entrepreneurship Fund</p>
	<p>Revive the North East Incense stick industry through waste utilization to create high value by-product</p>
	<p>Introduce high value products such as bamboo fibre, industrial craft, activated charcoal, bamboo vinegar, bamboo shoot as pharmaceutical and nutraceutical product, high end construction at globally competitive cost, flat furniture, toothbrush, bio-plastic, bamboo as packaging material.</p>
	<p>Organized Craft industry at cluster level through “Bottom up one cluster one product” approach.</p>
	<p>Promote Inter-cropping</p>
	<p>Separate HSN code of bamboo products</p>
	<p>Lift the ban on export of bamboo charcoal and activated charcoal.</p>

VISION, GOALS & IMPLEMENTATION STRATEGIES

Goal	Implementation Strategy
	Organize international buyer-seller meet, investors meet and expo.
To develop a self-reliant value chain of bamboo sector of North EAST India	<p>Promotion of Research and Development in Bamboo Sector through setting up National Institute of Bamboo Innovation and Technology (NIBIT)- the first bamboo specific R&D institute of the Country</p> <p>Fund Research Project under CBRI, IWST to study industry specific various properties of bamboo.</p> <p>L Glutinosa plantation to reduce import of incense stick raw material</p> <p>Establish Centre of Excellence of bamboo machinery Organize at least 5 nos. of international level Bamboo Technology Exhibition</p> <p>Establish Bamboo Financial Consortium</p> <p>Introduce "Bamboo Credit Guarantee Scheme for NER"</p>
To make North East India the centre of global bamboo industry	<p>Special Purpose Vehicle in the form of Society under the aegis of Ministry of DoNER, Govt. of India titled "North East Regional Bamboo Development Project (NERBDP).</p> <p>Set up Governing body chaired by Secretary, Ministry of DoNER, and members with Joint Secretary of relevant ministries and principal secretary, planning department</p> <p>Executive committee with central, state and industry representatives</p> <p>Setup RMPU in Guwahati and 8 nos., of SPMU, one each in every state</p> <p>Explore funding from international funding agencies</p> <p>Formulate National Bamboo Policy</p> <p>Collaboration with South East Asian Countries: For technology transfer, skill and knowledge to India</p>

9. Details of Strategies & Implementation Model >>>

9.1. Details of the Implementation Strategies

As stated previously, the implementation strategies are intended as the basic steps that will enable the present Action Plan to reach the stated Goals (which in turn have been derived from the Vision Statement of the Plan). The following section gives additional details regarding the above implementation strategies proposed for the present Action Plan.

Table-9.1(A) Implementation Strategy for Market Identification Survey

Strategy-1	<p>Market Identification:</p> <ol style="list-style-type: none"> 1. Identify the existing and rapidly emerging market segments – both nationally and globally including niche markets as an entry strategy-develop country wise market plan 2. Study to ascertain the mandatory norms, rules and regulations related to emissions and for raw material traceability existing in bamboo products importing countries.
Rationale	<ol style="list-style-type: none"> 1. So far bamboo development initiatives have been based on plantation related activities and craft cluster promotion. The market driven approach has been missing. 2. The present Action Plan seeks to be based on the market requirements, which include global markets. The study needs to determine the various markets and products required in these markets. In addition, entry and growth strategy has to be determined – separately for each major type of market. 3. Niche markets need to be addressed if these are viable, as they may permit easier entry for new players.
Action Points	<ol style="list-style-type: none"> 1. Finalization of Terms of Reference for Market Study 2. Engagement of Study Agency 3. Conduct of the Study – based on primary data / trade data and secondary information 4. Study findings & finalization of strategy and product range
Methodology	Stakeholder discussion, field survey
Coverage of the States	Not pertinent
Implementing Agencies	Study Agency engaged by Project Implementation Agency
Time Lines	6 months
Physical Target	To conduct 2 nos. of research study
Financial Requirements	Rs. 2 Cr
Convergence/Fresh Fund	NBM/TEDF

NOTES

1. The global bamboos market size was valued at \$ 68.8 billion in 2018 and is expected to grow at a CAGR of 5.0% from 2019 to 2025. Growing investments focused on infrastructure development, increasing use of sustainable building/ construction resources, and rising consumer awareness

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

regarding the uses and benefits of bamboos are expected to drive the market growth over the forecast period.

2. Bamboos are increasingly becoming a preferred choice over timber as they are easier to harvest, transport, and are relatively affordable. They are water-resistant by nature and offer high durability. These benefits result in the sustainable use of bamboos in applications such as furniture, shelter, and handicraft products. Bamboo is also used to produce flooring, charcoal, mats/screens, and woven products. Therefore, a vast range of commercial applications is anticipated to boost the sales of bamboos products and subsequently, drive the market growth.
3. The usage of toxic chemicals in the processing of processed bamboos products including furniture, flooring, and pulp & paper has increasingly led to the introduction and implementation of stringent laws and regulations. The intrusion of such regulations may negatively impact the markets. This has to be assessed for its impact on the present Action Plan.
4. China dominates the global trade, with its products forming over 70% of global exports. India does not figure in the major exporter list. The study needs to explore viable strategies to enable Indian entities from NE Region to meet the global market needs as well as the national business.
5. The size of the national market is just 4.5% of the global size – but nevertheless amounts to over Rs 23,500 crore per annum. Hence, the national market needs to be suitably addressed to enable NE Region based companies to get a larger share of the same, especially in the higher value added segments.

Table-9.1 (B) Implementation Strategy for Development of Bamboo Trade Support Tools

<p>Strategy-2</p>	<p>Development of Bamboo Trade Support Tools:</p> <ol style="list-style-type: none"> 1. Assessment of Species Wise Resource Availability 2. Develop digital and innovative tool for real-time database on annually harvestable bamboo of each state of NER
<p>Rationale</p>	<ol style="list-style-type: none"> 1. Availability of reliable data on raw material is the stepping stone for setting up of any industry. However, a huge information gap exists in the North Eastern region in terms of bamboo sector data. The type of products to be manufactured and machineries to be used hugely dependent on the species of the bamboo. Presently, there is no database available on species wise availability of bamboo sector of the region. The only reliable source of data available in terms of bamboo sector is the Forest Survey of India report. However, the survey does not cover the species wise extractable amount of bamboo. The Government of Assam has undertaken the exercise for the Non Forest Area of the state. Meghalaya Bamboo Mission is currently undertaking this with the help of North East Space Application Centre (NESAC). During the stakeholder meeting, it was found that, the Rain Forest Research Institute is also currently working in this direction at pilot scale in the state of Nagaland Therefore, it is suggested that the other states of NER should also take this up on priority basis. 2. The demand-supply gap is more than 40% in the domestic bamboo market. While it's important to know the total species wise stock of the states as mentioned above, at the same time, for the industry and enterprises it is more important to know the amount of harvestable bamboo, species, location and time of availability. Therefore, digital tools need to be developed for real-time bamboo raw material intelligence.
<p>Action Points</p>	<ol style="list-style-type: none"> 1. Identify the species wise stock of bamboo for each state of NER 2. Develop real time database based on growers' detail, location, species and quantity available, tentative farm gate price, etc. The database can act as basis of the annual bamboo plantation roadmap of the implementing agencies. 3. Use innovative ideas of startups to address challenges of bamboo sector through technology driven solution.
<p>Methodology</p>	<p>For species wise resource estimation-</p> <ul style="list-style-type: none"> • Engage agency such as North East Space Application Centre (NESAC) or Rain Forest Research Institute (RFRI) • Adopt the techniques of both visual interpretation and field data collection. For visual interpretation GIS technology will be used. For field data collection prescribed procedure of Forest Survey of India may be used. • Each state may map the bamboo resource till block level. <p>For developing real-time information system on bamboo resource availability -</p> <ul style="list-style-type: none"> • Encourage startups to develop innovative technology based solution. • Startup India portal has section of "Idea Bank" for sharing various problem statements of different sectors where startups are encouraged to participate and develop solution. Real time Resource mapping of bamboo can be one such area where

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

	startups can help in developing solution.
Coverage of the States	Assessment of Species Wise Resource Availability may cover all NER states except Meghalaya which is undertaking the assignment currently.
Implementing Agencies	<ol style="list-style-type: none"> 1. Project Implementing Agency for Species Identification <ul style="list-style-type: none"> • North East Space Application Centre (NESAC) for remote sensing (including identification of wasteland areas and their extent) • Rain Forest Research Institute – Ground Verification 2. For development of Real Time Resource Mapping tool: <ul style="list-style-type: none"> • Start-up India- for on-boarding start-up to develop real time resource estimation tools. • National Bamboo Mission can also organize Start-up Contest to partner with start-ups to address bamboo sector challenges.
Time Lines	2 years (8 months for remote sensing)
Physical Target	<ol style="list-style-type: none"> 1. To undertake state wise and species wise bamboo resource mapping and its periodic updation 2. Develop digital tool for real-time information system on raw material availability
Resource Requirements	Rs. 12.44 Crore as given below
Convergence/Fresh Fund	Convergence: National Bamboo Mission

NOTES:

1. There is no database available on species wise availability of bamboo sector of the region. The only reliable source of data available in terms of bamboo sector is the Forest Survey of India report. **However, the survey does not cover the species wise extractable amount of bamboo.**

2. The Government of Assam has undertaken the exercise for the Non-Forest Area of the state.

3. Bamboo Resource Mapping Exercise by the Meghalaya Bamboo Mission

The Meghalaya Bamboo Mission is currently undertaking the exercise of species wise bamboo mapping of the state of Meghalaya by engaging North East Space Application Centre (NESAC). The objective of the exercise is to-

- To identify and assess bamboo resources of the state
- To identify and map the different forest types associated with a particular bamboo species
- To estimate the bamboo growing stock

As a part of the methodology, visual interpretation of the bamboo pure/mixed is done using multispectral LISSIV and the field data from the sample points identified by NESAC will be collected along with the geo-coordinate by the project team from Soil and Water Conservation Department, Government of Meghalaya. The sample points are distributed randomly in the areas where bamboo occurred. The field data gathered will be segregated species wise and mean values will be generated for different diameter classes. The mean number of bamboo culms per unit area will be interpolated to the bamboo polygons at stratum. Aggregate of the bamboo polygons within a district/block will give the district/block level estimate of bamboo growing stock in terms of number of culms and also in terms of weight.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

4. During the stakeholder meeting, it was found that, the Rain Forest Research Institute(RFRI) is also currently working in this direction at pilot scale in the state of Nagaland.
5. For Specie wise estimation of bamboo stock, the other states of NER take up the initiative in partnership with North East Space Application Centre (NESAC) and Rain Forest Research Institute (RFRI).

Table- 9.1.B (i): Fund Requirement

Sl. No	Action Points	Budget (In Cr)	Time-Line	Fund Convergence	Implementing Agency
1	Survey of species wise stock availability satellite imagery, ground trooting	7.44Cr	2 years	NBM/NEC	NESAC, RFRI
2	Real time database on annual species wise harvestable bamboo	5 Cr	1 years	NBM/NEC	Startup India, Startups
	Total	12.44 Cr			

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1(C) Implementation Strategy for Plan for productivity enhancement

Strategy-3	Increased Productivity: Implement a plan to increase bamboo productivity of North East to 10-12 MT/Ha from existing 3-6 MT/ha through <ol style="list-style-type: none"> 1. Scientific management of plantation 2. Use of Fertilizer
Rationale	<ol style="list-style-type: none"> 1. The existing bamboo productivity of India including North East is 3-6 MT in comparison to 30-40 MT of China 2. Productivity is even lower in case of natural stock of bamboo (2-3 MT) 3. Presently, the practice of scientific management of bamboo forestry is limited in the region. 4. The existing National Bamboo Mission has limited provision for scientific management of the plantation. 5. Scientific management reduces mortality, improves clump health and eases extraction. 6. Use of fertilizer/farm input can increase number of shoots up to 80%. 7. Increase of productivity is also dependent on proper selection of species. 8. The existing plantation cost norms of NBM is not sufficient for the NER states.
Action Points	<ol style="list-style-type: none"> 1. Implement the practice of scientific management and use of fertilizer in the existing 1,47,300 Ha of Forest Area and 85,280 ha of non-Forest area bamboo cultivation done under NBM 2. To start with, implement the practice of scientific management and use of fertilizer in the proposed new cultivation of 59,743 Ha under Wasteland and Captive Plantation under Forest Department as proposed in the next chapter 3. Revise the existing cost norms of plantation under NBM for improved care and input. 4. Provision of annual fund support for scientific management of plantation
Methodology	<ol style="list-style-type: none"> 1. Selection of proper species 2. Use of fertilizer 3. Scientific management 4. Promotion of intercropping till 3rd Year
Coverage of the States	All states of NER
Implementing Agencies	Communities through FPOs, State Forest Departments, Entrepreneurs, National Bamboo Mission
Time Lines	Over 5 years
Physical Target	To increase the productivity of Indian bamboo from existing 2-3 MT per Ha to minimum 10-12 MT/Ha
Resource Requirements	<ol style="list-style-type: none"> a. Rs. 930.00 Cr for maintenance of 50,000 Ha of Waste land bamboo cultivation (@Rs. 62,000/- Per ha per year for 3 years) b. Rs. 181.27 Cr for maintenance of 9746 Ha of Captive Plantation under Forest Department (@Rs. 62,000/- Per ha per year for 3 years) c. Revision of plantation Cost Norms of NBM from existing Rs. 1 lakh per Ha to Rs. 1.9 Lakhs per Ha (total resource requirement is calculated in next chapter of "Plantation Roadmap")
Convergence/Fresh Fund	<ol style="list-style-type: none"> 1. Plantation & monitoring under NBM, CAMPA, JICA for plantation 2. Fresh fund Annual cost for scientific management

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Notes

1. Strategy for Increased Productivity

Assumptions: One Ha of Land can be planted with 400 nos. of bamboo saplings. One sapling contains average 3-4 nos. of offshoots which leads to formation of a clump. Therefore, one Ha of land can lead to development of 400 nos. of clump. To increase productivity of these 400 nos. of clumps following interventions are proposed-

a. Enhanced care during Plantation

Presentation Cost Norms of NBM Mission for Plantation: The present cost norms of bamboo plantation is Rs. 1,00,000/ha which is normally utilized in following manner-

Table- 9.1.C (i): Year wise cost norms of bamboo plantation

Year	Fund Provision
Year 1	Rs. 50,000/-
Year 2	Rs. 30,000/-
Year 3	Rs. 20,000/-
Total	Rs. 1,00,000/-

During primary survey and discussion with the State Bamboo Missions it was found out that the fund provision is not sufficient for providing required support to the plantation for better yield. Considering the difficult terrain, challenge of transportation, high cost of labour, input, need of pest and disease management, and need of constant monitoring, the cost norms of plantation need to be increased as follows-

Table- 9.1.C (ii): Estimation of Plantation Costs (in Rs. per Ha)

Estimation of Plantation Costs (in Rs. per Ha)				
Sl. No.	Activity	Unit cost (Rs.)	No of Unit	Amount (Rs.)
1	Demarcation and Ranging	20	500	10000
2	Jungle Cleaning & levelling (LS)			30000
3	Labour cost -pits digging			7500
4	Planting materials costs at planting site	50	400	20000
5	Transportation cost within plantation site	6	500	3000
6	Soil manure mixing	10	500	5000
7	Labour cost on plantation	5	500	2500
8	Gap Filling	100	20	2000
9	Labour cost of Gap Filling	5	500	2500
10	Fertilize-vermi-compost/bamboo bio-fertilizer(per kg)	15	1000	15000
11	Soil Working	10	500	5000
12	Fencing(LS)-bamboo	1		25000
13	Weeding (LS)	30	500	15000
14	Replanting for juvenile death	50	100	5000
15	Cost on Pest & disease			2000
16	Storage and Handling of Saplings			32500
17	Sustainable Management			3000
18	Tools and equipment			5000
	Total :			1,90,0000

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

b. Continued Care of the Plantation:

For improved productivity, the plantation needs in terms of mounding, soil loosening, mulching, thinning, pruning, weeding etc. The present cost norms for maintenance of plantation provisioned only for the first two years is not sufficient. A bamboo plantation needs continued care throughout its lifespan, which is normally 30 years. Approximate annual cost required for plantation care and management is proposed as below-

Table- 9.1.C (iii): Approximate annual cost required for plantation care and management

Sl. No	Headings	Annual Cost (in Rs.)
1	Mounding	16,000
2	Loosening	16,000
3	Mulching	5,000
4	Thinning	5,000
5	Pruning	5,000
6	Weeding	5,000
7	Cost of Fertilization (@ Rs. 25 per clump for 400 clumps)	10,000
	Total	62,000

2. Projections for Improved Productivity

One Ha of scientifically planted bamboo forest contain 400 nos. of clumps (planted at the gap of 5 meter by 5-meter spacing). Scientific extraction of bamboo requires extraction of bamboo from 5th year onwards. Some numbers of culms will be utilized from 3rd year onwards, however, commercial extraction is advised from 5th year onwards. Schedule of annual extraction is given below-

Table- 9.1.C (iv): Schedule of annual extraction

Year	No. of Culms to be extracted per clumps per Ha	Total clumps/Ha	Total Culms	Average green weight per culm in Kg	Total weight of culms per Ha (in Kg)	Total Green weight in MT	Total Dry weight (in MT) considering 50% moisture content
5 th	2	400	800	25	20,000	20	10
6 th	2	400	800	25	20,000	20	10
7 th	5	400	2000	25	50,000	20	10
8 th	5	400	2000	25	50,000	50	25

As shown above, with scientific management of the bamboo plantation, productivity can be improved to 10 MT/Ha from 5th Year onwards. The average green weight of bamboo is considered at 25 kg. Species wise green weight of bamboo varies between 7-8 kg to 80-85 kg per culm in NER. Mix cropping of various species of bamboo is suggested for catering to various industries instead of mono-cropping.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

3. Intercropping

Intercropping is suggested in bamboo plantation from 1st year onwards up to 3rd Year till the clumps get matured. Suggested intercrops which are common across all the states of NER are Ginger and Turmeric. Cost of intercropping, yield and expected farm gate revenue is calculated below-

For Ginger:

Table- 9.1.C (v): Year-wise productivity for ginger

Year	Productivity per Ha for Ginger	Productivity in case of intercropping	Yield	Revenue (@ Average Rs. 45 /Kg)	Cost of Production (in Rs.)	Profit
1 st	11 MT	1/3	3.6 MT	1,62,000	66,666	96,000
2 nd	11 MT	1/4	2.7 MT	1,21,000	50,000	71,000
3 rd	11 MT	1/4	2.7 MT	1,21,000	50,000	71,000

For Turmeric:

Table- 9.1.C (vi): Year-wise productivity for turmeric

Year	Productivity per Ha for Ginger	Productivity in case of intercropping	Yield	Revenue (@ Average Rs. 16 /Kg)	Cost of Production (in Rs.)	Profit
1 st	18 MT	1/3	6 MT	96,000	66,666	29,334
2 nd	18 MT	1/4	4.5 MT	72,000	50,000	22,000
3 rd	18 MT	1/4	4.5 MT	72,000	50,000	22,000

4. Cost of Bamboo Farming Management

Assumption:

- Per Ha Maintenance cost is assumed at Rs. 62,000/0 per Ha.
- Maintenance cost should be provided for minimum 3 years.
- Government grant for maintenance should be 50% of the total cost.
- The Farmer Producer Organization or Forest Department may contribute balance 50% of the cost.
- In case of Farmer Producer Organization, the contribution is expected to be brought in from sales proceed from inter-cropping (refer to calculation above).
- In case of Forest Department/Forest Development Corporation, the same may be invested from projects such CAMPA which has fund provision for FSC certification.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1.C (vii): Maintenance cost for 3 years for cultivation of 50,000 ha bamboo at wasteland

Maintenance cost for 3 years for cultivation of 50,000 ha bamboo at wasteland @ Rs. 62,000/ha											
State	Year-1	Maintenance cost for 3 years	Year-2	Maintenance cost for 3 years	Year-3	Maintenance cost for 3 years	Year-4	Maintenance cost for 3 years	Year-5	Maintenance cost for 3 years	Total
Arunachal Pradesh	1295	24.09	1295	24.09	1295	24.09	1295	24.09	1295	24.09	120.44
Assam	2535	47.15	2535	47.15	2535	47.15	2535	47.15	2535	47.15	235.76
Manipur	1747	32.49	1747	32.49	1747	32.49	1747	32.49	1747	32.49	162.47
Meghalaya	1208	22.47	1208	22.47	1208	22.47	1208	22.47	1208	22.47	112.34
Mizoram	1332	24.78	1332	24.78	1332	24.78	1332	24.78	1332	24.78	123.88
Nagaland	1567	29.15	1567	29.15	1567	29.15	1567	29.15	1567	29.15	145.73
Sikkim	35	0.65	35	0.65	35	0.65	35	0.65	35	0.65	3.26
Tripura	281	5.23	281	5.23	281	5.23	281	5.23	281	5.23	26.13
Total	10,000	186.00	10,000	186.00	10,000	186.00	10,000	186.00	10,000	186.00	930.00

Table- 9.1.C (viii): Maintenance cost for 3 years for cultivation of 9746 ha bamboo at captive plantation under Forest Department

Maintenance cost for 3 years for cultivation of 9746 ha bamboo at captive plantation under Forest Department @ Rs. 62,000/ha												
State	Year 1	Maintenance cost for 3 years	Year 2	Maintenance cost for 3 years	Year 3	Maintenance cost for 3 years	Year 4	Maintenance cost for 3 years	Year 5	Maintenance cost for 3 years	Total	Maintenance cost for 3 years
Arunachal Pradesh	1000	18.6	200	3.72	240	4.46	288	5.36	345.6	6.428	2073.6	38.57
Assam	1500	27.9	300	5.58	360	6.70	432	8.04	518.4	9.642	3110.4	57.85
Manipur	1000	18.6	200	3.72	240	4.46	288	5.36	345.6	6.428	2073.6	38.57
Meghalaya	200	3.72	40	0.744	48	0.89	57.6	1.07	69.12	1.286	414.72	7.71
Mizoram	500	9.3	100	1.86	120	2.23	144	2.68	172.8	3.214	1036.8	19.28
Nagaland	200	3.72	40	0.744	48	0.89	57.6	1.07	69.12	1.286	414.72	7.71
Sikkim	100	1.86	20	0.372	24	0.45	28.8	0.54	34.56	0.643	207.36	3.86
Tripura	200	3.72	40	0.744	48	0.89	57.6	1.07	69.12	1.286	414.72	7.71
Total	4700	87.42	940	17.484	1128	20.98	1353.6	25.18	1624.32	30.212	9745.92	181.27

** Details and rationale for cultivation target set under Wasteland and Captive plantation is discussed in detail in next chapter

Table- 9.1.C (ix): Total Fund Requirement for Scientific Management of Bamboo Plantation

Sl. No.	Plantation Target	Fun Requirement (in Cr)	Govt. Funding (in Cr) 50%	Promoter's Contribution(in Cr) 50%
1	50,000 Ha of Waste land cultivation	930.00	465.00	465.00
2	9746 Ha of Captive Plantation under Forest Department	181.27	90.65	90.65
	Total	1111.27	555.65	555.65

5. Bamboo farming management to increase productivity

Site Selection

Heavy soils are not good for bamboo growth. Sandy loams to loamy clay type of soil derived from river alluvium or the underlying rock are suitable. Usually bamboo prefers well-drained soils. No bamboo is reported on saline soils. Majority of bamboos thrive at temperature range 8.8° C to 36° C. The minimum requirement of rainfall is 40 inches (1000 mm) per year. The most common range is 40-160 inches (1270-4050 mm) per year. However, they are also found in high rainfall zones with over 250 inches (6350 mm) rainfall. Site may be of gentle slope or levelled. Generally waterlogged area should be avoided.

Field Preparation

Fencing: Cattle proof fencing is required during the establishment period (first 4-5 years). Otherwise tranche may be created along the boundary to prevent entry of cattle.

Clearing and Ploughing: Land preparation is an important part, which directly influence the planting quality. For developing intensely managed plantations clearing and ploughing of the area is necessary. It removes the woody growths that compete for scarce resources. Sparsely distributed trees should be retained, as partial shade is beneficial for growth of bamboo. Soil preparation is done in winter before planting season.

Spacing: Depending on species, main objective of plantation, climatic and soil factor etc. due consideration has to be given on spacing between the clumps. Closely spaced clumps lead to congestion and make the area non workable. From experiments it has been found that for most of the Bambusa species 5*5-7*7 m spacing is adequate. For large clump forming bamboos like Dendrocalamus giganteus, Dendrocalamus hamiltonii etc., 10*10 m spacing is a must.

Pit Digging: For offsets and rhizomes plantation, pit size should be 50*50*50 cm. For seedlings and rooted cuttings it should be 30*30*30 cm. The pits should be dug at the prescribed distances well before the rainy season and kept as such for weathering. The purpose of such big pits is to provide adequate worked space for the easy establishment and growth of rhizomes.

Planting and Aftercare: A few days before planting mix one basket (Approx. 5kg) of FYM, Urea-100 gm, SSP-100 gm and MOP-50 gm to the dugout soil. Plant the offsets/ rooted cuttings/seedlings vertically keeping the rhizome and root portion below the ground level. Compact the area around the plant. Mulching around the plant is beneficial.

Management Practices:

Clump and Culm Behaviour: It is very important to know the clump and culm behaviour before applying any management practices. Depending on the type of rhizome growth the bamboos may be clump forming or non-clump forming. Most bamboo species of commercial importance form clumps. The establishment period of clumps varies depending on the propagules used. The period is 3-5 years for clumps established from offsets and rooted cuttings. The same is 5-7 years for seedlings. During the

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

establishment period the clumps produce culms of smaller height and diameter, which increases in the succeeding years till it reaches the fuller dimension. New culms emerge from the ground around the previous two-year's culms (rhizome) with the early rains and grow rapidly. The culms older than 3 years do not play any role in the new culm production. At this stage the culms are very tender and there is no terminal bud in the culm. Height growth is caused by the successive elongation of the internodes. The basal internode is the first to grow and the top-most one the last. However, several internodes from bottom upwards grow simultaneously. The internodes are enclosed in sheaths. It is usually after completion of 65-75 per cent of their height growth that the internodes become visible above the edges of the sheaths. The base of an internode is the most active part so far as growth is concerned. Unlike trees, there is no secondary growth in bamboos; the new shoots emerge with full diameter and attain their full height in 60-120 days. Though the culms do not grow in diameter after emergence, they continue to change in density and strength properties. Culms are tender during the first year, grow tough during the second year and become mature in the third year. Depending on the climatic conditions and the species, culms dry up in 4-12 years.

Soil Working Around the Clumps: Soil loosening is practiced generally to make underground buds and root earlier and higher shooting as being stimulated by sunlight and higher temperature, and also to make easier and better fertilization. Rhizomes emerge at an upwardly inclined angle. During this period of growth any exposure to sunlight stops rhizome development. Hence, it is very important to raise the soil (make mounds) around the clump every year before the new culm emergence. From experiments it has been found that soil working increases the number of new culm emergence.

Pruning: Pruning is practiced only in those species, which produce thorny thickets like Bambusa bambos. This should be started in the second year after planting. It prevents congestion and helps in keeping the clump in working condition. All the branches up to 1.5 m height should be pruned leaving one node on the branch stalk.

Thinning/Improvement Cutting: This practice should be started in the second year after planting and carried out every year before the rains. All malformed and damaged culms should be removed. Culms causing congestion should be cut to make the remaining culms equally spaced. Thinning in the establishment period ensures that the clumps reach their productive age without any congestion. It will also provide working space for new culms and act as a stimulus for vigorous new culm production.

Drainage: Proper drainage is very much essential to take out the water from the plantation area during rain to avoid stagnation.

Manuring and Fertilizer Application: Fertilization is better for more time and small dosage for each. Therefore, fertilization is done in some management, 2 times in a season. Even more times with small dosage each time in a month during shooting season of from July to August. The experiments conducted in various organizations have shown increased productivity with yearly manuring and fertilization. Three things need to be taken into consideration while fertilizing the clumps.

- Method of application
- Kind and dosage of fertilizer

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

- Fertilization time

There are several methods of fertilizer application like broadcasting, in furrows around the clump, foliage dressing and stump fertilization. Fertilizer application efficiency is high when it is applied in furrows around the clump. The efficiency is also good in stump application, where it is absorbed through the inner wall of the internodal cavity. Organic manures should, also be placed in furrows around the clump.

Both the organic and the chemical fertilizers should be used widely. Nitrogen is the most important followed by P and K. 50 Kg N/ha (109 Kg Urea/ha) is the recommended dose. If the soil lack in P and K, 50 Kg P₂O₅/ha (313 kg SSP/ha) and 25 Kg K₂O/ha (43 Kg MOP/ha) is recommended. The proportion of N: P: K should be 2:2:1.

The period of shoot bud differentiation is the suitable time for fertilization. It may be carried out along with the soil working before the emergence of new culms.

Harvesting and Harvesting Schedule:

Once the clumps are established and reach productive stage proper harvesting technique and schedule should be followed in order to ensure continuous production for a longer period of time. Usually the culm selection system is followed in harvesting. This system involves-

- The felling of all culms 3-year-old and above keeping few culms for mechanical support. They have no role in the new culm emergence and their support. Only one and two-year-old culms give rise to new shoots and provide support to them.
- The cut should be given above the first prominent node (about 15 cm from the ground level) with a sharp instrument. Splitted stumps are susceptible to pathogens.
- Under no circumstances the rhizomes should be dug out and exposed.
- Under no circumstances the felling will be done between May and October. Felling operations should be completed well before the new culm emergence in the clumps.
- Only the flowering clump should be clear felled.

Harvesting should preferably be done each year. In case large plantations, where harvesting each year is not possible, it should be done in alternate years by dividing the whole area into blocks.

Method of Working Large Clumps:

If the clumps are not thinned from the very beginning, they become congested at the time they reach their productive age. There are special techniques of opening such congested clumps. These techniques are also followed in natural forest, when the clumps are brought under management for the first time.

- Perpendicular Tunnel Method

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

- Horse Shoe Method.

In the first method two tunnels are made right angles to each other so that the clump is divided into four quadrants.

In the second method the clump is converted into a horseshoe shape by thinning the inner culms.

While applying these techniques some immature culms may have to be thinned initially. The whole purpose of this opening of clumps is to facilitate uniform working of clumps both from inside and outside

Working of Flowered Clumps: Gregarious flowering in bamboo takes place at an interval of 25-40 years or more, sporadic flowering can be observed at any time in between two successive gregarious flowerings. The clumps usually die after such flowering. Such clumps should be clear felled after they have shed the seeds. The underground rhizome system may be dug up for fuel wood purpose or may be left as such for bio degradation. The area may be replanted with other commercial bamboo species to avoid large scale gregarious flowering.

Pest and Disease Management:

Various insects belonging to the orders Coleoptera, Lepidoptera & Hemiptera, attack bamboo plantations. According to their food habit, these insects can be grouped into defoliators, culm borers and sapsuckers of culm leaf & seed.

Sometimes during rainy season large-scale defoliation can be noticed in bamboo plantations. The causal organism is a leaf roller named *Pyrausta coclesalis*. It has got several natural parasites and predators. A solution of 0.2% fenitrothion or 0.1% carbaryl in water can control this pest. Few grasshoppers, also found to defoliate bamboos. Dusting of BHC (5-10%) gives effective control.

The most important shoot and culm borer are the two bamboo weevils *Cyrtotrachelus dus* and *C. longimanus* and the bamboo hispine beetle *Estigmena chinesis*. This pest attacks with the onset of Southwest monsoon. They bite deep holes in the tender culm shoots to obtain sap. They lay eggs in pits similar to the feeding holes. The larvae bore into the culm and perforate each node. Culms may be killed outright. Damage is less in well-thinned areas than in stands with dense culms. Thus, cultural measures prescribed for treatment of congestion can take care of this pest. Attacked culms should be cut & exposed to sunlight to kill the beetles.

The aphid (*Oregma bambusae*) is a sapsucker of bamboo shoots. Due to excessive drainage of sap the vitality of growing shoot is affected and it gets reduced in size, bent and twisted, or may even die. It can be controlled with a spray of Kerosene oil in soap emulsion or foliar spray of 0.04% Dimacron or Rogor or 0.2% fenitrothion.

Bamboo blight is a very serious disease in plantations and natural stands. It results in a sequential dieback of culms in the first season of growth. The first sign of blight is the premature death of culm. Culm sheath is easily removed. Rotting and partial collapse takes place in the fragile apical region. Wet rotten patches develop in the internodes and these necrotic areas spread rapidly in the tender culm in

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

advanced stage the infected culms turn brownish grey and dries up. The causal organism of this disease is *Fusarium equiseti*. Once attacked it is very difficult to check the disease completely. Removal of severely affected culms, controlled light burning of debris before onset of monsoon results in the reduction of inoculum potential of the fungus existing in the debris or in the top few centimeters of soil. Water stagnation around the clumps must be avoided. If necessary, drenching of soil around the bamboo clump with a combination of Bavistin (0.16%), Dithane-M-45 (0.3%) and Fytolan (0.3%) is effective in controlling the disease.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1 (D): Implementation Strategy for Plantation

Strategy-4	Plantation: Implement a plan for commercial cultivation of bamboo to supplement the existing plantation initiative through- 1. Plantation in wastelands 2. Captive Plantation under State Forest Departments		
Rationale	1. NBM is working to establish plantations in non-forest Government and private lands (through farmers). In NE states, there are ample wastelands which can be converted to bamboo plantations – in collaboration with the communities which have traditional rights over these wastelands. 2. The revised guideline of NBM has also stressed upon the need of bamboo cultivation at wasteland. 3. In addition, there are ample bamboo stocks in forest areas (not being Reserve Forests and Protected Areas). These can be used sustainably (including through re-plantation) in partnership with State Forest Departments and other stakeholders.		
Action Points	1. Identification of wastelands (through NESAC) 2. Awareness campaign with communities having rights over such lands 3. Conversion of wastelands into bamboo plantations through planting, maintenance 4. Identification of bamboo resources in forests (by NESAC) 5. Partnership with State Forest Departments and Communities (since Un-Classified State Forests are under their traditional management) 6. State Forest Department/Corporation to develop their own captive bamboo plantation. 7. Implement Forest Stewardship Council (FSC) Forest Management (FM) Certification for captive plantation under the Forest Departments/Corporation		
Methodology	Through Community FPOs / FPCs (for wastelands) and through State Forest Departments / Corporations & Communities (for forests) and monitoring of the project		
Coverage of the States	All states – notes below may be seen as per following targets:		
Implementing Agencies	1. Wasteland cultivation- Communities through FPOs and State Bamboo Mission as nodal agency 2. FSC Certified Captive Plantation- State Forest Departments/Corporation		
Time Lines	Over 5 years		
Physical Target	3. To set up 6 nos. of Bamboo Cell under Forest department of Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim 4. Strengthening of Forest Development Corporation in Arunachal Pradesh and Tripura 5. Wastelands cultivation– 50,000 hectares as per schedule in Note (11) 6. Captive Plantation under Forest Department/Corporation – 9746 hectares as per Note (4)		
Resource Requirements (All figures are Rs. in crore)	Plantation	1135.17 Cr	Note (13)
	Monitoring cost (2% of the above)	22.70 Cr	Note (15)
	Bamboo Cell Under State Forest Department	16 Cr	@ Rs 2 crore / state
	Cost of FSC Certification	11.13 Cr.	
	Assessment of Wasteland	0.50 Cr	By NESAC
	Total	1185.51 Cr	
Convergence/Fresh Fund	1. Plantation & monitoring under NBM, CAMPA, JICA, Assessment of wasteland under NBM		

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

	2. Cost of FSC FM Certification under CAMPA 3. Cost of formation of FPO is considered under Multi-model supply chain and convergence under "Promotion of 10,000 FPP" scheme of Ministry of Agriculture & Farmers Welfare, GoI
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NOTES:

1. ROLE OF FOREST DEPARTMENT

The amount of forest bamboo stock in North East is higher than the out-of-forest stock. A mechanism may be developed to extract the forest based bamboo where the respective Forest Department of NER states can play the role of facilitator. The model of Tripura Forest Development and Plantation Corporation under the Department of Forest, Government of Tripura can be mentioned in this regard. Under its Plan for Responsible Rubber wood and Bamboo Plantations Management, the Corporation has been maintaining pure bamboo plantation for sustainable production of raw material. Further, the Corporation ensures FSC certification of the produced raw material and supply it to the various processing enterprises. Similar model can be adopted by other states of NER, where the Forest Department can become the facilitator for supplying certified and sustainably harvested bamboo to the industry. "Bamboo Division" may be set up under the State Forest Department in this regard with following objectives:

- Restoration of degraded forest through bamboo plantation.
- Management of pure bamboo plantation
- FSC Forest Management and Stump-to-Forest Gate Chain-of-Custody Certification
- Promotion of sustainable harvesting through Joint Forest Management Committee
- Addressing issues related to transport of forest based bamboo
- Monitoring and research in terms of productivity, growth rate, regeneration, harvesting, cost and efficiency.

