

**PROCEEDINGS OF
THE NATIONAL CONFERENCE ON
DISSEMINATION OF INNOVATIONS IN
BAMBOO SECTOR FOR IMPROVING
THE RURAL ECONOMY
&
ARTICLES ON BAMBOO**

3 - 4 March, 2022

NIRDPR, Hyderabad, Telangana

Jointly organised by



**Centre for Innovations in Public
Systems (CIPS)**

College Park Campus (CPC) of
Administrative Staff College of India
(ASCI), Banjara Hills, Road No. 3,
Hyderabad - 500034, Telangana.

www.cips.org.in



**National Institute of Rural Development
and Panchayati Raj (NIRDPR)**

(Ministry of Rural Development, Government
of India)

Rajendranagar, Hyderabad - 500030

Telangana

www.nirdpr.org.in

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1. National Institute of Rural Development and Panchayati Raj (NIRDPR)

Rajendranagar, Hyderabad - 500030, Telangana, India

2. Centre for Innovations in Public Systems (CIPS)

College Park Campus (CPC) of Administrative Staff College of India ASCI,

Banjara Hills, Hyderabad - 500034, Telangana, India

Advisory Team:

1. Dr. G Narendra Kumar, IAS, Director General, NIRDPR

2. Mr. C Achalender Reddy, IFS (Retd.), Director, CIPS

3. Dr. R Ramesh, Associate Professor, NIRDPR

4. Dr. Partha Pratim Sahu, Associate Professor, NIRDPR

Organising Team:

1. Dr. C Kathiresan, Associate Professor & Head, CIAT&SJ, NIRDPR

2. Mr. Mohammad Khan, Senior Consultant, CIAT&SJ, NIRDPR

3. Dr. P K Ghosh, Assistant Director, CIAT&SJ, NIRDPR

4. Dr. Fareed Ahmed, Advisor, CIPS

5. Mr. Dasari Balakishan, Advisor, CIPS

6. Ms. P Sri Vidya, Manager (Admin.), CIPS

7. Mr. Mohammed Ahmed, Sr. PRA (IT), CIPS

8. Mr. Shaik Mirza Mohan Bethune, Jr. Consultant/PRA, CIPS

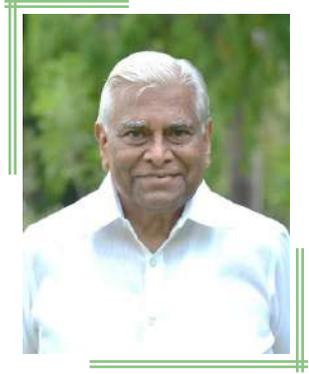
9. Mr. Arpan Hazra, Project Associate, CIAT&SJ, NIRDPR

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Message

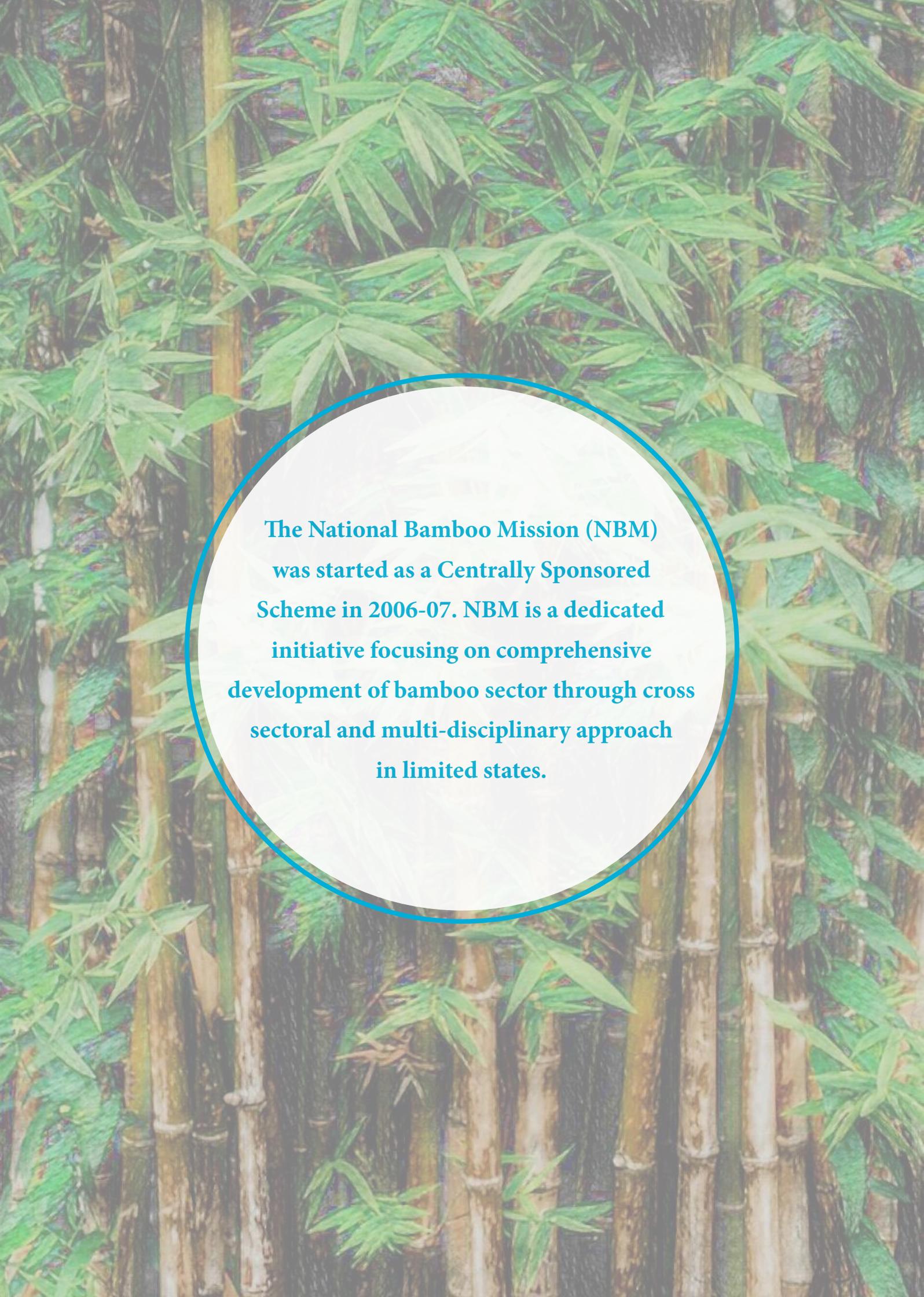
The National Conference on Dissemination of Innovations in Bamboo Sector for Improving the Rural Economy brought the stakeholders of Bamboo from all over India on to one platform and helped to deliberate the issues and solutions in promoting Bamboo and in improving the Rural Economy.



I believe that this conference proceedings and articles on various aspects of Bamboo will pave the way for promoting Bamboo. I am happy that CIPS has become a vibrant platform for promoting and replicating the innovations focused on the improvement of Rural Economy. I also take this opportunity to highlight that there are wide variations in terms of information on certain aspects related to Bamboo and also statistics quoted. Therefore, there is an urgent need to consolidate the data by cross checking by professionals and experts so that we have correct figures in respect of different species and the areas in which they are growing, both in forest (wild) and cultivated by farmers in India. This action would help us to plan for comprehensive promotion of Bamboo in India. This document throws light on various aspects of Bamboo propagation, its utility etc. I am hopeful that this publication will be useful for all the stakeholders interested in promoting Bamboo and facilitate in doubling the farmers' income.

A handwritten signature in blue ink, appearing to read 'K. Padmanabhaiah', with a stylized flourish at the end.

Shri. K. Padmanabhaiah, IAS (Retd.)
Chairman, Court of Governors, ASCI &
Chairman, Advisory Council – CIPS



The National Bamboo Mission (NBM) was started as a Centrally Sponsored Scheme in 2006-07. NBM is a dedicated initiative focusing on comprehensive development of bamboo sector through cross sectoral and multi-disciplinary approach in limited states.

Foreword

I am pleased to present the proceedings of National Conference on “Dissemination of Innovations in Bamboo Sector for Improving the Rural Economy” held on 03 - 04 March, 2022 at the NIRD&PR campus to promote “Bamboo Sector” and help stimulate the exchange of knowledge and best practices that have been developed both in the public and private spheres.



The purpose of this conclave was to invite eminent speakers with vast experience on the bamboo ecosystem for promoting the holistic growth and innovation in the sector across the entire value chain. The conclave also attempted to find suitable solutions to issues being faced by the bamboo sector and options for improving the rural economy through promotion of advancements in the bamboo sector and relevant technology. The conference facilitated experience-sharing and knowledge-exchange, bringing informed ideas, inputs and insights.

This proceedings provides glimpses of the experience shared by Policy makers, innovators and entrepreneurs in the conclave. I am sure this will encourage all the stakeholders with very useful and innovative ideas to come forward and contribute to the task of transforming rural India. I am hopeful that the National Bamboo Mission launched in 2019 by Ministry of Agriculture and Farmers Welfare, envisages to promote the holistic growth of bamboo sector, by supporting farmers in commercial bamboo cultivation through supply of planting material, establishing processing centres and imparting training to rural artisans in bamboo based product development and marketing. There are greater opportunities to harness the market potential by increasing its production and ensuring establishment of a proper value chain ecosystem, bringing together all the key stakeholders and improve the rural economy. There is a great potential to create value chain in bamboo sector, by linking the key stakeholders in this sector, including bamboo cultivators, bamboo processing centres, bamboo product manufacturers, construction companies using bamboo, rural artisans etc. Many innovative and appropriate technologies in bamboo processing and product manufacturing have been documented from various states.

I am sure that this report will be of immense use in uplifting the bamboo sector and enable in transforming the rural economy of the country.


Dr. Narendra Kumar, IAS
Director General, NIRDPR



NBM initiative is focusing on comprehensive development of bamboo sector. Keeping in view Hon'ble Prime Minister's vision of doubling farmers income and 'Har Medh Par Ped', it will supplement income and livelihood sources, including during crop damage caused by extreme events.

From the Desk of Director

The dizzying pace of innovation has led to new advancements in all sectors bringing forth new processes, services, and exciting discoveries. This is true in the case of the bamboo sector also.

Centre for Innovations in Public Systems, whose main objective is promoting an innovative eco-system for transforming creative ideas into sustainable practices mooted the idea of conducting the National conference on “Dissemination of Innovation in Bamboo sector for Improving the Rural Economy” because of its multifarious uses. Bamboo has the potential to contribute significantly to the National objective of Doubling the Farmers’ Income.