2. ACTION POINTS WITH FOREST DEPARTMENT

1. In states such as Arunachal Pradesh and Tripura, the proposed role can be played by the existing Forest Development Corporation
2. For rest of the NER states, Bamboo Division may be established under the respective State Forest Department for facilitating bamboo trade.
3. An amount of Rs. 2 crores per state is proposed for setting up of Bamboo Cell under Forest Department and strengthening of the existing Forest Development Corporation including strengthening and capacity building of Forest Research Divisions.
4. Total 4,700 Ha of Certified Pure Bamboo Forest may be developed under the respective state Forest Departments to begin with. The same may be expanded at the rate of 20% per year.
5. The Department may implement FSC certification in the proposed plantation
6. Proposed FSC certified pure bamboo forestry under each NER state is mentioned below

3. FSC CERTIFIED PURE BAMBOO FORESTRY TO BE PROMOTED BY FOREST DEPARTMENT (in Hectares)

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1.D (i): State wise & Year wise plan for FSC certified pure bamboo forestry to be promoted by Forest Department

SN	State	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	Arunachal Pradesh	1000	200	240	288	345.6	2073.6
2	Assam	1500	300	360	432	518.4	3110.4
3	Manipur	1000	200	240	288	345.6	2073.6
4	Meghalaya	200	40	48	57.6	69.12	414.72
5	Mizoram	500	100	120	144	172.8	1036.8
6	Nagaland	200	40	48	57.6	69.12	414.72
7	Sikkim	100	20	24	28.8	34.56	207.36
8	Tripura	200	40	48	57.6	69.12	414.72
	Total	4700	940	1128	1353.6	1624.32	9745.92

4. ANNUAL EXPANSION OF CAPTIVE PLANTATION PROMOTED BY FOREST DEPARTMENT

Table- 9.1.D (ii): Annual Expansion of captive plantation promoted by Forest Department

		Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	Physical (Ha)	4700	940	1128	1353.6	1624.32	9745.92
2	Financial (Rs in Cr)	89.30	17.86	21.43	25.72	30.86	185.17

5. BAMBOO PLANTATION ON WASTELANDS

NE Region has vast areas classified as Wastelands. As per the Wasteland Survey of India 2019, 17.72% of the total geographical area of the region (about 46,277 sq. km) is classified as wasteland. The details of the same have been given at Appendix-5.

6. The following wasteland with potential for bamboo cultivation:

Table- 9.1.D (iii): State wise wasteland areas fit for bamboo cultivation

States	Total Wasteland	Potential Areas for Bamboo Cultivation on Wasteland (in Ha)								Total
		3	4	9	10	11	12	14	20	
Arunachal Pradesh	1390616	63353	181825	50911	120422	1680	59		0	418250
Assam	900308	209281	199334	5260	8209	176125	211606		8632	818447
Manipur	565189	121112	314510	49998	29865	48600	21		0	564106
Meghalaya	413577	50998	261219	23787	42268	6461	0		5429	390162
Mizoram	430066	158684	46688	69155	101139	54400	0		0	430066
Nagaland	506417	131587	207772	97933	68121	1	159		492	506065
Sikkim	329479	0	1630	0	0	9209	0		0	10839
Tripura	92052	20480	21451	3062	6420	37156	1611	615	0	90795
	4627704									3228730

Source: Wasteland Atlas of India 2019

7. The categories of wastelands suited for bamboo plantation are as follows:

- | | |
|---|---|
| 3- Land with Dense Scrub, | 11-Under-utilised/degraded forest (Scrub dominant), |
| 4- Land with Open Scrub, | 12-Under-utilised/degraded forest (Agriculture), |
| 9-Shifting Cultivation - Current Jhum, | 14- Degraded land under plantation crop, |
| 10-Shifting Cultivation - Abandoned Jhum, | 20 - Mining Wastelands. |

8. Cultivation of bamboo in wasteland will not only address the crisis of raw material, but it will also contribute to helping the country in its fight towards climate change mitigation. Cultivation of bamboo as wasteland can potentially help India in achieving its "SDG goals", "Bonn Targets" and

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

various other climate targets. Further, the cultivation of bamboo at waste and degraded land will also lead to reduction of man animal conflict which has currently become a cause of concern for the region. With bamboo plantation especially at the existing barren animal corridors, the food source of the animal especially elephant will increase and this will create a long lasting impact on environmental ecosystem of the region.

9. Total Target for wasteland cultivation of bamboo in NER:

Bamboo plantation on waste land is suggested in different states as per the following table under NBM etc., which is based on the utilization of 10% of the bamboo cultivable wasteland.

Table- 9.1.D (iv): State wise proposed area

State	Area proposed (n Ha)
Arunachal Pradesh	41825.0
Assam	81844.7
Manipur	56410.6
Meghalaya	39016.2
Mizoram	43006.6
Nagaland	50606.5
Sikkim	1083.9
Tripura	9079.5
Total	322873

10. Under present Action Plan, coverage of 50,000 hectares of wasteland may be taken up on pilot basis (being about 15% of the above identified area). The state-wise coverage is proposed as follows (in hectares) which will be finalized based on NESAC assessment:

Table- 9.1.D (v): State wise & Year wise coverage

State	Year-1	Year-2	Year-3	Year-4	Year-5
Arunachal Pradesh	1295	1295	1295	1295	1295
Assam	2535	2535	2535	2535	2535
Manipur	1747	1747	1747	1747	1747
Meghalaya	1208	1208	1208	1208	1208
Mizoram	1332	1332	1332	1332	1332
Nagaland	1567	1567	1567	1567	1567
Sikkim	34	34	34	34	34
Tripura	281	281	281	281	281
	10,000	10,000	10,000	10,000	10,000

11. The project may be taken up on pilot scale with the cost of plantation being considered as Rs. 1.9 Ha, cost of maintenance at Rs. 62,000 Per Year per Ha for three year and separate costing for FSC Certification.

12. Community plantations on wastelands are planned to be done through FPOs / FPCs, which can undertake cluster activities in addition.

13. FOREST STEWARDSHIP COUNCIL (FSC) FOREST MANAGEMENT (FM) CERTIFICATION AND COST

The FSC FM certification ensures certified sustainably harvested raw material which fetches higher price while exporting forest products due to conformation to import rules of the developed country markets.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

In the plantation roadmap, 50,000 Ha of bamboo plantation is proposed under wasteland cultivation. The plantation will be undertaken mainly by the communities in the form of farmer's group. Similarly, 9746 Ha of captive bamboo plantation will be undertaken by State Forest Departments/Corporations. The cost norms for FSC certification for Group and individual entity are different. These costs include Pre-Assessment, Full Assessment and Surveillance audit for 4 years. Certification cost for both wasteland cultivation and captive plantation are shown over-leaf which includes costs of audit, FSC Annual administration fee and travel and logistics of certification agency.

Table- 9.1.D (vi): FSC FM Group Certification Cost for 50,000 Ha of bamboo Cultivation at Wasteland

FSC FM Group Certification Cost for 50,000 Ha of bamboo Cultivation at Wasteland											
State	Year-1	FSC-FM Cost (in Lakh)	Year-2	FSC-FM Cost (in Lakh)	Year-3	FSC-FM Cost(in Lakh)	Year-4	FSC-FM Cost (in Lakh)	Year-5	FSC-FM Cost (in Lakh)	Total (in Lakh)
Arunachal Pradesh	1295	24.33	1295	24.33	1295	24.33	1295	24.33	1295	24.33	121.64
Assam	2535	24.33	2535	24.33	2535	24.33	2535	24.33	2535	24.33	121.64
Manipur	1747	24.33	1747	24.33	1747	24.33	1747	24.33	1747	24.33	121.64
Meghalaya	1208	24.33	1208	24.33	1208	24.33	1208	24.33	1208	24.33	121.64
Mizoram	1332	24.33	1332	24.33	1332	24.33	1332	24.33	1332	24.33	121.64
Nagaland	1567	24.33	1567	24.33	1567	24.33	1567	24.33	1567	24.33	121.64
Sikkim	35	21.44	35	21.44	35	21.44	35	21.44	35	21.44	107.21
Tripura	281	21.44	281	21.44	281	21.44	281	21.44	281	21.44	107.21
Total	10,000	188.86	10,000	188.86	10,000	188.86	10,000	188.86	10,000	188.86	944.28

Table- 9.1.D (vii): FSC FM Group Certification Cost for 9746 Ha of Captive Bamboo Cultivation under Forest Department

FSC FM Group Certification Cost for 9746 Ha of Captive bamboo Cultivation under Forest Department							
State	Year 1	Year 2	Year 3	Year 4	Year 5	Total	Total cost of FSC Certification
Arunachal Pradesh	1000	200	240	288	345.6	2073.6	23.37
Assam	1500	300	360	432	518.4	3110.4	23.37
Manipur	1000	200	240	288	345.6	2073.6	23.37
Meghalaya	200	40	48	57.6	69.12	414.72	18.80
Mizoram	500	100	120	144	172.8	1036.8	23.37
Nagaland	200	40	48	57.6	69.12	414.72	18.80
Sikkim	100	20	24	28.8	34.56	207.36	18.80
Tripura	200	40	48	57.6	69.12	414.72	18.80
Total	4700	940	1128	1353.6	1624.32	9745.92	168.67

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1.D (viii): Total cost of FSC Certification

Sl. No.	Plantation Strategy	Amount (Rs. In Cr)	Per Ha cost (in Rs.)
1	Certification of 50,000 Ha Bamboo Plantation under Wasteland	9.44	1888.57
2	Certification of 9746 ha of Captive Plantation under Forest Department	1.68	1730.68
3	Total	11.12	1862.80

Table- 9.1.D (ix): Total resource requirement for plantation is as follows:

Area under FSC Certified Pure Forestry	9745.92 Ha	Note (3) at above
Area from Wasteland	50,000 Ha	Note (11) at above
Total Area	59,745.92 Ha	
Cost of Plantation	Rs 1135.17 crore	@ Rs 1,90,000 per hectare
Monitoring of Plantation (2%)	Rs. 22.70 Cr	
Assessment of Wasteland	Rs. 0.5 Cr	
Setting up of Bamboo Cell under Forest Department	Rs. 16.00 Cr	
Cost of FSC Certification	Rs. 11.12 Cr	
Total	Rs. 1185.51 Cr	

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1(E): Implementation Strategy for Local Production of Certified Planting Material

Strategy-5	Planting Materials: Develop Tissue Culture Labs & nurseries to ensure availability of planting materials for the proposed plantation under Strategy 3.
Rationale	Each hectare of plantation will need 415 seedlings, and as about 59,746 hectares of plantation are planned – nearly 30 million seedlings will be needed in the 5 years under the plan including 20% for vacancy filling This will require a chain of Tissue Culture Labs, and Nurseries (Hi Tech Nurseries, Large Scale Nurseries and Small Nurseries in the NE states The system can be used for raising other seedlings.
Action Points	<ol style="list-style-type: none"> 1. Establish 3 TC labs each with annual capacity of 15,00,000 planting material/year 2. Establish 74 High Tech Bamboo Nurseries @ 1,00,000 saplings / year 3. Establish 417 Large Scale Nurseries @ 25,000 saplings/ year 4. Establish 744 Small Nurseries @ 16,000 saplings / year
Methodology	Component will be implemented through Partners
Coverage of the States	All States, except TC labs will be located in Assam (2 Nos.) & Arunachal Pradesh (1 No.) Note (4) below may be seen
Implementing Agencies	TC Lab- Government Agency / Entrepreneur Hi Tech Nurseries – State Government Large Scale Nurseries – Company / Entrepreneur Small Nurseries – FPOs & SHGs
Time Lines	As per Note (5) below
Physical Target	Mentioned under "Action Points"
Resource Requirements	Rs. 191.74 Cr crore as given below- <ol style="list-style-type: none"> 1. Rs. 13.62 Cr towards setting up of 2 nos. of Tissue Culture Labs 2. Rs. 27 Cr for setting up of 74 nos. of hi-tech nurseries 3. Rs. 66.72 Cr for setting up of 417 nos. of large scale nurseries 4. Rs. 74.40 Cr for setting up of 744 nos. of small scale nurseries
Synergy/Fresh Fund	<ol style="list-style-type: none"> 1. Tissue culture lab may be established under NBM/DST/DBT 2. The infrastructures proposed under Sl. No. 2, 3, 4 may be established under the fund support of National Bamboo Mission.

NOTES:

1. Present Status of Nurseries in NE Region

Table- 9.1.E (i): State-wise Present Status of Nurseries in NE Region

State	Tissue Culture Lab	Hi Tech Nursery	Large Nursery	Small Nursery
Arunachal Pradesh	0	2	7	4
Assam	2	1	4	5
Manipur	0	1	10	5
Meghalaya	0	0	3	1
Mizoram	0	0	0	1
Nagaland	0	2	Data not available	Data not available
Sikkim	0	Data not available	Data not available	Data not available
Tripura	0	13	16	7

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

State	Tissue Culture Lab	Hi Tech Nursery	Large Nursery	Small Nursery
Total	2	19	40	23

At present, the region has 2 nos. of tissue culture labs. The one promoted by government is situated at Rain Forest Research Institution in Jorhat, Assam and the one promoted by private sector is situated at Silchar promoted by Pratyaksha Agrotech Private Limited. While most of the hi-tech nurseries are functional, those at Assam and Arunachal Pradesh are under implementation.

2. Capacity of Planting Materials from the Proposed TC Labs & Nurseries & Resource Requirements

Table- 9.1.E (ii): Capacity of Planting Materials from the Proposed TC Labs & Nurseries & Resource Requirements

	Nos.	Capacity	Total	Rate (Rs. lakh)	Amount (Rs lakh)
TC Labs	3	15,00,000	45,00,000	453.85	1361.55
Hi Tech Nurseries	74	1,00,000	55,00,000	50.00	3700.00
Large Nurseries	417	25,000	76,75,000	16.00	6672.00
Small Nurseries	744	16,000	95,52,000	10.00	7440.00
TOTAL	1,238	16,41,000	2,72,27,000	529.85	19173.55

3. The state-wise numbers of proposed numbers of units are given below.

Table- 9.1.E (iii): State-wise numbers of proposed numbers of units

States	Hi Tech	Large Scale	Small Scale
Arunachal	10	54	96
Assam	18	105	189
Manipur	13	73	130
Meghalaya	9	50	90
Mizoram	10	55	99
Nagaland	12	65	117
Sikkim	1	1	2
Tripura	2	14	21
Total	74	417	744

4. The annual phasing is as follows:

Table- 9.1.E (iv): Year wise phasing of High tech, Large nursery, Small nursery and Tissue culture lab

		Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	High Tech	18	25	30	0	0	74
2	Large Nursery	105	122	190	0	0	417
3	Small Nursery	148	180	180	236	0	744
4	Tissue Culture Lab	0	3	0	0	0	3

5. While the tissue culture labs may be established with 100% fund support from government, for ease of financial closure of rest of the projects, it is suggested that the existing guideline of NBM (credit linked back ended subsidy of 50% to NER private sector) may be suitably modified to propose 75% of non-credit linked front ended subsidy for FPOs/SHG and 50% credit linked front ended subsidy with minimum 10% promoter's contribution in case of entrepreneur.

6. North East Cane and Bamboo Development Council (NECBDC), one of the Bamboo Technology Support Group (BTSG) may be strengthened to undertake the role of independent assessment agency- for the non-credit linked project proposals

7. COST OF TISSUE CULTURE LABORATORY

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1.E (v): Cost of tissue culture laboratory

Sl. No.	Particulars	Amount (in Rs. Lakhs)
1	Construction of main plant including electrification	200.83
2	Reverse Osmosis Plant 1 & 2	6.00
3	Water Management Tank, Supply and Drainage	2.00
4	Captive power & Transformer	8.00
5	Air Conditioning System of Lab	9.00
6	Growth Room, Racks and Electrification	22.00
7	Lab Equipment	49.20
8	Green House and Shed Home	52.00
9	Equipment for Green House and Shed Home	1.63
10	Vehicle	7.65
11	Bottle Drying and Washing Area	2.11
12	Hardening Plant	10.00
13	Consumable	26.00
14	Salary for 1 year	57.42
	Total	453.84

8. Tissue culture lab is man power intensive unit. In the project size mentioned above, one tissue culture lab requires 54 nos. of manpower of various categories. Therefore, it is proposed that the 3 nos. of tissue culture labs will cater to the needs of all the 8 states of the region. The proposed states, locations and their coverage are mentioned below:

Proposed Site for TC Lab	State	Nos.	Coverage
Guwahati	Assam	1	Meghalaya, Sikkim, Part of Arunachal n& Nagaland
Silchar	Assam	1	Tripura, Mizoram and Manipur
Pasighat	Arunachal	1	North bank (Assam) and Eastern Arunachal

The Tissue Culture Laboratory units may be established with the fund support of Department of Biotechnology, Department of Science & Technology and North Eastern Council. For the sustainability of the labs need, it is proposed that the funding agency may consider 1-year salary of the manpower under each unit. Upon selling of their products, the labs are expected to generate their own revenue which will take care of their recurring expenditures. Further, it is proposed that, for additional revenue, the labs may also work in tissue culture of other species from sectors such as horticulture etc., which may be supplied to others.

9. Species for Plantation

The region is rich in terms of bamboo biodiversity. However, for state-wise commercial cultivation as per the plan mentioned above, following species are suggested-

Table- 9.1.E (vi): State-wise commercial cultivation

S.N.	State	Suggested Species
1	Assam	B.tulda; B.balcooa, B. Nutans, D. Hemiltonii, B. cacharensis, B Bambos
2	Arunachal Pradesh	D.hamiltoni; B.tulda, D.giganteus, B Pelida
3	Manipur	D.hamiltoni; B.balcoa, D. Letiflora, D.giganteus
4	Meghalaya	D.hamiltoni; B.tulda, B.balcooa
5	Mizoram	D. brandisii, D. Letiflora, B.tulda, D.hamiltoni;, B.balcoa
6	Nagaland	D.hamiltoni; B.tulda, B.balcoa, D.giganteus
7	Sikkim	D.hamiltoni and B.balcooa
8	Tripura	B.tulda; B.polymorpha, T.oliveri, B.balcoa and B.cacharansis,

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

10. The commercial use of the suggested species is given below-

Table- 9.1.E (vii): Commercial use of the suggested species

Name of the Species	Commercial use of the species
B.tulda	Incense sticks; bamboo RBW; handicrafts, charcoal and activated charcoal
Bambusa balcooa	Construction sector, bamboo bottle, energy, charcoal and activated charcoal
Bambusa Nutans	Handicrafts ; mats; blinds, charcoal and activated charcoal
D. Hemiltonii	Handicrafts; bamboo RBW; bamboo feed and fodder; bamboo shoots, mats, furniture, charcoal and activated charcoal
B.polymorpha	Handicrafts , mats, utility basket, charcoal and activated charcoal
T.oliveri	Round pole furniture; Fishing rod; sports industry and housing sector – truss/ruffine, charcoal and activated charcoal
D. brandisii	Housing and construction; utility products, charcoal and activated charcoal
D. Letiflora	Bamboo shoots; Housing and construction, charcoal and activated charcoal
Dendrocalamus giganteus	RBW; shoots and kitchen utility, charcoal and activated charcoal
B. pallida	Construction; mats, bamboo basket and utility products, charcoal and activated charcoal.

Table- 9.1.E (viii): State-wise action plan for Hi-tech labs

Hi Tech		Year 1	Year 2	Year 3
Arunachal Pradesh	Physical (in No.)	3	4	3
	Financial (in Cr.)	1.5	2	1.5
Assam	Physical (in No.)	4	6	7
	Financial (in Cr.)	2	3	3.5
Manipur	Physical (in No.)	4	4	5
	Financial (in Cr.)	2	2	2.5
Meghalaya	Physical (in No.)	2	3	4
	Financial (in Cr.)	1	1.5	2
Mizoram	Physical (in No.)	3	3	4
	Financial (in Cr.)	1.5	1.5	2
Nagaland	Physical (in No.)	2	4	6
	Financial (in Cr.)	1	2	3
Sikkim	Physical (in No.)	0	1	0
	Financial (in Cr.)	0	0.5	0
Tripura	Physical (in No.)	0	1	1
	Financial (in Cr.)	0	0.5	0.5
Total	Physical (in No.)	17	26	30
	Financial (in Cr.)	9	13	15

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1.E (ix): State-wise action plan for large scale nurseries

Large Scale		Year 1	Year 2	Year 3	Total
Arunachal Pradesh	Physical (in No.)	12	15	27	54
	Financial (in Cr.)	1.92	2.4	4.32	8.64
Assam	Physical (in No.)	25	34	46	105
	Financial (in Cr.)	4	5.44	7.36	16.8
Manipur	Physical (in No.)	20	20	33	73
	Financial (in Cr.)	3.2	3.2	5.28	11.68
Meghalaya	Physical (in No.)	15	15	20	50
	Financial (in Cr.)	2.4	2.4	3.2	8
Mizoram	Physical (in No.)	15	14	26	55
	Financial (in Cr.)	2.4	2.24	4.16	8.8
Nagaland	Physical (in No.)	15	20	30	65
	Financial (in Cr.)	2.4	3.2	4.8	10.4
Sikkim	Physical (in No.)	1	0	0	1
	Financial (in Cr.)	0.16	0	0	0.16
Tripura	Physical (in No.)	2	4	8	14
	Financial (in Cr.)	0.32	0.64	1.28	2.24
Total	Physical (in No.)	105	122	190	417
	Financial (in Cr.)	16.8	19.52	30.4	66.72

Table- 9.1.E (x): State-wise action plan for Small scale nurseries

State		Year 1	Year 2	Year 3	Year 4	Total
Arunachal Pradesh	Physical (in No.)	18	23	23	32	96
	Financial (in Cr.)	1.8	2.3	2.3	3.2	9.6
Assam	Physical (in No.)	38	43	43	65	189
	Financial (in Cr.)	3.8	4.3	4.3	6.5	18.9
Manipur	Physical (in No.)	28	33	33	36	130
	Financial (in Cr.)	2.8	3.3	3.3	3.6	13
Meghalaya	Physical (in No.)	18	21	25	26	90
	Financial (in Cr.)	1.8	2.1	2.5	2.6	9
Mizoram	Physical (in No.)	18	23	23	35	99
	Financial (in Cr.)	1.8	2.3	2.3	3.5	9.9
Nagaland	Physical (in No.)	23	28	27	39	117
	Financial (in Cr.)	2.3	2.8	2.7	3.9	11.7
Sikkim	Physical (in No.)	1	1	0	0	2
	Financial (in Cr.)	0.1	0.1	0	0	0.2
Tripura	Physical (in No.)	4	8	6	3	21
	Financial (in Cr.)	0.4	0.8	0.6	0.3	2.1
Total	Physical (in No.)	148	180	180	236	744
	Financial (in Cr.)	14.8	18	18	23.6	74.4

Table- 9.1 (E-1): Implementation strategy for Inbound Logistics

Strategy-5 (1)	Inbound Logistics: 1. Develop inbound logistics through the construction of Bamboo Extraction Roads to reach bamboo rich belts in remote areas and raw material stores near usage areas 2. Develop multi model supply chain through Farmers Producer Organization
Rationale	1. As informed by several State Bamboo Missions, natural stock of bamboo in some of the states is significant in amount which have commercial utility. This naturally growing stocks are located in remote areas – most of which are far away from the existing roads of the hilly states. 2. Each part of a bamboo culm has different industrial utility as raw material of different types of units. Therefore, the whole culm bamboo when used as a single product generates huge waste. More value is created across the value chain, if the bamboo culms are cut and graded according to the need of the industry and supplied.
Action Points	1. The natural stock of bamboo bearing areas will be identified by through NESAC 2. The feasibility of constructing Bamboo Extraction Road based upon the species, amount, scope of sustainable harvesting and regrowth will be assessed. 3. The viable roads may be constructed as gravel roads (without black-topping) as these are meant to be used by trucks mainly 4. Roads may be constructed by State PWD or some other agency
Methodology	Gravel roads only – fit for movement of loaded trucks
Coverage of the States	520 km in 6 states of NE Region – Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram and Nagaland
Implementing Agencies	State PWD or some other agency as decided
Time Lines	BER Feasibility Study – 8 months BER Construction - From Year-2 onward
Physical target	1. Undertake 1 no. of survey. 2. Construct total 520 km of Bamboo Extraction Road
Resource Requirements	BER Feasibility Study – Rs 1.70 crore BER Construction - Rs 208.00 crore [as per Note (3) below]
Convergence/Fresh Fund	PMGSY, NBM, Formation of 10,000 FPOs

NOTES:

- The above suggestion is based on suggestions received from the respective State Bamboo Missions. The feasibility of constructing Bamboo Extraction Road depends upon the species available on the naturally grown stock, amount available, scope of sustainable harvesting, and scope of re-growth of bamboo and subsequent replenishment of stock. Therefore, a survey may be undertaken to assess the viability of the proposal through North East Space Application Centre (NESAC) which has the experience in assessment of bamboo stock in North Eastern States.

2. Table- 9.1.E1 (i): The state-wise requirement is as follows:

Sl. No.	States	No. of Proposed	BER Per district (km)	Total Length of BER
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DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

		Districts to be covered		(km)
1	Assam	3	30	90
2	Manipur	2	30	60
3	Meghalaya	2	20	40
4	Arunachal Pradesh	7	20	140
5	Mizoram	8	10	80
6	Nagaland	11	10	110
	Total	33	120	520

- After completion of survey, an amount of Rs. 208 Cr is proposed for construction of 520 km of Bamboo Extraction Road at the Rate of Rs. 40 Lakh per km. The construction of gravel road may be undertaken under the Pradhan Mantri Gram Sadak Yojana (PMGSY).
- The year-wise break-up of construction of BER is proposed as follows.

	Year-1	Year-2	Year-3	Year-4	Year-5
Construction (km)	0	70	100	150	200

5. Table- 9.1.E1 (ii): State-wise target

State		Year 1	Year 2	Year 3	Year 4	Year 4	Total
Arunachal Pradesh	Phy (in km)	0	22	28	36	54	140
	Fin (in Cr.)	0	8.8	11.2	14.4	21.6	56
Assam	Phy (in km)	0	12	18	29	31	90
	Fin (in Cr.)	0	4.8	7.2	11.6	12.4	36
Manipur	Phy (in km)	0	2	8	16	34	60
	Fin (in Cr.)	0	0.8	3.2	6.4	13.6	24
Meghalaya	Phy (in km)	0	4	6	14	16	40
	Fin (in Cr.)	0	1.6	2.4	5.6	6.4	16
Mizoram	Phy (in km)	0	12	18	20	30	80
	Fin (in Cr.)	0	4.8	7.2	8	12	32
Nagaland	Phy (in km)	0	18	22	35	35	110
	Fin (in Cr.)	0	7.2	8.8	14	14	44
Total	Phy (in km)		70	100	150	200	520
	Fin (in Cr.)		28	40	60	80	208

Table- 9.1.(E-2): Implementation strategy for Inbound Logistics

Strategy-5 (2)	Inbound Logistics: Development of multi model supply chain through Farmers Producer Organization
Rationale	Each part of a bamboo culm has different industrial utility as raw material of different types of units. Therefore, the whole culm bamboo when used as a single product generates huge waste. More value is created across the value chain, if the bamboo culms are cut and graded according to the need of the industry and supplied.
Action Points	1. Formation of Farmer Producer Companies/Organization (FPO/FPC) 5. Capacity building in terms of multi-model supply chain development-use of machinery, grading, sorting
Methodology	Formation of FPO/FPC
Coverage of the States	All the 8 states of NER
Implementing Agencies	State PWD or some other agency as decided
Time Lines	2 years
Physical target	Form 77 nos. of FPO/FPC as per Note 2.
Resource Requirements	Rs. 11.55 Cr
Convergence/Fresh Fund	Scheme for "Formation of 10,000 FPOs" under Ministry of Agriculture and Farmers Welfare

NOTES:

1. Multi-model Supply chain is the proposed mechanism for delivering the pre-process material from the established bamboo processing zone (BPZ) to the respective industry and enterprises as per the specific requirement with the aim to minimize the waste and add value. Currently, Northeast India the bamboo sector is missing the multiple- supply chain systems due to which huge waste is generated at the processing level, thereby increasing the cost of production. Strengthening the flow of multiple-supply chain will create employment in rural areas and bamboo smallholders' farmers. The SME and industry value chains could be strengthened by introducing multi-product supply-chain development. Establishing producer's organization near the resource base could be a viable option to initiate multi-product supply-chain. It will help to use the bamboo properly to minimize waste and also different products verticals in the cluster. In addition, it will create small and micro enterprises in the different chain to maintain steady supply chains for growth and development of the sector.

Parts of a Bamboo Culm	Uses
Leaves	Manure, Fodder, Beverages, Medicine, Juice, Pigments
Twigs	Brooms, Cloths
Top Part	Poles, scaffolding
Middle Upper Part	Carpet, Mat, Curtain, Woven Articles, Handicrafts
Left over of Upper Middle Part	Fibre Boards, Charcoal, pulp, Lumber, Fuels
Middle Lower Part	Laminated Furniture, Flooring
Base Part	Charcoal
Shoots	Food, Pharmaceutical, Nutraceutical, Fodder
Sheaths	Handicrafts
Rhizomes	Handicrafts

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

2. Formation of 77 nos. of Bamboo Producer's Organization in North East India with minimum 300 nos. of farmers per FPO. State wise break up and fund requirement mentioned below-

Table- 9.1.E2 (i): State wise break up and fund requirement

Sl. No.	State	No. of FPO/FPC	Fund Requirement (@ Rs. 15 Lakh per FPO)
1	Arunachal Pradesh	10	150.00
2	Assam	30	450.00
3	Manipur	5	75.00
4	Meghalaya	5	75.00
5	Mizoram	5	75.00
6	Nagaland	5	75.00
7	Sikkim	2	30.00
8	Tripura	15	225.00
	Total	77	1155.00

3. Year-wise phasing

	Year-1	Year-2	Year-3	Year-4	Year-5
FPO	35	42	0	0	0

4. Table- 9.1.E2 (ii): State-wise road map

State		Year 1	Year 2	Total
Arunachal	Phy (in nos.)	5	6	11
	Fin (Rs. In Cr.)	0.75	0.9	1.65
Assam	Phy (in nos.)	5	6	11
	Fin (Rs. In Cr.)	0.75	0.9	1.65
Manipur	Phy (in nos.)	5	6	11
	Fin (Rs. In Cr.)	0.75	0.9	1.65
Meghalaya	Phy (in nos.)	4	5	9
	Fin (Rs. In Cr.)	0.6	0.75	1.35
Mizoram	Phy (in nos.)	5	5	10
	Fin (Rs. In Cr.)	0.75	0.75	1.5
Nagaland	Phy (in nos.)	5	6	11
	Fin (Rs. In Cr.)	0.75	0.9	1.65
Sikkim	Phy (in nos.)	2	3	5
	Fin (Rs. In Cr.)	0.3	0.45	0.75
Tripura	Phy (in nos.)	4	5	9
	Fin (Rs. In Cr.)	0.6	0.75	1.35
Total	Phy (in nos.)	35	42	77
	Fin (Rs. In Cr.)	5.25	6.3	11.55

Table- 9.1.(E-3): Implementation strategy for Outbound Logistics

Strategy-5 (3)	Outbound Logistics: 1. Promote In-Land Water Transport of bamboo and bamboo products 2. Promote railway transport of bamboo and bamboo based products within the region and as well as outside the region
Rationale	1. The average cost of road of road transport per km is 10/km, for railway 6 Rs/km and for waterway Rs. 1/km. 2. In-land water ways have made tremendous progress in terms of planned connectivity 3. The railway connectivity has been significantly improved in the region
Action Points	1. The feasibility of establishing in-land container depot in Tinsukia, Tezpur, Agartala, Kolasib and Dimapur may be examined 2. Monthly Service from Guwahati port may be examined 3. Necessary infrastructure such as bamboo depot in major cities with regard to in land water transport may be introduced. 4. Introduction of transport subsidy in bamboo may be examined. A detailed study in this regard need to be taken up.
Methodology	Undertake study and assess the feasibility
Coverage of the States	Major bamboo transit hubs of India and NER states.
Implementing Agencies	Professional agency as decided
Time Lines	1 year
Physical target	4 nos. of studies
Resource Requirements	Rs. 2 Cr.
Convergence/Fresh Fund	Fresh Fund from NEC or under TEDF

NOTES:

1. The challenge of any product o NER including bamboo is the high cost of transportation. The Government of India has identified in-land water transportation as one of the focus area for increasing the connectivity. The solution to the challenge associated with high transportation cost from NER is the use of in-land waterways. While the average cost of road transport per km is 10/km, for railway 6 Rs/km and in case of waterway it is Rs. 1/km. The India-Bangladesh Protocol on Inland Water Transit and Trade (PIWTT) signed in 2015 has created the much needed collaboration to unlock the economic potential of North East India. As per the agreement, the two countries have agreed to develop 309-kilometre Ashuganj-Zakiganj stretch of the Kushiya River and 146-kilometre Sirajganj-Daikhowa that of the Jamuna for round the year use. The Sirajganj-Daikhowa stretch is expected connect National Waterway-1 (the Ganga) and National Waterway-2 (the Brahmaputra) and enable movement of larger vessels from Varanasi in Uttar Pradesh to Assam's Sadiya, via Bangladesh. Further, India is also working to develop the National Waterway-1 as part of the World Bank-funded Rs 5,369 crore Jal Marg Vikas Project from Haldia in West Bengal to Varanasi.

Bamboo sector can be a winner from this development. The via Bangladesh water route opens door for the bamboo sector to all the major market of the country. Water transport of the bamboo sticks can revive the agarbatti sector of entire country including stick manufacturer in North East

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

and Agarbatti manufacturers in the states of Gujarat, Uttar Pradesh, Maharashtra, and Madhya Pradesh. Similar impact may be achieved in terms of supply of treated bamboo pole for the construction sector which has the demand throughout the country.

2. **Railway Connectivity:** During the last 5 years, remarkable development has been witnessed in terms of expansion of railroad network. In 2018, India's largest railroad bridge the Bogibeel Bridge was constructed in Assam, which will play a strategic role in connecting the lesser developed districts of Assam and Arunachal Pradesh. Naharlagun, a suburban town of Itanagar, Arunachal Pradesh was connected via broad gauge in 2015. Similarly, broad gauge line has already connected Agartala, the capital of Tripura via Silchar. To achieve the Government of India's goal to connect all the NER state capitals through railway network, presently work is going on for following projects-Jiribam to Imphal, Manipur, Dimapur (Dhansiri) - Zubza (Kohima), Nagaland; Nagaland, Sivok to Rangpo, Sikkim, Agartala-Sabroom, Tripura; Tetelia-Byrnihat, Meghalaya; Byrnihat-Shillong, Meghalaya; Bhairabi-Sairang, Mizoram; Murokongselek-Pasighat, Arunachal Pradesh; Agartala (India) – Akhaura (Bangladesh).

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1.F-1: Implementation strategy for Promotion of Research and Development

Strategy-6 (1)	Promotion of Research and Development in Bamboo Sector through setting up National Institute of Bamboo Innovation and Technology (NIBIT)- the first bamboo specific R&D institute of the Country	
Rationale	<ol style="list-style-type: none"> 1) The institute is proposed to address the huge gap of industrial application based Research and Development of Bamboo in India. Details mentioned in Note 1, 2 & 4 below 2) The institute in its first phase will only focus on research and development and knowledge generation. 3) Upon successful building of a bamboo ecosystem in the region, the institute will expand itself towards knowledge transmission through offering courses. 	
Action Points	To establish National Institute of Bamboo Innovation and Technology (NIBIT)	
Methodology	<ol style="list-style-type: none"> 1) Identification of Suitable Location 2) Preparation of DPR 3) An Advisory Committee may be formed with former Director, IIT as chairman and experts from other technical institutes, World Bamboo Organization, NITI Aayog, Department of Science and Technology, Department of Biotechnology, Ministry of Environment Forest Change and Climate Change, Ministry of Agriculture and Farmers Welfare, Ministry of Rural Development, Ministry of Textile, Ministry of Food Processing, Ministry of DoNER, India Bamboo Forum and experts from South East Asian countries. 4) A Research Advisory Council may be formed with representative from NITI Aayog, DST, DBT and IIT. 5) Phase –wise construction <p>Details mentioned in Notes below</p>	
Coverage of the States	Will cater to the regional, national and global needs	
Implementing Agencies	Professional Agency	
Time Lines	5 year	
Physical Target	Set up 1 no. of research and development institute	
Resource Requirement	Indicative cost of the project	Rs. 302.63Cr
	Cost of DPR and Feasibility (1%)	Rs. 3 Cr
	Total	Rs. 305.63 Cr
Convergence/Synergy	To be anchored by Ministry of Agriculture and Farmer Welfare with fund support from other relevant ministries. Details given in Note below-	

NOTES:

1. **Need for Unlocking Bamboo Sector Potential:** A comprehensive analyses of the bamboo sector of the north-east taking into account the broad perspectives of the current status of knowledge, resource estimation, economy, market structure, technology and human resource relating to bamboo, reveals the following-
 - a) The present status of the bamboo sector in the north-east calls for urgent initiatives in order to harness the tremendous potential inherent in the bamboo resources of the region. The strategies for such initiatives that have been made during the last nearly two decades by a

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

few organisations under the aegis of the National Bamboo Mission and the INBAR, contributed valuable insights into the issues that are to be addressed in a systematic manner with much more focused and strategic approaches.