In order to achieve this objective, eminent speakers on various aspects of Bamboo across the country were invited. They deliberated and discussed various issues and provided probable solutions and the same were brought out in the form of proceedings of the conference.

Along with the proceedings, some articles contributed by eminent experts and professionals post conference were also included, which, I think will give some insights into various issues for the holistic promotion of Bamboo.

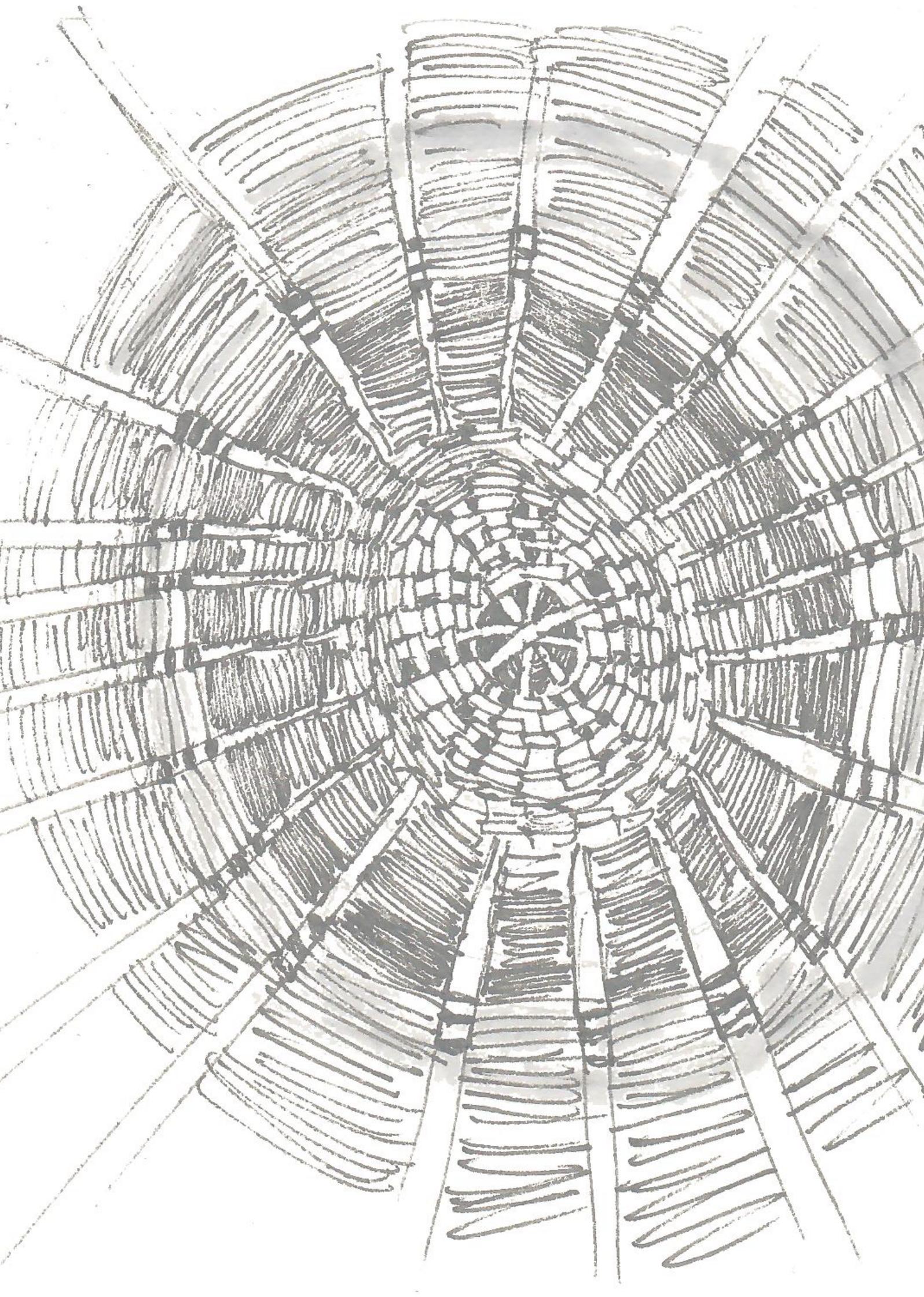
The insightful contents, I am sure would help in stirring the minds of all the stakeholders and will pave the way for incremental development in Bamboo propagation and its uses eventually leading to improving the livelihoods of rural people and in turn Rural Economy.



A handwritten signature in blue ink, consisting of a stylized 'C' followed by a series of loops and a long horizontal stroke extending to the right.

Shri. C. Achalender Reddy, IFS (Retd.)

Director, Centre for Innovations in Public Systems (CIPS)



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PART - I:
PROCEEDINGS





1. Introduction

Bamboo is one of the versatile and fastest growing plant species. With its multifarious uses, bamboo has the potential to contribute significantly for the national objective of 'Doubling Farmers Income' as an important contributor to secondary agriculture. Promotion of bamboo sector has many opportunities and perspectives for supporting livelihoods of rural people. The demand for bamboo in India is being met from bamboo plantations from the forests of North eastern Region, Northern Plains and Central part of the Deccan Plateau. Plantations outside the forest area, are the viable alternative to meet the growing demand. The Bamboo industry in India has potential to be worth nearly Rs 30,000 crores per annum (as per Mr. Nitin Gadkari, Union Minister, MSME, GoI). In spite of huge growing stock within forests and plantations on farmers lands, India is a net importer of bamboo (as per National Bamboo Mission, MSME, GoI). There are greater opportunities to harness the market potential by increasing its production and ensuring establishment of a proper value chain ecosystem, bringing together all the key stakeholders to improve the rural economy.

The restructured National Bamboo Mission launched in 2019 by Ministry of Agriculture and Farmers Welfare, envisages to promote the holistic growth of bamboo sector, by supporting farmers in commercial bamboo cultivation through supply of quality/certified planting material, establishing processing centres, common facility centres, bamboo research and technology centres and imparting training to rural artisans in product development leading to marketing. In the last 3 years, demand for bamboo for construction industry and manufacturing innovative products has increased. Many innovative and appropriate technologies in bamboo processing and product manufacturing have been documented from various states. There is a great potential to create value chain in bamboo sector, by linking the key stakeholders in this sector, including bamboo cultivators, bamboo processing centres, bamboo product manufactures, construction companies using bamboo and rural artisans etc..

Keeping in view of the above, National Institute of Rural Development and Panchayati Raj (NIRD & PR) and Centre for Innovations in Public Systems (CIPS) had jointly organized a two-day National Conference on "Dissemination of Innovations in Bamboo Sector for Improving the Rural Economy" on 03-04 March 2022 at the NIRD & PR campus to promote "Bamboo Sector" and to help stimulating the exchange of knowledge and best practices that have been developed both in the public and private spheres.

Participants for this conference included, bamboo farmers, promoters of bamboo products, scientists from reputed institutions working in bamboo sector including forest research institutes, representatives from construction sector, bamboo processing centres and bamboo entrepreneurs from various states.

2. Purpose and Rationale of holding the Conference

Often Ironically, communities that grow or conserve bamboo diversity in our country are among the poorest. One of the key reasons could be lack of adequate R&D support, tools and techniques for insitu value addition, identification of Bamboo diversity for multiple high-value products like composites for industrial use, bamboo-based food, nutrition, and health products. Therefore, scouting, identification and documentation of “Innovations for Replication in Bamboo Sector”, can be a promising solution.

For cultivating ideas and capitalising the strength of innovations across Bamboo sector, a 2-day National Bamboo conference was planned and organised jointly by CIPS and NIRD&PR for helping to develop entrepreneurial mindset among the youth. This is also aimed at supporting start-ups towards sector rejuvenation and create a zeal in bringing innovations towards self-reliant India i.e., Atmanirbhar Bharath with equal participation from Industry to Academia and stakeholder connect while developing future road map for bamboo-based initiative models.



3. Inaugural Session

3.1. Address by Shri Nagendra Nath Sinha, IAS, Secretary, Ministry of Rural Development, GoI



Shri Nagendra Nath Sinha, IAS, Secretary, Ministry of Rural Development, Government of India, virtually inaugurated the conference and was the Chief Guest of the conference. Dr. G. Narendra Kumar, IAS, Director General, NIRD&PR and Shri C. Achalender Reddy, IFS (Retd.), Director, CIPS, were also present. Around 160 participants, including entrepreneurs, manufactures of Bamboo products, bamboo farmers, artisans, forest officials and research scholars from various states, participated in the programme.

Shri Nagendra Nath Sinha, IAS, Secretary, Ministry of Rural Development, Government of India, delivered the inaugural address and highlighted the key role played by Rural Development schemes, particularly Mahatma Gandhi National Rural Employment Generation Act (MGNREGA), in promoting livelihoods through bamboo plantations. He advised NIRD&PR and CIPS to focus on developing value chain in bamboo and creating livelihood opportunities in rural areas.

3.2. Address by Dr. G. Narendra Kumar, IAS, Director General, NIRD&PR



Dr. G. Narendra Kumar, IAS, Director General, NIRD&PR, emphasised the need for bringing in coordination among the stakeholders so that the promotion of bamboo technologies reaches the common man in the rural areas for employment generation. This will bring down cost of production and lead to affordable prices for the Bamboo products. The issues pertaining to shortage of Bamboo raw materials and suitable Bamboo species for cultivation should be addressed. These issues are hampering the potentiality of Bamboo in construction sector and manufacturing artifacts. Bamboo will be the best alternative to farmer for assured income because of its non-perishable nature and long life span with multiple harvestings. The conference focussed on all the areas right from cultivation to value addition to marketing.



3.3. Address by Shri C. Achalender Reddy, IFS(Retd.), Director, CIPS



Shri C. Achalender Reddy, IFS (Retd.), Director, CIPS, presented the current scenario of the bamboo sector in the country and highlighted the need for connecting the missing links. He explained the context of the conference, where the focus was given equally on technical innovations and processes i.e., administration and regulatory innovations. The objective of the conference was to deliberate issues on increasing production, Enhancing productivity, doubling the farmers' income and raising their standard of living. He also shared his thoughts on the regulatory innovations brought out by the Government of India by bringing the amendment to the Indian Forest Act, 1927 which is a major game changer in Bamboo cultivation, felling and transportation. The amendment declassified Bamboo from timber to ordinary Bioresource



and equated to grass. He emphasised that Bamboo should become a tool not only for poverty alleviation but also to stimulate growth and prosperity of the rural masses.

3.4. Exhibition cum Sale of Bamboo Products

As part of this conference, an 'Exhibition cum Sale of Bamboo Products' was organised showcasing the bamboo technologies and innovations by various entrepreneurs. Sri Prasada Rao Vaddarapu, IFS, Director, livelihood & capacity development JICA Project, Tripura, Mr Sravan Kumar, a young entrepreneur from Telangana (Vrushali Live Innovations with Bamboo), Konkan Bamboo and Cane Development Centre (KONBAC), Maharashtra, Mr R.K. Mehta, Bamboo Promoter from Hyderabad and representatives from TRIFED participated in the Bamboo Products Exhibition organised alongside of the conference, which was inaugurated by Dr Narendra Kumar, IAS, Director General, NIRDPR.

While concluding the inaugural session Dr. C. Kathiresan, Associate Professor and Head, Centre for Innovations, Appropriate Technologies, Skills & Jobs (CIAT&SJ), National Institute of Rural Development and Panchayati Raj (NIRD&PR), Hyderabad extended vote of thanks to all the participants.



4. Presentation by the Eminent Speakers



ABSTRACT

Deliberations were held with experts from all over the country on the thematic areas:

- Why Bamboo?
- Bamboo for Construction & Furniture
- Innovative Products of Bamboo
- Prospects and Challenges of the Bamboo sector
- Bamboo: A Versatile Product
- Way Forward

SESSION - I: WHY BAMBOO?



Shri. Punati Sridhar, IFS (Retd.)

Former PCCF & HOFF Karnataka. Chairman, Bamboo Society of India (BSI).

[Bamboo- a versatile grass with great potential for rural economy]

Mobile: 9448105097

Email: poonatis@gmail.com

- Globally, millions of people across the world are making a living on Bamboo. India is blessed with 148 species of bamboo with 29 genera covering 15.69 million hectares of land.
- Bamboo reduces the effect of climate change by releasing 30% more oxygen than regular trees and sequesters and store 40% more carbon from air and fixes in its body and soil.
- No part of the bamboo plant is wasted. Shoots are harvested for food; branches for poles; main bamboo pole for fibers, pulp or charcoal production. Lower trunk for construction uses or flooring and engineered bamboo products.
- Traditional uses - scaffolding and basketry, food, musical instruments.
- Present uses - furniture, decor, beverages, engineered bamboo products, activated bamboo charcoal, cosmetics, chemicals, bamboo textiles, organic pesticides / fungicides, paper, ornaments, toys, bio- plastic granules, replacement for plastic, construction sector including schools, resorts, hotels, houses, architecture, interior decoration, etc.
- Innovative uses - heavy duty drainage pipes, wind turbines, dashboards in cars, aircrafts, etc.
- Ecology and environment: Combat climate change, phytoremediation, promoting agroforestry, live fencing, dry bamboo fencing, bamboo leaf composting.
- Over 2.2 billion people across the world are dependent on bamboo and bamboo based industries for bamboo products, income, food, and housing. China has over 8 million and India over 2 million people working in bamboo sector.
- Thus, the potential for increasing India's bamboo economy several folds is fairly good if we have the right policy, inventory information and support. This can create livelihood for millions of people especially women and youth as the sector mostly employs them. The increase in demand for bamboo products would also drive the expansion of commercial cultivation which would in turn enhance the farmers income.



Dr. Amit J. Agrawal

Assistant Professor, Department of Petrochemical Technology, Laximnarayan Institute of Technology, RTM Nagpur University, Nagpur. [Indigenous Technologies simplified for commercial & sustainable application of Bamboo to support Rural Economy]

Mobile: 9403148956

Email: amitjagrawal@gmail.com

- Looking towards the versatility of bamboo and to promote its farming, some research projects as mentioned below were undertaken in association with the Maharashtra Bamboo Development Board, Nagpur (MBDB) to improve the applicability of bamboo in several areas.
- Introduction, application and production of Activated Carbon
- Bamboo Fibers
- Disposables & Pencil Body
- Food Grade Silica from Bamboo Leaves
- Fire Retardant Coatings and Anti-Bacterial Coatings for Bamboo Structures



Ar. Neelam Manjunatha

Principal Architect,

Manasaram Architects. [Human Resources Development for Bamboo Seepashapator]

Mobile: 9945466204

Email: mansarch@gmail.com

- Ar. Neelam Manjunatha presented a film on the innovative bamboo products made by the gond tribes and its application in their house construction.
- There is a felt need for preparing a systematic Action plan covering multiple overlapping issues plaguing the use of Bamboo in building sector.
- Formulation of legal framework and policies by government in respect of governmental housing strategies i.e., including bamboo in building codes, generation of HSN codes, and funding for bamboo buildings.
- Inclusion of topic on Bamboo in academics like architecture, civil engineering and other related construction/building science degrees.

-
- Establishment of inter-disciplinary specialisation and partnerships with council of architects.
 - Area of action in research development, skill development, marketing.

SESSION - II: BAMBOO FOR CONSTRUCTION & FURNITURE



Dr. Sanjeev Shashikant Karpe

Managing Director

Native Konbac Bamboo Products Pvt. Ltd., Maharashtra. [Bamboo based construction and Furniture]

Mobile: 9422369789

Email: sanjeev.karpe@gmail.com,

konbacbamboogiftd@gmail.com

- Konbac Bamboo & Cane Development Center (KONBAC) has evolved over the years in the township of Kudal in the district of Sindhudurg, Maharashtra, as a market leader in bamboo products. Established in 2004 as a Section 25 company set up by the Centre for Indian Bamboo Resource and Technology (CIBART) and over a period of a decade, developed the expertise and experience in producing niche quality bamboo furniture and structures while promoting the better practice of the poor farmers growing bamboo, which is the most environmentally friendly plant on this planet.
- Konbac, with its present portfolio of bamboo-based construction and furniture products, has excelled in serving the demand across public and private sectors, boasting of a client base comprising of Taj Hotels, Mahindra Resorts, LAVASA, and Orissa Tourism Development Corporation, among others.
- Konbac is also developing its new innovative designs of engineered bamboo board-based furniture considering future demands.
- One of the key strategies developed by Konbac was to work towards positioning bamboo as a credible alternative to tree wood. Also, to provide the means where the rural poor, small and marginal farmers can participate in and benefit from the US \$100+ million wood products market. This would provide them with the needed income stability, buffer the uncertainties of agriculture and create a very large number of new jobs in rural areas.



Dr. Soham Pandya

Chairman

Centre for Environmental Development (CED)

Maharashtra. [Versatile and innovative uses of bamboo]

Mobile: 7030288445

Email: soham.ced@gmail.com

- Bamboo is divided into five distinct parts: (1) Rhizome; (2) Culms; (3) Sheaths; (4) Leaves, and (5) Roots.
- Bamboo has been used in various ways. The following list indicates some of the important uses of bamboo in different fields.
- Some of the Products: Toys for Children, Animal Sheds, Cups, Blow Gun, Baskets of different kinds, Bullock Cart, Candle holder, Chicken cage, Pig Cage, Cutlery, Char coal for variety of uses, Hand Holding Fans, Artistic wall hangings, Fencing (Live and from dry Culms), Flute, Fishing Nets, Furniture of hundreds of kinds for indoor and outdoor use, Swings of different kinds, Storage Baskets, Containers for transportation, Hats / Caps, Fruit Harvesters, Ladders, Support to Trees Bearing Huge amount of Fruits, Looms for Weaving, Musical Instruments, Bow and Arrows, Trays, Water lifting device, Winnower.
- Modern Products: Bicycle; Tricycle; Brief Case; Suit Case; Bags with hangers; Wardrobe Hangers; Toothbrush; Manure from leaf litter; Mulching Pads from Leaf litter; Paper; Racks; Fabrics; Strainers; Windmill.
- Edible Products: Young and soft bamboo shoots are an important ingredient in the food of North East India and Odisha. Bamboo Pickle; Bamboo Chips; Bamboo Drink (Fermented).
- Health: Bone Setting; Vanshlochan.
- Construction Industry: Bridges; Tree Houses of dozens of Kinds; Bamboo Reinforced walls and roofs are plastered on both sides with cement and sand mortar; Bamboo Houses are seen in almost all parts of India (Assam Houses, Mizo Houses; Chhattisgarh Houses); Doors; Windows; Ply Sheets; Wardrobe; Furniture; Sliding Shutters; Room Divider; Roofing Tiles; Window Blinds.



Dr. Charuchandra Arun Korde

Assistant Professor

Indian Institute of Technology, Bombay. [Bamboo for construction of Rural and agricultural infrastructure]

Mobile: 7428776099

Email: ckorde@iitb.ac.in

- It is an equally challenging time for India to promote alternative materials that can complement the sustainability issues.
- One such material is Bamboo, which in recent times is gaining attraction both amongst farmers and the government due to its rapid growth potential.
- The construction sector is one of the main consumers of the existing bamboo stock in the country and also provides substantial return to farmers and forest communities.
- There is significant potential for the application of bamboo in infrastructure development such as Agricultural, Irrigation, Forest, Coastal, Tourism, Energy, Rural and Urban development, Housing, Animal Husbandry Shelters, Silos, Warehouses, Schools, Hospitals, Water Tanks, Bridges, etc. When planned systematically, they will usher in, in a true sense, an all-inclusive development of villages and lead toward Gram Swaraj.



SESSION - III: INNOVATIVE PRODUCTS OF BAMBOO



Dr. Braja Narayan Mohanty, IFS (Retd.)

Ex-PCCF & HoFE, Manipur

Ex-Director IPIRTI. [Innovations in Bamboo Value addition for Rural Economy and Entrepreneurship]

Mobile: 9449043115

Email: bnmohanty86gmail.com

- The multiple usage potential of bamboo bears the promise of integrating various socio-economic sectors, starting from the most traditional to the next generation of bamboo activities.
- Introducing innovative processes and products will help enrich the income and employability potential for poor artisans. This would further lead to a sustainable process of rural industrialization, ushering in inclusive growth and livelihood optimization. (As in Hindi, “Jan hai to Jahan bhi hai”).
- Bamboo as a construction material has many favorable technical properties, viz., high strength to weight ratio, high modulus of elasticity, high modulus of rupture, etc., making it ideal for housing in areas prone to natural calamities such as earthquakes and hurricanes.
- In India, with its huge bamboo resources and a potentially large national market, various stakeholders have spearheaded innovations in bamboo composites such as bamboo mat board (BMB), bamboo mat veneer composite (BMVC), bamboo mat corrugated sheets (BMCS), bamboo mat ridge cap (BMRC) for roofing and bamboo scrimbers for flooring and panelling. These value-addition technologies have immense employment generation potential, mainly for the rural and tribal poor, who can earn money at each step of the value chain.
- The study in Kerala found that the mat weavers get an amount of Rs 166 per mat (of size 8.25’ X 4.25’), and they can make about three mats per day. Even after deducting the cost of bamboo, earns Rs 500/-per day and, taking 220 person-days per year, they can earn up to Rs 1.10 lakh/annum.