- b) There are quite a few Indian Universities, IITs, Technical Institutes and other higher educational institutions in India where research relating to various aspects of bamboo are being pursued. There are also a number of Universities and institutions abroad like the MIT, University of Hamburg, the Green School in Bali, Indonesia, etc., where remarkable research on bamboo is in progress. However, most of these studies are sporadic, insular and academic in nature.
- c) There exists a huge knowledge gap in the assessment of the diversity of the bamboo resources available in the North-East and the mapping of the bamboo resource of the region is far from complete
- d) The understanding of the material application of bamboo is a dynamic process which needs focused attention.
- e) There is a near total absence of standardised data with respect to the different structural parameters of various bamboo species of the region which are basic for any economic utilisation of the resource for different applications in the construction and manufacturing industries.
- f) There is an immediate need for a platform that can cater to the needs of the entrepreneurs, researchers and the industry where collaborative exercise can take place.
- g) Unlike China, the bamboo sector of India has never been looked at through the lens of developing intellectual properties with industrial orientation.
- h) The region needs to be developed as a destination of global bamboo experts, agencies and industries for conducting their research which will act as a catalyst to the local ecosystem.
- i) Bamboo has the potential to provide alternative livelihood to a vast majority of the rural community in the north-east which requires regular mechanism for motivation, training on skill and plantation and on creating value chain in the growing bamboo market in the Asia-Pacific region where north-east India plays a crucial role.

2. **Research & Development Gaps in Bamboo Sector:** The industrial growth and development of any sector has direct correlation with innovation and technology adoption. Innovation and technology development is a dynamic process which can only be achieved through continuous research and development. Globally, bamboo has been recognized as the material of the 21st century which has unlimited potential to cater to the needs of ranges of industry. The economic benefit and impact potential of bamboo on the lives of the poor and marginalized section of the society is tremendous. Looking at the bamboo sector of the successful countries, the common factor across the globe is their initiative taken towards research and development.

The bamboo sector of India is far from unlocking its potential. The understanding of the bamboo as material is at a very nascent stage in the country. Some of existing gaps in the understanding of bamboo sector in India are mentioned below-

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

- a) The species wise various properties of bamboo and their specific industrial use is far from complete.
- b) The bamboo production of the country is characterized by low productivity. No significant improvement has been made so far in this regard. This is worth mentioning that while China owns more 80% of global bamboo trade with 6 million Ha of bamboo plantation which has productivity of 30-40 MT/Ha, India has 14 million Ha bamboo plantation with productivity of 3-6 MT/Ha.
- c) The productivity of each species of bamboo is highly dependent on the agro-climatic zone. Research on species specific farming depending upon various agro-climatic zone needs to be undertaken.
- d) Industry-wise targeted bamboo forestry and their scientific management needs development of species wise package of practice which is currently absent.
- e) A species of bamboo may exhibit different properties even within the region due to altitude, temperature, soil condition etc. This raises the need of cohort mapping of the bamboo biodiversity which has not been undertaken till now.
- f) **The availability of machinery which suit the Indian bamboo species is a challenge. The machinery industry is highly import dependent. The country needs development of both high end and affordable indigenous tools and technology. Research and development in this direction is currently lacking in the country.**
- g) The recent advancement of bamboo has proven successful use of bamboo from bullet proof vest, luxury car to anti-ageing healthcare products. The young talents of India have the potential to begin a bamboo startup revolution based which is innovation and technology oriented.
- h) Industrial use of bamboo in the construction, manufacturing and energy sectors require development of high quality human resource.
- i) The construction sector has been witnessing paradigm shift with introduction of bamboo as material of construction. India has the potential to become the global hub of raw material for the bamboo based construction industry world-wide. This will require research and development of bamboo as construction material from multiple aspects such as architecture, design, testing, mechanical properties, chemical properties, safety aspect, standardization etc. Presently, there is no such organization in the country which has been armed to undertake such activity.
- j) Bamboo fibre has multi-industry use globally which includes silk, intimate wear, hospitality industry, Geo-textile, automobile etc. At present, India is importing bamboo fibre from China which are further converted to yarns and supplied to various garment manufacturing country. The research and development for identification of suitable species for fibre production, standardization of production technique, prototype development for various target industry, standardization of products is the need of the hour.
- k) On the other side of the ecosystem, the entrepreneurs have started understanding the potential of bamboo. There is a growth of bamboo sector startups in the country who at present is facing challenge in terms of technology for new product development, product

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

testing, market linkage etc. Academia collaboration can address these challenges to a great extent.

- l) The North Eastern region has the strength in terms of bamboo based artisanal skills which is mostly based traditionally inherited skills. Use of standard machines and tools is largely absent with little or no mechanization. This has led to the major challenge of the NER bamboo craft sector which is product standardization and large scale manufacturing. The existing capacity building institute of the region need to intensify their effort towards this.
- m) At present, bamboo trade intelligence information is very limited. In addition to forecasting global market demand or trend, the region also needs real-time detailed data on annual amount of harvestable bamboo in the region vis-a-vis estimated industrial demand.

These are some of the indicative gaps and the list goes on.

3. **Existing Institutes:** The region currently has 4 nos. of dedicated agencies working for bamboo sector development which are as follows-

1. Bamboo Cane and Development Institute (BCDI), Agartala, Tripura
2. Tripura Bamboo and Cane Development Centre (TRIBAC), Tripura
3. Advanced Research Centre for Bamboo and Rattan, Mizoram
4. North East Cane and Bamboo Development Council (NECBDC), Byrnihat, Meghalaya

These agencies have been successful in catering to the skill building needs of the artisans. Further, other institutes of the country who have considered bamboo under their mandate are as follows-

- Indian Plywood Industries Research and Training Institutes
- NID Ahmedabad, Bengaluru and Jorhat
- Institute of Wood Science and Technology
- National Institute of Natural Fibre Engineering and Technology
- Department of Design, IIT Guwahati
- Bamboo Design Studio, IIT Bombay
- Indian Institute of Packaging
- Rain Forest Research Institute
- National Institute of Fashion Technology, Shillong
- Forest Research Institute, Dehradun
- Central Food Technology and Research Institute, Mysore

The international institutes working in this directions are-

- Central Food Technology and Research Institute, Mysore
- Saint-Petersburg State Forest Technical University, Russia
- Nanjing Forest University, China
- Bamboo U, Bali
- Kyoto Prefectural University
- Columbia College of Forestry and Natural Resource, Columbia

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

- Faculty of Forestry, University of British Columbia, Canada
- The Faculty of Agriculture and Forestry, University of Helsinki, Helsinki
- Institute of Agricultural and Life Sciences and Asian Centre for Natural and Environmental Sciences, University of Tokyo, Japan
- Chair for Wood Technology, Hamburg University, Germany

4. **Need of New Approach towards Bamboo Sector Research and Development:** These institutes have taken up research and development initiative on various aspects of bamboo relevant to their field of expertise. However, the gaps mentioned in the bamboo sector as a whole and North East in particular demands a more focused and holistic approach to cater to the larger needs of the bamboo sector industries. Further, the conventional technical institutes of the country and of the north-east have limited scope for upgradation, conservation and application of the traditional knowledge and skill sets relating to the local natural resources due to their other inherited mandates. The New Education Policy, 2020 gives a strong emphasis on these aspects of the traditional knowledge and skills through the institutional mechanism of Lok Vidya. The economy is already witnessing a surge in bamboo entrepreneurship, but currently there is lack of a platform which can act as the one stop solution for the researchers, industries and entrepreneurs. Therefore, it is proposed that the first higher technical institution of the world focusing on bamboo may be established in the North Eastern region.

As the planet earth is confronting the challenges from Climate Change and Global Warming, the disruptions of the ecosystems have brought to the fore the fact that our economic system has to be in sync with the basic principles of natural ecosystem functioning. This calls for a paradigm shift in the way we think and act and the world needs a new value system to build its economic order that can ensure sustainability to life and the earth. A new approach involving paradigm shifts in research and development is the only instrument through which this can be achieved. Bamboo is the companion of planet earth in this battle of climate change which can directly contribute in achieving 7 of the SDGs and no other region in the world is more ideally placed than North East India to unlock bamboo to its full potential.

5. The Concept of National Institute of Bamboo Innovation and Technology (NIBIT):

Vision

The Institute aims at building a new model in the realm of research and development for sustainable development, keeping bamboo at the centre stage in which traditional knowledge and skill relating to use of bamboo shall be blended with the contemporary knowledge of science, engineering and technology for creating human resources who shall contribute towards a green economy that is sustainable, value based, culturally relevant and universally acceptable.

Mission

1. To lead the north-east towards a rich and sustainable bamboo based economy which shall make India the global hub of excellence for bamboo based industry.
2. To create global citizen with conscientious, scientific and rational attitude towards nature and environment.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

3. To enable NER youth in harnessing the existing potential of bamboo for a rich economy and sustainable environment.
4. To work for strong Industry- Academia interfacing.
5. To promote research and innovation in developing new and novel bamboo based value added products and services.
6. To equip researchers with modern knowledge relating to bamboo through multi-, inter- and trans-disciplinary approaches.
7. To create world class professional technocrats on bamboo based products and services.
8. To equip youths with the knowledge and skills of Finance and Business for a strong and sustainable bamboo based economy.
9. To nurture the traditional skill sets relating to all applications and use of bamboo in contemporary perspectives amongst communities through regular extension activities.
10. To empower the community for viable and sustainable bamboo based enterprises as sources of livelihood.

Objective:

1. To act as a global destination of researchers, entrepreneurs and industries working in the bamboo sector
2. To act as a unique higher education institute dedicated to technology development, study, research and training of bamboo sector
3. To cater to the human resource, skill and talent needs of the next generation bamboo industry.
4. To act as the one-stop solution for idea generation, product development and testing.
5. To act upon the untapped human resource in the youth who for a variety of reasons are not utilising the traditional knowledge and skill they have for livelihood/ Bamboo based entrepreneurship.
6. To act as a platform for facilitating innovation that has industrial application and generate intellectual properties for bamboo sector of the country.
7. To act on real time bamboo trade intelligence

Broad Outline of the Institute and its Mandate

Research and Development shall be directed towards creating knowledge base on:

- Bamboo Diversity
 - Documenting and Mapping
- Bamboo Propagation
 - Traditional Practices
 - Innovations
- Bamboo Crafts
 - Mapping Traditional Designs
 - Documenting
 - IPR

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

- Design Innovation
- Bamboo Engineering & Design
 - Civil Engineering Practices
 - Mechanical Engineering Practices
 - Architecture & Town Planning
 - Landscaping
 - Interior Design & Decoration
 - Furniture Making
 - Low cost housing solutions
 - Community Housing
 - Technology Incubation
- Business Development & Entrepreneurship focused on Bamboo
 - Bamboo & Forest Economics
 - Management Practices
 - Entrepreneurship
 - Commerce & Business Studies
 - Business Incubation
 - Start-up Eco System
- Food & Beverage
- Energy
- Bamboo Community Development
- Bamboo Tourism

Blended learning is proposed to be adopted as a practice by the University with extensive use of information and communication technology.

Research and Innovation

A major focus of the University shall be on Research and Innovation. Thrust areas of research for each domain shall be worked out within multi and cross disciplinary frame work. The primary focus of the research will be on development of products which have industrial application and adds to the intellectual property of the country. Two Research Incubation Centres –one for Science and Technology and the other for Liberal Arts, to be set up with industry partnership which shall act as the nuclei for supporting research and innovation at the University.

Partnerships

The institute shall have collaboration with organisations and institutions from the industry, company, Government and Non-Government sectors. The collaborations shall be for the purpose of academic, research and consultation activities. The institute shall have a mandate to forge collaboration with the organisations and institutions of the south-east Asia within the frame work of the bi and multilateral treaties and conventions of Government of India.

Academic Collaboration

The proposed institute shall develop its research programmes in collaboration with some of the established and reputed higher education institutes of the country and abroad. One of the basic mandates of the proposed institute will be to make our youth ready for the 4.0 industry which encompasses critical capacity development in areas like artificial intelligence, big data analytics, quantum technology, etc. NIBIT has to collaborate with some of the best centres of excellence in the country and abroad to fulfil this mandate.

There are several Universities in the north-east where some research relating to bamboo is in progress. The IITs in Guwahati, Bombay, Kanpur and Delhi are engaged in remarkable research in the areas of bamboo crafts and design, bamboo micro-structures, bio-composites and in developing pest and fire resistant bamboos. The ICFRE and its affiliated institute the Rain Forest Research Institute in Jorhat are engaged in developing suitable agro technology for propagation of bamboo. There are quite a few Universities in the country where the Biotechnology departments are conducting research in tissue culture of bamboo. NIBIT shall develop collaboration with these institutes for charting its own academic and research plans.

Groups of researchers in the Massachusetts Institute of Technology (MIT), Cambridge, the USA and a few Universities in the UK and the University of Hamburg, Germany have been conducting research and studies on bamboo. The new University shall collaborate with these Universities and institutes in due course of its development.

Few identified institutions and Universities within India and around the globe are already mentioned. More and more Institutions and Universities across the globe shall be welcomed to partner the effort towards creating meaningful body of knowledge befitting the need for sustainable growth of Bamboo sector in particular and the community in general.

Industry-Academia interfacing

The proposed institute has the grand vision of ushering in a new economic model in the region. It shall engage in study, training and research leading to generation of knowledge, creation of quality human resource and technology innovation to cater to the growing demands of the bamboo based economy and industry. NIBIT shall have close synergy with the relevant industries of the nation and the world in every sphere of its academic activities. It shall embark upon research related to the industries in close collaboration with experts from the industries. It shall work out new models of industry-academia interfacing whereby not only the experienced and qualified faculty members shall take up industry related issues needing research, but there will be provisions for engaging the entrepreneurs for their creative and innovative ideas. The various divisions within the institute will be encouraged to take up consultancy/ Projects from the Industry and other stakeholders, engage in effective HR and Technology Transfer mechanism etc. Appropriate IPR cell will be provided in place to safeguard the intellectual property.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

6. Implementation Approach:

1. The institute may be anchored by Ministry of Agriculture and Farmers Welfare where other ministries of Govt. of India can contribute through their respective bamboo sector fund.
2. An Advisory Committee may be formed with former Director, IIT as chairman and experts from other technical institutes, World Bamboo Organization, NITI Aayog, Department of Science and Technology, Department of Biotechnology, Ministry of Environment Forest Change and Climate Change, Ministry of Agriculture and Farmers Welfare, Ministry of Rural Development, Ministry of Textile, Ministry of Food Processing, Ministry of DoNER, India Bamboo Forum and experts from South East Asian countries.
3. A Research Advisory Council may be formed with representative from NITI Aayog, DST, DBT and IIT.
4. To work out the Feasibility cum Detailed project report an amount of Rs. 3 Cr (1% of the indicative project cost) may be earmarked.
5. Based upon the result of the feasibility study, the location can be any of the state in NER with higher bamboo diversity.

7. Table- 9.1.F1(i): Year-wise Requirement of Financial Resources (in Cr)

Components	I	II	III	IV	V	Total
Infrastructure Development Cost	38.3	40.425	39.565	44.865	38.955	202.11
Cost on Furniture's and Fixtures	3.475	0.9	1.285	1.05	0.975	7.685
Cost on Office Stationary and Consumables	0.85	0.5	0.65	0.75	0.9	3.65
Cost on Laboratory Equipment	0.55	0.9	1.6	2.2	2.3	7.55
Cost on Office Automation & ERP	0.4	0.7	1	1.25	1.5	4.85
Cost on HR Salary Component	4.14	10.315	15.08	20.115	24.62	74.27
Cost on Library Procurement	0.46	0.575	0.575	0.45	0.45	2.51
Tentative Requirement of Funds Phase-wise	48.175	54.315	59.755	70.68	69.7	302.625

Assumptions of Cost calculation:

NEDFi was engaged by National Centre for Design and Product Development (NCDPD) under the Ministry of Textile, Govt. of India to undertake DPR cum feasibility study for setting up of a Bamboo University in Agartala, Tripura. The cost of the project was Rs. 604 Cr which involved both research and development and academic courses. **The current Action Plan proposes to take up only research and development to begin with in the first phase instead of offering academic courses.** Therefore, the cost of the project is considered at 50% of 604.Cr which is indicative. A detailed estimation is required through preparation of DPR and Feasibility study.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1.F2: Implementation strategy for Establishment of a Bamboo Entrepreneurship Fund

Strategy-6(2)	Establishment of a Bamboo Entrepreneurship Fund
Rationale	This fund will be established to promote entrepreneurs in the bamboo sector in the NE Region. The Start-up revolution of India needs to expand its wings to bamboo sector. The need of a the proposed fund is explained in Note 1
Action Points	<ul style="list-style-type: none"> • Establish Fund • Awareness Creation • Selection of entrepreneurs for Bamboo Entrepreneurship Development Fund • Identification of Bamboo sector challenge that require start-up involvement • Selection of Entrepreneurs for Bamboo Challenge Fund • More emphasis for the grant mode • Formation of guideline for scaling up of venture • Selection of Fund Disbursing/Management agency • Divestment and re-use of divested proceeds
Methodology	Selection of Entrepreneurs through: Start-up Route (based on Ideation, Proof of Concept and Scale up) Bamboo Challenge Fund – opportunity to entrepreneurs to come up with solutions to the challenges of the bamboo industry in NE Region
Coverage of the States	Not pertinent
Implementing Agencies	North East Cane and Bamboo Development Council (NECBDC), Research Advisory Committee of NIBIT
Time Lines	5 years
Resource Requirements	Rs. 100 crores as Corpus Fund
Convergence/Fresh Fund	Fresh Fund from Ministry of DoNER, NITI Aayog

NOTE

1. **Need of the Fund:** The primary objective of Bamboo Entrepreneurship Fund (BEF) would be to invest in enterprises focused on bamboo sector and located in the NER and to provide resources for entrepreneurs from the region to expand throughout the country. The investment focus of the BEF will be early and growth stage investment mostly in enterprises involved in the fields of bamboo. BEF would inter alia invest in areas such as development of new products and services, technological up gradation, expansion or diversification, process improvement and quality improvement with the purpose of creating value for all stakeholders.

Investments will typically be in start-ups, early stage and growth stage enterprises with new products and technologies or innovative business models which have the potential to bring superior value proposition to the customers and clients and high growth in earnings and profitability and also in enterprises undertaking expansions which already have sound financial performance. Fund Manager will select businesses for investments which have high scalability and can reap dividend by quickly and cost effectively reaching to their target customers. The Fund will also cover organizations which are in partnership / proprietorship form with the aim to convert them into

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

company form of organization, so that the Fund is able to invest in them. Each investment will be limited to a minimum of Rs.25 lakhs and a maximum of Rs.10 crores.

2. **Fund Objective:** The objective of the Fund is to contribute to the entrepreneurship development of the NER in bamboo sector and achieve attractive risk-adjusted returns through long term capital appreciation by way of investments in privately negotiated equity/ equity related investments. Specific objectives are mentioned below-

1. To promote North East as a global bamboo valley
2. To promote innovation and technology in bamboo based entrepreneurship in India
3. To address the challenges of NER bamboo sector through cutting edge new technology and new ideas.
4. To complement the proposed bamboo institute of higher learning in terms of market driven areas of research and development.
5. To promote innovating financing in bamboo sector enterprise.
6. To enhance region's capacity to attract private investment.
7. To anchor the capacity of growers with market demand approach
8. To mentor the growers and crafts-persons through entrepreneurs

Criteria:

- Entrepreneurial person with innovative vision for bamboo sector and implementation power
 - Strong management team and commitment
 - Viable business model with sustainable growth
 - Large scaling opportunities
 - Market-fit product with good traction
 - Realistic exit potential
3. **Fund Modality:** The proposed fund of Rs.100 Cr may be combination of both technology and entrepreneurship development. promotion two sub-sectors funds as follows-

a. An amount of Rs.60 Cr as Bamboo Entrepreneurship Development Fund

The aim of the proposed fund is to develop new age bamboo sector entrepreneurs through innovative funding. The eligible enterprises will be the bamboo start-ups/entrepreneurs operating in North East or sourcing their product from NER having both tangible and intangible contribution to the economy of the region. Since the start-up ecosystem of the region is at early stage, therefore entrepreneur/start-up of any legal form may be considered to apply for the fund. The stage-wise funding amount is suggested below-

Table- 9.1.F2 (i): stage-wise funding amount

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Stage	Eligible amount	Fund Type
Ideation	Rs. 5 Lakh to Rs. 10 Lakh	Grant
Proof of Concept to Pre-Revenue	Rs. 10 Lakh to Rs. 25 Lakh	Grant
Revenue	Rs. 25 Lakh to Rs. 30 Lakh	Grant/Loan/Equity

b. An amount of Rs.40 Cr as Bamboo Challenge Fund

In light of the Start-up India Policy, start-ups may be encouraged to solve various challenges related to bamboo sector of the country. The proposed Bamboo Institute of Higher Learning along with the Start-up Policy Implementing Agencies can take lead in identification of the challenges. Award in the form of grant between the amounts of Rs. 5 Lakh to Rs. 25 Lakh may be proposed per challenge to the winner.

Table- 9.1.F2 (ii): The annual fund requirement is proposed below- (Rs. In Cr)

SI No.	Fund	Year 1	Year 2	Year 3	Year 4	Year 5
1	Bamboo Entrepreneurship Development Fund	12	12	12	12	12
2	Bamboo Challenge Fund	8	8	8	8	8
	Total	20	20	20	20	20

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1.G1: Implementation strategy for Value Addition and Waste Utilization

Strategy-7 (1)	Value Addition and Waste Utilization: Agarbatti (Incense Stick Industry)	
Rationale	1) The industry is dependent on import of raw material 2) Paralysed with challenge of unutilized waste of around 88% (Details given on Note)	
Action Points	1) Setting up of bamboo round raw sticks units 2) Setting up of Bamboo Round Agarbatti Units 3) Bamboo Incense stick masala processing 4) L. Glutinosa Plantation 5) Use of generated waste for production of charcoal, activated charcoal and other products 6) Use of charcoal for masala production 7) Research for indigenous alternative to L. Glutinosa 8) DGFT may lift export ban on bamboo charcoal and activated charcoal for marketing the utilized waste of the Agarbatti Industry. 9) Use of FSC certified raw material	
Methodology	1) Decentralized production, SHG to promote manufacturing 2) For scaling up, additional units at cluster levels 3) Forest to take up L.Glutinosa Plantation for Jiggjit (Agarbatti Masala) production 4) Waste to be converted to charcoal and activated charcoal- collection of waste periodically 5) Market Linkage with ITC, TRIFED Details given in Note	
Coverage of the States	All 8 states of NER	
Implementing Agencies	Entrepreneur, SHG	
Time Lines	5 year	
Physical Target	Type of Unit	No.
	Bamboo Round Raw Sticks Units	21
	Bamboo Agarbatti Rolling Unit	15
	Bamboo Incense Masala Processing	5
	L. glutinosa Plantation (in Ha.)/Govt.& Private	5000 Ha
Resource Requirement	Rs. 22.25 Cr (break up given in note below)	
Convergence/Synergy	National Bamboo Mission	

NOTE

1. Existing scenario:

The incense stick industry in India is an excellent example of social entrepreneurship in the rural and semi-urban areas that has slowly made its niche in the international market. It is one industry that uses natural products and has a demand both in urban and rural India. The demand for Agarbatti is more in rural areas of India (around 52%) and in urban areas it is around 48%. It is one area wherein Indians have taken it up as a household and cooperative industry and there is community effort in the manufacturing of the products. A large number of women are employed in this industry.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

India is a leading country in Agarbatti production and supplies almost half of the world's incense sticks requirements. Export is almost across more than 120 countries and worth around Rs. 965 crores while the domestic market profits are projected at about Rs. 3500 crores. Currently, the market is growing at a rate of around 7 per cent, and more than 1000 billion sticks are produced every year. Further, these export figures for Rs. 965 crores have been achieved after imports for Rs. 780 crores or more for the Agarbatti industry that was earlier being procured indigenously. Nevertheless, it proves a point that there is a demand for Indian Agarbatti outside the country. The main competitors of India in this sector have been China, Vietnam and Thailand.

There is a huge scope for India to gain back the control of Agarbatti industry from China and Vietnam and become 'Atma Nirbhar' if we take appropriate and right measures. This will also help in reviving the closed round bamboo stick units, especially in Tripura and generate thousands of jobs that were lost due to Chinese dominance in Agarbatti and round bamboo stick trade. There is therefore the need to come up with an action plan so that India is self-reliant again in the Agarbatti industry as it was a few years ago. The NER Region, with its vast stock of bamboo, can take up the mantle of reviving India's Bamboo trade.

2. Bamboo Waste: The Main Reason for the Agarbatti Trade Debacle:

The major reason why the costs of indigenous round bamboo sticks are higher in India is the non-utilization of bamboo waste that is generated when round bamboo sticks are manufactured from bamboo. 88% of the bamboo goes as waste, and only 12% is utilized to make round bamboo sticks for the Agarbatti. Therefore, the focus need to be given on this 88% waste. This cost gets added to the finished bamboo round stick, and that makes the Indian sticks costlier as compared to that of Vietnam and China. This wastage has not been put to any economic use. On the other hand, China and other countries make use of 100% of their bamboo and there is virtually no wastage. Further, Vietnam's bamboo trade success is mechanization and in situ manufacturing. They have put their manufacturing machine close to the resource site and save on the expenses in transportation while that is not in the case of India. It is true with China also. The bamboo waste needs to be utilized in such a way that it generates income. The more value the waste will generate, the cheaper the Indian bamboo stick would become. To reduce dependency on import, the waste the cost of manufacturing need to be reduced through waste utilization. The various valuable products that can be made from bamboo waste are - Bamboo charcoal and Activated bamboo charcoal, Bamboo composite boards for furniture and housing, Bamboo fibre and Bamboo pulp for use in dentistry.

3. Strategy for Production:

- a) Production of round bamboo sticks should be done in a decentralized manner. Mechanization and situ manufacturing need to be adopted by putting manufacturing machine close to the raw material source which will also save transportation.
- b) The waste generated is to be used gainfully, and for this, the State Department of Industries should take the lead. Among the easiest would be the Bamboo Charcoal, bamboo vinegar and Activated Charcoal manufacturing from the bamboo waste.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

- c) Production of these round sticks should be done with the production of other items such as Bamboo charcoal and Activated bamboo charcoal, Bamboo composite boards for furniture and housing, Bamboo fibre and Bamboo pulp for use in dentistry.
- d) Machines are available in India, and there are many units which were closed down in states like Tripura that can be made functional again. Additional units of the above-said products will have to be installed in correlation with these machines of round bamboo sticks. This will ensure:
 - 1. Utilization of waste from making round bamboo sticks
 - 2. Manufacturing of new products
 - 3. Driving the costs of round bamboo sticks down
 - 4. Generating more employment
 - 5. Reducing transportation costs of the waste to their respective units in other areas or states

4. Machines needed

"Bamboo Cross-Cutting Machine" - cuts the whole bamboo in various sizes, "Bamboo Splitting Machine"- splits the bamboo into many parts, "Bamboo Knots Removing Machine"- removes the knots and makes two strips by slicing each split bamboo (It separates the green and the yellow layers as well); "Bamboo Slicer Machine"- make two more slices from each strip by removing the knots, thereby reducing and minimizing the wastage and leading to thinner strips. (If some strip is found thicker, this process of further slicing of the strips is repeated till they are all even, thin slices), "Bamboo Sticks Forming Machine" - makes the Bamboo Sticks of particular and desired diameters; "Bamboo Stick Length Setting Machine" - cut the bamboo sticks into various desired sizes. In fact, by changing the shaping blades, we can change the sizes and shapes of the sticks according to the demand. For example, 2.00 mm round stick is suitable for toothpick making; and 1.3 mm or 1.4 mm round stick is for incense stick making. Using different blades, as mentioned earlier, can make sticks of much other thickness; "Multifunctional Cutter Sharpener" - does the sharpening of blade and cutter.

5. Market Linkages:

Tie-ups with various organizations should be looked into. Some are discussed, such as:

- 1. MOUs should be signed with companies like ITC or with local traders to provide an outlet of these products.
- 2. Government marketing agencies such as TRIFED.
- 3. The by-product of Charcoal and Activated Charcoal (ABC) has a great international market besides an upcoming market of Bamboo Charcoal and Bamboo Activated charcoal. FMGC and pharmaceutical companies buy ABC for various uses like in all kinds of filters, especially in RO systems and kitchen chimneys, Air conditioners, toothpaste, fabric, cosmetics, medicines etc. The manufacturing units should enter into marketing contracts with these companies. (details discussed in next chapter)

6. State Specific Suggestion:

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

1. States such as **Tripura, Assam, Meghalaya** and **Nagaland** can look into the production of Agarbatti sticks. They will also have to set up additional units, as mentioned above, for the production of other products from the waste generated.
2. **Assam, Nagaland** and **Tripura** are the States where Round Bamboo Stick was being manufactured, but all the units have closed down due to flooding of the market by cheaper products.

7. Economics of Raw Material and Waste Management

ITC was working in Tripura for manufacturing round Agarbatti sticks, and their requirement is around 1 MT of bamboo per day, i.e. 30 MT of Bamboo per month and around 300-360 MT of bamboo per annum. This 360 MT of bamboo will generate only around 36 MT of round bamboo sticks. The rest is bamboo waste of around 324 MT of wastes. This waste can be converted into Bamboo charcoal or Activated Bamboo Charcoal to earn good money. A cost analysis reveals the following- Even if bamboo is procured at a higher rate of Rs.5000/- per MT it will be able to generate good profits. If one manufactures Activated Bamboo Charcoal, the profit margin would be Rs.80000/- per MT of bamboo. If we make only Bamboo Charcoal, then the profit will be Rs. 40000/- per MT of Bamboo. So these entrepreneurs can afford to pay a high price for bamboo raw material which will benefit the growers. So by any conservative estimates, 360 MT would give $50000 \times 360 = \text{Rs.}1.8$ crores. Even if very low margins are considered, yet the Bamboo waste manufacturers stand to get good money. Needless to say, Activated Charcoal will fetch them more money. Therefore, instead of calling it "waste", the same can be called by- product that is feeder material for another industry, here it is Charcoal industry.

8. Specific Action Proposed for the Government & Related Organizations:

MOEFF&CC and RNBM can work with Forest Department for the plantation of "Litsea Glutinosa", the tree that is responsible for the masala "jiggiti" that is used over the round bamboo stick. It is the part of the Agarbatti mix that burns. This will reduce the dependency on the import of this "masala" or mix. The research institutions like RRFI, Jorhat and IWST, Bengaluru should take it up as one of their priority research areas to find more alternatives to jiggiti and also its propagation through established methods and techniques.

Tripura State Bamboo Mission: Tripura State Bamboo Mission has been taking technology driven initiative for the state bamboo sector development. The Project has introduced technologies in bamboo treatment, dyeing, use of Japanese Juki machines/ Taiwanese stick-making machines/ Power tools/ Semi-mechanized/mechanized Agarbatti Rolling/ Finishing machines/semi-mechanized tools for bamboo stick-making, etc. Induction of improved techniques & tools has greatly helped the producers to enhance their product quality & productivity. The mission also made a good stride in marketing linkages and have entered into Marketing Tie-up with NEHHDC, THHDC, ITC, NRRS, Mother Earth, Giskaa and many other private players. They have also tied up with Flipkart, Amazon, etc. For handicraft they have engaged "Simanta Handicraft Products Pvt Ltd" represented by the producer groups, to facilitate the marketing of bamboo products outside the state. But all these things will come to naught if the issue of bamboo waste generated is not addressed in the manufacturing of round bamboo sticks for Agarbatti. The mission should work in this direction.

TRIFED, Ministry of Tribal Affairs and **Ministry of Rural Development** may utilize SHG and their revolving grants to set up manufacturing units of Agarbatti and other related products. This will create a boon in the bamboo trade and new products manufacturing.

The State Bamboo Missions in the North Eastern States may set up decentralized units for waste utilization. As mentioned above, various units for the production of different products can be set up. In

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

areas where it's difficult to set up additional units for such products, then 4-6 clusters can have a centralized unit for waste utilization. Waste can be collected over a period of 7-15 days, and then products can be made at the centralized unit.