Shri Prasada Rao Vaddarapu, IFS

Director

Livelihood & Capacity Development – JICA Project. [Innovations in Bamboo utility products to improve Rural economy in Tripura]

Mobile: 9402307944

Email: tr050@ifs.nic.in

trpcltd83@gmail.com

- The development of eco-friendly brooms with bamboo handles, bamboo bottles, and other bamboo utility products has created a lot of opportunity for the state's bamboo artisans, the majority of whom are poor forest-dwelling tribal communities.
- These products have brought a lot of value to the abundantly available bamboo resources of the state and thereby promoted the bamboo-based economy. These innovations have promoted bamboo as an alternative to plastic and facilitated environmental conservation by replacing plastic with bamboo.
- Tripura Rehabilitation Plantation Corporation (TRPC) Ltd. have procured 85 MT of hill broom grass under the MFP-MSP scheme at Rs. 50/- per kg in the last two years and pumped about Rs. 42,00,000/- into the rural economy during the corona pandemic crisis.
- Through the innovation of bamboo bottles and other utility products like bamboo boards, bamboo wall and ceiling panels, bamboo clocks, bamboo trays, bamboo cutlery, bamboo desktop souvenirs, etc., unique utility products were created, which attracted the attention of the entire country, including the attention of our Honorable Prime Minister, Sri. Narendra Modi, and brought a lot of recognition to the bamboo artisans of the state. The Honorable Prime Minister, Sri. Narendra Modi, has well appreciated this initiative during one of his Man ki Bath programs, praising the unique Atmanirbhar Bharat and Vocal for Local initiative.
- TRPC Ltd. has produced and marketed 8000 bamboo bottles and generated about Rs. 1,05,00,000/- in economic activity through this product alone in the last one year.
- TRPC Ltd. successfully trained 1000 bamboo artisans in the state in these innovative trades and facilitated the marketing of these artisans' products through the VDVK schemes.
- LBSNAA, IGNFA, ONGC, TRIFED, SIPARD, Fab India, and other reputed corporate companies are major clients who are taking delivery of these products for gifts.



Shri Rajeev Valasala Kumaran

Wind Craft, Bamboo Crafts.

[Innovations and Modernization of Bamboo Craft Sector]

Mobile: 9961972376

Email: rajivwind@gmail.com

- Mr. Rajeev showcased many innovative and artistic handicraft items made from bamboo. Bamboo has multiple utility i.e., shoots as food, stem to make dwellings and musical instruments.
- They are interested in creating utilitarian items out of bamboo including masks, sculptures, wall decors, trays, card books, mobile holders and sound amplifier made of bamboo stem.
- The company markets its products under the brand name “Wind Crafts”. For it’s the ‘wind’ that powers his beautiful creations made of bamboo - wind chimes. Their unique wind chimes are made out of Ochlandra travancorica, a bamboo variety endemic to the Western Ghats which runs through Kerala, Tamil Nadu and Karnataka.
- Bamboo is a unique and magical raw material for the future, benefitting both the environment as well as the economy.

SESSION- IV: PANEL DISCUSSION

The panel discussion deliberated on all the presentations made by various speakers and came up with potential recommendations for wider adoption and replication across the country as illustrated in the Recommendations/Way forward chapter.



SESSION - V: PROSPECTS AND CHALLENGES



Dr. Sandeep Liladhar Chopde

Associate Professor

MET Institute of Management.

[Bamboo Farming for Sustainable Agriculture]

Mobile: 9821418522

Email: sandeepchopde@gmail.com

rajivwind@gmail.com

- Dr. Chopde explained the bamboo selection methodology adopted for planting in his native village in the year 2011 after in-depth research and analysis.
- He highlighted the various challenges and difficulties encountered after plantation and how the plantation was managed over the years. He also shed light on the financial perspective and the profits gained from plantation.



Shri R. S. C. Jayaraj, IFS,

PCCF & Director

Rain Forest Research Institute

[Bamboo Sector in North-East India -Prospects and challenges]

Mobile: 9442531990

Email: rsc.jayaraj@gmail.com

- Bamboo is an integral part of life in Northeast India, which holds one-third of the country's bamboo resources and a rich diversity of 99 species. Nine out of the ten prioritised bamboos of the Restructured National Bamboo Mission are found naturally in this area, with a high degree of variability, providing scope for selection and improvement.
- He discussed the various domestic and industrial uses, raw material availability, strategy to be adopted for a bamboo-based economy in the North-East India region, and a roadmap for future production, utilization, and research on bamboo.
- On the utilization aspect, there is a need to introduce primary processing to avoid wastage and optimize the use of bamboo. While most of the bamboo goes for domestic use in housing, fencing, and production of household articles, the industrial use is picking up, especially for the production of agarbatti sticks, bamboo wood and bamboo boards.

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- Bamboo-based ecotourism structures are also on the rise. There is a need for investment in industries engaged in the production of novel products of low volume and high value, besides having an export market.
 - The exclusive plantations for shoot harvest are to be raised, the production can be increased, and facilities for canning and export can be introduced.
 - Bamboo related research in the region needs strengthening, especially in the aspects of bamboo resource mapping, productivity enhancement, nursery and plantation silviculture, scientific harvesting, post-harvest management, mechanization of operations, preservative treatment, use of engineered bamboo, bamboo reinforcement in construction, use of bamboo in carbon sequestration and bamboo-based ecotourism.



Shri. Anand Banthia

Head – Marketing

Garnet India, Madhya Pradesh

[Innovations in Bamboo Processing and Product Manufacturing]

Mobile: 9827333191

Email: garnetindia@gmail.com

- Discussed about processing and proper usages of Bamboo for varied application.
- Explained about Bamboo Processing Machines, manufactured by their company.
- Explained about the various innovative and useful bamboo products such as Tooth Brush, Cutlery, Bamboo Photo Frames and Bamboo gift Boxes.
- Explained about the unique mufflers and insulation for the the bonnets for BMW vehicles made out of engineered bamboo.
- Explained Charcoal production from Bamboo waste to make cost of production viable especially for small scale producers.



Shri. Ranganath Krishnan

Secretary cum Treasurer

Bamboo Society of India

[Developing Bamboo Market Linkage]

Mobile: 7899997761

Email: goldensandsagro@gmail.com

- He discussed about the identification of market gaps, Strength, Weakness, Opportunities and Threats (SWOT) and way forward in developing bamboo market.
- One critical aspect at present is the lack of proper marketing linkages and value chain channels. There are lots of legislation and regulatory issues, exploitation of poor etc., in terms of challenges in Bamboo industry. There is no well established price regulatory mechanism, no MSP/MFP and lack of Market Information are some of the critical challenges in the sector.
- There is need to bring the entire bamboo ecosystem on to a common platform. There is need for a common platform encompassing legal coverage, e-catalogue, Payment gateway, Buyer/Supplier Reverse Action Dashboard, which will provide the search engine for buyer and seller.
- He also informed the audience regarding the online bamboo marketing avenue at www.bamboo.market, which is very useful for the different stakeholders.
- He also informed regarding Bamboo plantation Insurance which is now available and farmers should know this as part for their bamboo cultivation plan.

SESSION - VI: BAMBOO - A VERSATILE PRODUCT

Representative from TRIFED

- TRIFED was established in the year 1987 under the Multi State Cooperative Societies Act, 1984 by the GoI. He informed that there are 64 NGOs working in the Bamboo sector and TRIFED is marketing all the handicrafts items of cane and bamboo and has established 120 showrooms across India under the brand name “Tribes India”.
- The annual turnover is in excess of Rs. 40 crores and out of which Rs. 5 crores was realised from cane and bamboo products. In Andhra Pradesh, TRIFED has established 28 Van Dhan Vikas Kendra clusters who are involved in making bamboo products under the Scheme named “Prime Minister Van Dhan Vikas Yojana”.

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- TRIFED organises an annual event called 'ADI MAHOTSAVA' in India. In November 2021, it was organised for 15 days in New Delhi. The material worth Rs. 12 crores were sold. Out of which, Rs. 2-2.5 crores were only from the bamboo and cane products.



Shri T. Sai Kumar Reddy, IFS (Retd.)

Ex-MD

Bamboo Development Corporation,
Maharashtra Bamboo Development Corporation.

[Bamboo-Green Gold of 21st Century]

Mobile: 7773932046

Email: saireddy5599@gmail.com

- Bamboo is the “The Green Gold” of the 21st century. It has multiple uses and is a gift of Mother Nature.
- Bamboo is set to bounce back on centre stage to booster the rural economy owing to its multiple uses in products such as engineered bamboo wood, bamboo ply boards, flooring, wall cladding, furniture, ethanol, charcoal and many other uses.
- The future is very bright for the bamboo species as the felling and Transit Permit (TP) required for Government of India has removed this species by amending the Indian Forest Act (IFA) 1927 and omitting bamboo from the definition of tree/timber. This step is great encouragement for the farmers to plant bamboo in their fields.
- He also shared the experience that the Maharashtra was the first State for keeping the bamboo in grass category instead of tree category.
- Traditional uses of bamboo: The traditional uses of bamboo in different regions of the country due to its lightweight, good tensile strength, straightness, smoothness, and durability are favoured in rural housing, scaffolding in urban constructions, handicrafts, for agriculture implements like ploughs, storage of grain, baskets, supports in vegetable growing areas, etc.
- New utilisation of bamboo: In the wake of reducing timber supplies, several environmentally and people-friendly technologies have been developed to manufacture innovative bamboo products. These products are wood-substitutes (engineered bamboo), bamboo mat boards, laminated bamboo, and corrugated bamboo sheets.
- Bamboo charcoal can be used in cosmetology, pharmaceuticals, water and air filtration

units. From the pyrolysis process, bamboo charcoal and bamboo oil can be derived. This oil can be utilised as bio fuel. Bamboo mats and split bamboo can replace geo textiles (plastic) while laying the roads. Bamboo is anti-bacterial in nature and will make excellent rayon fabric, which has high potential in the market.