National Rural Livelihood Mission and TRIFED, Ministry of Tribal Affairs may take up Agarbatti as one of the focus areas under bamboo sector initiative for SHG and SHG Federations. MOEFF&CC and NMB should direct its fund to the Forest Department for the plantation of "Litsea Glutinosa". The agro-climatic condition of North East India is suitable for plantation

Table- 9.1.G1(i): Summary of Resource Requirement & State-wise Plan

Units	No.	Cost/Unit in Lakh	AP	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura	Total in Rs. Lakh
Bamboo Round Raw Sticks Units	21	25	2	5	2	2	2	2	1	5	525
Bamboo Agarbatti Rolling Unit	15	15	1	5	1	1	1	1	0	5	225
Bamboo Incense Masala Processing	15	15	1	5	1	1	1	1	0	5	225
L. glutinosa Plantation (in Hac.)/Govt.& Private	5000	0.25	350	2000	500	250	500	500	150	750	1250
Total	5041	55.25	354	2015	504	254	504	504	151	765	2225

Table- 9.1.G1(ii): Year wise Phasing

Sl. No.	Fund	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	Bamboo Round Raw Sticks Units	4	5	4	4	4	21
	Cost	1	1.25	1	1	1	5.25
2	Bamboo Agarbatti Rolling Unit	3	3	3	3	3	15
	Cost	0.45	0.45	0.45	0.45	0.45	2.25
3	Bamboo Incense Masala Processing	3	3	3	3	3	15
	Cost	0.45	0.45	0.45	0.45	0.45	2.25
4	Jiggat Plantation(in Hac.)/Govt.& Private	1000	1000	1000	1000	1000	5000
	Cost	2.5	2.5	2.5	2.5	2.5	12.50
	Total	4.1	4.35	4.1	4.1	4.1	22.25

Table- 9.1.G1(iii): State wise & Year wise planning of Rolling Unit

Rolling unit		Year 1	Year 2	Year 3	Year 4	Year 5	Total
Arunachal	Phy (in No.)	1					1
	Fin (in Cr.)	0.15					0.15
Assam	Phy (in No.)	1	1	1	1	1	5
	Fin (in Cr.)	0.15	0.15	0.15	0.15	0.15	0.75
Manipur	Phy (in No.)	1					1
	Fin (in Cr.)	0.15					0.15
Meghalaya	Phy (in No.)		1				1

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

	Fin (in Cr.)		0.15				0.15
Mizoram	Phy (in No.)			1			1
	Fin (in Cr.)			0.15			0.15
Nagaland	Phy (in No.)		1				1
	Fin (in Cr.)		0.15				0.15
Sikkim	Phy (in No.)						
	Fin (in Cr.)						
Tripura	Phy (in No.)			1	2	2	5
	Fin (in Cr.)			0.15	0.3	0.3	0.75
Total	Phy (in No.)	3	3	3	3	3	15
	Fin (in Cr.)	0.45	0.45	0.45	0.45	0.45	2.25

Table- 9.1.G1(iv): State wise & Year wise planning of L Glutinosa Plantation

L Glutinosa Plantation		Year 1	Year 2	Year 3	Year 4	Year 5	total
Arunachal	Phy (in No.)	70	70	70	70	70	350
	Fin (in Cr.)	0.175	0.175	0.175	0.175	0.175	0.875
Assam	Phy (in No.)	400	400	400	400	400	2000
	Fin (in Cr.)	1	1	1	1	1	5
Manipur	Phy (in No.)	100	100	100	100	100	500
	Fin (in Cr.)	0.25	0.25	0.25	0.25	0.25	1.25
Meghalaya	Phy (in No.)	50	50	50	50	50	250
	Fin (in Cr.)	0.125	0.125	0.125	0.125	0.125	0.625
Mizoram	Phy (in No.)	100	100	100	100	100	500
	Fin (in Cr.)	0.25	0.25	0.25	0.25	0.25	1.25
Nagaland	Phy (in No.)	100	100	100	100	100	500
	Fin (in Cr.)	0.25	0.25	0.25	0.25	0.25	1.25
Sikkim	Phy (in No.)	30	30	30	30	30	150
	Fin (in Cr.)	0.075	0.075	0.075	0.075	0.075	0.375
Tripura	Phy (in No.)	150	150	150	150	150	750
	Fin (in Cr.)	0.375	0.375	0.375	0.375	0.375	1.875
Total	Phy (in No.)	1000	1000	1000	1000	1000	5000
	Fin (in Cr.)	2.5	2.5	2.5	2.5	2.5	12.5

Table- 9.1.G1(v): State wise & Year wise planning of Round Stick

Round stick		Year 1	Year 2	Year 3	Year 4	Year 5	Total
Arunachal	Phy (in No.)	1	1				2
	Fin (in Cr.)	0.25	0.25				0.5
Assam	Phy (in No.)	1	1	1	1	1	5
	Fin (in Cr.)	0.25	0.25	0.25	0.25	0.25	1.25
Manipur	Phy (in No.)		1	1			2
	Fin (in Cr.)		0.25	0.25			0.5
Meghalaya	Phy (in No.)		1			1	2
	Fin (in Cr.)		0.25			0.25	0.5
Mizoram	Phy (in No.)	1		1			2
	Fin (in Cr.)	0.25		0.25			0.5
Nagaland	Phy (in No.)	1	1				2
	Fin (in Cr.)	0.25	0.25				0.5
Sikkim	Phy (in No.)				1		1
	Fin (in Cr.)				0.25		0.25

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Tripura	Phy (in No.)			1	2	2	5
	Fin (in Cr.)			0.25	0.5	0.5	1.25
Total	Phy (in No.)	4	5	4	4	4	21
	Fin (in Cr.)	1	1.25	1	1	1	5.25

Table- 9.1.G1(vi): State wise & Year wise planning of Masala Processing

Masala Processing		Year 1	Year 2	Year 3	Year 4	Year 5	Total
Arunachal Pradesh	Phy (in No.)	1					1
	Fin (in Cr.)	0.15					0.15
Assam	Phy (in No.)	1	1	1	1	1	5
	Fin (in Cr.)	0.15	0.15	0.15	0.15	0.15	0.75
Manipur	Phy (in No.)	1					1
	Fin (in Cr.)	0.15					0.15
Meghalaya	Phy (in No.)		1				1
	Fin (in Cr.)		0.15	0	0	0	0.15
Mizoram	Phy (in No.)			1			1
	Fin (in Cr.)			0.15	0	0	0.15
Nagaland	Phy (in No.)		1				1
	Fin (in Cr.)		0.15				0.15
Tripura	Phy (in No.)			1	2	2	5
	Fin (in Cr.)			0.15	0.3	0.3	0.75
Total	Phy (in No.)	3	3	3	3	3	15
	Fin (in Cr.)	0.45	0.45	0.45	0.45	0.45	2.25

Table- 9.1.G2: Implementation strategy of Value Addition and Waste Utilization

Strategy-7 (2)	Value Addition and Waste Utilization: Charcoal, Activated Charcoal and Bamboo Vinegar
Rationale	<ol style="list-style-type: none"> 1. Any bamboo species can be utilized for bamboo charcoal and activated charcoal. This creates commercial opportunity for remaining 126 Indian species of bamboo which has not been focused by NBM. 2. Bamboo charcoal can be eco-friendly and more efficient alternate fuel to wood charcoal. It has other industrial uses such as water filtration etc. 3. Activated bamboo charcoal has huge domestic market in white goods and cosmetic industry along with high export potential 4. Valued at \$5,882.8 million in 2018, the global charcoal market is projected to surpass \$6,566.5 million by 2024 5. Considered better than wood charcoal 6. Bamboo charcoal and activated charcoal production unit can be set up both at small scale at cluster level and large scale at entrepreneur level. 7. Use of bamboo charcoal for nitrogen retention instead of urea can open new market 8. Global activated carbon market size was estimated at USD 4.72 billion in 2018 9. Bamboo vinegar has good market as pesticide
Action Points	<ol style="list-style-type: none"> 1) To set up bamboo charcoal unit near clusters of round bamboo stick making unit which generates huge bamboo waste (upto 88%) 2) To set up micro scale bamboo charcoal unit at cluster level which can produce charcoal and vinegar. These units may be set up alongside bamboo handicraft cluster which also generates huge wastage. 3) The cluster level micro scale unit will produce charcoal, charcoal briquette and bamboo vinegar. 4) To set up large scale unit which can produce both charcoal and activated charcoal. 5) Each unit will produce bamboo vinegar as by-product. 6) DGFT may lift ban on export of bamboo charcoal 7) In areas where it's difficult to set up additional units for such products, then 4-6 clusters can have a centralized unit for waste utilization. Waste can be collected over a period of 7-15 days, and then products can be made at the centralized unit. 8) Training of entrepreneur for charcoal and activated charcoal production 9) Organize Investors meet targeting industries which use charcoal as fuel, filtering agent etc. 10) Target FMCG manufacturer, pharmaceutical industry to market activated charcoal.
Methodology	<ol style="list-style-type: none"> 1) There are total 61 nos. of craft clusters in North East covering 54 nos. of districts. Those clusters which generates more than 50% wastage from its raw material needs to be selected for setting up of cluster level micro units of bamboo charcoal units. Scoping study may be undertaken in this regard. 2) Additional numbers of small scale units may be set up at Tripura covering its incense stick manufacturing clusters. 3) Selection of handicraft clusters where generation of waste is more than 50%. Scoping study may be undertaken in this regard.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

	<p>4) For large scale charcoal and activated charcoal units the focused states are- Arunachal Pradesh, Assam, Manipur, Meghalaya Mizoram and Nagaland</p> <p>5) Training of entrepreneur for activated charcoal production</p> <p>6) Focus should be on species which are not covered under NBM</p> <p>7) Government may brainstorm with Municipality bodies, Public Health Engineering Departments and Water Supply Projects to encourage procurement of bamboo charcoal for water filtration. Same can be promoted at household level water filtration. Huge local market can be opened with this.</p> <p>8) Hotel industries may be encouraged to procure charcoal for cooking of various items.</p> <p>9) Bamboo charcoal briquette can also be used by the cement industries as fuel especially in the state of Meghalaya.</p> <p>10) Tie up with FMCG manufacturer, pharmaceutical industry for Activated Bamboo Charcoal needs to be explored.</p>	
Coverage of the States	All 8 states of NER	
Implementing Agencies	Entrepreneur, SHG	
Time Lines	5 years	
Physical Target	Units	No.
	Cluster level micro unit of bamboo charcoal and vinegar	20
	Aggregation based small scale unit of bamboo charcoal and vinegar	10
	Large scale charcoal and activated charcoal unit	5
	Total	35
Resource Requirement	<p>Rs. 27 Cr (break up given in note below)</p> <ul style="list-style-type: none"> Rs. 25 Cr for setting up of 5 nos. of large scale units @ Rs. 5 Cr/unit Rs. 1.2 Cr for setting up of 10 nos. of aggregation model based unit @ Rs. 12 Lakhs/Unit Rs. 0.80 Cr for setting up of 20 nos. of micro level unit @Rs. 4 Lakhs/unit 	
Convergence/Synergy	National Bamboo Mission	

NOTE:

1. Existing Scenario

Presently under the initiative of North East Cane and Bamboo Development Council, bamboo charcoal briquettes are produced by Ri-Bhoi Area Welfare Association (RAWA). They are using low cost technique of making bamboo charcoal at drums. They are selling briquettes at Rs. 25-30/half kg.

Recently, a large scale bamboo activated charcoal unit has been set up at Byrnihat, Meghalaya which has 72 MT daily capacity of raw material processing. The unit is species agnostic which is expected to procure raw bamboo from entire North East. The unit is expected to be operational from May, 2021. The key products of the unit are bamboo activated charcoal, charcoal and

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

bamboo vinegar. The target market of the unit is organic fertilizer industries, FMCG companies and pharmaceutical industries.

2. Detailed cost of both micro and small scale unit of bamboo charcoal and activated charcoal production

- The micro scale unit has the capacity of processing 100 kg of Bamboo/ waste which can be scaled upto 500 kg processing capacity.
- 100 kg processing unit will cost in Rs. 4,00,000/- (Four Lakhs)
- The small scale unit has the capacity of processing 3000 kg of Bamboo/ waste. This unit will cost in Rs. 12,00,000/- (Twelve Lakhs)
- The technology is available indigenously.

3. Raw Material Required

The main objective behind using the machine is to process Bamboo/ Bamboo waste into Charcoal. Whereas, the machines are designed such that any kind of wood or agro waste can be successfully converted into charcoal using these machines.

4. Output quantity and categories of products to be produced

The machines can produce 1 kg of charcoal for every 3 kg of Bamboo fed. This charcoal can be effectively used for smokeless briquettes manufacturing, water filtration purpose and air purifiers.

5. Economics of the Unit

Detailed Financial aspects for 3 Ton (3000 Kg.) per day processing for Bamboo/ Bamboo waste may be understood as under:

INVESTMENT:

Cost of Furnace and Supporting Equipment (Pulveriser, sieving machine, shredding machine): Rs. 20 Lakh.

Depreciation: 15% Annual

Raw Material: Rs. 2/ kg for Bamboo dust.

Power requirement: Basic.

Manpower requirement: 10 labours.

Infrastructure Requirements: 1000 sq. ft. shed with concrete RCC flooring. Water required for cooling purpose.

PROCESS OUTPUT:

33% Carbon (1000 kg): Market rate of Rs. 25/ kg.

1-2% Vinegar (30-60 ltr): Market rate of Rs. 20/ ltr.

3% Tar (90 ltr): can be upgraded further.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

30-45% Syn Gases: Recycled back for burning, thus making the process cost efficient.

Table- 9.1.G2(i): Raw Material cost and expenses for processing 3 Tons/ Day of Bamboo:

Sr. No.	Particulars	Qty./ Day	Rate	Total
1	Raw Material	3 Tons/ Day	Rs. 2/ kg	Rs. 6000.00
2	Power (for Basic purpose)	10 Units/ Day	Rs. 8/ Unit	Rs. 80.00
3	Labour	10/ Day	Rs. 500/ Day	Rs. 5000.00
4	Burning Wood (For Process Start up)	200 kg/ Day	Rs. 10/ kg	Rs. 2000.00
5	Depreciation	@ 15% on Capital of Rs. 25 Lakh	Rs. 375000/ 365	Rs. 1028.00
6	Other Misc.		Rs. 500/ Day	Rs. 500.00
Total Expenses to Process 3 Tons Bamboo/ Day				Rs. 14608.00

Production Quantity and Rate:

Sr. No.	Particulars	Qty./ Day	Rate	Total
1	Carbon/ Charcoal	1000 kg.	Rs. 25/ kg	Rs. 25000
2	Vinegar	30 ltr.	Rs. 20/ kg	Rs. 600
Total Sale Value/ Day				Rs. 25600
Sale value/ Day – expenses/ Day = Rs. 25600 – Rs. 14608 = Rs. 10992.				

Considering 200 working days per calendar year, the overall payback period for the project comes out to be THREE years for the equipment including its interest and depreciation.

6. Probable markets and buyers

Charcoal produced from these units has number of applications. Its calorific value is higher as compared to conventional coal. Also, its ash content is less than 5 % by weight. One of the in-house uses of this charcoal could be in Making Agarbatti Masala.

Other end users of prime importance are:

- Municipal and/or Private Water Filtration Plants.
- Thermal Power Plants utilizing conventional charcoal for energy generation.
- Converted into Smokeless Briquettes, Bamboo Charcoal will attract many International Customers and Hoteling Industry of STAR rating where it is used in edible purpose for Barbeque and Tandoor.

7. Fuel consumption.

Micro units run on Electricity, they require 10 units of electricity for processing 100 kg bamboo waste. The small scale units run without electricity and utilize either firewood or LPG as a fuel for initial combustion and afterwards process completion is carried out by the indigenous gases generated during carbonization. This makes the process very cost effective and environment friendly.

8. Direct and indirect employment generation

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Directly 10-15 labours can be employed for carbonization process unit. Further production of value-added products like smokeless briquettes, air purifiers, etc. will generate another employment opportunity.

9. Bamboo Charcoal and Activated Bamboo Charcoal makes all the Bamboo Species Economically Viable

During the discussion with State Bamboo Missions, the success story of making all the charcoal and activated bamboo charcoal from any species of bamboo had been observed in case of State Bamboo Development Agency of Nagaland which is the nodal agency of Nagaland State Bamboo Mission. There are about 46 species of Bamboo found in Nagaland out of which 6 are economically viable as per species identified by NBM. The State Bamboo Development Agency of Nagaland has been working on the Bamboo Waste Management by producing Charcoal, with the principle that species which do not qualify to the list of "Economically viable" species under NRM can be used for producing charcoal. The target market of this charcoal is fuel for Bakery units and household purpose like barbeque. The prospects for activated charcoal was also discussed with the state and it was informed that it has a huge market in South East Asian countries. The state of Nagaland is also in the process of signing a MOU with Taiwan, for India Taiwan Technical Centre to be set up in Nagaland.

10. Detailed Action Points:

- There is a need for all the round bamboo Agarbatti stick manufacturers to join hands and establish units for the production of BC and ABC. For these, respective State Governments, Ministry of DoNER and NEC can take the lead. The special focus could be on Tripura Nagaland and Assam who are into round bamboo stick manufacturing.
- The State Bamboo Missions in the North Eastern States must set up decentralized units for waste utilization. As mentioned above, the various units for the production of different products can be set up.
- In areas where it's difficult to set up additional units for such products, then 4-6 clusters can have a centralized unit for waste utilization. Waste can be collected over a period of 7-15 days, and then products can be made at the centralized unit.
- NRLM and TRIFED can promote SHG and SHG Federations to manufacture charcoal and activated bamboo charcoal.
- Matters may be taken up with DGFT at the Government of India level to allow for the Export of Bamboo charcoal and activated charcoal.
- There is a need to establish marketing linkages, especially with the FMCG industries. Pharmaceutical industries also need to be contacted.
- As bamboo charcoal can be a good replacement of urea based chemical fertilizers, therefore, it also can play a huge role in promoting organic fertility of the soil of not just the region, but also of the country. The Ministry for the Development of North Eastern Region

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

may take up the matter with the Ministry of Chemicals & Fertilizers for replacing urea and also with the Ministry of Agriculture for issuing a directive to the States for compulsory use of Bamboo Charcoal.

- Ministry for the Development of North East Region may take a pro-active lead role in promoting the bamboo charcoal and activated charcoal based industry in the region.

11. Table- 9.1.G2(ii): Summary of Resource Requirement & State-wise Plan

Units	No.	Cost/Unit in Lakh	AP	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura	Total in Rs. Lakh
Cluster level micro unit	20	4	2	4	3	3	3	3	2	4	80
Aggregation based small scale unit	10	12	0	3	1	0	0	2	0	4	120
Large Scale Units	5	500	1	1	1	1	1	1	0	0	2500
Total											2700

12. 11. Table- 9.1.G2(iii): State wise & Year wise planning of Micro unit

Micro Unit		year 1	Year 2	Year 3	Year 4	Year 5	Total
Arunachal Pradesh	Phy (in No.)	1		1			2
	Fin (in Cr.)	0.04		0.04			0.08
Assam	Phy (in No.)	1		1		1	3
	Fin (in Cr.)	0.04		0.04		0.04	0.12
Manipur	Phy (in No.)	1				1	2
	Fin (in Cr.)	0.04				0.04	0.08
Meghalaya	Phy (in No.)	1		1		1	3
	Fin (in Cr.)	0.04		0.04		0.04	0.12
Mizoram	Phy (in No.)		1		1		2
	Fin (in Cr.)		0.04		0.04		0.08
Nagaland	Phy (in No.)		1	1	1		3
	Fin (in Cr.)		0.04	0.04	0.04		0.12
Sikkim	Phy (in No.)		1		1		2
	Fin (in Cr.)		0.04		0.04		0.08
Tripura	Phy (in No.)		1		1	1	3
	Fin (in Cr.)		0.04		0.04	0.04	0.12
Total	Phy (in No.)	4	4	4	4	4	20
	Fin (in Cr.)	0.16	0.16	0.16	0.16	0.16	.80

13. 11. Table- 9.1.G2(iv): State wise & Year wise planning of Aggregation unit

Aggregation Unit		year 1	Year 2	Year 3	Year 4	Year 5	Total
Assam	Phy (in No.)	1		1		1	3
	Fin (in Cr.)	0.12	0	0.12	0	0.12	0.36
Manipur	Phy (in No.)	1				0	1
	Fin (in Cr.)	0.12	0	0	0	0	0.12
Nagaland	Phy (in No.)		1	0	1		2
	Fin (in Cr.)		0.12	0	0.12	0	0.24
Tripura	Phy (in No.)		1	1	1	1	4
	Fin (in Cr.)		0.12	0.12	0.12	0.12	0.48
Total	Phy (in No.)	2	2	2	2	2	10
	Fin (in Cr.)	0.24	0.24	0.24	0.24	0.24	1.2

14. Table- 9.1.G2(v): State wise & Year wise planning of Large scale unit

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Large scale unit		year 1	Year 2	Year 3	Year 4	Year 5	Total
Arunachal Pradesh	Phy (in No.)			1			1
	Fin (in Cr.)			5			
Assam	Phy (in No.)	1					1
	Fin (in Cr.)	5					
Manipur	Phy (in No.)		1			0	1
	Fin (in Cr.)		5				
Mizoram	Phy (in No.)		0		0	1	1
	Fin (in Cr.)					5	
Nagaland	Phy (in No.)			0	1		1
	Fin (in Cr.)				5		
Total	Phy (in No.)	1	1	1	1	1	5
	Fin (in Cr.)	5	5	5	5	5	25

Table- 9.1.G3: Implementation strategy of Value Addition: Bamboo Fibre

Strategy-7 (3)	Value Addition: Bamboo Fibre
Rationale	<ol style="list-style-type: none"> 1. India has imported around 1000-1200 MT of bamboo fibre from China in the year 2020, spending USD 3.6 million. Bamboo fibre demand is increasing every year. In 2016 the imports of bamboo fibre were around 600 MT which went up to 900 MT in 2019. 2. Bamboo fibre has captured the global market due to its natural anti-bacterial, anti- UV, and bacteriostatic properties. 3. Because of its antibacterial properties, it is being used in making sanitary towels, gauze, bandages, absorbents, pads, surgical apparel, surgical masks etc. 4. Scope of integration with traditional handloom industry and create new market 5. Presently India does not have any industry standard bamboo fibre technology. The bamboo textile enterprises import fibre mainly from China, then converts it to yarn by mixing with other fibres to produce fabric. 6. Agencies such as NITRA and CIBERT have been working on various technologies, however, they are in the research and development phase.
Action Points	<ol style="list-style-type: none"> 1. Fund Indian startups who have made significant development in bamboo fibre technology that can create new product and market 2. Explore technology transfer from countries such as Japan, Taiwan etc.
Methodology	<ol style="list-style-type: none"> 1. 100% grant support to Indian Startups who have developed bamboo indigenous technology for bamboo fibre extraction 2. Funding to be done for setting up of pilot scale unit. 3. Explore technology tie up with countries such as Japan and Taiwan to set up pilot scale unit in North East. Invest India can facilitate the same. 4. In contrast to chemical treatment technology of China, India can explore environmentally sustainable mechanical method of extraction which are currently adopted by countries such as Japan. 5. While China has been producing Rayon fibre which has low share in the textile, India may develop technology which can produce polyester alike fibre which has higher market share both as apparel textile and technology textile.
Coverage of the States	Any of the North Eastern States with better connectivity. Pilot scale units are proposed in Assam to start with.
Implementing Agencies	<ol style="list-style-type: none"> 1. BIRAC other Startup funding agency who invest in prototype stage. 2. National Bamboo Mission may fund such startups 3. Invest India for transfer of bamboo fibre technology to India from countries such as Japan or Taiwan
Time Lines	2 years
Physical Target	<ol style="list-style-type: none"> 1. Set up one model unit for bamboo polyester production by using indigenously developed technology 2. Set up one model unit for bamboo fibre extraction through mechanical method by means of technology collaboration with Japan or Taiwan
Resource Requirement	<ol style="list-style-type: none"> 1. Rs. 25 Cr for developing melt spinning technology based

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

	demonstration and pilot scale unit 2. Rs. 63 Cr for Technology transfer from Japan
Convergence/Synergy	BIRAC, National Bamboo Mission, Invest India

NOTE:

1. Status of Existing Research and Development

There has been no commercial manufacturing of bamboo fibre in India. Further, limited amount of Research and Development has been done in this regard. At present, Northern Indian Textile Research Institute (NITRA) has been working on extraction of bamboo fibre through Lyocel technique and CIBERT has been working towards extraction of fibre from whole bamboo through mechanical process. Both the projects are yet to give any standard technology which can be implemented at this stage. Upon successful final product from the projects, further research is required in terms of identification of suitable species.

2. Indian Start-ups Working in Bamboo bio composite fibres suitable for melt spinning

Bio Craft Innovation Private Limited (BCIPL), an Uttar Pradesh based Indian Start-ups has developed bamboo fibre extraction technology based on mechanical means. The technology is described below-

This technology will create thermoplastic fibres that can be drawn into filaments and staple fibres. The good properties of thermoplastic bamboo fibre will that be

- a. Can be easily produced throughout the year and with zero waste and zero discharge of water or any solid
- b. Easy to blend with other natural fibres
- c. Easy to process as blend or otherwise, because same cellulose dyeing needed
- d. Consistent strength, unlike rayon that has low wet strength
- e. Quick dry
- f. Anti-microbial and odour free
- g. Applications can be for both fashion and technical textile
- h. Compostable
- i. Negative or very low carbon foot print
- j. Bamboo waste can also be used as raw material

Market scope of the products

Thermoplastic bamboo fibre will be a sustainable alternative to Polyester and Nylon fabrics. Polyester fibre accounts 52% of all fibres used in textile whereas viscose is 6.5%. World is moving towards plastic free materials and compostable bamboo based fibre that has properties of thermoplastic material like polyester or nylon is going to be material of choice for buyers. Today

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

material used in textile is chosen based on functional properties and climate impact. Bamboo based melt spun fibre will give maximum benefits to buyers and brands. Globally companies in Japan, Germany and Finland are working towards melt spun cellulosic fibres and India can be good place for developments of such material considering abundant bamboo resource and relative ease of manufacturing such fibres.

Cost of the micro/small scale plant

A demonstration unit for prototyping needs Rs 2 Cr approx. A smallest capacity micro plant of 20 tons per day will cost between 20-25 Cr.

Economics of the product.

Granules will be costing approx. Rs 400 / kg and fibres approx. Rs 500/ kg at pilot scale. Cost can be brought down to Rs 250/ kg on scaling up. Today sustainable fibres are sold for between Rs 400-1000/ kg and in textile value chain our fibres can be as a blend with cotton to bring the overall price of yarn similar to Poly Cotton yarn.

Price realization by the growers

Considering Rs 20/ kg for bamboo fibre, that mean we can pay up to Rs 10000 to 12000/ ton for bamboo growers compared to Rs 1500-2500 they realize presently.

Possible value addition at cluster level

Pulverisation of bamboo can be done at cluster level from where growers can earn additional Rs. 5000/MT.

Estimated direct and indirect employment

Direct employment of 20 people in Micro plant and indirectly can support at least 300 farmers to procure 250 MT bamboo per month.

Cost Break-up

Phase 1 -Production of actual fibres on lab scale and development of products for textile and other applications

Cost of this phase. Rs 2 Cr

Cost Breakup. –

Rs 1.25 Cr for Equipment

- lab scale melt spinning equipment Rs 25 Lakh
- Melt blowing non-woven fabric equipment. Rs 65 Lakh
- Micro Pulveriser Rs 25 Lakh
- Sundry Equipment Rs 10 Lakh
- Raw material. Rs 30 Lakh
- Consumables Rs 25 Lakh

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

- Staff salary and other expenses like travel etc. Rs 20 Lakh

Timeline of Phase 1

- 3 months for Machine installation
- 3-4 months for testing of formulations
- 3 months for validation of test results into a textile products suitable for apparel and other applications
- Submission of completion report within 12 months

Production capacity will be not at commercial scale as these will be small volume machines to test the material and produce filament and staple yarns to validate the formulation and testing. Not suitable for commercial production.

Phase 2

A micro melt spinning unit of 20 tons per day capacity will be set up. Cost of such unit will be approx. Rs 22 Cr.

3. Collaboration with Bamboo Sector Leaders for Technology Transfer

Unlike China, which uses chemical treatment method to produce bamboo rayon fibre, Japan has been using sustainable and eco-friendly mechanical method of fibre extraction where natural bamboo is opened, fibre is taken out and yarn is produced by mixing with other fibres. It has been claimed that, while chemical treatment method reduces the anti-bacterial properties of bamboo fibre, mechanical method retains it even after 10 wash. The process involved making of bamboo chips and converting them to fibres. Collaboration for such technology will approximately cost the following-

Table- 9.1.G3(i): Cost of 10 MT Production per month Capacity Bamboo Fibre unit with Technology Transfer from Japan:

Sl No.	Description	Rate (Japanese Yen)	Nos.	Unit	Amount (JPY)
1	Bamboo chip making machine	5,000,000	5	Units	25,000,000
	Transportation, installation, operation test, etc.				50,000,000
2	Bamboo fibre manufacturing machine	50,000,000	10	Units	500,000,000
	Transportation, installation, operation test, etc.				50,000,000
3	Technical guidance, etc.	10,000,000	20	Months	200,000,000
4	Public relations, general supervision	2,000,000	20	Months	40,000,000
5	Factory construction cost	100,000,000	1	Unit	100,000,000
	Total				965,000,000
	Equivalent to 63 Cr Indian Rupees				

Table- 9.1.G4: Implementation strategy of Value Addition: Bamboo Shoot Based Food, Pharmaceutical and Nutraceuticals

Strategy-7 (4)	Value Addition: Bamboo Shoot Based Food, Pharmaceutical and Nutraceuticals
Rationale	1. India is the second largest resource of bamboos after China

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

	<ol style="list-style-type: none"> 2. China supplies 75% of the global need 3. NER produces annually 5685 MT of shoots get harvested with an estimated worth of INR 26.96 million 4. Growing awareness of consumer about bamboo shoot's therapeutic and nutraceutical properties 5. In past few decades, the consumption of bamboo shoots has increased tremendously 6. Economic benefit to local
Action Points	<ol style="list-style-type: none"> 4. Target Domestic market for fermented shoots, pickle, soups etc., International market for vacuum packed and canned shoots and Nutraceuticals. 2 million tons annually in Europe, North America, Australia and Africa for canned or vacuum packed bamboo shoots 5. Careful selection of high yield varieties with large shoot size and use of proper packaging material 6. Standardization of processing technique, protocols and standards 7. R&D needs to be promoted for improved packaging, standardization of raw material and product, and development of new product. 8. Tie up with World Bamboo Organization for R&D and MoFPI for setting up units under SAMPADA. 9. Promote under One District One Product (ODOP) scheme of MoFPI
Methodology	<ol style="list-style-type: none"> 1. Value chain development of bamboo shoot with intervention at targeted forestry, processing, quality control and quality assurance, product standardization and new product development. 2. Improved packaging 3. Develop shoot based bamboo forestry 4. Selection of entrepreneur 5. Understand export norms 6. Set up units with integrated unit with laboratory facility for testing of products and maintain parameters
Coverage of the States	Manipur, Assam, Mizoram and Nagaland
Implementing Agencies	Entrepreneur
Time Lines	5 years
Physical Target	4 nos. of units
Resource Requirement	Rs. 8.47 Cr Cr (Rs. 2.12 Cr Per unit)
Convergence/Synergy	National Bamboo Mission

NOTE:

1. Existing Scenario

North-East Indian region has a total of 24110 km² area covered with bamboos from where annually 5685 tonnes of shoots get harvested with an estimated worth of INR 26.96 million (US\$ 0.43 million) (Bisht et al., 2012). Small scale bamboo shoot handling units established in Aizawl (Mizoram), Jorhat (Assam) and Dimapur (Nagaland) areas of North-East India, are not efficient enough to provide services even to the local market. It is ironical that India (in spite of being the second largest resource of bamboos after China) imports bamboo shoots from other countries like Thailand and Bhutan which are available in the departmental stores of not only big cities like Delhi and Chandigarh but even in the North Eastern states.

At the household level, there are a number of bamboo shoot processing units in North-East India based on local technology and know-how and fulfilling the local demand. But these local bamboo shoot products are not able to enter in the national and in the international market due to lack of proper processing, packaging and certification. There is as yet no viable bamboo shoot processing unit that produces canned bamboo shoots in the North-East to even cater to the domestic market. Rather, bamboo shoots are imported bamboo shoots for its domestic consumption.

2. Market Potential

The greatest markets for trading bamboo shoots are in China, Japan and South East Asian local markets, while other countries like Bangladesh, India, Indonesia, Malaysia, Philippines, Sri Lanka and Vietnam also have markets at domestic level (Benton et al., 2012). Countries like Japan, United States, Canada, Australia and many countries from Europe are new developing market for shoots and other products of bamboo shoots and as of bamboo as a whole. Now these countries are the main importers of shoots mainly from three countries, China, Thailand and Taiwan. China is at the top in exporting bamboo shoots, accounting for value of US\$ 195 million as per UN Comtrade Data (2009) representing around 75% of the total global export, which extended to US\$ 240.9 million in 2012 and account for 87% of the entire export market (INBAR 2012). Japan, USA and EU are the topmost importing countries, collectively making up around 95% of the total global import. Japan, the biggest bamboo shoot product importer, imported worth US\$ 160.4 million (59% of global import) in 2012 followed by EU with import value US\$ 55.2 million (20%) and USA with worth US\$ 40.4 million import of bamboo shoot (15%) (INBAR, 2012). The recent record (2016-17) of bamboo shoot import estimated approximately 61 million Kg of canned bamboo shoot by USA from various countries, chiefly from China and also from countries like Japan, Taiwan, Thailand, and India (Dabas and Kumar, 2018).

In past few decades, the consumption of bamboo shoots has increased tremendously, as in Japan it is now 3.0 kg per person which was earlier just 1.2 kg per capita. , In China the consumption of bamboo shoot is reported to be around 1.0 kg per capita, which is predicted to rise. As the popularity of organic foodstuff enhanced, the edible bamboo shoots intake and trades are anticipated to increase worldwide, as at present bamboo shoots are totally organic growing in the wild without addition and application of any fertilizers or chemicals.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

3. Emerging Areas

The juvenile bamboo shoots being rich in nutrients, health promoting bioactive compounds (phenols, phytosterols, dietary fiber), vitamins (vitamin A, vitamin B1, B3, B6, vitamin C and vitamin E), amino acids and minerals, hence, play a significant role in maintaining good health and is being projected as superfood. Thus, formulation of novel food products by incorporating nutrients, bioactive compounds, dietary fiber and antioxidants from bamboo shoots, as ingredients for physiological benefits or disease prevention and control has drawn the attention of researchers, nutritionists, consumers and industrialists. Bamboo shoots can be used to fortify food products like bakery, dairy and meat products or in the development of nutraceuticals.

4. Economic benefits to the local

At the peak production period, i.e. all through the rainy season, fresh shoots sold at a local price range of INR 30- 60/ kg which is tremendously cheaper than the imported canned shoots for half of the weight ranging from INR 189–380 /500g pack (Saini et al., 2019). With the increasing demand of bamboo shoot worldwide and considering the wealth of bamboos and traditional knowledge of processing shoots, North-East India has a golden opportunity to enter the international market and has tremendous potential of setting up a viable bamboo shoot industry for utilizing the vast bamboo resources and enabling socio-economic development of the people of this region.

5. Markets to target:

- Domestic market, especially for fermented shoots, pickle, soups etc.
- International market, especially for vacuum packed and canned shoots
- Nutraceuticals

6. Production:

The followings points need to be addressed for the establishment of a successful bamboo shoot processing industry in the region to cater to the needs of national and international markets-

- Selection of Proper species: Most preferred shoots are those of *Chimonobambusa callosa*, *Bambusa balcooa*, *B. cacharensis*, *B. kingiana*, *B. manipureana*, *B. nutans*, *B. oliveriana*, *B. pallida*, *B. tulda*, *B. vulgaris*, *Cephalostachyum capitatum*, *Dendrocalamus giganteus*, *D. hamiltonii*, *D. hookeri*, *D. latiflorus*, *D. longispathus*, *D. manipureanus*, *D. sikkimensis*, *D. strictus*, *Melocanna baccifera*, *Phyllostachys manii*, *Schizostachyum dulloa*, *S. polymorphum* and *Teinostachyum wightii*. Shoots of *C. callosa*, *M. baccifera* and *P. manii* are soft, sweet with very less content of cyanogen (55.97mg/kg, 315.22mg/g and 36.32mg/kg respectively) and can be consumed fresh without minimum processing. However, they are not suitable for fermentation. Proper selection of species for canning, fermentation and food fortification is necessary
- Selection of Appropriate Processing Method: Due to seasonal availability of bamboo shoots and its short shelf life of three to four days after harvesting, it is necessary to process the young shoots using appropriate methods for long term usage and storage. Moreover,

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

processing such as soaking, boiling, drying, fermentation and brine treatment is needed to remove the anti-nutrients. Method of processing needs to be selected depending upon the end product. Boiling gives a yellow tinge to the shoots. Drying is good, it decreases the bulk and weight and also enables easy handling, storage, packaging and transportation. However, different drying methods may affect the product differently by altering mechanical, physical, biological and chemical properties and hence selection of the best drying method is important with respect to economical product, functional and physical quality. Fermentation is one of the ancient methods to preserve food, prolong shelf life and improve flavor. Fermented bamboo shoots are associated with many health benefits due to the microorganisms associated with the fermentation process that synthesizes vitamins and minerals, produces biologically active compounds and fermented products have recently attracted a lot of scientific interest

- Fresh shoots sold in the market should be properly cleaned and packaged so that consumers are attracted to buy this vegetable. Presently, they are sold in a very shabby manner whereas in countries like South Korea, shoots are properly packaged.
- There is as yet no viable bamboo shoot processing unit that produces canned bamboo shoots in the North-East to even cater to the domestic market. Rather, bamboo shoots are imported bamboo shoots for its domestic consumption.
- Appropriate species need to be selected taking into consideration the shoot size, nutrient and bioactive compound contents.
- Shoots react differently according to the processing method used. Appropriate processing method needs to be selected to remove the anti-nutrients and also to ensure that the shoots retain crunchiness, colour and there is minimum loss of nutrients and bioactive compounds.
- To start a bamboo shoot industry, one cannot depend only on natural resources. Shoots are available for 4-5 months depending upon the species. Extensive plantation is necessary to harvest maximum shoots during the shooting season for producing canned shoots and also for making fortified food products. It should be ensured that there is no dearth of raw material.
- A well functional bamboo shoot processing unit requires proper water supply, power, packaging system, canning system and waste management system. Bamboo forests are spread over entire North-East India so one or two vehicles is a must for transporting shoots within 24 hours after harvest for processing. If shoots are not processed quickly after harvesting, they undergo lignification and a major part of the shoot are wasted as it becomes too hard for consumption and lose their nutritional value. There should also be a proper storage places for the processed shoots so that the shoots do not get spoiled by microorganisms. The shelf-life of post harvested bamboo shoot is very short (just two to three days).
- Selection of appropriate packaging material of the finished products is a must.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

- Appropriate utilization of the non-edible culm sheaths should be worked out.

7. State-wise suggestion:

Manipur, Assam **Mizoram** and **Nagaland** are the states that can foray into the bamboo shoot industry due to the availability of favourable species.

In **Manipur** state, the main demand is for fermented shoots (soibum and soidon). Fermented shoots are sold everywhere in Manipur, particularly in Imphal, Bishnupur, and Thoubal districts.

Nagaland has a big local market for the fermented bamboo shoot as well as for the exudates of fermented bamboo shoots. In **Meghalaya**, fermented bamboo shoots are sold in two forms. One is semi-fermented, kept in plastic bottles submerged in water and another is dry fermented shoots packed in polythene.

In **Assam**, fermentation is slightly different. In the region of Karbi Anglong of Assam, bamboo shoots are chopped in small pieces and kept in a semi-air tight container mixed with oil and spices for round the year use.

These are the current market demand of the bamboo shoots in some of the states. The production currently is happening at the local level without any mechanisation. Therefore, it is important to target this market through mechanisation. That will ensure the branding of different bamboo shoots products as well as the maintenance of the desired quality.

8. Market Linkage:

Outside North-East India in other parts of India and in the international market fermented shoots do not have much demand presently. Canned bamboo shoots are in demand in high end restaurants and hotels in India wherein imported bamboo shoots are used as no domestic product is available. Due to the popularity of Chinese restaurants worldwide, the consumption of bamboo shoots is more than 2 million tons annually and is widespread in Europe, North America, Australia and Africa (Ding and Wang 2018) and canned or vacuum packed bamboo shoots are in great demand. At present the main demand in international market is for the shoots of *Phyllostachys pubescens* and *Dendrocalamus asper* which are supplied by countries like China and Thailand which do not grow abundantly in North-East India. But we have species which are at par or better than these species. Selection of market for the bamboo shoots of the North-East region is the third important aspect for setting bamboo shoot processing unit.

Successful development of a bamboo shoot industry could result in Supply of shoot in the local, domestic and international markets, Generation of export earnings from the sale of fresh and processed shoots and fortified food products. And opportunity to farmers to diversify into an enterprise that is environmentally friendly and profitable.

9. Plan for Bamboo Shoot Value Chain Development in NER:

Bamboo Shoot value chain development involves the following-

- Selection of bamboo shoot species which are suitable for high yield bamboo shoot cultivation. State-wise list of species is mentioned under Table No. X.XX

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

- Bamboo shoot specific targeted plantation and nursery
- Bamboo shoot processing with water supply, power, packaging system, canning system, waste management system and storage
- Attached research lab for regular biochemical analyses as shoots are to be used for food and medicine.