Ms. Daya Anand Patki

Founder of Bamboo Tantra, Pune.

[Bamboo Plantations to Value Addition]

Mobile: 9011861529

Email: bambootantrapune@gmail.com

- Under agroforestry practices, bamboo is one of the major crop because it plays a vital role in livelihood generation and can be cultivated in harsh conditions.
- One should only proceed with bamboo plantation of specific species depending upon the end product. If the grower take care of the plants for the first three years, crop can take care of grower for generations.
- Bamboo Tantra are seasoned producers of quality bamboo saplings and handicraft articles, especially bamboo jewellery and bamboo lamps. Bamboo Tantra promotes bamboo artisans for their handmade products to conserve bamboo art skills and give work to hands more than machines.
- Value addition in bamboo can be done on farm with minimum efforts and minimum machineries.
- Bamboo Tantra is in process to promote the bamboo products of NE and Kerala throughout the country.



Mrs. Neeramoni Sarmah

The Bamboo Lady of India.

[Help Nature and Community]

Mobile: 7896859803

Email: neecol@rediffmail.com

- The organisation is working towards improvement of quality of life of Socially and physically disabled groups.
- They are ensuring viable livelihood for the forest dwellers.
- Providing alternate income generation by producing eco-friendly bamboo and utility handicraft using ZERO investment i.e., using locally available raw materials and forest agro waste.

SESSION - VII: WAY FORWARD



Shri. S.T.S. Lepcha, IFS (Retd.)

Ex-PCCF, Uttarakhand.

[Think beyond Bamboo National Mission]

Mobile: 9412071394

Email: cctpfmua@gmail.com

stsllepcha@gmail.com

- Bamboo has played a significant role in the livelihood of the people since time immemorial. It is linked with the livelihood of the people and has a role in fulfilling the Sustainable Development Goals (SDGs) of India.
- Realising the value of bamboo in the rural sector, GoI started the National Bamboo Mission (NBM) in 2006-2007 under the Ministry of Agriculture, the first phase of which was completed in 2015-2016. The second phase of NBM started in 2018-2019.
- During the first phase, the focus was on resource development through plantations and rehabilitation of bamboo in the forest areas. In the second phase, there is a greater focus on plantations in non-forest areas, value addition, and the establishment of linkages with related industries.

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- Despite the government's push in the bamboo sector, the market share that India holds today is around 4%, lower than other countries like China, Vietnam, Thailand, Cambodia, etc. Almost 25% of the total share in the bamboo sector is from the service sector. The slow progress of the bamboo sector in India may be due to two factors: (a) attitude towards bamboo and (b) lack of strategic planning and weak cross-sectoral synergy.
 - The National Bamboo Mission is a stepping stone or launching pad for the development of the bamboo sector in India. To further augment industrial production, we need to look beyond and broaden the horizons.
 - For the development of an appropriate ecosystem for the bamboo sector, due focus is required on both vertical and horizontal policy actions. For all the bamboo growing states of India, there should be a broad policy or guideline for the states. At the same time, each state should critically focus on one, or in the case of bigger states, at the most, two species for the development of their bamboo industry.
 - Each focus area may have a bamboo "Special Economic Zone" to achieve zero waste of bamboo, logistics costs, and to gain confidence from the bamboo growers and labourers.
 - To bring cross-sectoral synergy in the bamboo sector, GoI should establish a full-fledged institution in the line of Tea Board, Rubber Board, Coir Board, etc. for accurate species-wise bamboo resource inventory to promote the bamboo enterprise, coordination, and to create appropriate policy with different ministries to further develop the bamboo sector in perpetuity. In a way, this board should act as a "single window facility" for the development of the bamboo industry in India.
 - As regards to Bamboo Industry, India is the first Country who has made the craft paper in 1923. He also quoted how China is ahead of India by producing many innovative products from bamboo i.e., Bamboo wood composite and furniture; wine, beer and beverages like Coco-cola type from the bamboo leaf; Green Pipe from Bamboo wood composite; making the petroleum product for transporting from Bamboo. Bamboo shoot biscuit, bread from bamboo shoot, tea from the Bamboo leaf, bamboo Beer and Bamboo Wine.
 - He hoped bamboo marketing will be picked up as the 13 items of Plastics are going to be banned after First of July.



Dr. R. Murugesan

Director

NERC- NIRDPR (Guest Speaker)

Mobile: 9435019953

Email: murugesan.nird@gov.in

- While a lot of speakers talked about the Bamboo product etc., but the question remained on how we have to carry it forward.
- There is a strong need for imparting quality training for different stakeholders.
- We may choose to adopt our own indigenous technology like making bamboo ornaments etc. We need to ensure overall connectivity in terms of physical, knowledge and financial connectivity. This will promote entrepreneurship and branding both of which are vital elements for promoting growth of the Bamboo sector in the country.



Prof. Sudhakar Puttagunta

Former Professor, IIT Delhi.

[Innovations & Demos in Bamboo and Bamboo use]

Mobile: 9391343085

Email: sudhakar.puttagunta@gmail.com

- The important innovations are Bamboo load bearing structures, Bamboo tied arches, foldable bamboo structures for temporary shelters for human, cattle and agro produce, bamboo wall panels and the bodies for small transport vehicles which are cost effective by using off-the shelf subsystems and components. Haritha Hotel and Resorts are one of their important customer.
- He advised to promote bamboo arches and bamboo cycle rickshaw as eco-friendly option.
- Schools and higher academic institutions are ideal places to disseminate innovative uses of renewables like bamboo for mass consumption. Building and operating such structures on the campus creates awareness of both the necessity of using renewable and the issues involved in using them. Such a scenario would be ideal to spur and inspire innovation and experimentation in places of learning, from schools to higher institutions.
- The institutions could actually host the entrepreneurs that operate the bank of certified

bamboo and other renewable building materials in the local area. Such a policy would go a long way towards utilization of MHRD resources in imparting holistic education encompassing skills needed for sustainable technologies and development from the bottom up.



Shri Parmeswaran Krishna Iyer

Bamboo Entrepreneur & Specialist

Director,

Bamboo pecker Lifestyle Crafts Pvt. Ltd. & NGC Member BSI.

[Policies and Entrepreneurship in Bamboo]

Mobile: 9844777402

Email: babukiyer@gmail.com

- Bamboopecker entered the field and proved that there is a possibility and potential for the bamboo sector for a wide range of applications, from furniture to construction, using bamboo. With such a large domestic market, India has the potential to become one of the largest producers of bamboo furniture in the world. A boost in domestic production will automatically result in looking at markets outside India.
- Bamboopecker entered this sector with a vision of creating rural employment by making this unorganized sector in an organized way.
- Bamboopecker Group has two production facilities and one showroom in St. Marks Road, Bangalore. Bamboopecker Lifestyle Crafts wanted to revive the dying art of bamboo craft making and showcase the artisan's abundant talent to the appreciative buyer with quality products. The encouragement from the bamboo lovers will not only make them economically independent but also keep nature green.



Shri. Pasha Patel

Chairman

Phoenix Foundation.

[Promotion of Bamboo in India]

Mobile: 9422071786,

Email: pashapatelforfarmer@gmail.com

- Shri Patel highlighted about the potential of ethanol, functioning of Numaligarh Refinery based on ethanol and bamboo.

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- Phoenix group is trying to establish one more refinery with the help of industrialists and like minded investors.
 - He stressed on the reduction of environmental pollution by adopting various ecofriendly methods and large scale bamboo plantation can play a vital role in this endeavor.



Dr. Ch. Radhika Rani

Associate Professor and Director,

NRLM,

NIRD&PR, Hyderabad (Guest Speaker)

Mobile: 9959968602

Email: radhikarani.nird@gov.in

- NRLM is in the process of collecting data about the SHGs dealing with Bamboo Products all over the country. NRLM has set out an agenda to cover 7 Crore rural poor households, across 600 districts, 6000 blocks, 2.5 lakh Gram Panchayats and 6 lakh villages in the country through self-managed Self-Help Groups (SHGs) and federated institutions and support them for livelihoods collectively over a period of 8-10 years.
- NRLM is also working for the poor to facilitate increased access to rights, entitlements and public services, diversified risk and better social indicators of empowerment.

5. Valedictory Session

Valedictory session held on 4th March 2022, was attended by



Shri Prasanta Kumar Swain, IPoS,

Additional Secretary,

Department of Agriculture and Farmers Welfare, Government of India as Guest of Honour

Smt. Shanti Kumari, IAS,

Special Chief Secretary (Forestry),
Department of Environment, Forest,
Science & Technology, Government of
Telangana, as Chief Guest.



It was decided to create a 'National Bamboo Network' jointly by NIRD & PR and CIPS for the benefit of all the stakeholders associated with Bamboo Sector and decided to have workshops exclusively for bamboo farmers, bamboo artisans, entrepreneurs, structural engineers for in-depth deliberations and to identify the Capacity Building and Training needs. Further, it was decided to forward the key recommendations that emerged from this conference to Government of India for their examination and consideration.

6. Key Recommendation / Way forward

The **key recommendations** of the two-day Bamboo Conference are as following:

1. A detailed national level study needs to be carried out on problems and issues faced by National Bamboo Mission (NBM) and State Bamboo Missions.
2. Strengthening institutional mechanisms for sustainable funding and guidance for growth of the bamboo sector. Accordingly, establishing a **Bamboo Board** on lines of Coffee Board and Tea Board at National Level and State Level Boards is strongly recommended.
3. An appropriate **National Bamboo Policy** is to be developed capturing various national level policy elements and based on identified gaps.
4. **Research on local species and other introduced commercial species of bamboo** in India is to be undertaken, emphasising on **R&D for value chain development** and addressing issues at various stages of the bamboo value chain.
5. Institutional support for establishing **Forest Stewardship Council (FSC) certification**.
6. **Setting standards for bamboo value chain** for enabling international competition.
7. **Establishment of Bamboo Cooperatives** on the lines of Agriculture Cooperatives.
8. Encourage **mass propagation of quality planting material** using high yielding/high quality mother stock bamboo species. **Propagation protocols** need to be developed and standardised for tissue culture propagation of bamboo making it available to farmers at affordable cost.
9. Dovetailing of other Rural Development Schemes like MGNREGA, NRLM etc., and **mainstreaming of bamboo cultivation in Government supported schemes**.
10. Promote downstream products of bamboo-based industries such as charcoal, tar, vinegar etc., to give **better livelihood opportunities** for rural poor.
11. Agriculture, Horticulture, Forest Universities and R&D institutions (like ICFRE & ICAR) should make bamboo as a focal subject to promote it on mission mode.
12. Constitution of Farmers Producer Organizations/Companies (FPO/FPC) should be encouraged in bamboo sector.

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13. Prioritised lending policy for bamboo sector needs to be formulated to encourage entrepreneurs in this sector and develop model bankable projects for bamboo sector.
 14. Establish small capacity of 3 to 10 KVA biomass-based power projects supporting small scale / cottage industries using bamboo biomass.
 15. A policy on use of bamboo in construction in Government and private sectors needs to be developed at the earliest. Further, experts should develop and standardise structural engineering parameters for developing bamboo structures. Bamboo based poly-houses for horticulture crops should be encouraged to reduce the use of steel.
 16. Generate employment opportunities to local artisans by promoting new and innovative approaches in developing bamboo-based utility products as well as high-value products for export.
 17. Creation of learning management systems focussing on skills to facilitate bamboo courses and promote wide scale training using “Train the Trainer” approach across different verticals of the bamboo industry.
 18. Promotion of bamboo products on all Government portals including GeM, to **replace the image of bamboo as ‘Poor man Timber’ to “upmarket premium product”** in order to compete at international level. Similarly, government institutions should encourage use of bamboo products in their offices.
 19. Create a **unified bamboo directory** (indexed and searchable) across all verticals to connect all stakeholders associated with bamboo sector.
 20. Create a **Centre of Excellence for Bamboo** as one stop shop in every state capturing the best practices of bamboo industry across all verticals for knowledge sharing and dissemination.
 21. **Strengthening of Crop insurance** for Bamboo as a Horticulture/Agroforestry Crop.
 22. Creating common facilitation centres at cluster level to enable bamboo artisans to use the facility for bamboo processing and product manufacturing to deliver cost effective products.
 23. Create additional avenues for marketing of bamboo and facilitating its promotion through e-commerce platforms to create a larger client base both nationally as well as internationally.

7. Media Coverage





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వెదురు కర్రల సాగుతో లాభాలు

● ఎన్ఐఆర్ఓపీఆర్ డైరెక్టర్ జనరల్ నరేందర్ కుమార్

రిశ. శంషాబాద్ : వెదురు కర్రల సాగుతో రైతాంగానికి ఎంతో లాభదాయకమని ఎన్ఐఆర్ఓపీఆర్ డైరెక్టర్ జనరల్ నరేందర్ కుమార్ అన్నారు. రాజేంద్రనగర్లోని ఎన్ఐఆర్ఓపీఆర్ లో వెదురు సాగుపై జరిగిన అవగాహన సదస్సు నిర్వహించారు. అనంతరం ఆయన విలేకరులతో మాట్లాడుతూ వెదురు కర్రల సాగు ద్వారా రైతులు ఆర్థికంగా లబ్ధి పొందుతారని, వ్యాపారపరంగా అన్ని రంగాల వారికి లాభదాయకమన్నారు. దేశంలో వాతావరణ కాలుష్యం పెరిగి ప్రజల ఆరోగ్యంపై ప్రభావం చూపుతుందన్నారు. ఈ నేపథ్యంలో ఈ వెదురు సాగుతో



మాట్లాడుతున్న నరేందర్ కుమార్

కాలుష్య నియంత్రణతో పాటు రైతులు ఆర్థికాభివృద్ధి సాధించడంతోపాటు దేశాభివృద్ధిలో కీలకపాత్ర పోషిస్తుందన్నారు. కార్యక్రమంలో సీఐపీఎస్ డైరెక్టర్ అచలేందర్ రెడ్డి, తదితరులు పాల్గొన్నారు.

జి.సి.



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వెదురు తోటల పెంపకంపై దృష్టి పెట్టాలి

● ఎన్ఐఆర్ఓపీఆర్ డైరెక్టర్ జనరల్ నరేంద్ర కుమార్ సవతలంగాణ-రాజేంద్రనగర్

వెదర్ తోటల పెంపకం పై రైతుల దృష్టి పెడితే దీర్ఘకాలంలో రైతులకు ఎన్నో లాభాలు వస్తాయని ఎన్ఐఆర్ఓపీఆర్ డైరెక్టర్ జనరల్ నరేంద్ర కుమార్ అన్నారు. ఎన్ఐఆర్ఓపీఆర్ రెండు రోజులుగా జరుగుతున్న గ్రామీణ ఆర్థిక వ్యవస్థను మెరుగుపరచడానికి వెదురు రంగంలో ఆవిష్కరణల వ్యాప్తిపై జరుగుతున్న జాతీయ సదస్సులో ఆయన ప్రసంగించారు. గ్రామీణ ప్రాంతంలోని యువత, మహిళలు వెదర్ పెంపకంపై దృష్టి పెడితే అనేక లాభాలు వస్తాయని ఆయన అన్నారు. వెదురు వలన అనేక రకాల వస్తువులను తయారు చేయవచ్చని ఆయన స్పష్టం చేశారు. వెదర్ తోటల పెంపకం పై రైతులకు పూర్తి స్థాయిలో అవగాహన కల్పించడానికి అనేక కార్యక్రమాలు రూపొందిస్తున్నామని ఆయన స్పష్టం చేశారు. ఈ రెండు రోజుల పాటు జరిగిన ఈ సదస్సులో రైతుల నుంచి వెదర్ ఉత్పత్తులను తయారు చేసిన పరిశ్రమల వారితో అనేక



ఎర్పాటు చేయాలని డిమాండ్ వచ్చిందని, అదేవిధంగా వెదర్ కార్పొరేషన్ ఏర్పాటు చేయాలని చాలామంది అభిప్రాయపడ్డారని ఆయన తెలిపారు. అదేవిధంగా వెదర్ పరిశోధన కేంద్రాలను కూడా ఏర్పాటు చేయాలని రైతులు తెలిపారని అన్నారు. సీఐపీఎస్ డైరెక్టర్ అచలేందర్ రెడ్డి మాట్లాడుతూ ఆటవీ కలప ఉత్పత్తుల నుండి వెదురు వ్యవసాయ ఉత్పత్తులను గుర్తించాలని ఆయన అన్నారు. వెదర్ నుంచి అనేక రకాల వస్తువులు ముఖ్యంగా ఫర్నిచర్ గహాలంకరణ వస్తువులు బట్టలు ఇతర వస్తువులను కూడా తయారు చేయవచ్చని ఆయన స్పష్టం చేశారు.

వెదురు రంగం ద్వారా గ్రామీణుల ఆర్థిక ప్రగతి

● నూతన విధానాలపై అవగాహన కల్పించాలి: ఎన్ఐఆర్డీపీఆర్ డీజీ

హైదరాబాద్, మార్చి 4 (ఆంధ్రజ్యోతి): వెదురు వస్తువుల వినియోగం పర్యావరణ హితమని, ఈ రంగంలో కొత్త ప్రయోగాలు చేసి ప్రజలకు మరింత చేరువ చేయాల్సిన అవసరం ఎంతైనా ఉందని ఎన్ఐఆర్డీపీఆర్ డైరెక్టర్ జనరల్ జి.నాగేంద్రకుమార్, సీఐపీఎస్ డైరెక్టర్ అచలేందర్ రెడ్డి పేర్కొన్నారు. గ్రామీణ ఆర్థిక వ్యవస్థను మెరుగుపర్చడం కోసం వెదురు రంగంలో ఆవిష్కరణల వ్యాప్తి అనే అంశంపై నేషనల్ ఇనిస్టిట్యూట్ ఆఫ్ రూరల్ డెవలప్ మెంట్, పంచాయతీరాజ్ (ఎన్ఐఆర్డీపీఆర్), సెంటర్ ఫర్ ఇన్నోవేషన్స్ ఇన్ పబ్లిక్ సిస్టమ్స్ (సీఐపీఎస్) సంయుక్త ఆధ్వర్యంలో ఎన్ఐఆర్డీలో చేపట్టిన రెండు రోజుల సదస్సు శుక్రవారం ముగిసింది. ఈ సందర్భంగా వారు మీడియాతో మాట్లాడుతూ వెదురు పెంపకంతో పర్యావరణంతో పాటు పలు ప్రయోజనాలు ఉంటాయని, రైతులకు ఆర్థికంగా సమాజికంగా ఉపయోగకరంగా ఉంటుందన్నారు. వెదురు రంగాన్ని ప్రోత్సహించడం ద్వారా గ్రామీణ ప్రాంత ప్రజల ఆర్థిక ప్రగతి సాధ్యమవుతుందన్నారు. ప్రపంచవ్యాప్తంగా వెదురు సాగు, దాని వినియోగంలో జపాన్ మొదటి స్థానంలో ఉందని, భారతదేశంలో కూడా దీన్ని ప్రోత్సహించాల్సిన అవసరం ఎంతైనా ఉందన్నారు. పంట పొలాల్లో వెదురు సాగు చేసేందుకు కేంద్రం వెసులుబాటు కల్పించిన నేపథ్యంలో ఆటవీ, ఉద్యాన శాఖ ఆధ్వర్యంలో వెదురు తోటల ఏర్పాటుపై రైతులకు అవగాహన కల్పించాలన్నారు. అదేవిధంగా వెదురు ఉత్పత్తుల తయారీలో సాంకేతిక పరిజ్ఞానాన్ని ప్రోత్సహించాలని, గ్రామీణ ప్రాంతాల్లోని సామాన్యులకు ఉపాధి కల్పన కోసం వెదురు ఉత్పత్తి వ్యయాన్ని తగ్గించడానికి కృషి చేయాలన్నారు. అంతే కాకుండా వెదురు రైతులు సాగు సుంచి మార్కెటింగ్ వరకు అన్ని రంగాలపై దృష్టి పెట్టాలని.. అప్పుడే రైతులు లాభ పడతారన్నారు. రెండు రోజుల సదస్సులో చర్చించిన ప్రధాన అంశాలను నాగేంద్రకుమార్, అచలేందర్ రెడ్డి వివరించారు.