Cost of each component is mentioned below-

Table- 9.1.G4(i): Cost of Setting up of Bamboo Shot Processing Unit

S. No.	PARTICULARS	Cost (in Lacs)
1.	Land with proper accessibility to processing unit (one to half hectare)	6.00
2.	Building for processing shoots Room for cleaning Storage room Office room Staff room with all basic facilities	8.00
3.	Equipment's and accessories Tables with steel top Plastic or bamboo baskets for shoots Containers and buckets for washing shoots Chopping boards and knives Containers for storing shoots Stove and gas for boiling shoots Plastic bag sealing machine Refrigerators	8.00
4.	Vehicle	10.00
5.	Water and electricity facility	8.00
6.	Running cost for five years	15.00
	Total	55.00 Lacs

Table- 9.1.G4(ii): Cost of Setting up of Nursery and Targeted Plantation

S. No.	PARTICULARS	Cost (in Lacs)
A	Nursery Development	
1.	Land for nursery, shade house and for processing unit near road head approximately 1 ha (10,000 sq. m)	10.00
2.	Shade house development	1.50
3.	Preparation of land for nursery, shade house and shoot processing unit	3.00
4.	Minor nursery implements	2.50
5.	Maintenance of plantlets for five years	10.00
6.	Electricity and water supply	2.50
7.	Running cost for 5 years	5.00
	Sub Total	34.50
B	Bamboo Cultivation farm	
1.	Land for cultivation of bamboo at two locations (one hectare each) @Rs. 1.9 Lacs/ha	3.80
2.	Preparation of land, planting of saplings and maintenance	12.00

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

	Sub total	15.30
Grand Total	A +B	50.30

Table- 9.1.G4(iii): Cost of Setting up Research Lab

Particulars	Cost (in Lacs)
T ISSUE CULTURE FACILITY Culture room, Laboratory space Culture racks, equipments (Autoclave, Laminar air flow, weighing balances, pH meter, hot plate and other minor equipments, Chemicals, glassware, plasticware	25.00
BIOCHEMISTRY LAB Equipments (Double beam UV Spectrophotometer, centrifuge, muffle furnace, deep freezer, lyophilizer, texture analyzer, fume hood, soxlet apparatus, rotatory evaporator, oven, water bath, weighing balance, Refrigerator pH meter and other minor equipments, Chemicals, glassware, plasticware etc.	55.00
Total	80.00 Lacs

Table- 9.1.G4(iv): Requirement of Manpower

Manpower Required (1 year)		
S. No.	PARTICULARS	Salary for five years (in Lacs)
1.	Manager (one) @Rs. 30,000 p.m.	18.00
2.	Lab technician (one) @Rs. 30,000 p.m.	18.00
3.	Supporting staff (four) @Rs. 8,000 p.m.	19.20
4.	Driver (one) @Rs. 10,000	6.00
5.	Nursery person (one) @Rs.9,000 p.m.	5.40
	Total	66.60

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1.G4(v): Prospects of Income from Bamboo shoot processing and sale

Purchasing Cost				Total Expenditure (in Rupees)	Selling Price (in Rupees)	Profit (in Rupees)
Particulars	Quantity (in kg)	Raw Shoot (in Rupees)	Processing Costs (in Rupees)			
Raw Bamboo Shoot	1	50	50	100	150	50
Raw Shoot Per Day	2000	1 lacs	1 lacs	2 lacs	3 lacs	1 lacs
Raw Shoot for 30 days	60,000	30 lacs	30 lacs	60 lacs	90 lacs	30 lacs
Raw Shoot for 1 year (for 6 months in a year availability of shoots)	3,60,000	18 lacs	18 lacs	360 lacs	540 lacs	180 lacs
Total Cost for 5 years	18,00,000 (shoot harvest for 5 years @ 2000 kg/ day)	900 lacs	900 lacs	1800 lacs	2700 lacs	900 lacs

Cost of One Integrated Bamboo Shoot Unit: (in Rs. Lakh)

Cost for establishing bamboo shoot processing unit	55.00
Expenditure for development of nursery and bamboo plantation farm	50.30
Man power (for nursery, bamboo plantation farm maintenance, shoot processing unit)	16.65
Working Capital	90.00
	211.95

State-wise Potential Bamboo Species for Shoot Production:

STATES	BAMBOO SPECIES SELECTED FOR SHOOTS
Arunachal Pradesh	<i>Bambusa nutans</i> , <i>B. pallida</i> , <i>Chimonobambusa callosa</i> , <i>Dendrocalamus giganteus</i> , <i>D. hamiltonii</i> , <i>Gigantochloa albociliata</i> ,
Assam	<i>Bambusa burmanica</i> , <i>B. pallida</i> , <i>B. tulda</i> , <i>Dendrocalamus hookeri</i> , <i>D. giganteus</i> , <i>D. sikkimensis</i> , <i>Gigantochloa rostrata</i> , <i>Melocanna baccifera</i> , <i>Phyllostachys bambusoides</i> , <i>Schizostachyum dulloo</i>
Manipur	<i>Chimonobambusa callosa</i> , <i>Dendrocalamus asper</i> , <i>D. hamiltonii</i> , <i>D. longispathus</i> , <i>D. strictus</i> , <i>D. giganteus</i> , <i>D. latiflorus</i> , <i>Melocanna baccifera</i> , <i>Bambusa bambos</i> , <i>B. nutans</i> , <i>B. kingiana</i> , <i>Phyllostachys heterocyclus var. pubescence</i> , <i>P. bambusoides</i> , <i>Schizostachyum beddomei</i>
Meghalaya	<i>Dendrocalamus hamiltonii</i> , <i>D. hookeri</i> , <i>D. sikkimensis</i> , <i>Gigantochloa albociliata</i> , <i>G. rostrata</i> , <i>Schizostachyum dulloo</i> , <i>Melocanna baccifera</i> , <i>Phyllostachys mannii</i>
Mizoram	<i>Phyllostachys mannii</i> , <i>Bambusa longispiculata</i> , <i>Bambusa pallida</i> , <i>B. tulda</i> , <i>Chimonobambusa callosa</i> , <i>Dendrocalamus calostachyus</i> , <i>D. hamiltonii</i> , <i>D. hookeri</i> , <i>D. sikkimensis</i>
Nagaland	<i>Bambusa pallida</i> , <i>B. tulda</i> , <i>Chimonobambusa callosa</i> , <i>Dendrocalamus calostachyus</i> , <i>D. giganteus</i> , <i>D. hamiltonii</i> , <i>D. hookeri</i> , <i>D. sikkimensis</i>
Sikkim	<i>Dendrocalamus hamiltonii</i> , <i>D. hookeri</i> , <i>D. sikkimensis</i> ,
Tripura	<i>Bambusa pallida</i> , <i>B. tulda</i> , <i>B. polymorpha</i> , <i>Dendrocalamus hamiltonii</i> , <i>D. longispathus</i> , <i>Gigantochloa rostrata</i> , <i>Melocanna baccifera</i> , <i>Thyrsostachys oliveri</i>

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

10. Role of organizations and ministries:

- There is a vital role of SFAC (Small Farmers' Agri-Business Consortium), MoA and Ministry of Food Processing Industry. SFAC should take up the mantle of the development of bamboo shoots industry in the same it did for the Leh berries in Ladakh in 2001. It can enter into a joint venture and also take bamboo shoot development under their "Technological Mission for Horticulture in North-Eastern India."
- For standardization, quality control and assurance, handholding support may be requested from experts of World Bamboo Organization can be roped in.
- Flagship scheme on Food Processing industry- Pradhan Mantri Kishan Sampada Yojana may be explored for setting up of bamboo shoot industry. Ministry of Food Processing, Govt can contribute in this regard.
- Department of Science and Technology, Department of Biotechnology and Council for Scientific and Industrial Research (CSIR) can promote Research and Development in terms of standardization of bamboo food based products.

11. Action points:

- Again, the forest department can play a key role. As most of the bamboo in NER lies in the forest land, forest department should be involved for a regular supply of bamboo shoots for the processing units.
- Manufacturing, processing and storage units are a must to turn this household production into a mechanized production. Only then a quality can be ensured, and market can be tapped into.
- R&D is a must before foraying into the bamboo shoots industry. Appropriate machines for various stages in the production chain needs to be identified, developed or modified according to the Indian species and conditions
- The bamboo shoot manufacturing should be an integrated one covering bamboo shoots manufacturing, nutraceuticals and cosmetics. One complete integrated unit like this would give the maximum benefit and profits leading to sustainable employment. Since the shoots are to be used for food and medicine, regular biochemical analyses need to be conducted for the shoots and the value added products which necessitates the development of research laboratories in the integrated manufacturing unit.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1.G4(vi): State-wise Financial Requirement

Units	No.	Cost/Unit in Lakh	AP	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura	Total in Rs. Lakh
Integrated Bamboo Shoots Value Chain Development	4	211.95	0	1	1	0	1	1	0	0	847.80

Table- 9.1.G4(vii): State wise & Year wise planning of financial requirement of bamboo shoots

State		Year 1	Year 2	Total
Assam	Phy (in No.)	1		1
	Fin (in Cr.)	2.12		2.12
Manipur	Phy (in No.)	1		1
	Fin (in Cr.)	2.12		2.12
Mizoram	Phy (in No.)		1	1
	Fin (in Cr.)		2.12	2.12
Nagaland	Phy (in No.)		1	1
	Fin (in Cr.)		2.12	2.12
Total	Phy (in No.)	2	2	4
	Fin (in Cr.)	4.24	4.24	4.47

Table- 9.1.G5: Implementation strategy of Value Addition: Bamboo Construction

Strategy-7 (5)	Value Addition: Bamboo Construction		
Rationale	<ol style="list-style-type: none"> 1. Bamboo based construction has gained global momentum in developed countries which has reached new heights of technological advancement. 2. The positive strength-weight ratio of bamboo also supports its use as a highly resilient material against forces created by high velocity winds and earthquakes. 3. In India construction sector is the major area of bamboo consumption, however it is limited to scaffolding and low cost housing. 		
Action Points	<ol style="list-style-type: none"> 1) Need of primary treatment and grading facility & Multi-supply chain 2) Initiate research project with Central Building Research Institute for testing and standardization and test methods of bamboo. 3) Development of guidelines and frameworks for building bamboo structures by the Central Building Research Institute (CBRI). 4) Skill building in age-grading and preservative treatment 5) Farmer level aggregated Bamboo depots; Warehouses for age-graded and treated Bamboo storage; State of the art machinery for engineered Bamboo manufacturing. 6) FSC Certification, Streamlining of production through expert engagement 7) Inclusion of bamboo in the State Schedule of Rates (SSR) of construction; 8) Financial incentives for existing private stakeholders in the Bamboo industry 9) Development of Standards and testing methods 10) Display of bamboo based construction at prominent locations which can generate public awareness 11) Integrate bamboo based construction with tourism 12) Creation of parallel construction industry 13) Development of fire retardant technology 		
Methodology	<ol style="list-style-type: none"> 1) Selection of FPO/FPC and Entrepreneur for setting up primary treatment unit. 2) Policy advocacy to include bamboo in PWS SORs. 3) Policy advocacy 4) Setting up of primary treatment unit 		
Coverage of the States	All the 8 states of NER		
Implementing Agencies	Entrepreneur/FPO/FPC		
Time Lines	5 year		
Physical Target	18 nos. of primary treatment and grading unit		
Resource Requirement	Primary Treatment and Grading Unit	18 no. @ 15.5 Lakh	2.79 Cr
	Research Project Funding for CBRI, IWST, FRI		10 Cr
	Total		12.79 Cr
Convergence/Synergy	National Bamboo Mission		

NOTE:

1. Existing Scenario

Bamboo has a long and well-established tradition for being used as a construction material throughout the tropical and sub-tropical regions of the world. The high tensile strength of Bamboo and its capacity to withstand up to 3656 kg/cm² of pressure make it an ideal material to be used in the construction industry. The positive strength-weight ratio of bamboo also supports its use as a highly resilient material against forces created by high velocity winds and earthquakes. Bamboo can be worked upon by simple tools and machines and if properly treated components made by bamboo can have a reasonable life of 30 to 50 years. Besides, unlike iron and steel Bamboo does not rust in the damp tropical climate.

Besides, Bamboo is the most environment friendly plant on this planet, being one of the highest carbon sequesters amongst all the floral species. Bamboo also requires lower emissions intensive processes to create components for the construction industry. Bamboo requires 1/3rd of energy compared to timber, 1/8th of energy compared to cement and 1/50th of energy for processing equivalent mild steel. At the end of a bamboo component's life cycle, it can be recycled, repurposed, or burned to produce heat or electricity. Thus, compared to other materials, bamboo products can have a low or even negative eco-cost over the course of their lifecycle.

Last but not the least, Bamboo is a perennial 'renewable' agro-forestry resource. It grows fast, matures within a few years and re-grows after harvesting without the need for replanting. A 60-hectare bamboo plantation would yield enough material build 1000 bamboo houses annually whereas it would require 500 hectares of forest cover if the houses were to use timber instead. With a 10-30% annual increase in biomass versus 2 to 5% for trees, bamboo creates greater yields of raw material for use. It can be harvested in 3- 5 years versus 10-20 years for most softwood. Bamboo generates an annual crop with one clump of Bamboo can yielding 100 poles within three to five years.

Research & Development undertaken by the Bamboo sector over the past few decades has established and adequately demonstrated that Bamboo could be a viable substitute of wood and other traditional material like steel and cement, for the housing and building construction and other infrastructure sectors. Thus, Bamboo can be an important part of low-carbon lifestyles, especially in the construction sector.

2. Present Status, Gaps & Challenges for use of bamboo in the construction sector:

Understanding Bamboo as a material- Non-renewable natural raw materials like steel, wood, iron etc. have a legacy of over a century or two as preferred raw material in the construction industry. Huge investments in research and development have been made globally to mould these raw materials to the requirements of the construction industry while the construction industry has also innovated to optimally harness the strength of these materials. Policy has also played a crucial role in this exercise.

As practice on the field has highlighted, the specific technical properties of Bamboo, as different from traditional raw material like wood and steel, have to be taken into consideration to optimally

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

harness Bamboo as a universally applicable construction material. The key dimensions to be taken into account are Durability, Flammability, Jointing, Design and Codification of Bamboo.

Structural strength and durability: Action is being taken in many countries to elevate bamboo technically to a level for it to qualify as a sufficiently durable and structurally safe material for construction for the building sector and for bamboo buildings to become bankable assets

Jointing Systems: Owing to its round shape, jointing is very difficult and cumbersome in bamboo. The reduction of diameter along the length is another limiting factor. Various types of engineered and tested jointing systems with appropriate materials being developed for effective structural load distribution and transfer. Studies in many countries have been done relating suitability of joints and their mechanical behaviour along with researchers related to connection types with complete structural systems.

Conical form of bamboo: Bamboo reduces in diameter and weight along its length. With an approximately hollow circular transverse section with varying density in both directions, bamboo is a unique and difficult material to design with. Digital Image Analysis (DIA) is a reliable tool to derive appropriate equations to map fibre distribution in sections of bamboo. This can help an architect or engineer to calculate the modulus of elasticity of bamboo with fair degree of accuracy.

Splitting Behaviour of bamboo: The most common failure is the splitting of bamboo across its length. These failures are usually due to tension, compression and flexure loads in bolted connections and also from drying. It is a technical and practical necessity and needs to be fully addressed. We need to formulate simple mathematical equations involving fundamental properties of bamboo which can be used for designing complex structures with bamboo with the same confidence as for other materials.

Crack control: Bamboo has a round cross section, often with a variable internal and external diameter. This complicates the execution of joints between different poles since multiple drillings and tightening of bolts may be mismatched and may cause cracks in the vertical fibres. The heating and bending of bamboo may also cause cracks. It is difficult to avoid these cracks unless the craftsmen working are extremely skilled and experienced. Because bamboo is mostly used in longitudinal stresses, in trusses and columns, often the cracks do not cause any structural disruption unless they are close to the horizontal nodes. It is difficult to ascertain the fatality of cracks since there is no set quality parameter for this and it may differ according to species, and on the function of said bamboo pole in the completed structure.

Flammability: Since bamboo is a kind of timber, the tendency for the structure to catch fire is more. Though, like timber, it behaves "better-than-steel" in conditions of fire, retaining its resistance to forces over a longer period than steel. It is not easy to coat or encase in concrete to provide a fire-proof layer without losing its characteristic elegance. Hollow poles of bamboo also represent a high fire risk. Though the skin of bamboo stems creates silicates that reduce its flammability, this is often sanded off to create a smoother look for interior elements in a building increasing the fire risk. In exterior elements, the possibility of fire coatings and treatments leaching out of the material is real. Fire prone-ness becomes even more critical in case of multi-storey and high-rise buildings. There is

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

no standard practice to increase the fire safety in buildings. In this context, the multi-storey timber code in Canada (that accepts buildings up to six storeys high) can be adapted to bamboo structures. Worldwide different practices such as filling the cavities with concrete, adding a panelling or plastering over bamboo elements are adopted to retard fire. The boron and boric acid treatments done on bamboo to increase the pest resistance also provide an added advantage as fire retardants. Recently, various proprietary fire-resistant coating materials have been tried out on lightly sanded bamboo poles and provided good results. Although, local artisans from the North-East region have been involved in bamboo craftsmanship for generations, several constraints limit the rural communities from gaining from existing and growing market demand for eco-friendly bamboo construction.

3. Constraints in the Current Bamboo Based Livelihood Mechanism in the North-east

Forest Management: Lack of effective and sustainable management of bamboo resources. Absence of proper harvesting and age grading and location classification of culms/poles to enable standardization and commoditization.

Policy: Absence of appropriate pro-people government policies or apathy for proper implementation by the machinery or absence of required institutional linkages. Regulatory and policy constraints, including lack of conversion of policy opportunities for market development and price support.

Research and Development: Lack of appropriate technology, tools and machinery adaptation and development, Infrastructure.

Limited or no access to basic infrastructure: Absence of sufficient treatment facilities and lack of production of quality dimensioned intermediary commoditized construction components to ensure quality bamboo-based building construction, so that reproducibility and replaceability is possible and construction components are standardized. Inadequate production systems which result in an inability to produce in volume with quality.

Skilling: No enabling and dependable institutional arrangements that deliver community services and technical support locally.

Credit: Lack of community-friendly working and risk/venture capital finance and marketing support (including product design)

Market: Inequitable supply chains linking rural producers to their markets, causing low value share realization and poor product quality

Culture: Extremely low risk-taking capacities of the local artisans to innovate on the traditional product ranges despite the demand in an upper end market in other parts of country

Social acceptability: Experts from the industry indicate that whole bamboo has failed to live up to the social urban image. This can be dealt with by modern bamboo construction and aesthetical architectural design using global innovations and best practices. Cost reduction by using prefabricated components, increasing the speed of construction, availability of finance and insurance facilities will go a long way in social acceptance of bamboo buildings.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

In summary, the informal nature of the bamboo sector in the North-East region could do much better if it was to be organized with backward and forward linkages while being integrated into the entire value chain.

4. The Best Practices

Indonesia - Contemporary technologies –

While bamboo has been used for making houses and sheds for centuries, recent advancements in bamboo based construction in Indonesia has allowed for a leap in architectural possibilities using bamboo. With the right kind of treatments, the right thickness of bamboo poles, complex joints made employing fiberglass and metals, bending technologies, and complex 3D-modeling using computers, large span and multi-story structures successfully created using bamboo as construction material in Indonesia in last two decades.

Bamboo based modern buildings can be observed across the world today from South America to Southeast Asia. The method of design and construction adopted in each part of the world is unique, using locally available species, deriving from the local traditions and available technologies while being inspired by best practices around the world. Many case studies can be observed today where large span structures are built using bamboo poles that are bunched to create columns and frames for arches, vaults, domes etc. There have been experiments in low rise multi-storey structures in bamboo as well, with some remarkable examples in Bali.

Organic Shaped Bamboo Buildings –

Bamboo as a building material is not constantly used in constructing organic shaped building. The reference shape of bamboo building mostly comes from wooden buildings which are generally constructed using a simple frame structure. Therefore, the builders tend to construct bamboo in a frame structure thus becoming a box, static and, considered as boring, simple form building. However, scholars, architects and builders are conducting studies, research and exploring use of bamboo as building material. As a result, the evolution of building shape and form of building with has become more dynamic, moving and flowing. The strength and internal property of bamboo are studied. Bamboo is pushed to the limit to find what bamboo can do in building, what shape and form can be develop using bamboo, and what the suitable system is needed to design a unique bamboo building. The Green School located in Bali, Indonesia, is a school building built using bamboo as the main structural material. Initiated by John Hardy, the school building complex won the Aga Khan award in 2010. The school building is located in Bali, Indonesia. Designed in 2006 and completed in 2007, the Green School is considered as the originator of bamboo revival in Indonesia. The Green School building design has been through various stages of exploration in building forms, structural systems and construction processes. The award raised awareness of Bamboo as a material of construction with the design being discussed by experts and lay people. Various buildings using bamboo as a building material were designed and built. If at first bamboo was used in a simple frame structure, nowadays bamboo is pushed to the limit and other structural systems are proposed. OBI Great Hall which is located in Jatiluhur, West Java province, Indonesia, is known as one of the phenomenal buildings using bamboo. Designed by Andry Widjowijatnoko,

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

OBI Great Hall is an example of wide span building structure using bamboo. The oval shape plan is covered by a combination of dome and hyper shaped roof. The opening at the roof top creates a stunning and striking skylight.

Along with the increasing popularity of bamboo among the general public, the use of bamboo as a building material began to be implemented in commercial buildings such as exclusive yet expensive resort hotels and restaurants. Bamboe Koening, a (yellow bamboo) restaurant in Lodtunduh, Bali recently received an award from FuturArc for using local material and workers. Designed by young architect, Effan Adhiwira, the restaurant has a circular plan with a circular stage at the center of the restaurant that allows for the performance of a Balinese traditional dance on the stage. Its roof also has a circular and dynamic shape making the building look like a serpent.

Another organic shaped bamboo building, also designed by Effan Adhiwira, is a community building for a community development project in Poso, Central Sulawesi (Celebes) province, Indonesia, namely as Dodoha Mosintuwu. This unique building is built on land that is flooded every rainy season thus the construction process was conducted during the dry season. It has a dynamic and twisting roof shape combination of synclastic and anticlastic curvature. The synclastic curvature roof shape serves as an envelope for the multipurpose hall while the anticlastic curvature roof shape covers the day-to-day activities space, such as the office and library.

5. Detailed Action Point:

The price for Bamboo components in the construction industry is about 50% higher than that of timber. There is immense scope for the bamboo industry to enter this market and take a slice of this big pie provided we could match prices with timber components. But it is also important that the Bamboo industry follows a holistic approach and addresses both the backward and forward linkages across the supply chain and enters the construction industry market as a professional player. This involves making investments in all the aspects of the Bamboo construction industry as mentioned below-

Forestry: Identification of species of Bamboo having high commercial value for components for construction industry; Forest Management Framework marking out responsibilities of each stakeholder.

Agriculture: Propagation through better planting material like tissue culture to ensure standardised high-quality planting material, raising good quality planting material in nursery

Skill Building: Training farmers in scientific nursery management, cultivation, plantation management and harvesting; Skill building in age-grading and preservative treatment; Skill-gap mapping of artisans, Skill building in making components for the construction industry; Skill building for Bamboo structures construction; Capacity building of PWD and other related government agencies teams, procurement, consulting and implementation teams on technical properties of Bamboo.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Infrastructure: Bamboo treatment plants; Farmer level aggregated Bamboo depots; Warehouses for age-graded and treated Bamboo storage; State of the art machinery for engineered Bamboo manufacturing.

Supply Chain Management: Information repositories should be created and mechanisms to facilitate dissemination of this information should be put in place. This will include information on existing Bamboo plantations disaggregated by species giving volume and age, treatment Depots, age graded and treated Bamboo warehouses, construction components production centre, marketing channels

Product Development

Design: Design inputs are essential to help traditional and non-traditional bamboo construction artisans to connect with viable markets through focused value- added applications. Design is a very important stage, as it orchestrates the entire production-to-consumption system (PCS), and thereby determine the sustainability of bamboo products, construction components and systems. Regular design inputs should be given to producer groups at different levels, from micro-enterprises to industries, by expert design consultants and reputed design institutes.

Production Streamlining: Optimal productivity, production quality and production efficiency should be facilitated through inputs given to producer groups at different levels, from micro-enterprises to industries, by expert consultants and reputed institutions. Production streamlining and productivity inputs should be given to producer groups at different levels, from microenterprises to industries.

Sustainable Consumption & Production: Cleaner production and technology should be facilitated by cleaning up existing production chains. Towards this, process chains of different bamboo technologies need to be studied and changes should be introduced to clean them up, based on inputs from sustainability and technology experts.

Certification: Bamboo products should be certified through FSC certification, for the sustainable management of the resource, process, system, chain of custody. High- quality treated bamboo should be used for production, which should be available from treatment plants in CFCs.

Quality Control: Appointment of expert technical agency to monitor process and ensure quality

Policy: Modern bamboo construction demonstration projects, state level- different departments; Develop proper specification, quality control and costing of construction components; Inclusion in the State Schedule of Rates (SSR); Financial incentives for existing private stakeholders in the Bamboo industry; Creation of a policy ecosystem that will encourage high-value private; investment in the Bamboo industry in the country, especially for the engineered Bamboo manufacturing.

Marketing

Awareness raising: Institute a policy for massive and consistent awareness about bamboo as an eco-friendly timber-replacement material. Necessary mechanisms to actualize this, including seminars, workshops, training programmes, Road Shows should be planned and operationalized.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Marketing Platform: Entrepreneurs producing Bamboo components for the Bamboo industry, including those involved in Bamboo plantation & harvesting, treatment & grading as well component making should be provided with marketing platforms at the level of urban centres and districts, especially at real-estate and other housing industry exhibitions. Bamboo Components for Construction Haats should be organised in metro cities every year to provide artisans and entrepreneurs a platform for showcasing and marketing their products and interacting with experts.

Branding A branding programme for bamboo products needs to be put in place. This would include a holistic sustainability labelling scheme and communication through a specific NE bamboo brand, in line with existing sustainability branding schemes such as UNIDO's holistic sustainability label.

6. Specific Points suggested for central, state, expert agencies and private sector: Considering the huge scale of future building works in India, effective application of Bamboo as a green building material will make significant contributions to the promotion of sustainable construction. It is very important to understand the barriers that prevent bamboo from being used in this huge building sector. Without proper understanding of these barriers, application of bamboo in India will remain limited, the value of green nature embodied in bamboo materials will be virtually wasted, and the potential of using bamboo for promoting sustainable construction will be overlooked. Therefore, it is essential to examine these barriers. Based on which proper measures can be taken to address these barriers, the effective application of bamboo can be promoted effectively.

i. Policy Changes for to Promote Bamboo as Material of Construction: The Central government and states should take the initiative and begin using Bamboo construction for its structures. A good example is that of the Government of Maharashtra commissioning construction of over 100,00,000 square feet of Bamboo construction with the investment of about 50 Cr. for the Bamboo Research and Training Centre (BRTC). This project is being executed by KONBAC in partnership with Jans Bamboo and the state Public Works Department (PWD). Based on the positive experience of working successfully with Bamboo, PWD has included rates for modern Bamboo construction items in the State Schedule of Rates (SSR).

ii. Need for Standards and testing methods: Due to global warming, increasing focus is now being placed on the standardization of green and sustainable building materials like bamboo. Standardization of bamboo as a construction material will serve both technical and social purposes. It will give a more reliable understanding of the material's properties which can lead to refinement and confidence in design values, leading to acceptance of the material in the design community. Such acceptance, coupled with advocacy, can lead to broader social acceptance of previously marginalized vernacular construction material and technologies like Bamboo.

iii. Field Testing: An important consideration in development of standard test methods should be the ease to conduct them reliably in a field setting with minimum equipment and specialized machinery. This would allow material properties to be assessed by non-technical personnel. Also, the field test must produce a useful data that can- directly determine design values; get

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

correlated to values obtained in a laboratory test; or be accurately used to compare different batches of materials.

- iv. Standardization** of bamboo test methods is critical if material is to gain greater engineering acceptance. The focus must be on methods that capture fundamental material properties permit comparison of the behaviour and performance of different bamboo species, their geometry, weathering patterns and the treatment required. Standardized test methods used in well-defined experimental studies also permit the isolation of factors that affect material performance and behaviour. This process represents the path to rational and universal design methods for bamboo. Also testing of bamboo is quite difficult due to a) diversity of bamboo species b) Variations within the same species. So for general usage, economical testing methods could be developed even if they are not as accurate.

The Central Building Research Institute (CBRI) can take the lead in undertaking necessary research work for standardization and associated test methods.

- v. Raising the standards of implementation:** In India, Bamboo had been a well-established building material. But this has drastically changed in last 20 years because the construction of bamboo buildings is generally very poorly implemented most of the time. The implementation of bamboo structures seems to be generally quite poor, with poor planning and design, and specifications being abandoned in favour of other building techniques. We need to form superior guidelines and frameworks for building bamboo structures. The guideline and framework can be developed by the Central Building Research Institute (CBRI).

A multipurpose kit for constructing bamboo structures that includes pre-fabricated connections, tools and instructions etc. can be made available. In this way, we will empower the execution team with basic building skills to become more confident and execute high quality bamboo buildings. For linking the standards with industry, Forest Research Institute, Dehradun can take the lead.

- vi. Strengthen Backward Linkages:** In order to be able to substitute the energy intensive materials on a large scale, parallel activities involving plantation, drying, seasoning and chemical treatment have to be promoted and up-scaled as parallel industries, as backward linkages within an extension of a "focused agro-based employment scheme" for small and marginal farmers. The product would thus be "especially and exclusively treated and graded bamboo for the purpose of building for the urban and rural areas, following the customized design specifications and construction details.

- vii. Creation of a Parallel Construction Industry:** A new segment of alternative building sector is needed to be initiated. A fresh look at the age-old materials and technologies, repackaged to blend with the current socio-cultural environment and the demands of the time, is inevitable. Measures need to be evolved to formulate techno-financial models or system mechanisms which should operationally be able to transform an architecturally designed bamboo house into an easily accessible commodity which can be treated as an asset or an investment, attracting speculations for its value and appreciation. It could be visualized as a material which shall simultaneously create a parallel construction industry, while also being commercially beneficial for the owner. This would encourage investments in bamboo buildings.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

In this context it would be beneficial to review global best practices for alternative technologies, where the Policies have led to an increase in the efficiency in construction and distribution, for the bamboo-building sector. The use of bamboo as building material in organic shaped building has a huge potential because the nature and properties of bamboo are capable of accommodating it. Organic shaped buildings are generally developed using form active structure systems or semi form active systems, although it is also possible to use non-form active structure systems, i.e. trusses. There are several methods that can be done to curve or bend the bamboo into desired shape, such as hot bending method and cold bending method. Beside hot bending and cold bending, curvature shape also can be generated by connected natural curve bamboo. Beside the understanding about the nature and properties of bamboo, the knowledge about structure system and bending method, the knowledge about joinery system is also needed.

Institute of Wood Science and Technology, Bengaluru can lead the research and technology development for thermal treatment of bamboo without use of chemical. For developing Fire Retarding technology, Forest Research Institute, Dehradun can be roped in.

- viii. Selection and Looping:** In order to arrive at a standard package, several looped packages linking limitations, potentials and possibilities, measures, policies and the legislative-techno-financial models are expected to be generated, through experiences, developments, innovative break-through and traditional practices. All of these are inter-dependent factors and only by connecting all these factors appropriately, a reasonably workable package with a comprehensive strategy can be evolved.

7. Use of Bamboo in Foot Over-bridge- an Initiative of the Government of Assam

In February, 2021, the Government of Assam has inaugurated escalator based foot overbridge at Khanapara, Guwahati. The bridge which has extensive bamboo design is located at entrance of the Guwahati city. The bridge at the entrance of Guwahati also signifies the rich bamboo resource of the North Eastern region. Similar initiative can also be taken up by the state government of other NER states to create awareness about high end utilization of bamboo.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1.G5 (i): Resource Requirement for Setting up of Primary Treatment Unit

Fund	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Bamboo Primary Treatment and Grading	4	4	4	4	2	18
Cost	0.62	0.62	0.62	0.62	0.31	2.79

Table- 9.1.G5(ii): State-wise Plan

States		Year 1	Year 2	year 3	Year 4	Year 5	Total
Arunachal Pradesh	Phy (in No.)		1				1
	Fin (in Cr.)		0.155				0.155
Assam	Phy (in No.)	2	1	1	2	1	7
	Fin (in Cr.)	0.31	0.155	0.155	0.31	0.155	1.085
Manipur	Phy (in No.)		1				1
	Fin (in Cr.)		0.155	0	0	0	0.155
Meghalaya	Phy (in No.)	1					1
	Fin (in Cr.)	0.155	0	0	0	0	0.155
Mizoram	Phy (in No.)	1	1				2
	Fin (in Cr.)	0.155	0.155	0	0	0	0.31
Nagaland	Phy (in No.)			1	1		2
	Fin (in Cr.)			0.155	0.155	0	0.31
Sikkim	Phy (in No.)			1			1
	Fin (in Cr.)			0.155	0	0	0.155
Tripura	Phy (in No.)			1	1	1	3
	Fin (in Cr.)			0.155	0.155	0.155	0.465
Total	Phy (in No.)	4	4	4	4	2	18
	Fin (in Cr.)	0.62	0.62	0.62	0.62	0.31	2.79

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1.G6(a): Implementation strategy of Value Addition: Bamboo Boards and Furniture

Strategy-7 .6 (a)	Value Addition: Bamboo Boards and Furniture
Rationale	<ol style="list-style-type: none"> 1. Can potentially reduce timber import. Currently, India imports Rs. 43000 -45000 crore worth of timber for furniture and other purposes 2. Bamboo grows quickly in a span of 4-6 years; it can be utilized at a quicker rate in creating these products. In contrast, a tree takes 20-30 years to grow 3. More robust and almost non-susceptible to the termite 4. Traditional round bamboo furniture has limited market 5. Flat furniture has bigger market
Action Points	<ol style="list-style-type: none"> 1. Main focus should be Scrimber based products. 2. Govt. Offices may make mandatory procurement 3. Discussion with online players such as Pepperfry who does not have policy for bamboo furniture procurement 4. Capacity building of entrepreneurs for procurement policy of other large scale enterprise such as IKEA. 5. Training and capacity building for operating the machines 6. Constant design improvement through NIDs 7. Use of certified raw material
Methodology	<ol style="list-style-type: none"> 1. Selection Entrepreneur for setting up primary treatment unit 2. Focus on market oriented product 3. Design intervention
Coverage of the States	Assam, Arunachal Pradesh, Meghalaya, Mizoram, Nagaland,
Implementing Agencies	Entrepreneur
Time Lines	5 year
Physical Target	5 nos. of Bamboo Boards and Furniture units
Resource Requirement	Rs. 125 Crore (Details given in Notes Below)
Convergence/Synergy	National Bamboo Mission

NOTE:

1. Existing Scenario

Till now most of the skill training programs in creating furniture from bamboo are round bamboo oriented. However, the demand of such furniture is limited. Bamboo boards and beams etc. can be polished better than teak and have excellent density and tensile strength. It is high in demand while the supply is less. Its cost is comparable to hard timber at present, but with the increase in production and 10 % bamboo waste utilization the cost is expected to go down.

Slowly, companies are looking into bamboo boards to make furniture and other related items. Mutha Industries, located in Tripura, and ESES Bio Wealth Private Limited, Jagiroad, Assam are only such industries that makes bamboo furniture, wall panelling and bamboo flooring under the name of Epitome.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

2. Marketing Tie Up:

For large marketing tie up, the entrepreneurs of the NER has been challenging few critical issues. For instances- large scale buyer such as Pepperfry does not have the policy of bamboo furniture procurement yet. Similarly, the cost of fulfilling the I-Standard procurement norms of IKEA costs is also high for small entrepreneurs. Further, due to the nature of labour intensiveness product and less of machinery, the credit worthiness of the bamboo furniture units is still considered to be low. In such scenario, they face challenge in terms of working capital required for adhering to the procurement norms of large scale private companies.