జాతీయ గ్రామీణ ఆర్థిక వ్యవస్థను మెరుగుపరచడం కోసం వెదురు రంగానికి పెద్దపీట భారత్ ప్రభుత్వ శాఖ కార్యదర్శి నరేంద్రనాథ్ సిన్హా

రాజేంద్రనగర్, మార్చి 4, (విజన్ ఆంధ్ర ప్రతినధి): నేషనల్ ఇన్స్టిట్యూట్ ఆఫ్ రూరల్ రివల్యూషన్ అండ్ పంచాయతీ రాజ్ (ఎన్ఐఆర్డీఏఆర్), 70ంటర్ ఫర్ ఇన్స్టిట్యూట్ ఆఫ్ పబ్లిక్ సెక్టర్స్ (సీఐపీఎస్) సంయుక్తంగా "గ్రామీణ ఆర్థిక వ్యవస్థను మెరుగుపరచడం కోసం వెదురు రంగంలో అభివృద్ధిని ప్రోత్సహించే" 03-04 మార్చి 2022న రెండు రోజుల జాతీయ సదస్సును నిర్వహించడం జరిగింది అయిన అధ్యక్షుడు ఎన్ ఐ ఆర్ డీఏఆర్ క్యాంపస్ "వెదురు రెక్కల్"ని ప్రోత్సహించే వచ్చి పథకాలు, ముఖ్యంగా వెదురు తోటల ద్వారా జీవనోపాధిని ప్రోత్సహించడంలో యంజిఎన్ ఆర్ఈఐపి పోషించిన కీలక పాత్రను సైన్లైట్ చేశారు. వెదురులో విలువ గాలును అభివృద్ధి చేయడం, గ్రామీణ ప్రాంతాల్లో జీవనోపాధి అవకాశాలను సృష్టించడంపై ఎన్ ఐ ఆర్ డీ ఆర్, సీఐపీఎస్ దృష్టి పెట్టాలని పట్టుబట్టారు. డైరెక్టర్ జనరల్ ఎన్ఐఆర్డీఏఆర్ తన ప్రారంభోపన్యాసంలో వెదురు సాంకేతిక పరిష్కారాన్ని ప్రోత్సహించడం గ్రామీణ ప్రాంతాల్లోని సామాన్యులకు ఉపాధి కల్పన కోసం, సరసమైన ధరలకు దారితీసే ఉత్పత్తి వ్యయాన్ని తగ్గించడానికి వాటాదారుల మధ్య సమన్వయం తీసుకురావాలని అవసరాన్ని నొక్కి చెప్పారు. వినియోగదారులకు నిర్మాణ పరిశ్రమలో వెదురు వినియోగానికి గొప్ప అవకాశం ఉన్నప్పటికీ, వెదురు ముడిసరుకు కొరత, తగిన జాతులను



పరిష్కరించాల్సిన అవసరం ఉంది కూడా అయిన సైన్లైట్ చేశారు. ప్రభుత్వ సైన్లైట్ రంగా లో నిర్మాణంలో వెదురు అవసరం, వెదురు యొక్క పంది నిర్మాణాత్మక ఉపయోగాలను అభివృద్ధి చేయడానికి 'ప్రకృతి అంజనినింగ్' ఇన్స్టిట్యూట్ను తయారు చేయడం ముఖ్యం, ఉర్వా పంటలకు వెదురు ఆధారిత పాత పానీయం, ఉప్పు వాడారాన్ని తగ్గించేలా ప్రోత్సహించాలి. వెదురు ఆధారిత యుటిలిటీ ఉత్పత్తులను అభివృద్ధి చేయడంలో కొత్త విమాన్య డిజైన్లను అభివృద్ధి చేయాలి, అది స్థానిక రేపక ఉత్పత్తుల వారికి ఉపాధిని ఇస్తుంది, ఎగుమతి సామర్థ్యాన్ని కలిగి ఉంటుంది మరియు రేపక మార్కెట్ డిమాండ్కు అనుగుణంగా ఉంటుంది. ఫ్యాషన్ డిజైన్లకు కళాకారుల అధిక ముగింపు విలువ జోడింపు లక్ష్యంగా ఉత్పత్తుల అభివృద్ధిలో పాల్గొనాలి. ఇప్పటికే ఉన్న వెదురు కళాకారుల సైన్లైట్లను రక్షించడానికి ప్రభుత్వం సుండి మద్దతు, సాంకేతిక సంస్థలలో వెదురు (ప్రెస్సింగ్, డిజైన్, యుటిలిటీ ఉత్పత్తుల తయారీ, పాత్రకళలు, ఫర్నిచర్, నిర్మాణ పరిశ్రమలో వెదురు

ఉపయోగించడం మొదలైనవి)పై నిర్మాణాత్మక సైన్లైట్ కోర్సులు అమలులో ఉండాలి. ఈ రంగంలో పరిశ్రా వికేంద్రీకరణను ప్రోత్సహించడానికి వెదురు రంగానికి ఆర్థిక సహాయ విధానాన్ని ప్రాధాన్యతపై చేయాల్సిన వార కంపై ఒక విధానం అవసరం. వెదురు యొక్క పంది నిర్మాణాత్మక ఉపయోగాలను అభివృద్ధి చేయడానికి వెదురు బ్రాండ్ ఇమేజ్ను పూర్తి మ్యాన్ టింబర్గా మార్చడం. లాభదాయక కోసం బలమైన వెదురు సేద్యంపై అభివృద్ధి చేయడం, వెదురు రంగానికి సంబంధించిన అన్ని వాటాదారులను కలిగ్ చేయడం. వ్యవసాయ ఆధారిత సంస్కారాల వెదురు వ్యవసాయం, యంజిఎన్ డిజైన్లను అభివృద్ధి చేయడంలో కొత్త విమాన్య వ్యాపారంగా మార్చాలి. ఈ శాస్త్ర భారత రేపకలో వెదురు రంగం సుండి పాతలు రేపకలోని ఇతర ప్రాంతాల్లో పునరావృతం కావాలి. పబ్లికల్చర్ పంటలు వెదురు కోసం పంట పరిమాణంలో పెంచడం చేయడం. క్రస్టల్ స్ట్రాలో సాధారణ సులభతర కేంద్రాలను సృష్టించడం, తర్వాత వెదురు కళాకారులు వెదురు ప్రెస్సింగ్, ఉత్పత్తి తయారీ కోసం సౌకర్యాన్ని ఉపయోగించుకోవచ్చు. వెదురు మార్కెటింగ్ కోసం రెస్ట్రెయిన్డ్ మార్కెట్లను సృష్టించడం జరిగింది అయిన చెప్పింది.

National Conference on "Dissemination of Innovations in Bamboo Sector for Improving the Rural Economy

National Institute of Rural Development and Panchayati Raj (NIRD&PR) and Centre for Innovations in Public Systems (CIPS) jointly organizing a two-day National Conference on "Dissemination of Innovations in Bamboo Sector for Improving the Rural Economy" on 03-04 March 2022 at the NIRD&PR campus to promote "Bamboo Sector" and help stimulate the exchange of knowledge and best practices that have been developed both in the public and private spheres. Conference was inaugurated by Shri Nagendra Nath Sinha, IAS, Secretary, Ministry of Rural Development, Government of India, virtually, who was the chief guest of this conference. Dr Narendra Kumar, Director General, NIRDPR and Shri Achalender Reddy, IFS (Retd.), Director, CIPS were present on the occasion. Around 160 participants from various states, including entrepreneurs making bamboo products, bamboo farmers, artisans, forest department officials and research scholars. "The chief guest during his inaugural address highlighted the key role played by Rural Development Schemes, particularly MGNREGA in promoting livelihoods through bamboo plantations and also insisted NIRDPR and CIPS to focus in developing value chain in bamboo and create livelihood opportunity in rural areas. "In his inaugural address Director General NIRDPR emphasized the need for bringing in the coordination among the stakeholders so that the promotion of bamboo technologies reach to the common man in the rural areas for employment generation

Photo: Syed Omer



affordable to consumers. He also highlighted, though there is a great potential for use of bamboo in the construction industries, shortage of bamboo raw material and appropriate species need to be addressed. Bamboo being a non-perishable commodity and multiple harvesting for many years is possible, it can be best alternate for farmers, bringing assured income. This conference is contemplated to focus on all these areas, right from cultivation to value addition, to marketing. "Shri Achalender Reddy, Director, CIPS highlighted the present scenario of bamboo sector in the country and need for connect the missing links. Recognizing bamboo from forest timber produce to Agriculture produce is a game changer in this sector. "Panel discussions organised on the first day, 3 panel discussions were organised covering various aspects of bamboo sector, wherein eminent persons working in this sector at national level, participated and shared their experiences and innovative ideas. "As part of this conference an 'Exhibition cum Sale of Bamboo Products' is organised for 2 days showcasing the bamboo technologies and innovations by various entrepreneurs. Mr Sravan Kumar, an young entrepreneur from Telangana (Vrushali Live Innovations with Bamboo), Konkan Bamboo and Cane Development Centre (KONBAC), Maharashtra, Mr RK Mehta, Bamboo Promotor from Hyderabad and representatives from TRIFED have participated in the Bamboo Products Exhibition organised alongside of the conference, which was inaugurated by Dr Narendra Kumar.

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Bamboo conference to be held in Hyderabad

The aim of the conference is to promote the bamboo sector and help stimulate the exchange of knowledge and best practices that have been developed both in the public and private spheres.



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Image used for representational purposes (Photo | PTI)

By Express News Service

HYDERABAD: The National Institute of Rural Development and Panchayati Raj (NIRD&PR) and Centre for Innovations in Public Systems will be jointly organising a two-day National Conference on “Dissemination of Innovations in Bamboo Sector for Improving the Rural Economy” on March 3 and 4, at the NIRD&PR campus in Rajendranagar.

The aim of the conference is to promote the bamboo sector and help stimulate the exchange of knowledge and best practices that have been developed both in the public and private spheres. The programme will be attended by delegates from all over the country for representing the bamboo ecosystem and from the prominent institutions working for the promotion of the bamboo sector.