3. Table- 9.1.G6 (a)(i): Financial Resource Requirement:

Units	No.	Cost/Unit in Lakh	AP	Assam	Meghalaya	Mizoram	Nagaland	Total in Rs. Lakh
Bamboo boards and furniture	5	2500	1	1	1	1	1	12500

Table- 9.1.G6 (a)(ii): State wise & Year wise Planning of Financial Resource Requirement

States		year 1	year 2	year 3	year 4	year 5	Total
Arunachal Pradesh	Phy (in No.)		1				1
	Fin (in Cr.)		25				25
Assam	Phy (in No.)	1					1
	Fin (in Cr.)	25					25
Meghalaya	Phy (in No.)		1				1
	Fin (in Cr.)		25				25
Mizoram	Phy (in No.)			1			1
	Fin (in Cr.)			25			25
Nagaland	Phy (in No.)			1			1
	Fin (in Cr.)			25			25
Total	Phy (in No.)	1	2	2			5
	Fin (in Cr.)	25	50	50			125

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1.G6 (b): Implementation strategy of Value Addition: Industrialized Craft/Utility Products & Bioplastics

Strategy-7.6 (b)	Value Addition: Industrialized Craft/Utility Products & Bioplastics
Rationale	<ol style="list-style-type: none"> 1. Bio Plastics can be solution to waste reduction 2. Semi-Mechanization is needed at cluster level for uniform raw material and volume. 3. Products with more daily utility can create more employment opportunity and revenue for the farmers.
Action Points	Establish- <ol style="list-style-type: none"> 1. Bio-plastic unit 2. Lifestyle product unit 3. Round pole unit 4. Toothbrush unit 5. Packaging unit 6. Home and utility unit
Methodology	<ol style="list-style-type: none"> 1. Focus on market oriented product 2. Promote NER brand of toothbrush and tie up with Bamboo India 3. Design intervention 4. Integration of handicraft with other crafts to create more value added products 5. Expedite R&D project under Indian Institute of Packaging for developing bamboo crates 6. Strategic production targeting national level festivals such as Diwali, Rakhi etc for craft products 7. Semi-Mechanization at craft clusters and improved tools 8. Form Guidance Group of Prominent Artistes 9. Identification of companies that are creating products using bamboo pulp and tie up 10. Utilize Bamboo Technology Park
Coverage of the States	All states of NER
Implementing Agencies	Entrepreneur
Time Lines	5 years
Physical Target	Mentioned in Note below
Resource Requirement	Rs. 13.43 Crore (Details given in Notes Below)
Convergence/Synergy	National Bamboo Mission

NOTE:

1. Bamboo Toothbrush

One of the most exciting and ecologically viable efforts is the profitable use of bamboo through value addition in this new field. Indian company like Bamboo India or Sweden Company like The Humble co. are strong players in this sub-sector. This venture also has an ecological viewpoint. Using bamboo toothbrush will reduce the consumption of plastic toothbrushes which is the second highest polluting agent amongst plastic products and thus will reduce plastic consumption, benefitting the environment. In India, this could be one of the best avenues to reach the masses

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

with a better version of the bamboo toothbrushes. The sheer volume of the Indian Market can push the teeth brushing to new horizons.

The success story of Bamboo India, the largest bamboo toothbrush making enterprise of India is worth mentioning. Within 5 years of its establishment, the company has set up India's largest bamboo tooth brush manufacturing unit at Pune, with capacity of 10 Lakhs tooth brush handles per month. It has signed agreement to supply to the largest tooth brush manufacturer of the world. In terms of competitiveness, the price has been reduced from Rs. 180 in the year 2016 to Rs. 50 in 2020. During interaction with the promoter of the enterprise, Mr. Yogesh Shinde, it was informed that currently he is procuring raw material from Assam and Meghalaya.

Establishing a North East Bamboo Tooth Brush Brand: The potential of developing a Brand North East for bamboo product, especially for tooth brush can be taken up. Companies like Bamboo India is willing to set up their unit in North East and provide market linkage. Brief proposal received from the company is mentioned below-

- Strip Making Plants - 2 (Assam & Shillong)
- Handle Making Plants - 1 (Guwahati)
- Brush Making Plant - 1 (Guwahati)

The required investment for the above proposal is Rs. 5 Cr. The unit will be able to manufacture 10,00,000 Bamboo Toothbrush per month, create 100 numbers of Direct employment and impact the lives of more than 500 numbers. The Company further proposed a brand of North East Bamboo based tooth brush under the brand name "Rhino".

2. Disposable Bamboo Cutlery

Another area, which could be very much profitable, is disposable Bamboo forks, spoons and stirrers. These items have a significant market ranging from high-end cafe and restaurants to marriages and other ceremonies. As this is a highly consumable item, once the market comes up, there will be no looking back. Already, these items are getting upmarket acceptability in major cities. With States like Maharashtra and others banning single-use plastic item, these items provide a very viable alternative. With the increasing demand, these bamboo items have a great future.

3. Bamboo Pulp and Bamboo Plastic

Various products can be developed through the bamboo pulp. Products such as tiffin, bottles, food packaging, etc., can be developed through the bamboo pulp. Bamboo pulp is strong and can be used in other applications as well. The bamboo pulp can be bleached and then be used to manufacture offset paper, typing paper and high-grade culture paper. The unbleached bamboo paper can be applied to package papermaking. Besides, the bamboo pulp can be mixed with wood pulp to make cable paper, insulation paper, and cement paper bag.

Bamboo plastic composite (BPC) is a composite material. BPC is an environmentally friendly bamboo and plastic mix (or composite) that contains bamboo fibres along with plastic granules. The machines required are- (i) bamboo pulverized dust/powder from the Bamboo -waste from the

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

bamboo factories and plastic granules mixing Pelletizer machine line and (ii) extruder machine with final embossing line.

The bamboo waste from the manufacturing units can be of great use in this regard, and this derivative product will help in reducing the cost of the bamboo products. It needs to be supported and properly handled to enable a sort of bamboo plastic environment. That will not only help in meeting the challenges but can show a way of utilizing the bamboo waste where the bamboo composite plastic made from it can be the answer to the bamboo trade challenges. It will also add tremendously to the farmer's income and support the cause of the environment.

In view of this, those bamboo sub-species that have not fallen into the "commercially viable" category of RNBM can be put in that category with the advent of Bamboo Composite Plastic and such innovative products. In fact, this could be very important insofar as the bamboo regime is concerned. This could spearhead the bamboo campaign globally, and the added environmental benefits with rural and the tribal tinge would make it an instant hit in the western world.

4. Bamboo as Packaging Material

Indian Institute of Packaging (IIP) is already looking into the scope of bamboo to be used as packaging material. Bamboo can be an alternative to wood based packaging material which are being used for transportation of fruits and vegetables. The crates and pallets used in shopping centres and various other places which is made of plastic can also be replaced by Bamboo. Proper quality analysis, structural requirement and other detailing should be worked on and should be initiated as this is a very viable option. Here the bamboo would have to compete with the plastics, and that would not be easy. The strategy in this regard can be to go for Bamboo Plastics composite molded crates and furniture that would reduce the use of plastics by 50%. Bamboo Plastics Composite (BPC) is a composite material. BPC is a bamboo and plastics mix or composite that contains the bamboo fibres and plastic granules. It involves a simple mechanical and chemical process. In fact, bamboo waste, including bamboo dust or powder, can also be used in making Bamboo Plastic Composite. For manufacturing the same, the Assam Bamboo Technological Park can take the responsibility.

Table- 9.1.G6 (b) (i): Summary of Financial Requirement

Units	No.	Cost/Unit in Lakh	AP	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura	Total in Rs. Lakh
Bamboo Bio-plastic	8	10.25	1	1	1	1	1	1	1	1	82.00
Bamboo Lifestyle Products	14	5.75	1	5	1	1	1	1	1	3	80.50
Bamboo Round Pole	8	5.75	1	2	1	1	0	1	0	2	46.00
Bamboo Toothbrush	2	500.00	0	1	0	1	0	0	0	0	1000.00
Bamboo Packaging	1	25.75	0	1	0	0	0	0	0	0	25.75

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Units	No.	Cost/Unit in Lakh	AP	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura	Total in Rs. Lakh
Bamboo Home and Kitchen Utility	7	15.50	1	1	1	1	1	1	1	0	108.50
	40		4	11	4	5	3	4	3	6	1342.75

5. Table- 9.1.G6 (b) (ii): State wise & Year wise planning of Bioplastic

Bioplastic		Year 1	Year 2	Year 3	Year 4	Year 5	Total
Arunachal Pradesh	Phy (in No.)				1		1
	Fin (in Cr.)				0.1025		0.1025
Assam	Phy (in No.)	1					1
	Fin (in Cr.)	0.1025					0.1025
Manipur	Phy (in No.)		1				1
	Fin (in Cr.)		0.1025				0.1025
Meghalaya	Phy (in No.)		1				1
	Fin (in Cr.)		0.1025				0.1025
Mizoram	Phy (in No.)			1			1
	Fin (in Cr.)			0.1025			0.1025
Nagaland	Phy (in No.)					1	1
	Fin (in Cr.)					0.1025	0.1025
Sikkim	Phy (in No.)			1			1
	Fin (in Cr.)			0.1025			0.1025
Tripura	Phy (in No.)				1		1
	Fin (in Cr.)				0.1025		0.1025
Total	Phy (in No.)	1	2	2	2	1	8
	Fin (in Cr.)	0.1025	0.2050	0.2050	0.2050	0.1025	0.82

Table- 9.1.G6 (b) (iii): State wise & Year wise planning of Lifestyle Product

Lifestyle Product		Year 1	Year 2	Year 3	Year 4	Year 5	Total
Arunachal Pradesh	Phy (in No.)				1		1
	Fin (in Cr.)				0.0575		0.0575
Assam	Phy (in No.)	1	1	1	1	1	5
	Fin (in Cr.)	0.0575	0.0575	0.0575	0.0575	0.0575	0.2875
Manipur	Phy (in No.)	1					1
	Fin (in Cr.)	0.0575					0.0575
Meghalaya	Phy (in No.)		1				1
	Fin (in Cr.)		0.0575				0.0575
Mizoram	Phy (in No.)			1			1
	Fin (in Cr.)			0.0575			0.0575
Nagaland	Phy (in No.)					1	1
	Fin (in Cr.)					0.0575	0.0575
Sikkim	Phy (in No.)		1				1
	Fin (in Cr.)		0.0575				0.0575
Tripura	Phy (in No.)			1	1	1	3
	Fin (in Cr.)			0.0575	0.0575	0.0575	0.1725
Total	Phy (in No.)	2	3	3	3	3	14
	Fin (in Cr.)	0.1150	0.1725	0.1725	0.1725	0.1725	0.8050

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1.G6 (b) (iv): State wise & Year wise planning of Round Pole

Round Pole		Year 1	Year 2	Year 3	Year 4	Year 5	Total
Arunachal Pradesh	Phy (in No.)	1					1
	Fin (in Cr.)	0.0575					0.0575
Assam	Phy (in No.)	1	1				2
	Fin (in Cr.)	0.0575	0.0575				0.115
Manipur	Phy (in No.)				1		1
	Fin (in Cr.)				0.0575		0.0575
Meghalaya	Phy (in No.)		1				1
	Fin (in Cr.)		0.0575				0.0575
Mizoram	Phy (in No.)						0
	Fin (in Cr.)						0
Nagaland	Phy (in No.)			1			1
	Fin (in Cr.)			0.0575			0.0575
Sikkim	Phy (in No.)						0
	Fin (in Cr.)						0
Tripura	Phy (in No.)			1	1		2
	Fin (in Cr.)			0.0575	0.0575		0.115
Total	Phy (in No.)	2	2	2	2		8
	Fin (in Cr.)	0.115	0.115	0.115	0.115		0.46

Table- 9.1.G6 (b) (v): State wise & Year wise planning of Home & Kitchen utility

Home & Kitchen utility		Year 1	Year 2	Year 3	Year 4	Year 5	Total
AP	Phy (in No.)		1				1
	Fin (in Cr.)		0.155				0.155
Assam	Phy (in No.)		1				1
	Fin (in Cr.)		0.155				0.155
Manipur	Phy (in No.)			1			1
	Fin (in Cr.)			0.155			0.155
Meghalaya	Phy (in No.)			1			1
	Fin (in Cr.)			0.155			0.155
Mizoram	Phy (in No.)				1		1
	Fin (in Cr.)				0.155		0.155
Nagaland	Phy (in No.)				1		1
	Fin (in Cr.)				0.155		0.155
Sikkim	Phy (in No.)					1	1
	Fin (in Cr.)					0.155	0.155
Tripura	Phy (in No.)						
	Fin (in Cr.)						
Total	Phy (in No.)		2	2	2	1	7
	Fin (in Cr.)		0.31	0.31	0.31	0.155	1.085

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1.G6 (b) (vi): State wise & Year wise planning of Toothbrush

Toothbrush		Year 1	Year 2	Total
Assam	Phy (in No.)	1		1
	Fin (in Cr.)	5		5
Meghalaya	Phy (in No.)		1	1
	Fin (in Cr.)		5	5
Total	Phy (in No.)	1	1	2
	Fin (in Cr.)	5	5	10

Packaging		Year 1	Year 2	Total
Assam	Phy (in No.)		1	1
	Fin (in Cr.)		0.2575	0.2575

Table- 9.1.G6 (c): Implementation strategy of Value Addition: Improved Traditional Craft through Cluster Approach

Strategy-7.6 (c)	Value Addition: Improved Traditional Craft through Cluster Approach
Rationale	<ol style="list-style-type: none"> 1. Every 14th person in the north-eastern region is dependent on handloom and handicraft products for a livelihood 2. Nearly 80% of income for the artisan comes from the handloom and handicraft sector 3. The difference between average price earned by the artisan and that at which the product is being sold in the local market is more than 35%. 4. The second most important economic activity in these hill states after agriculture is handloom and handicrafts. 5. The extent of value addition as percentage of prices earned by the artisan is around 32%. (only one-third is the artisan earning, nearly two-third is the sum total of expenses and overheads distributed between middlemen, transport, marketing, display and promotion, etc. 6. The craft clusters significant amount of unutilized waste huge reduces the cost competitiveness.
Action Points	<ol style="list-style-type: none"> 1. To take up bottom-up approach for selection of craft cluster instead of top-down approach. 2. Select craft clusters which are not just producing decorative items but also include those which are producing utility items at large scale. 3. Select at least two product categories per NER state based upon inherent traditional skill available amongst the artisans. 4. Select to clusters per state 5. Select product categories which brings diversity across product range. 6. Offer intervention which reduces efforts of artisans, reduces physical stress, increases productivity, creates standardized products, facilitates bulk production 7. Develop entrepreneur linked craft clusters 8. Develop dedicated grass root level force for marketing and logistics
Methodology	<ol style="list-style-type: none"> 1. Undertake scoping study to identify craft clusters. 2. Identify need of the cluster 3. Assessment of strength and weakness in terms of traditional skills 4. Selection of product categories and product range 5. Design development 6. Training of grass root level artisans 7. Training of dedicated group of youth for marketing and logistics management 8. Branding and market testing 9. Develop productivity enhancing tools 10. Develop raw material bank wherever required 11. Reduce wastage and develop by-products for additional income
Coverage of the States	All states of NER
Implementing Agencies	<ol style="list-style-type: none"> 1. Design Development Agency such as NID, NIFT, Department of Design IIT Guwahati 2. Marketing Agency such as North East Handicraft and Handloom Development Corporation Ltd (NEHHDC), North East Society for Handicraft Incubation and Livelihood Promotion (NE-SHILP) 3. Capacity building agency such as North East Cane and Bamboo Development Council (NECBDC), Indian Institute of Entrepreneurship

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

	(IIE), Meghalaya Institute of Entrepreneurship (MIE)
Time Lines	5 year
Physical Target	16 nos. of craft clusters in total 8 states of NER
Resource Requirement	Rs.12.43 Crore (Details given in Notes Below)
Convergence/Synergy	Scheme of Fund for Regeneration of Traditional Industries (SFURTI) / Ambedkar Hastashilp Vikas Yojna (AHVY)

NOTES

1. Status of Craft clusters in NER

Table- 9.1.G6 (c) (i): Distribution of handicraft clusters in NER is shown below-

State	Districts where Cluster exists	No. of clusters	Districts covered
Arunachal Pradesh	8	9	8
Assam	21	26	21
Manipur	9	22	9
Meghalaya	4	11	3
Mizoram	3	4	3
Nagaland	8	17	7
Tripura	4	61	4

2. Success Story of Clusters Intervention

Syntein Craft cluster at Mawsynram

The Syntein Craft cluster of Mawsynram, Meghalaya consists of 5 nos. of villages which are popular for the basketry skill of the artisans. The cluster mainly uses Shken bamboo (Bamboosa Jaintiana) as raw material. In the year 2015, Directorate of Commerce and Industries, Govt. of Meghalaya in partnership with Department of Design undertook a project of cluster development under the title SHKEN.IN. The project duration was for 18 months, which was led by Prof. Avinash Shende and Prof. Ravi Mokashi Punekar of Department of Design, IIT Guwahati and Prof. Mandar Rane of IDC, IIT Bombay. The project mainly provided intervention in two domains- first- intervention in the novel design and secondly, development of a new range of utilitarian bamboo products after a study of the high market demand for handcraft bamboo products amongst urban consumers. The design interventions followed the model of "Restrained Technology Intervention" which enhanced productivity and quality standards, while retaining the traditional skill sets of the artisan community. The project also developed comprehensive community development plan which included skill assessment, training for productivity enhancement. Branding and marketing exercise was undertaken to employ the local youths. Market testing was carried out with sample production of the newly designed products to verify their acceptance amongst leading retail-marketing agencies.

The project was successful in terms of capacity building of the artisans. Productivity enhancement training included development of molds, use of hand tools to reduce physical effort, ergonomically suitable work stations etc. The cluster also has common facility centre. However, the cluster is facing challenge in terms of continued market linkage, partially due to Covid-19 induced economic slowdown.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

3. Potential Clusters that can serve Organized Industry

Nongkinrih is the only village of Meghalaya which is catering to the needs of popular archery sports of Meghalaya by making Bamboo arrows and bows. The major product of the cluster is bamboo arrows of various length which are used for both short and long distance sports. Since the arrow making also involves metal craft, therefore the metal crafts such as small utility knives are also prevalent amongst the villagers. While the men are mainly involved in making the body of the arrow, which involves cutting of bamboo, heating and straightening, the women of the villages are involved in fixing the feathers to the arrow by using needle and thread. The artisans have been continuing the craft without any intervention of training and capacity building. There is no common infrastructure presently available. However, every involved household maintains their raw material stock which is normally kept smoked dried. The cluster has been facing challenge in terms of depleting stock. Due to un-scientific harvesting, the stock of bamboo at the vicinity of the village has been gradually depleting. The cluster has good scope of catering to the needs of archery institutes for practice arrows. However, this will require training for finer products with improved ballistics. It has been gathered that some of the Archery players of SAI centres used to procure arrows from the clusters. Presently it is catering only to the local market.

4. Table-9.74: Indicative Products for Intervention

Sl. No.	State	Indicative Product
1	Arunachal Pradesh	Cutlery, cap
2	Assam	Furniture, Dining and Kitchenware
3	Manipur	Furniture
4	Meghalaya	Basket, Arrow
5	Mizoram	Hanger, Cap
6	Nagaland	Cutlery, Small Gift Items in the form of Accessories
7	Sikkim	Lamps
8	Tripura	Water Bottle, Mat based decorative items

5. Table- 9.1.G6 (c) (ii): Indicative Cost per cluster (for duration of 24 months)-

Sl. No.	Particulars	Amount (Rs. In Lakhs)
1	Common Service Centre	50.00
2	Accessories, Lighting unit, work-shed for individual beneficiary	70.00
3	Skill Upgradation in technical, managerial areas and IT	35.00
4	Designer cum marketing executive	15.00
5	Project Management Cost	15.00
6	Corpus Fund for Marketing	5.00
7	Product Development, documentation	10.00
	Total	200.00

The cost components are kept in line with provisions of Ambedkar Hastashilp Vikas Yojna (AHVY). However, for taking up a bottom up approach, the cost components also need to have provision of the following-

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

1. Scoping Study
2. Awareness Programme
3. Infrastructure for waste utilization
4. Brand building
5. Market development and product testing
6. Training of cluster youths for marketing and logistics and management
7. Raw material bank

6. Table- 9.1.G6 (c) (iii): Year-wise phasing (in Lakh)

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
No. of Clusters	3	4	3	3	3	16
Cost	600	800	600	600	600	3200

7. Table- 9.1.G6 (c) (iv): State-wise phasing (in Lakh)

States		Year 1	Year 2	Year 3	Year 4	Year 5	Total
Arunachal Pradesh	Phy (in No.)	0	1	0	1	0	2
	Fin (in Cr.)	0	2	0	2	0	4
Assam	Phy (in No.)	1	1	0	1	0	3
	Fin (in Cr.)	2	2	0	2	0	6
Manipur	Phy (in No.)	0	1	1	0	0	2
	Fin (in Cr.)	0	2	2	0	0	4
Meghalaya	Phy (in No.)	1	0	0	1	0	2
	Fin (in Cr.)	2	0	0	2	0	4
Mizoram	Phy (in No.)	0	1	1	0	0	2
	Fin (in Cr.)	0	2	2	0	0	4
Nagaland	Phy (in No.)	1	0	0	1	0	2
	Fin (in Cr.)	2	0	0	2	0	4
Sikkim	Phy (in No.)	0	0	1	0	0	1
	Fin (in Cr.)	0	0	2	0	0	2
Tripura	Phy (in No.)	0	1	1	0	0	2
	Fin (in Cr.)	0	2	2	0	0	4
Total	Phy (in No.)	3	5	4	4	0	16
	Fin (in Cr.)	6	10	8	8	0	32

Table- 9.1.H: Implementation strategy for Machinery, Tools and Capacity Building

Strategy-8	Machinery, Tools and Capacity Building	
Rationale	<ol style="list-style-type: none"> 1. Bamboo Machinery market is highly import dependent 2. There are different species used for furniture, construction and engineered bamboo. Each has different wall thickness, inter-nodal length and other characteristics. Currently most tools and equipment are manufactured to general specifications which reduces precision inputs for industrialized production. Most plant and machinery are copied from Chinese designs suitable for only Moso bamboo. The development of the bamboo sector has led to some manufacturers making better quality machinery and equipment in collaboration with overseas companies, but these are expensive 	
Action Points	<ol style="list-style-type: none"> 1. Identification of national level bamboo machine manufacturer and importers and incentivize for indigenous technology development 2. Funding of research project to develop indigenous machinery to fit the requirement of Indian species. 3. A Centre for Excellence for Bamboo Machinery may be set up at NECBDC for demonstration of advanced bamboo machinery to entrepreneurs and growers. The Centre may run as "for profit" production unit and work as a model multi-processing unit with special focus on waste utilization. 4. Organize Bamboo Machinery and Technology Exhibition 5. Feasibility of setting up bamboo machinery bank in line of agree-machinery bank may be assessed 	
Methodology	<ol style="list-style-type: none"> 1. Policy advocacy for incentivizing machinery manufacturer 2. Tie-up with leading machinery manufacturer for Centre of Excellence of Bamboo machinery for Indian bamboo species 3. Identify species specific machinery challenges 4. Set up group of bamboo technology experts 5. Promote research and development 	
Coverage of the States	Not pertinent	
Implementing Agencies	NECBDC	
Time Lines	5 year	
Physical Target	<ol style="list-style-type: none"> 1. Establish 1 no. of bamboo machinery Centre of Excellence 2. Organize at least 5 nos. of international level Bamboo Technology Exhibition 3. One Feasibility study for setting up bamboo machinery bank 	
Resource Requirement	Centre of Excellence for Machinery	2 Cr
	Bamboo Technology Exhibition (Rs. 40 Lakh per exhibition)	2 Cr
	Feasibility of setting up bamboo machinery bank	0.40 Cr
	Total	4.40 Cr
Convergence/Synergy	NEC	

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1.1 : Implementation strategy of Policy Intervention

Strategy-9	Policy Intervention
Rationale	<ol style="list-style-type: none"> 1. The country does not have a National Bamboo Policy to spearhead the bamboo industrialization 2. Bamboo as a material comes under the purview of various ministries and presently convergence is limited 3. The success of National Bamboo Mission or any future bamboo specific initiative will need policy reforms in many fronts.
Action Points	<ol style="list-style-type: none"> 1. Formation of National Bamboo Policy 2. Revision of existing insufficient cost per Ha plantation norms under RNBM of Rs. 1 Lakh to Rs. 1.9 Lakh. Break up of revised cost norms is discussed under the "Strategy for Plantation 3. Feasibility of offering duty drawback rate of 7% to export of all bamboo products may be examined 4. Since bamboo starts generating revenue only after 3 years, therefore intercropping may be promoted. In North East, crops such as Ginger, Turmeric, Chilli, Hill Paddy, Maize etc. may be promoted as inter-crop. Convergence with MIDH, MOVCDNER, RKVY, Spice Board etc. 5. Mandatory procurement of bamboo furniture and waste bin baskets by Govt Departments, Schools, Hospitals etc. 6. Separate HSN code of bamboo products 7. Convergence among various ministries. 8. NECBDC need to act as a much needed "Single-Window" clearance Mechanism on all matters related to the dissemination of information and servicing point for all schemes as well as necessary clearances and permits, etc for the bamboo sector entrepreneurs and investors 9. NECBDC also may facilitate tie up with international best practice model for skill and technology transfer. 10. Assessment of various bamboo CFCs in terms of revival and scope to run as profit centre. 11. DGFT may lift the ban on export of bamboo charcoal and activated charcoal. 12. Assessment of Tissue Culture facilities under State Forest Departments and scope of their revival 13. BIS standards should be developed for high value bamboo furniture, construction and engineered products. 14. Eco-tourism and seaside resorts made of bamboo should be promoted
Methodology	<ol style="list-style-type: none"> 1. Formation of Interministerial monitoring committee
Coverage of the States	Not pertinent
Implementing Agencies	Ministry of DoNER can lead various policy reforms in bamboo sector with support from NITI Aayog, India Bamboo Forum, World Bamboo Organization and National Bamboo Mission
Time Lines	Not pertinent
Physical Target	Not pertinent
Resource Requirement	Not pertinent
Convergence/Synergy	Not pertinent

NOTE:

1. Status of the Common Facility Centres

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Numbers of Bamboo Common Facility Centres were established in the region under various centrally sponsored schemes such as SFURTI Scheme Common Facility Centers (CFCs) under Ministry of MSME, Ambedkar Hashtashilp Vikash Yojana (AHVY) and multilateral project such as JICA etc. Based upon information available on public domain, no. of bamboo CFCs and Micro/Mini CFCs were set up in NER under various schemes are mentioned below-

Table- 9.1.I (i): Bamboo CFCs under AHVY Scheme

State	Total Units
Arunachal Pradesh	5
Assam	8
Manipur	4
Meghalaya	1
Mizoram	3
Nagaland	2
Sikkim	1
Tripura	1
Total	25

Source: <http://handicrafts.nic.in/>

Table- 9.1.I (ii): Bamboo CFCs under Tripura JICA and SFURTI

CFCs Under Tripura JICA	
State	Total Units
Tripura	17
Bamboo CFCs under SFURTI	
State	Total Units
Assam	1
Manipur	2
Nagaland	2
Tripura	1
Total	6

https://sfurti.msme.gov.in/SFURTI/Reports/Cluster_Progress_Rpt.aspx

Approximately 48 nos. of CFCs were set up with facility for raw material, machinery etc. During discussion with various experts and it was gathered that many of the CFCs are defunct, especially those under AVHY scheme and JICA project. Assessment of these infrastructure and scope of revival need to be taken up in urgent basis.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Table- 9.1.J : Implementation strategy of Market Development

Strategy-10	Market Development
Rationale	<ol style="list-style-type: none"> 1. Use of bamboo is still limited to low end construction and cottage based handicraft 2. The sector lacks large scale private investment due to absence of cost competitive and quality products 3. Change in public procurement policy, export policy etc. can give the much needed push from supply driven market to demand driven market. 4. Many of the Asian countries which are leader in bamboo sector technology development are willing to invest in bamboo sector of North East India.
Action Points	<ol style="list-style-type: none"> 1. Organize Investor's Meet with Asian Countries who are bamboo sector leader and willing to share technology with India such as Taiwan, Japan, Thailand, Vietnam etc. 2. Promote entrepreneur anchored growers' clusters. 3. Upgrade craft clusters from "Handicraft" manufacturing to "Bamboo Lifestyle Product" manufacturing 4. Develop products which can connect bamboo to the digital world for attracting the youngsters. (bamboo stereo, speakers, headphone, hair dryer etc.- NID Ahmedabad Bamboo Digitization Project) 5. Facilitate training of entrepreneurs and artisans in global bamboo clusters. 6. Facilitate participation of NER entrepreneurs in international buyer seller meet 7. Facilitate of entrepreneurs in international exhibitions 8. PWD SOR may include bamboo as material of construction 9. DGFT may lift the ban on export of bamboo charcoal and activated charcoal. 10. Create niche segment such as polyester substitute bamboo fibre 11. Integration with other crafts such as- Bamboo fibre with Cocoon Silk fibre to promote low cost and affordable silk fabric and products to cater to mass market; bamboo craft integration with lacquered craft of Jharkhand. 12. Organize at least 4 nos. of international buyer-seller meet annually 13. Capacity building of artisans in terms of procurement norms of large scale private enterprises. 14. Tie with international best practices models
Methodology	<ol style="list-style-type: none"> 1. Network with India bases globally renowned experts in various fields of bamboo 2. Networking with international agencies such as World Bamboo Organization who has experts across the globe as their World Bamboo Ambassador 3. Cross country dialogue and planning through Invest India
Coverage of the States	Not pertinent
Implementing Agencies	North Eastern Council can be the anchor agency for bamboo market reform in NER
Time Lines	Not pertinent
Physical Target	As mentioned under Action Points

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Resource Requirement	North East Bamboo Market Development Fund of Rs. 10 Cr. Details given in the note below
Convergence/Fresh Fund	Invest India, NBM, NEC

NOTE:

1. North East Bamboo Market Development Fund

It may be funded by North Eastern Council and implemented by NECBDC with following objective and fund component-

Table- 9.1.J (i): Distribution of North East Bamboo Market Development Fund

Sl. No.	Component	Amount
1	20 nos. of buyer seller meet @Rs. 20 Lakh/meet	4 Cr
2	Participation of entrepreneur in international buyer seller meet	1.5 Cr
3	Project funding for new product development	2 Cr
4	Tie up with international best practices	2.5 Cr
	Total	10 Cr

Table- 9.1.K: Implementation strategy for Finance/Credit

Strategy-11	Finance/Credit
Rationale	<ol style="list-style-type: none"> 1. Major challenge in the North East region in terms of entrepreneurship development is weak credit linkage 2. Due to weak credit linkage many of the impact of the many centrally sponsored scheme were found to be limited.
Action Points	<ol style="list-style-type: none"> 1. Creating a Bamboo Financial Consortium based in Guwahati - A Corpus fund by scheduled banks and financial institutions and also by private sector 2. Credit policies should include provision of low interest or interest free loans to promote development in the bamboo sector as has been done for agriculture. 3. Introduce "Bamboo Credit Guarantee Scheme for NER" in line of Covid-19 Emergency Line of Credit 4. Under NBM, instead of back ended subsidy, front ended pro-rata subsidy may be introduced. 5. Since, the startup ecosystem of the region is at early stage, the bamboo entrepreneurship fund need to more through grunt at various stage of startup growth 6. For successful project development, experiences manpower/agency should be engaged for DPR preparation 7. In case of FPOs/FPCs, bank credit linkage may not be made mandatory. Independent Appraisal Agency may be engaged to assess such non-credit linked proposals. 8. Awareness about National Bamboo Mission and other scheme till branch level of banks specially at growers' clusters
Methodology	<ol style="list-style-type: none"> 1. Formation of network of bamboo experts and agencies 2. Policy advocacy for revision of NBM scheme norms 3. Engagement with Ministry of Finance for Bamboo Credit Guarantee Scheme for NER 4. Discussion with NITI Aayog and SIDBI for startup funding 5. Strengthening of NECBDC in terms of manpower to take up the envisaged role. 6. Promote bamboo as an investment opportunity in SLBC meetings of banker 7. Obtain the pain points of bankers in lending to bamboo sector 8. Address the issues, including by engagement of professional agency that can be engaged to assist the development of lending norms to bamboo units with data inputs 9. Work with Government / Reserve Bank of India to extend collateral-free and guaranteed loans to bamboo units
Coverage of the States	Not pertinent
Implementing Agencies	NECBDC, NEC, M-DoNER, NEC and identified professional agency
Time Lines	Not pertinent
Physical Target	Not pertinent
Resource Requirement	Not pertinent

NOTE:

1. Bamboo Credit Guarantee Scheme

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

Bamboo sector units are more manpower intensive than machinery intensive. Even in case of large scale bamboo wood based units, the use of labour is high at various stages of handling and manufacturing. This creates a challenge for the bamboo entrepreneurs to get access to working capital since the units are less machinery intensive. Therefore, it is proposed to launch a Bamboo Credit Guarantee Scheme in line of Covid Emergency Credit Line Guarantee Scheme. The ELGS scheme was launched as Atmanirbhar Bharat Stimulus Package, which has created an immense positive impact in sustaining the MSME sector during the pandemic induced economic slowdown. Till December, 2020 loans worth Rs 2,05,563 crore to about 81 lakh accounts under the Rs 3 lakh crore Emergency Credit Line Guarantee Scheme (ECLGS) for the MSME sector as a collateral free guaranteed loan. The Turnaround of bamboo sector of NER depends upon on-boarding of entrepreneurs which requires easy access to credit. Therefore, in line of ELGS, a Bamboo Credit Guarantee Scheme may be introduced.

Table- 9.1.I: Strategy for Implementation Model

Strategy-12	<p>Implementation Model:</p> <ul style="list-style-type: none"> • Model 1: Strengthening of National Bamboo Mission • Model 2: For a more North East Specific approach, creation of Special Purpose Vehicle in the form of Society under the aegis of Ministry of DoNER, Govt. of India titled "North East Regional Bamboo Development Project (NERBDP).
Rationale	<ul style="list-style-type: none"> • On-boarding of professional agency as PMU and formation of interministerial mission monitoring committee will result in better delivery of the National Bamboo Mission's interventions • The NERBDP project will supplement the existing initiative of National Bamboo Mission by working closely with it. While NBM has a pan India mandate, the NERBDP can have a north east specific approach in more focused manner considering the challenges of the region, thereby bringing more customized solution on-board. The project will bring much needed integration of all the stakeholders of bamboo sector through its governing and executive body.
Action Points	<ul style="list-style-type: none"> • For strengthening of NBM, Project Management Unit (PMU) may be set up • For better convergence interministerial mission monitoring committee may be formed • Formation of Special Purpose Vehicle North East Regional Bamboo Development Society with its Regional Project Management unit in Guwahati, Assam. • Explore funding from international funding agency. • Formation of Governing body with members of Joint Secretary Rank from stakeholder ministries, and Principal Secretary, Planning Department of NER states, which will be chaired by Secretary, Ministry of DoNER. (Indicative members of the committee given in Note) • Formation of Executive Committee with members from central and state representative which will be chaired by Official of the rank of Joint Secretary. (Indicative members of the committee given in Note). • The chairman of the Executive Committee will act as Managing Director/CEO of the Project • 1 nos. Of Region Project Management unit will be set up at Guwahati • 8 nos. of State Project Management Unit will be set up at state capitals of all the NER states.
Methodology	As outlined at above
Coverage of the States	All states
Implementing Agencies	Regional Project Management Unit, State Project Management Units
Time Lines	All years
Resource Requirements	Rs 69.25 Cr @2% of the total project cost of Rs. 3462.37 Cr.

DETAILS OF STRATEGIES & IMPLEMENTATION MODEL

NOTE:

1. Members of the Governing Body of NERBDP Project

Indicative members of the Governing Body are mentioned below-

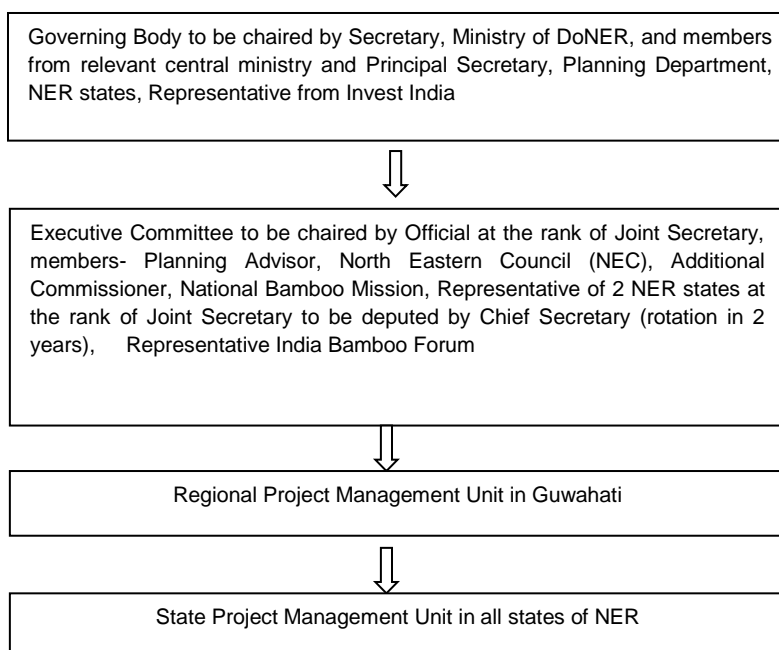
- a) Secretary, Ministry of DoNER as Chairman
- b) Additional Secretary, National Bamboo Mission as Member Secretary
- c) Joint Secretary, Ministry of Industry and Commerce
- d) Joint Secretary, Ministry of MSME
- e) Joint Secretary, Ministry of Environment, Forest and Climate Change
- f) Representative, NITI Aayog
- g) Representative, Invest India
- h) Principal Secretary, Planing Department, Govt of Arunachal Pradesh
- i) Principal Secretary, Planing Department, Govt of Assam
- j) Principal Secretary, Planing Department, Govt of Manipur
- k) Principal Secretary, Planing Department, Govt of Meghalaya
- l) Principal Secretary, Planing Department, Govt of Mizoram
- m) Principal Secretary, Planing Department, Govt of Nagaland
- n) Principal Secretary, Planing Department, Govt of Sikkim
- o) Principal Secretary, Planing Department, Govt of Tripura

2. Members of the Executive Committee of NERBDP Project

Indicative members of the Governing Body are mentioned below-

- p) Government official of the rank of Joint Secretary as MD/CEO
- q) Planning Advisor, North Eastern Council (NEC), member
- r) Additional Commissioner, National Bamboo Mission, member
- s) Representative of 2 NER states at the rank of Joint Secretary to be deputed by Chief Secretary (rotation in 2 years)
- t) Representative India Bamboo Forum, member

3. Implementation Model



SUMMARY OF FINANCIAL RESOURCE REQUIREMENT

10. Summary of Financial Resource Requirement

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10.1. Total Investment Outlay

Sources of Fund

S.N.	Particulars	Share	Govt. Funding	Bank Loan	Promoter's Contribution	Total	Convergence
1	Market Identification Survey	Govt-100%	2.00	0	0	2.00	NBM/TEDF
2	Development of Bamboo Trade Support Tools						
	a. Assessment of Species Wise Resource Availability	Govt-100%	7.44	0	0	7.44	NBM
	b. Real time database on annual species wise harvestable bamboo		5.00	0	0	5.00	Startup Missions
3	Plan for productivity enhancement	Govt.- 50%, Promoter-50%	555.66	0	555.66	1111.32	NBM/HMNEH
4	Plantation						
	a. Cost of 9746 Ha captive plantation under Forest Department	Govt-100%	185.17	0	0	185.17	NBM, CAMPA, JICA
	b. Cost of cultivation of 50,000 ha wasteland	Govt-100%	950.00	0	0	950.00	NBM, CAMPA, JICA
	c. Monitoring of Plantation	Govt-100%	22.70	0	0	22.70	Fresh Fund
	d. Assessment of wasteland	Govt-100%	0.50	0	0	0.50	NBM
	e. Bamboo Cell Under State Forest Department/Strengthening of Forest Development Corporation	Govt-100%	16.00	0	0	16.00	Fresh Fund
6	FSC Certification						
	a. FSC FM Certification to 9746 ha of Captive plantation under Forest Department	Govt-100%	1.69	0	0	1.69	CAMPA
	b. FSC FM for f 50,000 ha wasteland under Group	Govt-100%	9.44	0	0	9.44	CAMPA
7	Planting Material						
	a. Tissue Culture Lab	Govt-100%	13.62	0.00	0.00	13.62	DST/DBT/NBM
	b. Hi tech nursery	Govt.- 50%, Bank Loan- 40% Promoter-10%	18.50	14.80	3.70	37.00	NBM
	c. Large scale nursery	Govt.- 50%, Bank Loan- 40% Promoter-10%	33.36	26.69	6.67	66.72	NBM
	d. Small scale nursery	Govt.- 50%, Bank Loan- 40% Promoter-10%	37.20	29.76	7.44	74.40	NBM

SUMMARY OF FINANCIAL RESOURCE REQUIREMENT

S.N.	Particulars	Share	Govt. Funding	Bank Loan	Promoter's Contribution	Total	Convergence
8	Bamboo Extraction Road						
	a. Feasibility analysis of BER	Govt-100%	1.70	0	0	1.70	Fresh fund
	b. Construction of BER	Govt-100%	208.00	0	0	208.00	PMGSY
9	Bamboo FPO Formation-Multi Model Supply Chain	Govt-100%	11.55	0	0	11.55	Formation of 10,000 FPO
10	Assessment of Inland water way and railway transport for bamboo	Govt-100%	2.00	0	0	2.00	TEDF
11	Setting up of National Institute of Bamboo Innovation and Technology						Fresh Fund
	a. Project cost of NIBIT	Govt-100%	302.63	0	0	302.63	
	b. DPR preparation cost	Govt-100%	3.00	0	0	3.00	
	c. Research Project Funding at CBRI, IWST, FRI	Govt-100%	10.00	0	0	10.00	
12	Bamboo Entrepreneurship Fund	Govt-100%	100.00	0	0	100.00	Fresh Fund
13	Value Addition						
	a. Incense Stick Industry	Govt.- 50%, Bank Loan- 40% Promoter-10%	11.13	8.90	2.23	22.25	NBM
	b. Charcoal & Activated charcoal	do	16.00	12.80	3.20	32.00	NBM
	c. Bamboo Fibre	do	44.00	35.20	8.80	88.00	NBM
	d. Bamboo Shoot	do	4.24	3.39	0.85	8.48	NBM/SAMPADA
	e. Primary Treatment unit	do	1.40	1.12	0.28	2.79	NBM
	f. Bamboo Boards and furniture	do	62.50	50.00	12.50	125.00	NBM
	g. Industrialized Craft/Utility Products & Bioplastics	do	6.71	5.37	1.34	13.43	NBM
14	Improved Traditional craft through cluster approach	Govt-100%	32.00	0	0	32.00	SFURTI/AHVY
15	Machinery, Tools and Capacity Building						
	a. Centre of Excellence for Machinery	Govt-100%	2.00	0	0	2.00	Fresh Fund
	b. Bamboo Technology Exhibition	Govt-100%	2.00	0	0	2.00	Fresh Fund
	c. Feasibility of setting up bamboo machinery bank	Govt-100%	0.40	0	0	0.40	Fresh Fund
16	Bamboo Market Development Fund						Fresh Fund
	a. Buyer seller meet	Govt-100%	4.00	0	0	4.00	Fresh Fund
	b. Participation of entrepreneur in international buyer seller meet/exhibition	Govt-100%	1.50	0	0	1.50	Fresh Fund
	c. New product development	Govt-100%	2.00	0	0	2.00	Fresh Fund
	d. Tie up with international best practices	Govt-100%	2.50	0	0	2.50	Fresh Fund
	Subtotal						
	Project Management Cost (2%)	Govt-100%	69.50	0	0	69.38	
	Total		2756.54	186.026	602.16	3544.73	

The project can also explore funding from international agencies such as World Bank, IFAD, Asian Development Bank etc.

SUMMARY OF FINANCIAL RESOURCE REQUIREMENT

State-wise Fund Requirement:

Table-10.2: State-wise Fund Requirement for Arunachal Pradesh

SN	Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Total
2	Development of Bamboo Trade Support Tools						
	a. Assessment of Species Wise Resource Availability	1.30	1.30				2.60
3	Plan for productivity enhancement	42.69	27.81	28.55	29.45	30.52	159.02
4	Plantation						
	a. Cost of 9746 Ha captive plantation under Forest Department	19.00	3.80	4.56	5.47	6.57	39.40
	b. Cost of cultivation of 50,000 ha wasteland	24.605	24.605	24.09	24.605	24.605	122.51
	c. Monitoring of Plantation	0.87	0.57	0.57	0.60	0.62	3.24
5	Bamboo Cell Under State Forest Department/Strengthening of Forest Development Corporation	2.00					2.00
6	FSC Certification						
	a. FSC FM Certification to 9746 ha of Captive plantation under Forest Department	0	0	0	0	0	0.23
	b. FSC FM for 50,000 ha wasteland under Group	0.24	0.24	0.24	0.24	0.24	1.22
7	Planting Material						
	a. Tissue Culture Lab	0.00	4.54				4.54
	b. Hi tech nursery	1.50	2.00	1.50	0.00	0.00	5.00
	c. Large scale nursery	1.92	2.40	4.32	0.00	0.00	8.64
	d. Small scale nursery	1.80	2.30	2.30	3.20	0.00	9.60
8	Bamboo Extraction Road						
	a. Feasibility analysis of BER	0.28					0.28
	b. Construction of BER	0	8.8	11.2	14.4	21.6	56.00
9	Bamboo FPO Formation-Multi Model Supply Chain	0.75	0.9				1.65
12	Bamboo Entrepreneurship Fun	2.50	2.50	2.50	2.50	2.50	12.50
13	Value Addition						
	a. Incense Stick Industry	0.73	0.43	0.18	0.18	0.18	1.68
	b. Charcoal & Activated charcoal	0.04	0.00	5.04	0.00	0.00	5.08
	c. Bamboo Fibre						
	d. Bamboo Shoot						
	e. Primary Treatment unit	0	0.155	0	0	0	0.155
	f. Bamboo Boards and furniture	0	25	0	0	0	25.00
	g. Industrialized Craft/Utility Products & Bioplastics	0.06	0.16	0.00	0.16	0.00	0.37
14	Improved Traditional craft through cluster approach	0	2	0	2	0	4
15	Machinery, Tools and Capacity Building						
	b. Bamboo Technology Exhibition						
	c. Feasibility of setting up bamboo machinery bank						
16	Bamboo Market Development Fund						
	a. Buyer seller meet	0.1	0.10	0.10	0.10	0.10	0.50
	b. Participation of entrepreneur in international buyer seller meet/exhibition	0.0375	0.0375	0.0375	0.0375	0.0375	0.19
	Sub Total						465.39
	Project Management Cost (2%)						9.31
	Total Project Cost						474.70

SUMMARY OF FINANCIAL RESOURCE REQUIREMENT

Table-10.3: State-wise Fund Requirement for Assam

	Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Total
2	Development of Bamboo Trade Support Tools						
	a. Assessment of Species Wise Resource Availability	0.42	0.42				0.84
3	Plan for productivity enhancement	75.05	52.73	53.85	55.19	56.79	293.61
4	Plantation						
	a. Cost of 9746 Ha captive plantation under Forest Department	28.50	5.70	6.84	8.21	9.85	59.10
	b. Cost of cultivation of 50,000 ha wasteland	48.17	48.17	48.17	48.17	48.17	240.83
	c. Monitoring of Plantation	1.53	1.08	1.10	1.13	1.16	6.00
5	Bamboo Cell Under State Forest Department/Strengthening of Forest Development Corporation	2.00					2.00
6	FSC Certification						
	a. FSC FM Certification to 9746 ha of Captive plantation under Forest Department	0	0	0	0	0	0.23
	b. FSC FM for f 50,000 ha wasteland under Group	0.24	0.24	0.24	0.24	0.24	1.22
7	Planting Material						
	a. Tissue Culture Lab	0.00	9.08				9.08
	b. Hi tech nursery	2.00	3.00	3.50	0.00	0.00	8.50
	c. Large scale nursery	4.00	5.44	7.36	0.00	0.00	16.80
	d. Small scale nursery	3.80	4.30	4.30	6.50	0.00	18.90
8	Bamboo Extraction Road						
	a. Feasibility analysis of BER	0.28					0.28
	b. Construction of BER	0.00	4.80	7.20	11.60	12.40	36.00
9	Bamboo FPO Formation-Multi Model Supply Chain	0.75	0.9				1.65
10	Setting up of National Institute of Bamboo Innovation and Technology						
	a. Project cost of NIBIT	48.18	54.32	59.76	70.68	69.70	302.63
	b. DPR preparation cost	3					3.00
12	Bamboo Entrepreneurship Fun	2.50	2.50	2.50	2.50	2.50	12.50
13	Value Addition						
	a. Incense Stick Industry	1.55	1.55	1.55	1.55	1.55	7.75
	b. Charcoal & Activated charcoal	5.16	0.00	0.16	0.00	0.16	5.48
	c. Bamboo Fibre	25	63				88.00
	d. Bamboo Shoot	2.12					0.55
	e. Primary Treatment unit	0.31	0.155	0.155	0.31	0.155	1.085
	f. Bamboo Boards and furniture	25	0	0	0	0	25
	g. Industrialized Craft/Utility Products & Bioplastics	5.22	0.53	0.06	0.06	0.06	5.92
14	Improved Traditional craft through cluster approach	2	2	0	2	0	6
15	Machinery, Tools and Capacity Building						
	b. Bamboo Technology Exhibition						
	c. Feasibility of setting up bamboo machinery bank						
16	Bamboo Market Development Fund						
	a. Buyer seller meet						
	b. Participation of entrepreneur in international buyer seller meet/exhibition	0.0375	0.0375	0.0375	0.0375	0.0375	0.19
	Sub Total						1154.69
	Project Management Cost (2%)						23.09
	Total Project Cost						1177.79

SUMMARY OF FINANCIAL RESOURCE REQUIREMENT

Table-10.4: State-wise Fund Requirement for Manipur

	Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	Development of Bamboo Trade Support Tools						
	a. Assessment of Species Wise Resource Availability	0.53	0.53				1.06
2	Plan for productivity enhancement	51.09	36.21	36.95	37.85	38.92	201.02
3	Plantation						
	a. Cost of 9746 Ha captive plantation under Forest Department	19.00	3.80	4.56	5.47	6.57	39.40
	b. Cost of cultivation of 50,000 ha wasteland	33.19	33.19	33.19	33.19	33.19	165.97
	c. Monitoring of Plantation	1.04	0.74	0.76	0.77	0.80	4.11
4	Bamboo Cell Under State Forest Department/Strengthening of Forest Development Corporation	2.00					2.00
5	FSC Certification						
	a. FSC FM Certification to 9746 ha of Captive plantation under Forest Department	0	0	0	0	0	0.23
	b. FSC FM for f 50,000 ha wasteland under Group	0.24	0.24	0.24	0.24	0.24	1.22
6	Planting Material						
	a. Tissue Culture Lab	0.00	0.00				0.00
	b. Hi tech nursery	2.00	2.00	2.50	0.00	0.00	6.50
	c. Large scale nursery	3.20	3.20	5.28	0.00	0.00	11.68
	d. Small scale nursery	2.80	3.30	3.30	3.60	0.00	13.00
7	Bamboo Extraction Road						
	a. Feasibility analysis of BER	0.28					0.28
	b. Construction of BER	0.00	0.80	3.20	6.40	13.60	24.00
8	Bamboo FPO Formation-Multi Model Supply Chain	0.75	0.9				1.65
9	Bamboo Entrepreneurship Fun	2.50	2.50	2.50	2.50	2.50	12.50
10	Value Addition						
	a. Incense Stick Industry	0.55	0.50	0.50	0.25	0.25	2.05
	b. Charcoal & Activated charcoal	0.16	5.00	0.00	0.00	0.04	5.20
	c. Bamboo Fibre						
	d. Bamboo Shoot	2.12					0.55
	e. Primary Treatment unit	0	0.155	0	0	0	0.155
	f. Bamboo Boards and furniture						
	g. Industrialized Craft/Utility Products & Bioplastics	0.06	0.10	0.16	0.06	0.00	0.37
11	Improved Traditional craft through cluster approach	0	2	2	0	0	4
12	Bamboo Market Development Fund						
	b. Participation of entrepreneur in international buyer seller meet/exhibition	0.0375	0.0375	0.0375	0.0375	0.0375	0.19
	Sub Total						498.70
	Project Management Cost (2%)						9.97
	Total Project Cost						508.67

SUMMARY OF FINANCIAL RESOURCE REQUIREMENT

Table-10.5: State-wise Fund Requirement for Meghalaya

S N	Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	Development of Bamboo Trade Support Tools						
	a. Assessment of Species Wise Resource Availability	0.00	0.00	0.00			0.00
2	Plan for productivity enhancement	26.19	23.21	23.36	23.54	23.76	120.06
3	Plantation						
	a. Cost of 9746 Ha captive plantation under Forest Department	3.80	0.76	0.91	1.09	1.31	7.88
	b. Cost of cultivation of 50,000 ha wasteland	22.95	22.95	22.95	22.95	22.95	114.76
	c. Monitoring of Plantation	0.54	0.47	0.48	0.48	0.49	2.45
4	Bamboo Cell Under State Forest Department/Strengthening of Forest Development Corporation	2.00					2.00
5	FSC Certification						
	a. FSC FM Certification to 9746 ha of Captive plantation under Forest Department	0	0	0	0	0	0.19
	b. FSC FM for 50,000 ha wasteland under Group	0.24	0.24	0.24	0.24	0.24	1.22
6	Planting Material						
	a. Tissue Culture Lab	0.00	0.00				0.00
	b. Hi tech nursery	1.00	1.50	2.00	0.00	0.00	4.50
	c. Large scale nursery	2.40	2.40	3.20	0.00	0.00	8.00
	d. Small scale nursery	1.80	2.10	2.50	2.60	0.00	9.00
7	Bamboo Extraction Road						
	a. Feasibility analysis of BER	0.28					0.28
	b. Construction of BER	0.00	1.60	2.40	5.60	6.40	16.00
8	Bamboo FPO Formation-Multi Model Supply Chain	0.6	0.75				1.35
9	Bamboo Entrepreneurship Fun	2.50	2.50	2.50	2.50	2.50	12.50
10	Value Addition						
	a. Incense Stick Industry	0.13	0.68	0.13	0.13	0.38	1.43
	b. Charcoal & Activated charcoal	0.04	0.00	0.04	0.00	0.04	0.12
	c. Bamboo Fibre						
	d. Bamboo Shoot						0.00
	e. Primary Treatment unit	0.155	0	0	0	0	0.155
	f. Bamboo Boards and furniture	0	25	0	0	0	25
	g. Industrialized Craft/Utility Products & Bioplastics	0.00	5.22	0.16	0.00	0.00	5.37
11	Improved Traditional craft through cluster approach	2	0	0	2	0	4
12	Machinery, Tools and Capacity Building						
	a. Centre of Excellence for Machinery	2.00					2.00
	b. Bamboo Technology Exhibition						
	c. Feasibility of setting up bamboo machinery bank						
13	Bamboo Market Development Fund						
	a. Buyer seller meet						
	b. Participation of entrepreneur in international buyer seller meet/exhibition	0.0375	0.0375	0.0375	0.0375	0.0375	0.19
	Sub Total						338.45
	Project Management Cost (2%)						6.77
	Total Project Cost						345.21

SUMMARY OF FINANCIAL RESOURCE REQUIREMENT

Table-10.6: State-wise Fund Requirement for Mizoram

SN	Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	Development of Bamboo Trade Support Tools						
	a. Assessment of Species Wise Resource Availability	0.73	0.73				1.46
2	Plan for productivity enhancement	34.08	26.64	27.01	27.46	27.99	143.18
3	Plantation						
	a. Cost of 9746 Ha captive plantation under Forest Department	9.50	1.90	2.28	2.74	3.28	19.70
	b. Cost of cultivation of 50,000 ha wasteland	25.31	25.31	25.31	25.31	25.31	126.54
	c. Monitoring of Plantation	0.70	0.54	0.55	0.56	0.57	2.92
4	Bamboo Cell Under State Forest Department/Strengthening of Forest Development Corporation	2.00					2.00
5	FSC Certification						
	a. FSC FM Certification to 9746 ha of Captive plantation under Forest Department	0	0	0	0	0	0.23
	b. FSC FM for f 50,000 ha wasteland under Group	0.24	0.24	0.24	0.24	0.24	1.22
6	Planting Material						
	a. Tissue Culture Lab	0.00	0.00				0.00
	b. Hi tech nursery	1.50	1.50	2.00	0.00	0.00	5.00
	c. Large scale nursery	2.40	2.24	4.16	0.00	0.00	8.80
	d. Small scale nursery	1.80	2.30	2.30	3.50	0.00	9.90
7	Bamboo Extraction Road						
	a. Feasibility analysis of BER	0.28					0.28
	b. Construction of BER	0.00	4.80	7.20	8.00	12.00	32.00
8	Bamboo FPO Formation-Multi Model Supply Chain	0.75	0.75				1.50
9	Bamboo Entrepreneurship Fun	2.50	2.50	2.50	2.50	2.50	12.50
10	Value Addition						
	a. Incense Stick Industry	0.50	0.25	0.80	0.25	0.25	2.05
	b. Charcoal & Activated charcoal	0.00	0.04	0.00	0.04	5.00	5.08
	c. Bamboo Fibre						
	d. Bamboo Shoot	0	2.12				0.55
	e. Primary Treatment unit	0.155	0.155	0	0	0	0.31
	f. Bamboo Boards and furniture	0	0	25	0	0	25
	g. Industrialized Craft/Utility Products & Bio plastics	0.00	0.00	0.16	0.16	0.00	0.32
11	Improved Traditional craft through cluster approach	0	2	2	0	0	4
12	Bamboo Market Development Fund						
	b. Participation of entrepreneur in international buyer seller meet/exhibition	0.0375	0.0375	0.0375	0.0375	0.0375	0.19
	Sub Total						406.29
	Project Management Cost (2%)						8.13
	Total Project Cost						414.42

SUMMARY OF FINANCIAL RESOURCE REQUIREMENT

Table-10.7: State-wise Fund Requirement for Nagaland

SN	Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	Development of Bamboo Trade Support Tools						
	a. Assessment of Species Wise Resource Availability	0.39	0.39				0.79
2	Plan for productivity enhancement	32.87	29.89	30.04	30.22	30.44	153.46
3	Plantation						
	a. Cost of 9746 Ha captive plantation under Forest Department	3.80	0.76	0.91	1.09	1.31	7.88
	b. Cost of cultivation of 50,000 ha wasteland	29.77	29.77	29.77	29.77	29.77	148.87
	c. Monitoring of Plantation	0.67	0.61	0.61	0.62	0.62	3.13
4	Bamboo Cell Under State Forest Department/Strengthening of Forest Development Corporation	2.00					2.00
5	FSC Certification						
	a. FSC FM Certification to 9746 ha of Captive plantation under Forest Department	0	0	0	0	0	0.19
	b. FSC FM for f 50,000 ha wasteland under Group	0.24	0.24	0.24	0.24	0.24	1.22
6	Planting Material						
	a. Tissue Culture Lab	0.00	0.00				0.00
	b. Hi tech nursery	1.00	2.00	3.00	0.00	0.00	6.00
	c. Large scale nursery	2.40	3.20	4.80	0.00	0.00	10.40
	d. Small scale nursery	2.30	2.80	2.70	3.90	0.00	11.70
7	Bamboo Extraction Road						
	a. Feasibility analysis of BER	0.28					0.28
	b. Construction of BER	0.00	7.20	8.80	14.00	14.00	44.00
8	Bamboo FPO Formation-Multi Model Supply Chain	0.75	0.9				1.65
9	Bamboo Entrepreneurship Fun	2.50	2.50	2.50	2.50	2.50	12.50
10	Value Addition						
	a. Incense Stick Industry	0.50	0.55	0.50	0.25	0.25	2.05
	b. Charcoal & Activated charcoal	0.00	0.16	0.04	5.16	0.00	5.36
	c. Bamboo Fibre						
	d. Bamboo Shoot	0	2.12				0.55
	e. Primary Treatment unit	0	0	0.155	0.155	0	0.31
	f. Bamboo Boards and furniture	0	0	25	0	0	25
	g. Industrialized Craft/Utility Products & Bioplastics	0.00	0.00	0.16	0.16	0.00	0.32
11	Improved Traditional craft through cluster approach	2	0	0	2	0	4
12	Bamboo Market Development Fund						
	b. Participation of entrepreneur in international buyer seller meet/exhibition	0.0375	0.0375	0.0375	0.0375	0.0375	0.19
	Sub Total						443.40
	Project Management Cost (2%)						8.87
	Total Project Cost						452.27

SUMMARY OF FINANCIAL RESOURCE REQUIREMENT

Table-10.8: State-wise Fund Requirement for Sikkim

SN	Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	Development of Bamboo Trade Support Tools						
	a. Assessment of Species Wise Resource Availability	0.19	0.19				0.39
2	Plan for productivity enhancement	2.51	1.02	1.10	1.19	1.29	7.12
3	Plantation						
	a. Cost of 9746 Ha captive plantation under Forest Department	1.90	0.38	0.46	0.55	0.66	3.94
	b. Cost of cultivation of 50,000 ha wasteland	0.67	0.67	0.67	0.67	0.67	3.33
	c. Monitoring of Plantation	0.05	0.02	0.02	0.02	0.03	0.15
4	Bamboo Cell Under State Forest Department/Strengthening of Forest Development Corporation	2.00					2.00
5	FSC Certification						
	a. FSC FM Certification to 9746 ha of Captive plantation under Forest Department	0	0	0	0	0	0.19
	b. FSC FM for f 50,000 ha wasteland under Group	0.24	0.24	0.24	0.24	0.24	1.22
6	Planting Material						
	a. Tissue Culture Lab	0.00	0.00				0.00
	b. Hi tech nursery	0.00	0.50	0.00	0.00	0.00	0.50
	c. Large scale nursery	0.16	0.00	0.00	0.00	0.00	0.16
	d. Small scale nursery	0.10	0.10	0.00	0.00		0.20
8	Bamboo Extraction Road						
	b. Construction of BER						
9	Bamboo FPO Formation-Multi Model Supply Chain	0.3	0.45				0.75
10	Bamboo Entrepreneurship Fun	2.50	2.50	2.50	2.50	2.50	12.50
11	Value Addition						
	a. Incense Stick Industry	0.08	0.08	0.08	0.33	0.08	0.63
	b. Charcoal & Activated charcoal	0.00	0.04	0.00	0.04	0.00	0.08
	c. Bamboo Fibre						
	d. Bamboo Shoot						0.00
	e. Primary Treatment unit	0	0	0.155	0	0	0.155
	f. Bamboo Boards and furniture						
	g. Industrialized Craft/Utility Products & Bioplastics	0.00	0.06	0.10	0.00	0.16	0.32
12	Improved Traditional craft through cluster approach	0	0	2	0	0	2
13	Bamboo Market Development Fund						
	b. Participation of entrepreneur in international buyer seller meet/exhibition	0.0375	0.0375	0.0375	0.0375	0.0375	0.19
	Sub Total						35.79
	Project Management Cost (2%)						0.72
	Total Project Cost						36.51

SUMMARY OF FINANCIAL RESOURCE REQUIREMENT

Table-10.9: State-wise Fund Requirement for Tripura

SN	Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	Development of Bamboo Trade Support Tools						
	a. Assessment of Species Wise Resource Availability	0.14	0.14				0.29
2	Plan for productivity enhancement	8.95	5.97	6.12	6.30	6.52	33.86
3	Plantation						
	a. Cost of 9746 Ha captive plantation under Forest Department	3.80	0.76	0.91	1.09	1.31	7.88
	b. Cost of cultivation of 50,000 ha wasteland	5.34	5.34	5.34	5.34	5.34	26.70
	c. Monitoring of Plantation	0.18	0.12	0.13	0.13	0.13	0.69
4	Bamboo Cell Under State Forest Department/Strengthening of Forest Development Corporation	2.00					2.00
5	FSC Certification						
	a. FSC FM Certification to 9746 ha of Captive plantation under Forest Department	0	0	0	0	0	0.19
	b. FSC FM for f 50,000 ha wasteland under Group	0.24	0.24	0.24	0.24	0.24	1.22
6	Planting Material						
	a. Tissue Culture Lab						0.00
	b. Hi tech nursery	0.00	0.50	0.50	0.00	0.00	1.00
	c. Large scale nursery	0.32	0.64	1.28	0.00	0.00	2.24
	d. Small scale nursery	0.40	0.80	0.60	0.30		2.10
7	Bamboo Extraction Road						
	a. Feasibility analysis of BER						
	b. Construction of BER						
8	Bamboo FPO Formation-Multi Model Supply Chain	0.6	0.75				1.35
9	Bamboo Entrepreneurship Fun	2.50	2.50	2.50	2.50	2.50	12.50
10	Value Addition						
	a. Incense Stick Industry	0.38	0.38	0.93	1.48	1.48	4.63
	b. Charcoal & Activated charcoal	0.00	0.16	0.12	0.16	0.16	0.60
	c. Bamboo Fibre						
	d. Bamboo Shoot						0.00
	e. Primary Treatment unit	0	0	0.155	0.155	0.155	0.465
	f. Bamboo Boards and furniture						
	g. Industrialized Craft/Utility Products & Bio-plastics	0.00	0.00	0.12	0.22	0.06	0.39
11	Improved Traditional craft through cluster approach	0	2	2	0	0	4
12	Bamboo Market Development Fund						
	a. Buyer seller meet						
	b. Participation of entrepreneur in international buyer seller meet/exhibition	0.0375	0.0375	0.0375	0.0375	0.0375	0.19
	Sub-Total						102.27
	Project Management Cost (2%)						2.05
	Total Project Cost						104.32

11. Output and Outcome of the Plan >>>

11.1. Summary of the Expected Output and Outcome

Increase in Forest Bamboo Stock: The region has country's 40% of the growing stock of bamboo, however extractable stock is significantly less. The Action Plan aims to increase bamboo cultivation area by 59,746 Ha, out of which 50,000 Ha is proposed to be developed on wasteland and 9,746 Ha will be under certified captive plantation of Forest Department.

Improve Productivity: For improved productivity through scientific management, it is proposed to revise the existing plantation cost norms under NBM with incorporation of additional components vital for plantation health.

Environmental Benefit: Bamboo has found growing interest amongst the global community due to its contribution towards fight against climate change through restoration of degraded land and wasteland. With this Action Plan, 50,000 Ha of wasteland is expected to be restored. This will significantly contribute in India's commitment towards environment protection and will assist in achieving Bonn Target.

Production of Globally Standard Raw material: The proposed FSC certification in bamboo forestry management will ensure globally compliant raw material production. This will create new avenues for the entrepreneurs and growers for their products.

Emphasis on Indigenous Technology Development: The turn-around of Indian bamboo sector depends upon its emphasis on research and development. The proposed National Institute of Bamboo Technology is expected to give the much needed impetus to the industrial application oriented bamboo sector research and development.

Reduce Import Dependence: By introducing enterprise in the entire value chain of bamboo and focusing on waste utilization, it is expected that the Indian bamboo and raw material of bamboo based products will become cheaper than their import substitute.

Connectivity Improvement: Bamboo sector of the region suffers logistical challenge with poor road connectivity especially in the growing belt. This reduces cost competitiveness of the Indian products. The proposed Action Plan aims to improve connectivity from source till market. With the proposed 520 kms. of Bamboo Extraction Road, emphasis is given on ease of sustainable extraction of the natural stock. Further, it is also proposed to explore more cost effective inland water and railway route for raw material and finished goods transportation.

Bamboo Trade Intelligence: The glaring absence in the current ecosystem is that of reliable data on bamboo. The proposed species wise stock survey and development of portal for real time data of annually harvestable stock details will address this issue to a great length.

OUTPUT & OUTCOME OF THE PLAN

Entrepreneurship Development: In addition to supplement the NBM initiative of bamboo entrepreneurship development, it is proposed to capitalize on the startup movement of the country by launching Bamboo Entrepreneurship Development Fund. Startups can also help to tackle the bamboo sector challenges with newer and innovative approach.

Revival of Traditional Industry: Once a glorious Agarbatti industry of India is today facing challenge from other countries in terms of cheaper raw material. The Action Plan seeks to address the root causes of such debacle through action in terms of waste utilization and introducing high value supplementary products such as charcoal and activated charcoal.

Accelerate India's Race to Global Bamboo Market: Sector specific time bound and outcome oriented action is required to regain the global market. The Action Plan outlines several such critical gaps which need to be immediately addressed. Many of the existing research projects need to be expedited which aims to introduce new product development such as bamboo fibre, etc. Further through the proposed Bamboo Market Development Fund, it is proposed to develop Indian bamboo products at par with global standard through improved machinery, increased investment and global market linkage.

Global Skill and Skill Knowledge Transfer to NER: The NER region has strong artisanal skills. This can be further improved in terms of design, finishing etc. with help from experts or master artisans from South East Asian countries.

Improved Package of Practice for Harvesting: Through formation of 77 nos. of FPO with multi-model supply chain orientation, there will be improved harvesting practice, reduction in wastage and increase in farmers' income.

Strengthening existing stakeholder: Through setting up of Bamboo Cell/Division under each Forest Department of NER states; strengthening of State Forest Development Corporations; setting up of Centre of Excellence for Bamboo Machinery at NECBDC- dedicated bamboo specific initiative from the existing stakeholder institution is expected to increase.

Improving Credit Flow: The Action Plan understands challenges of central sector scheme implementation in the region. Institutional credit is inadequate for the bamboo ecosystem of NER. The Action Plan makes specific suggestion to improve credit flow to the entrepreneur through revision of existing NBM norms of funding and suggesting new financial products such as Bamboo Credit Guarantee Scheme etc.

Expected Socio-Economic Impact

On implementation of this Action Plan, it is expected that there will be generation of 47,000 nos. of direct employment and 1, 63,672 nos. of indirect employment. Detailed sector-wise employment generation is given under the relevant chapter. In addition to this, there will be an earning of Rs. 4.04 Cr in the form of GST by the government upon establishment of the proposed value addition units. Break up is given in relevant section.

OUTPUT & OUTCOME OF THE PLAN

Further, it will also help in increasing farmer's income, contribute towards the mission of doubling farmers' income, bring economic opportunity to rural women thereby reducing poverty.

1. Table-11.1: Employment Generation Across the Value Addition and Waste Utilization MSME Units:

SN	Sector	Direct Employment	Indirect Employment
1	Incense Sticks Units	6030	10640
2	Charcoal and Activated Charcoal Units	350	1500
3	Industrial Handicraft Units	2750	885
4	Primary Treatment Unit for Construction	250	500
5	Bamboo Industrial Product units	1230	4450
6	Bamboo extraction road	1000	5000
7	Plantation under Forest Dept.	9745	14,618
8	Bamboo Cell and strengthening of Forest Dept.	16	
9	Plantation Wasteland	1000	50,000
10	Monitoring and Project Management	20	
11	Tissue Culture Labs	180	1800
12	Hi Tech Nursery	1480	2960
13	Large Scale Nursery	4170	8340
14	Small Scale Nursery	7440	14880
15	Real Time bamboo database	20	0
16	Bamboo FPO Formation	1540	23100
17	National Institute of Bamboo Innovation & Technology (NIBIT)	200	10000
18	Bamboo Entrepreneurship Development Fund	10,000	15,000
19	Bamboo Machine and Tools Centre of Excellence	20	
	Total	47,421	1,63,672

2. Table-11.2: Total GST Collection on Revenue Basis

S. N.	Particulars of Line of Activity	Projection of Units	Capacity per Unit/per annum	Rates per MTs	Gross Revenue (INR)	GST rates	Govt. Revenue on GST
1	Bamboo Incense Sticks Sector :						
1.1	Bamboo Round Raw Sticks Units	21	35	100000	73500000	18	13230000
1.2	Bamboo Agarbatti Rolling Unit	15	25	70000	26250000	18	4725000
1.3	Bamboo Incense Masala Processing	15	50	40000	30000000	18	5400000
1.4	Jiggat Plantation	5000	2,000	10000	20000000	18	3600000
2	Charcoal and Activated charcoal						
2.1	Cluster level micro unit	20	180	25000	90000000	5	4500000
2.2	Aggregation based unit	10	360	25000	90000000	5	4500000
2.3	Large scale unit	5	8640	25000	1080000000	5	54000000
2.4	Vinegar from micro unit	20	1800	20	720000	18	129600

OUTPUT & OUTCOME OF THE PLAN

S. N.	Particulars of Line of Activity	Projection of Units	Capacity per Unit/per annum	Rates per MTs	Gross Revenue (INR)	GST rates	Govt. Revenue on GST
2.5	Vinegar from aggregation unit	10	108000	20	21600000	18	3888000
2.6	Vinegar from Large scale unit	5	260000	20	26000000	18	4680000
3	Bamboo Fibre unit						
3.1	Melt spinning technology based unit	1	3000	350000	1050000000	18	189000000
3.2	Mechanical Method-Japanese Technology	1	120	350000	42000000	18	7560000
4	Integrated Bamboo Shoot Unit	4	360	150000	216000000	12	25920000
5	Bamboo Board and furniture unit	5		5000000	25000000	18	4500000
5	Bamboo Industrial Handicrafts:						
5.1	Bamboo Bio-plastic	8		1000000	8000000	12	960000
5.2	Bamboo Lifestyle Products	14		500000	7000000	12	840000
5.3	Bamboo Round Pole Units	8		1500000	12000000	5	600000
5.4	Toothbrush unit	2	2000000	50	200000000	18	36000000
5.5	Bamboo Home and Kitchen Utility	7		1000000	7000000	12	840000
6	Others						
6.1	Bamboo Primary Treatment and Grading	18		1500000	27000000	5	1350000
6.2	Bamboo Multi-supply Chains	77	500000	60	2310000000	5	115500000
6.3	Startups under Entrepreneurship Fund				750000000	5	37500000
	INR (in lakhs)/per annum				6112070000		519222600
		In Rs. Cr				611.207	51.92226

Appendices

Appendix-1: Details of Stakeholders' Feedback

The following feedback had been obtained by organizing video-conferences with prominent persons in the bamboo sector located internationally, nationally and across NE Region. The stakeholders included businessmen, entrepreneurs, experts, academicians etc.

Use of Bamboo in Modern Industry

Bamboo in Food & Medicine: Juvenile bamboo shoots can be used as a natural food, which has anti-diabetic and other therapeutic use. It may be noted that fermented shoots have more pharmaceutical benefits than the regular ones. The presence of silica in bamboo shoots is another important factor for health benefits. Now, bamboo shoots have been included in many food products like Bamboo salt (in Korea), chocolates, bakery, diary, chicken, pork, health drinks, ice creams, etc. Each species has a different protocol associated with it for use in making food items. It has been opined that the main challenges associated with developing a bamboo shoot industry in the North East Region include deficiencies in awareness, processing technology, packaging, and overall management capacity.

The steps needed include: identification of appropriate species for use in food and medicine units, large scale efforts in propagation, establishment of tissue culture laboratory, development of appropriate processing and packaging techniques etc. Proper laboratory with equipment is essential to analyse bamboo shoots in order to maintain quality. Examples like Damyang County in South Korea, which specializes in bamboo shoots, could be emulated.

Bamboo Crafts Sector: Improving the Bamboo sector from a commercial perspective will require measures on fronts like identification of appropriate product range, finalization of suitable species, design innovation, technical interventions, training on design and production, quality management, marketing (branding, brand positioning and market promotion). While manufacturing and designing crafts and utility items, the factors that needed to be considered are: component work, assembling and above all, identifying market needs for designing products to meet the customers' demand. NID's Centre for Bamboo Initiatives has carried out improvements in bamboo products like hair dryer, headphone etc. In the case of bamboo furniture, it is vital to develop lightweight designs that can be easily moved. Research on various aspects of bamboo is required, particularly in following aspects: material applications, traditional skills, markets and user preferences, technical aspects including food grade adhesives and finishes. It is necessary to organize international workshops to identify export potential products.

Bamboo use in High End Construction: Efforts are being made in India to make bamboo a high end construction material, which are on-going. In India, construction of non-concrete buildings has been undertaken using bamboo in India, which can improve the aesthetics of the local cities. Bamboos like *Dendrocalamus stocksii* (Munro) and *Bambusa balcooa*, which is available in the North East India, can be used for construction after suitable treatment. Such treatment can be based on traditional or

OUTPUT & OUTCOME OF THE PLAN

chemical methods, or by using pressure treatments (used for high end construction). Promotion of bamboo in construction sector will need awareness among the users (builders, architects and homeowners) about the usage of bamboo. Globally competitive pricing should be followed and global quality standards should be met.

Bamboo Fibres: Bamboo apparel is softer than the softest cotton, and it has a natural sheen like silk or cashmere. Bamboo drapes like silk or satin yet is less expensive and more durable. Bamboo / Organic cotton blends are also extremely soft but heavier in weight. The characteristics of bamboo fibres include: non irritating properties (useful for persons with allergies and other skin conditions), good breathability, usefulness across wide temperature ranges, availability of anti-bacterial and anti-fungal properties, and bio-degradable nature of bamboo fibres. In view of the above, bamboo fibre has a great potential in the textile industry. It may be noted that as a regenerated cellulose fibre, bamboo fibre was 100 percent made, from bamboo through high – tech process. The bamboo fibre is extracted from 3-4 years old bamboos of suitable quality. The manufacturer does not use any chemical additives. Bamboo fibre has been praised as ‘the natural, green, and eco-friendly’ textile material of the 21st Century.

North India Textile Research Institute (NITRA) is working on a Government of India supported bamboo fibre project. As per the Director General of NITRA, there is a big market for regenerated viscose fibre, which has a big market that is being now met by imports. NITRA is working to identify the potential species for bamboo fibre using the Lyocell process, which is less hazardous.

Use as Geo-textiles: Bamboo can be used to make geo-textiles, which could be used for providing vegetative cover for slopes where the vegetative cover had been removed for purposes like road construction. In addition, the erosion of hill-sides requires such interventions for soil conservation. Bamboo based geo-textiles are effective, affordable and useful for sustainable land management.

Used as Light-weight Material for Electric Micro-mobility: Bamboo is a wonderful material to be used in electric micro mobility industry mainly because of the reason that due to the reduced weight of the material, the distance per charge and capacity of the battery increases significantly. Therefore, the bamboo can be game-changer for the electric micro mobility industry which includes bicycle, rickshaw etc. The start-up (based in Israel) uses composite bamboo material in their bicycle made of moso bamboo which is currently imported.

Bamboo Development Model: Inputs were received from a bamboo based Developmental Organization regarding their model for the promotion of bamboo in tribal areas in South India. As per the discussions, the organization makes use of the indigenous sciences and technology for the uplift of the tribes in the area and it runs a successful bamboo crafts design and production centre along with a bamboo nursery.

Bamboo is found abundantly in the area and the organization encourages the traditional technology and craftsmanship of the tribes in creating a whole range of products using bamboo. They include both functional and decorative products. The organization also helps in marketing these products through their sales outlets at some urban and tourist areas. In its efforts to uplift the locals using the

OUTPUT & OUTCOME OF THE PLAN

locally available materials, it not only provides more job opportunities to the local populace, but also ensures the restoration of the ecosystem and revives the traditional craftsmanship, which otherwise would have died down.

The organization has a large bamboo nursery with a range of useful species. It provides hand-holding to artisans, women, SHGs, etc. More than 100 artisans are a part of their network, and they are being helped in terms of design, training, technical, raw material, marketing assistance and space. The CEO of the organization opined that the challenges of present bamboo market include the nascent stage of industry, supply driven approach, lack of skilled labour and management, lack of awareness and market outreach, lack of cohesion between wings like R&D, production and marketing.

Institutional Role in Bamboo Promotion

Inputs were received from some of the Institutions and their role in bamboo promotion. These have been summarized below.

Institution	Role in Bamboo Promotion
Centre for Bamboo Development (CBD) Indian Plywood Industries Research & Training Institute (IPRTI)	IPRIT has been providing technical supports to the small clusters. The Head of CBD spoke about bamboo mat production. He added that the North East can be a major supplier of bamboo items. It may be noted that the CBD at IPIRTI has already become a nodal centre for development of industrial product from bamboo in the country. Its role of CBD includes the development of bamboo and its composites as engineering materials for various end-use applications, techno-economic feasibility studies of bamboo composite/panel materials. CBD drives its strength from the core competence available at the Institute in various related basic disciplines including adhesives technology, bamboo processing and preservation, products development, material/product testing, human resource development (training).
Indian Institute of Packing (IIP)	The Indian Institute of Packaging is a national apex body which was set up in 1966 by the packaging and allied industries and the Ministry of Commerce, Government of India, with the specific objective of improving the packaging standards in the country. The Deputy Director of IIP Kolkata had stated that bamboo can be used to replace paper packaging material for transportation of fruits and vegetables. The crates and palates used in shopping centres and various other places, which are made of plastic, can also be replaced by bamboo. The current materials used for packaging include paper, glass, metal and plastic. Bamboo has a scope of replacing these materials, as it is more eco-friendly as a raw material.
National Institute of Design (NID)	NID Ahmedabad has a Centre for Bamboo Initiatives. The faculty member from NID has designed a range of bamboo products, which have been internationally recognized. These include various types of innovative bamboo hangers and light weight and flat pack type furniture. NID has established an arm at Jorhat. It has made a face shield using bamboo and plastic.

OUTPUT & OUTCOME OF THE PLAN

Institution	Role in Bamboo Promotion
Indian Institute of Technology (IIT) Guwahati	<p>The Department of Design, IIT Guwahati has undertaken several initiatives for the development of the bamboo sector in the NE Region. These include setting up of technical back up unit at IIT Guwahati for KVIC, loom development, design development and branding of bamboo products for Government of Meghalaya, hand-tools development for bamboo handicrafts, setting up of production centre at Syntein village in the East Khasi Hills district of Meghalaya, crafts training program for nearly 500 bamboo crafts-persons in Assam and Meghalaya and Classroom projects in bamboo.</p> <p>The Department has also collaborated with other institutions like Plywood Research Institute in Bangalore and Forest Research Institute Jorhat for development of bamboo boards, with NERSAC for GPS mapping of bamboo forests, with IIT Guwahati's Chemical Engineering Department for development of bamboo treatment plant etc.</p>
IIT Guwahati (Continued)	<p>IIT Guwahati can assist bamboo promotion in NE Region by the following: Setting up Centre in Handicraft Product and Machinery Design Development at IIT Guwahati, Setting up Centre for Technical evaluation and Technical development of Bamboo products and Machinery, Setting up Entrepreneurship Training Centre at the Research Park at IIT Guwahati for start-ups in the handicraft and handloom Development sectors, Conducting Training programs in Product Planning and Market Development in Bamboo Handicrafts, Undertaking a Craft Documentation of Bamboo and cane Handicrafts of North East region in joint collaboration with NID Jorhat, NIFT Shillong, Design Department, Tezpur University.</p>
NIFT Shillong	<p>A National Institute of Fashion Technology has been established for the NE Region in Shillong. Faculty member of the institution mentioned that the NIFT can contribute for bamboo craftsmen by organizing design interventions and workshops.</p>
North East Cane & Bamboo Development Council (NECBDC)	<p>The North East Cane & Bamboo Development Council was earlier known as CBTC. The ECBDC has been formed with the objective of organizing the bamboo sector of NE India. ECBDC involves its creativity and resource in talent scouting, training, technology sourcing, and market linkage for giving a new age thrust to the age old bamboo sector.</p>
Bamboo & Cane Development Institute (BCDI)	<p>Bamboo and Cane Development Institute was set up to cater to the changing design and technology needs of buyers and to provide support to artisans and craftsmen in these two aspects. The services offered by BCDI are skill/ capacity development, design services, product development, technical services and education and R&D. The Institute conducts training programmes and workshops and acts as a resource Centre. The Centre also facilitates the participation of artisans and craftsmen in trade fairs.</p>
Tripura Bamboo & Cane Development Centre (TRIBAC)	<p>It has been promoted by the Centre for Indian Bamboo Research & Technology (CIBART), an NGO working for livelihood promotion of rural communities in India. TRIBAC follows a model whereby communities own the institution and set the priorities for their development.</p> <p>Since 2005, TRIBAC is mainly working through a Common Facility Centre at Gandhigram with land and a building leased from the State Government. Here, TRIBAC provides local artisans with training and capacity building for bamboo product production and enterprise development.</p> <p>The Centre is equipped with rolling, scenting, colouring, mat painting and packaging facilities for artisans to value add and</p>

OUTPUT & OUTCOME OF THE PLAN

Institution	Role in Bamboo Promotion
	make agarbatti sticks and bamboo mats. These are supplied directly to the market through trade fairs; agarbatti production capacity has increased to 3 tons per month. TRIBAC has also provided training in Assam and Meghalaya.
Rain Forest Research Institute Jorhat	Rain Forest Research Institute is a Central Research institute situated in Jorhat in Assam. It works under the Indian Council of Forestry Research and Education of the Ministry of Environment, Forest and Climate Change, Government of India. They are also one of the Bamboo Technology Support Group of National Bamboo Mission. As per the Director of the Institute: the present yield of forests based bamboo is 2-3 MT/ha (forests) and non-forest bamboo is 10-15 MT/ha (plantations). In order to increase productivity of forests based bamboo, the following are needed: soil management, decongestion, fire protection, scientific extraction. In case of non-forest bamboo: it is necessary to have high yielding genotypes of selected species and intensive cultivation, which can increase yield to 50-100 MT/ha. In addition, the integration of bamboo in agro-forestry systems is needed.
Indian Institute of Entrepreneurship (IIE) Guwahati	IIE is involved in the development of entrepreneurship in NE region. In addition, it supports crafts clusters. The bamboo sector faces numerous challenges in the entire value chain from raw materials, production, technology, finance and marketing. The different schemes of Govt. of India like SFURTI, MSE-CDP etc. can be used to provide a solution to some of the above issues.
Meghalaya Institute of Entrepreneurship (MIE)	MIE is the Nodal institution for facilitating rapid economic transformation through entrepreneurship education and promotion of micro enterprises involving the youth, women and other critical target groups in the State of Meghalaya. MIE can develop bamboo based entrepreneurship in Meghalaya.
North East Space Application Centre (NESAC)	North Eastern Space Applications Centre (NESAC), a joint initiative of Department of Space (DOS) and the North Eastern Council (NEC) is a society registered under the Meghalaya Societies Registration Act, 1983. The Centre has provided more than 20 years of dedicated service to the eight states of North Eastern Region (NER) of India using space science and technology. NESAC has already conducted exercises such as Bamboo resource mapping (pure patches) for the state of Arunachal Pradesh (2006), Bamboo flowering monitoring in the state of Mizoram State (2005, 2006 & 2008), Bamboo flowering and stock estimation for Dima Hasao District of Assam (2009), Bamboo resource and stock estimation for six districts of Nagaland (2010) and Bamboo growing areas mapping in two districts of Nagaland. NESAC Scientist stressed on the need of systematic estimation of bamboo resources of NER and emphasized on the role of satellite imagery in this regard.

Feedback from Bamboo based Industrial Units

For the regular supply of bamboo from the growers, the latter must earn adequately. This will induce others to take up bamboo cultivation. In this manner, the supply of quality bamboos can be built up.

As bamboo is a new material for the production of items like panels, tiles and laminated furniture; the confidence of consumers' needs are required to be developed. Bamboo items are considered as niche products. Awareness amongst potential users is low. Bamboo based products have been made mandatory in CPWD and other Central Govt. agencies. The State Governments can follow such an approach. The other way out is to launch a publicly funded awareness campaign.

Prices are higher in India, as units are not clustered (as in China). Clusters may be promoted for bamboo development. Financing is difficult and rates of interest are high. Power issues have to be addressed. Transport costs may be subsidized, and the occasional demands for forest permits can be checked. Mechanics need to be trained to repair the foreign supplied equipment.

Feedback was also received from Assam Bio-Refinery Pvt. Ltd., which is establishing a bio-refinery based on the processing of bamboo chips. The bio-ethanol produced by the refinery will be used to blend the fuels produced in the Numaligarh Refinery Ltd. (NRL), which is located nearby. The project is under establishment, and is proposed to be completed by 2021.

Inputs from Bamboo Entrepreneurs

The entrepreneurs working in the bamboo sector face challenges across the value chain from sourcing quality and appropriate bamboos to marketing of items. Despite the reported stock of bamboos, entrepreneurs in Assam, Mizoram and Tripura spoke about difficulties in obtaining the right kind of bamboos. They stated that Raw Materials Bank may be created.

The non-availability of bank finance was reported by the entrepreneurs, as banks were reluctant to lend and valuation of their business was a challenge. Payments for sales also took time in many cases, which increases the requirement for working capital. Another issue was the high cost of transportation as bamboo items tend to be bulky. The other aspects discussed included the higher labour costs in some states, skills development costs, need to upgrade tools and equipment etc.

While many stakeholders in the Government and Institutions were working on bamboo development, their efforts were not benefitting most of the entrepreneurs who are active in the bamboo sector.

Stakeholders working with Bamboo based Crafts

The following feedback was received on bamboo based crafts from the above category of stakeholders.

Tripura: The feedback provided from PURBASA was that there were a limited number of artisans working with them (200 master craftsmen in 19 clusters). Even then, these craftsmen faced issues like Insufficiency of raw material, challenges in transportation, unavailability of modern tools etc. The best-

OUTPUT & OUTCOME OF THE PLAN

selling items include Room Dividers, Basketry, Light Shades, Idols and Cane Furniture. It was suggested that the following are needed for promotion of bamboo crafts: skill development programme, bamboo plantation, up-gradation of tools, export of handicraft products and financial aid.

Assam: As per feedback received from a representative of a sizeable bamboo cluster in Upper Assam, they are exporting part of their output. The main items made by them include furniture, decorative items, musical instruments etc. The requirements of the units in this cluster include improved technology, market infrastructure, training and financial support.

In another cluster, craftsmen faced issues due to their reliance upon sun drying. This was not possible in the rainy months. Other issues included lack of warehouse for pre-processed and semi-processed products, requirement of raw materials bank along with treatment plant, non-existence of grading system of raw material, lack of market, constant power failure, issues of transportation due to bad road condition etc.

Officer from NEHDC, a public sector undertaking based in NE Region and working in the crafts sector, discussed about the problem being faced by the artisans and the manufacturing units in Assam. The main problem in Assam as opined by him is the lack of production as the farmers are part time artisans. Other issues include lack of bulk production, right raw material, and lack of awareness. He advised the need for improvised packaging, commercialization and 'Partial mechanization' of craft during production.

Inputs from Bamboo Machinery Suppliers

A meeting was held with suppliers of bamboo machinery. Many types of machines are being now made in India.

As per the feedback received, the selection of machinery needs to be done as per available species. In addition, the use of Intellectual Property Rights (IPR) is needed to safeguard innovative products. The development of design and product variants can be undertaken as per the requirements and quality expectation of consumers. Manufacturers of machinery and end users of such equipment can work in partnership for these matters. The suppliers also made suggestions for the general development of bamboo sector in India.

Feedback from Banks & Financial Institutions

Bankers pointed out the lack of post-harvest infrastructure for bamboo in the region. Bamboo as a versatile product can bring economic change to the NER but its large scale industrialization in the region has not taken off well. The bamboo ecosystem needs commercial system, organized marketing system and logistics management. Collaboration is required in this regard amongst various stakeholders. Appropriate financing schemes such as MUDRA Scheme need to be explored for the sector; along with convergence with schemes like Prime Minister Employment Generation Programme (PMEGP) and Deen Dayal Upadhyaya Swavalamban Yojana.

OUTPUT & OUTCOME OF THE PLAN

Data on bamboo sector is very limited which need to be worked on. Reliable data on the availability of raw material is the first necessity for setting up any industry. Further, on-boarding entrepreneur to work with cluster level artisans and growers is important to create a symbiotic ecosystem. The CSR funding option from private sector was discussed for creation of bamboo plantations.

National Bamboo Mission (NBM)

The key points suggested by the officials of NBM (Additional Secretary & I/C of NBM, and Additional Commissioner of NBM) are mentioned below-

- Business plan with each sector should be made. Bamboo can replace of wood, steel etc. There should be focus on the production of Biogas, Bio ethanol etc.
- Focus should be for marketable species. The resource mapping is in progress and NBM has identified 10 species for industrialization
- Nursery activities on non-forest land need to be taken up and forest land should be brought under the value chain
- Agriculture, Forest and Industry Department need to work together for development of the bamboo sector.
- There should be linkage between the Farmer and the Market. Similar linkage need to be developed between the Industry and the Domestic Producers.
- Industries should focus on zero wastage for value added products.
- Bamboo sector entrepreneurship development should be led by IIE. Analysis of the challenges of bamboo enterprises of North East India needs to be analysed. Awareness of the financial institutes for bamboo sector credit needs to be increased.
- There should be major focus on the Engineered Bamboo for high end construction, for that institutes which are already working on it should be contacted like KONBAC, BRTC Maharashtra along with expert architects.
- Handicrafts sector should be made attractive to increase the demand.
- Bamboo Wood and Composites need to be promoted through promotion of possible uses in terms of technical aspects.
- The Mantra should be increase of Exports and decrease of Imports.
- Quality Certification need to be introduced
- Infrastructure support such as uninterrupted power supply needs to be ensured.

Discussions with State Bamboo Missions

Discussions were organized with officers of State Bamboo Missions of five NE states – Assam, Meghalaya, Mizoram, Nagaland and Tripura. Their major inputs have been furnished below.

Assam: Representative from the State Bamboo Mission of Assam mentioned that the Assam State Bamboo Mission has already developed a Bamboo and Cane Policy during the last year. A draft of Operational Guidelines has also been prepared in this regard. The state has cultivated 585 hectares of land with 520 farmers. Presently the priority of the state is Bamboo Plantation and Bamboo Processing. The state is also facing issue in terms of fund release from the central. There has been no proper study or plan for the Bamboo Sector of the state, so a feasibility study would be helpful in this regard by hiring a professional agency. The State Bamboo Mission of Assam also sent a few artisans for training with the BCDI, Tripura. The mission is closely working with Assam Bio Refinery Pvt. LTD. It has also signed an MOU with Cycle Brand Agarbatti. There is also a plan to develop two more clusters in the state in the plantation sector.

Meghalaya: The Meghalaya State Bamboo Mission has developed a 5-year Action Plan last year, which they will share with NBM. Currently they are engaged with different projects one of them is Resource Mapping with North Eastern Space Application Centre, (NESAC), which will be helpful in the species wise estimation of Bamboo in the region. And the other project is Bamboo Market Survey with NEDFi. Their priority areas are mainly small scale industries and Handicrafts. In terms of industries, they are focusing on Semi Processed Bamboo Products. There is no shortage of entrepreneurs in the state. The major problem that the State Mission faces is the fund release from the NBM. The mission is also working on Product Development, Product Design and Product Certification in order to maintain the standards for export of the product and widen their existing market.

Mizoram: The Mizoram State Bamboo Mission is currently working on sustainable Development with Bamboo, Promotion of community based Bamboo Plantation, Small, Medium & Large scales bamboo industry, collaboration with trade association and model Bamboo Plantation development. The state currently has 5 nos. of demonstration plots. The state has identified two species for Industrial purpose. The mission aims at promoting optimum utilization of the current species, promote certified material. The mission has also formed nursery verification team.

The state has also formed Bamboo Development Board. The challenges faced by the state are- Poor connectivity due to uneven topography, limited availability of quality planting material, lack of sufficient Human Resources, lack of entrepreneurs. The state informed that allocations are not received on time from NBM and due Bamboo is a season bound crop, with late funding plantation is difficult. Further, the cost of production is also much higher due to poor connectivity.

Nagaland: The Nagaland State Bamboo Mission aims at Poverty alleviation, modernization of the value added products and development of caged bamboo. The state has undertaken 474 hectares plantation has been done in 6 districts. They have also launched several lifestyle units like bamboo toothpick, etc., handicrafts units, Bamboo Treatment Plant, furniture unit, big nurseries etc. They are also

OUTPUT & OUTCOME OF THE PLAN

in the process to sign a MOU with Taiwan, for India Taiwan Technical Centre to be set up in Nagaland. There are about 46 species of Bamboo found in Nagaland out of which 6 are economically viable. For remaining species, the state is focusing on production of charcoal with target market of bakery unit and household purpose like barbeque. Activated charcoal can be another potential product of the state with good export market especially in South East Asia. The state has also raised the issue of late fund release by NBM.

Tripura: The Tripura State Bamboo Mission has taken up development of Grass root institutes, Capacity building, Production making and marketing, Semi mechanized Agarbatti. The state has developed 25 clusters and 50 village level units. Design Development Cell has been set up. The state has targeted formation of 100 nos. bamboo round stick making units. In this regard, Mukhya Mantri Agarbatti Mission has also been launched. The state requires support in terms of National Level Buyer Seller meet, Packaging and Marketing. The NBM has provided modern machines which has been helpful in terms reducing cost and improving quality. Two Bamboo Depots has been developed in the state to promote cultivation and popularize the use of bamboo mainly at Kumarghat in Unokoti, North Tripura and at Chakmaghat in Khowai district.

International Best Practices (Video Conferencing)

Participants from nations like Philippines, Vietnam, Indonesia, Kenya and Tanzania joined the above discussions. They spoke from their perspectives. The major inputs were as follows.

Participant from Philippines (Executive Director of Foundation working on Bamboo): She began her session by discussing the process of Value Addition Chain of Philippines. For the Development Planning of Bamboo, she said the considering factors such as Market: (what the kind of Market is, who are the Buyers, the quantity and the prices, the capacity of the people, these are the interims of Market), Raw Materials (the quantity required, the prices, the production time period, Technology available), Infrastructure (infrastructure for the raw material, production, cost of the infrastructure), Funding (to develop the market, to develop the product and to develop the plantation) are important. All these elements are important for developing the bamboo industry.

Focus should be placed on the vision for the region. In Philippines, industrialized handicraft is focused and for that the main aspects are availability of raw materials, which will lead for the higher volume production. In terms of skill development, it is always the training cum production. It was also mentioned that everyone who plays a part in the entire value chain process gets a share in the cost of the product.

Participant from Vietnam (Field Coordinator of INBAR): He focused on the collaboration between the local community and the private company. He emphasized on facilitate partnership through collaboration between target groups such as local community, private sectors, local governments, NGOs, CBOs and educational institutions. He explained the bamboo based livelihood model of Lung species of Bamboo available in Vietnam.

OUTPUT & OUTCOME OF THE PLAN

Lung is a unique bamboo species of Vietnam, which has economic value and is found naturally grown in forest area. Lung is being over exploited as a result of poor management and planning that lead to volume and quality. The approach of the project managed by the speaker was mainly through equitable local community private sector partnership on forest and intervention of the government. The project aimed at reducing deforestation and forest degradation, increasing forest cover, carbon stock, Benefits sharing of added value of Lung Value Chain, explore social interests and investment to forest landscape restoration and biodiversity conservation and Improved forest management. Under the project 5 Lung Farmers groups were established covering 121 households. Interventions included negotiation meetings training course on sustainable Lung Bamboo Harvesting and Management and on strengthening local community capacity.

The changes after project intervention that has been observed included: improved organization of the production, stable consumer base for Lung Bamboo materials, improved capacities of local communities, improved value chain and increase in farmer incomes.

Participant from Kenya (National Programme Coordinator of Bamboo Development Project): The participant spoke about the bamboo based livelihood model in Kenya. After the introduction of exotic bamboo, a number of farmers and entrepreneurs have planted bamboo in country as she informed. Government institutions, CBOs, individual/private firms are propagating and planting bamboo seedlings. Her suggestions for making bamboo an organized sector of the economy include:

- Determine the quantity of bamboo planted;
- Use on-farm mobile application database;
- Research studies on physical, mechanical and chemical properties;
- Value chain analysis, site matching, Increased awareness on value of bamboo;
- Promotion of on-farm planting;
- Promote value chains - bamboo nurseries, value addition (timber, furniture, stick industry, handicrafts, biomass energy etc.); and
- Development of standards, curricula, guidelines etc.

She also discussed about promotion of bamboo by the government for environmental management of the country which includes development of Mt. Kenya Ecosystems Management Plan and the Aberdares Ecosystems Management Plans. The government has also come up with a guideline for managing natural bamboo resources of the country. The country is promoting bamboo in riverine areas to recharge the river which can serve in uptake of heavy metals from polluted aquatic ecosystems.

Appendix-2: Wastelands in NE States

The following pages give the details of wastelands in different NE states as per the Wasteland Atlas of India 2019. The following summarizes the extent of wastelands in these states.

Table-A (5).1: Summary of Wastelands in NE Region

	Total Geographical Area (km ²)	Total Wastelands in km ² ¹ (2019 Atlas)	Wasteland to Area as (%)
Arunachal Pradesh	83743	13906.16	16.61
Assam	77438	9003.08	11.63
Manipur	22327	5651.89	25.31
Meghalaya	22429	4135.77	18.44
Mizoram	21081	4300.66	20.4
Nagaland	16579	5064.17	30.55
Sikkim	7096	3294.79	46.43
Tripura	10486	920.52	8.78
NE Region	261179	46277.04	17.72

It may be noted that the following categories of wastelands can be covered by bamboo as per experts.

- 3- Land with Dense Scrub,
- 4- Land with Open Scrub,
- 9-Shifting Cultivation - Current Jhum,
- 10-Shifting Cultivation - Abandoned Jhum,
- 11-Under-utilised/degraded forest (Scrub dominant),
- 12-Under-utilised/degraded forest (Agriculture),
- 14- Degraded land under plantation crop,
- 20 - Mining Wastelands.

The extent of the above categories is summarized as follows-

Table-A (5).2: Extent of Wastelands suited for Bamboo in NE Region

States	Total Wasteland	Bamboo Cultivation Wasteland (in Ha)								Total
		3	4	9	10	11	12	14	20	
Arunachal Pradesh	1390616	63353	181825	50911	120422	1680	59		0	418250
Assam	900308	209281	199334	5260	8209	176125	211606		8632	818447
Manipur	565189	121112	314510	49998	29865	48600	21		0	564106
Meghalaya	413577	50998	261219	23787	42268	6461	0		5429	390162
Mizoram	430066	158684	46688	69155	101139	54400	0		0	430066
Nagaland	506417	131587	207772	97933	68121	1	159		492	506065
Sikkim	329479	0	1630	0	0	9209	0		0	10839
Tripura	92052	20480	21451	3062	6420	37156	1611	615	0	90795
	4627704									3228730

APPENDIX-2: WASTELANDS IN NORTH EASTERN STATES

Table-A (5):3: Classification of Wastelands in the North Eastern States

		Arunachal Pradesh	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura	NE Region
(A)	Total Geographical Area	83743.00	77438.00	22327.00	22429.00	21081.00	16579.00	7096.00	10486.00	261179.00
(B)	Total Wastelands (2019 Atlas)	13906.16	9003.08	5651.89	4135.77	4300.66	5064.17	3294.79	920.52	46277.04
C	Wasteland to Area as (%)	16.61	11.63	25.31	18.44	20.40	30.55	46.43	8.78	17.72
(D)	Categories of Wastelands									
1	Gullied & Ravine Land (Medium)	0.00	0.00	1.29	0.00	0.00	0.00	0.00	0.48	1.77
2	Gullied & Ravine Land (Deep)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	Dense Scrub	633.53	2092.81	1211.12	509.98	1586.84	1315.87	0.00	204.80	7554.95
4	Open Scrub	1818.25	1993.34	3145.10	2612.19	466.88	2077.72	16.30	214.51	12344.29
5	Water-logged / Marshy Land (Permanent)	1.28	175.86	7.53	0.00	0.00	0.00	0.00	1.82	186.49
6	Water-logged / Marshy Land (Seasonal)	0.00	573.67	0.00	0.01	0.00	0.00	0.00	6.18	579.86
7	Land affected by salinity / alkalinity (Medium)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Land affected by salinity / alkalinity (Strong)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	Jhum Land - Current	509.11	52.60	499.98	237.87	691.55	979.33	0.00	30.62	3001.06
10	Jhum Land - Abandoned	1204.22	82.09	298.65	422.68	1011.39	681.21	0.00	64.20	3764.44
11	Degraded Forest - Scrub Dominant	16.80	1761.25	486.00	64.61	544.00	0.01	92.09	371.56	3336.32
12	Degraded Forest - Farm Dominant	14.94	2116.06	0.21	0.00	0.00	1.59	0.00	16.11	2148.91
13	Degraded Pastures	253.52	21.35	0.37	0.00	0.00	0.00	3.10	0.00	278.34
14	Plantations on Degraded Lands	0.00	0.00	0.00	0.15	0.00	0.00	0.00	6.15	6.30
15	Sands - River	0.00	42.02	0.00	0.00	0.00	0.00	0.00	3.68	45.70
16	Sands - Coastal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	Sands - Desert	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	Sand Dunes > 40 m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	Sand Dunes 15-40 m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	Mining Wastelands	0.00	86.32	0.00	54.49	0.00	4.92	0.00	0.00	145.73
21	Industrial Wastelands	0.00	5.71	0.00	0.00	0.00	0.00	0.00	0.42	6.13
22	Barren & Rocky Land	124.24	0.00	1.63	233.78	0.00	3.53	1116.92	0.00	1480.10
23	Snow & Glacier	9330.26	0.00	0.00	0.00	0.00	0.00	2066.38	0.00	11396.64

Source: Wasteland Atlas of India 2019

APPENDIX-2: WASTELANDS IN NORTH EASTERN STATES

The following gives the description of the various types of wastelands referred to in the above table.

	Gullied and Ravine Land	Gully is a narrow channel when surface water flow increases in response to clearing and excessive use of land. Other factors that play a role in gully initiation are the type of landscape, geology, rainfall, soil texture, hill-slope length and seasonal climatic extremes. The intricate network of gullies is referred to as ravines. Two categories of ravines viz., medium ravines and deep ravines could be delineated based on their depth
1	Gullied & Ravine Land (Medium)	These are the ravines with a depth of gullies ranging between 2.5 and 5 meters. Generally, these are seen confined to the head region of the stream close to agricultural land.
2	Gullied & Ravine Land (Deep)	The depth of ravines is more than 5 meters. Deep ravines, generally, occur along the higher order stream areas that are close to the main river.
	Scrubland	This is the land, which is generally prone to deterioration due to erosion. Such lands generally occupy topographically high locations, excluding hilly/mountainous terrain. Based on the presence of vegetation cover, two sub-classes could be delineated i.e., land with dense scrub and land with open scrub.
3	Dense Scrub	These areas have shallow and skeletal soils, at times chemically degraded, extremes of slopes, severely eroded and are subjected to excessive aridity with scrubs dominating the landscape. They have a tendency for intermixing with croplands.
4	Open Scrub	This category is same as mentioned in the earlier category except that it has sparse vegetative cover or is devoid of scrub and has a thin soil covers.
	Water-logged / Marshy Land	Waterlogged land is that low lying land where the water is at/or near the surface and the water stands for most part of the year. Depending on duration of water-logging, two sub-classes viz., permanently waterlogged and seasonally waterlogged areas could be delineated.
5	Water-logged / Marshy Land (Permanent)	Permanently waterlogged areas are those where the water-logging conditions prevail during most part of the year. These areas are mostly located in low-lying areas, with impervious substratum along the canals/ river banks, coastal inlands, etc.
6	Water-logged / Marshy Land (Seasonal)	Seasonally waterlogged areas are those where the water-logging condition prevails usually during the monsoon period. These lands are mostly located in plain areas associated with the drainage congestion. Use of multi-season satellite data enables delineation of this category.
	Land affected by salinity / alkalinity	Land affected by salinity/alkalinity has excess soluble salts (saline) or high exchangeable sodium. Salinity is caused due to capillary movement of water, during extreme weather conditions leaving salt encrustation on the surface. Alkali soils have exchangeable sodium percentage (ESP) values of 15 or more, which is generally considered as the limit between normal and alkali soils. The predominant salts in alkali soils are carbonates and bicarbonates of sodium. Considering the degree of salinity and or alkalinity, the following two sub- classes viz., moderately saline / alkali and strongly saline / alkali areas could be delineated
7	Land affected by salinity / alkalinity (Medium)	These are the areas located in the fluvial plains with the degree of salinity (ECe) ranging from 8 to 30 (dS/m), pH between 9.0 – 9.8 and the Exchangeable Sodium Percentage (ESP) values ranging between 15 and 40.
8	Land affected by salinity / alkalinity (Strong)	These are the salt-affected lands with ECe values greater than 30 dS/m, pH values more than 9.8 and ESP values of >40. 5)
	Jhum Land (Shifting Cultivation)	Shifting cultivation is a traditional practice of growing crops on forested/ vegetated hill-slope by the slash and burn method.
9	Jhum Land - Current	The areas that are used for cultivation by the slash and burn practices and are clearly perceptible on the satellite image in pre-burnt /post-burnt conditions.
10	Jhum Land - Abandoned	those areas that were earlier under shifting cultivation but subsequently left idle for more than one year but less than 5 years, thereby giving a scope for the regeneration of secondary vegetation such as bamboo or grasses. This category has a tendency to get mixed with forests.

APPENDIX-2: WASTELANDS IN NORTH EASTERN STATES

	Degraded Forests	Two sub-classes have been delineated viz., scrub dominated degraded forest land and agriculture land inside notified forest area
11	Degraded Forest - Scrub Dominant	Land, as notified under the Forest Act and those lands with various types of forest cover with less than 20 % of vegetative cover, are classified as degraded forest. These lands are generally confined to the fringe areas of notified forest.
12	Degraded Forest - Farm Dominant	This category refers to land that have been notified under the Forest Act, in which agriculture is being practiced, (excluding for the de-notified forest areas).
13	Degraded Pastures & Grazing Land	These are the lands in non-forest areas that are either under permanent pastures or meadows, which have degraded due to lack of proper soil and water conservation and drainage development measures
14	Plantations on Degraded Lands	These are the degraded lands that have been brought under plantation crops after reclamation, and are located outside the notified forest areas
	Sand (coastal / desert / riverine)	This category refers to land with accumulation of sand, in coastal, riverine or inland areas. Generally, these lands vary in size, occur in various shapes with contiguous to linear pattern. These lands are mostly found in deserts, riverbeds and along the shores.
15	Sands - River	Riverine sands are those that are accumulated in the flood plain of the river as sheets, or sand bars. It also includes inland sand which was accumulated along the abandoned river courses or by reworking of sand deposits by wind action leading to long stretches of sand dunes or sand cover areas noticed in Indo-Gangetic alluvial plains
16	Sands - Coastal	Coastal sands are the sands that are accumulated as a strip along the seacoast due to action of seawater. These are not being used for any purpose like recreation.
17	Sands - Desert	These are those confined to arid environment where the rainfall is scanty. These lands are characterized by accumulation of sand in the form of varying size of sand dunes and height that have developed as a result of transportation of soil through aeolian processes. The following two categories of desert sands could be mapped based on their vertical approximate heights.
18	Sand Dunes > 40 m	Semi-stabilized to stabilized dunes with >40 m height
19	Sand Dunes 15-40 m	Semi-stabilized to stabilized moderately high dunes with heights ranging between 15 and 40 m
20	Mining Wastelands	Mine dumps are those lands where waste debris is accumulated after extraction of minerals. Included in this category is the mine / quarry areas subject to removal of different earth material (both surface and sub-surface) by manual and mechanized operations. Large scale quarrying and mechanical operations result in creation of mine dumps. It includes surface rocks and stone quarries, sand and gravel pits, soil excavation for brick kilns, etc
21	Industrial Wastelands	These are areas of stockpile of storage dump of industrial raw material or slag/effluents or waste material or quarried/mixed debris from earth's surface.
22	Barren & Rocky Land	These are rock exposures of varying lithology often barren and devoid of soil and vegetative cover. They occur amidst hill-forests as openings or as isolated exposures on plateau and plains. Barren rocky areas occur on steep isolated hillocks/hill slopes, crests, plateau and eroded plains associated with barren and exposed rocky/stony wastes, lateritic out-crops, mining and quarrying sites. The category also includes steep sloping areas devoid of vegetation cover that were classified separately in the earlier exercise
23	Snow & Glacier	These lands are under perpetual snow cover and are confined to the Himalayan region. The mountain peaks and slopes and high relief areas are the places where snow/glacial areas occurs