PART - II:
ARTICLES ON
BAMBOO





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1. Mainstreaming Bamboo as a Building Material in the Construction Sector Globally

- Ar. Prof Neelam Manjunatha

Introduction

Bamboo has been used for construction since time immemorial. However, with the industrialization that occurred in the last centuries, its usage has reduced and knowledge was lost. Despite this, with the renewed interest in local and natural materials for mitigation of global warming, Bamboo has come out as one of the most promising and viable materials for the building sector. There are over 1200 species of bamboo in 70 genera found across

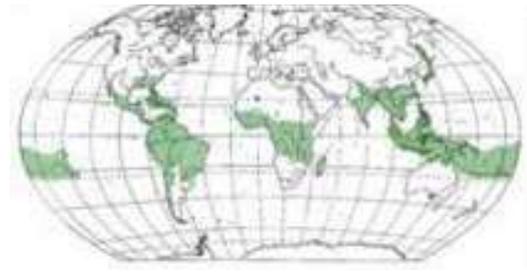
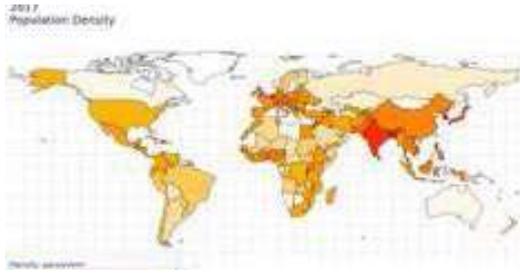


the world. Today, a significant part of the world's population lives in houses which use bamboo as a major construction material. Though, a majority of them do it more out of compulsion rather than by choice. Due to this, most of the traditional technologies of construction with Bamboo have gotten lost. Thus, bamboo nowadays is not being used to its full potential. Most of the research on Bamboo as a building material remains on paper and does not reach the market. The institutions and organisations have minimal interface with the building fraternity. Several civil societies are trying to bring change but are plagued with severe dearth of resources.

The world distribution of bamboo species closely resembles the population density (figure 2). The global bamboo belt reaches approximately 1000 miles above and below the equator (figure 1).

In addition, considering the number of victims from natural disasters, one can find that bamboo is present in a large area where these incidents take place (figure 3). Therefore, bamboo holds an enormous potential to create safe, economical and eco-friendly buildings and infrastructure, respecting the triple bottom line of Sustainable Development in a large part of the world. It could be the vehicle of an integrated development for millions below the poverty line, thereby being an agent of equity of resources to the masses on the planet.

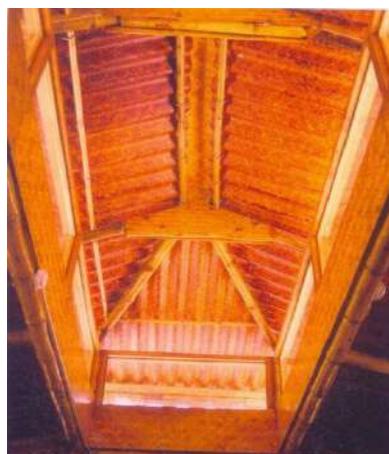
Given the current global perception of bamboo, which is still seen by the building industry as a material with several limitations, that range from legal matters to educational, economic, technical and the general acceptance from the public, we conducted a global survey, based on which we derived some action pointers to address the issue. These pointers can be translated



into a **Systemic Action Plan** with stakeholders participation guidelines with a very broad spectrum covering multiple overlapping issues plaguing the use of bamboo in the building sector. This action plan can then further connect the intergovernmental, governmental and non-governmental bodies to the various issues, actions and recommendations to approach and solve the issue in a holistic manner. This action plan is intended to be a comprehensive instrument that summarizes what needs to be done to mainstream bamboo at local, national and international level as a major building material in the construction sector. We divided them into seven broad categories.



Interior and Exterior of 2BHK house at Indian Plywood Industrial Research and Training Institute, Bangalore, India.



2BHK house at Indian Plywood Industrial Research and Training Institute, Bangalore, India.

These actions, when undertaken by various organisations, ministries and civil societies in different countries - on a Global level, the UN with its diverse programmes having a central role in this mission, several international organisations like the various arms of UN, SAARC, BRICS, DFID, TRADA, International NGOs such as INBAR, WBO, working in the field of ecological preservation and restoration, welfare programs and so on, could collaborate with national, state and local bodies in organised and vertically connected programs - will make positive influence in capturing people's imagination and change the perception of bamboo in the construction and sustainability sector.



The Lunardi Prefab House, Bracciano, Italy, 2004



Pantry and VIP toilet block Raj Bhavan, Bangalore, India, 1999

Legal framework and policies: There is a need to reach the higher bodies within government and sensitize them about the importance of bamboo so that laws will change. Directives that come from the top to the bottom of the hierarchy usually have a bigger impact (although the legal aspects are seen by the professionals as one of areas of action in which the implementation is not as easy as in others, measures such as redefining governmental housing strategies, including bamboo in building codes and funding for bamboo buildings are important).



Interior and Exterior of Creche, DEI, Agra



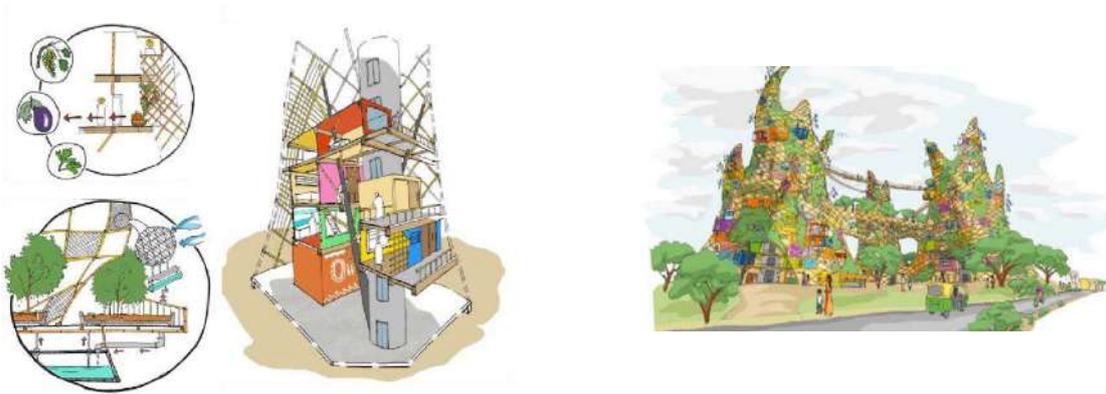
Creche, DEI, Agra

Advocacy: Creating awareness among the public, designers, policy makers, artisans etc about the possibilities of bamboo will increase its acceptability across all professional sectors and social strata. Showcasing bamboo in key locations by prominent architects will have a big impact according to a survey conducted by CGBMT. Using bamboo in bigger buildings, showing the material in attractive designs will positively impress the public. Its use in urban furniture and making ready-to-use kits should attract the user to bamboo.



Interiors of Solar Hut at Energy Park, Bangalore

Academics: Including Bamboo in Architecture, Civil Engineering and other related building science degrees is very important. This opinion is especially popular among countries where bamboo is a native species, but presently its inclusion in higher education doesn't match the material's availability and potential.



Competition Entry for Metaslum, Bangalore, 2018

Research & Development: In this area of action, there are some measures which are seen as the most effective and easy to implement: make data usable, develop engineered bamboo and composites, and bamboo specific software for architects and engineers. The overall belief is that this will allow bamboo to reach new types and scales of buildings (also, industry specific research to solve issues would go a long way to achieve the target, for example, fire rating of bamboo poles and bamboo composite products. It is a significant obstacle for use in public and large infrastructure projects).



Proposal for Millet Centre, Bangalore



Prototype development for Tsunami, Hutbay, Anandmans, 2005



*15 m Bamboo Bridge at Yamuna Bio-diversity Park at
Jharoda mazda & Wazirabad, New Delhi, 2006*

Skill Development: Providing skilled laborers, supervisors as well as architects and engineers with the knowledge and practical skills and innovation to work with bamboo, will solve project execution issues and spread its use. Apart from the significant portion of architects who don't have the skills to design with bamboo, even the architects willing to work with it, have trouble finding qualified laborers and engineers to execute their work (educational institutions, foundations and NGOs could significantly contribute to this).



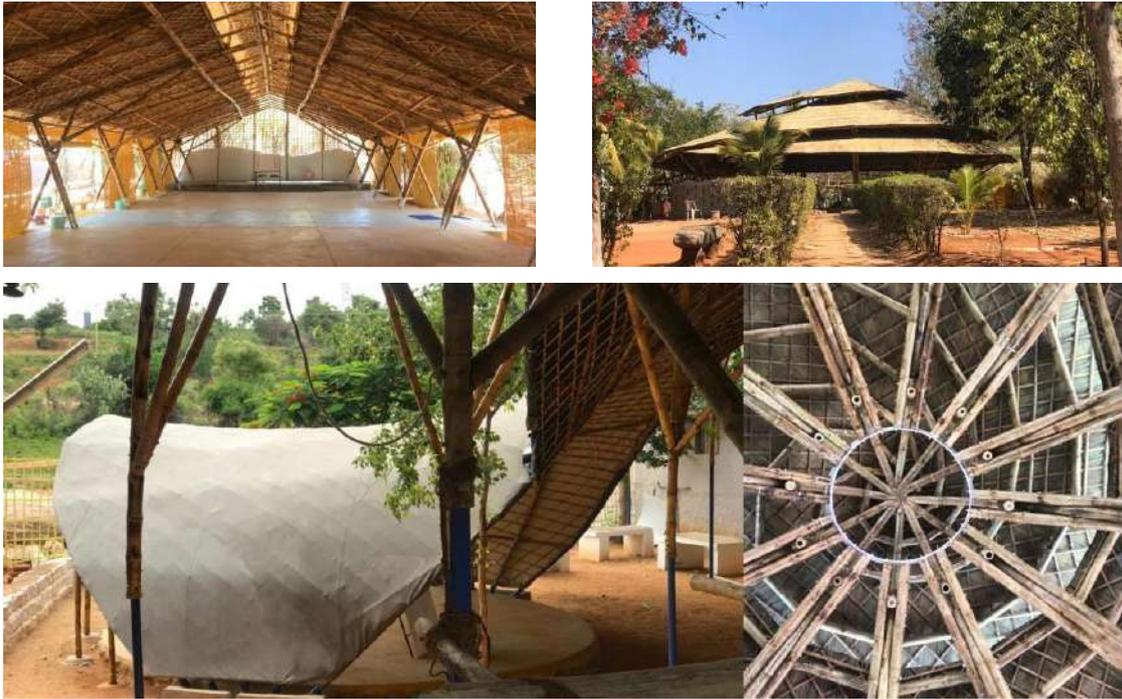
Workshops hosted at CGBMT Headquarters, Bangalore



India Pavilion, World Bamboo Workshop, Imphal, 2019

Marketing: Proving bamboo as an affordable material as well as advertising it in mass media by including public figures and celebrities are perceived as effective actions to spread the use of bamboo. Making it appealing and good for both low-income audiences, for its affordability, and also desirable for high-income audiences, for its appearance and industrial enhancement.

According to many, Bamboo should be promoted as a technically sound, eco-friendly and aesthetically pleasing material rather than affordable and cheap material.



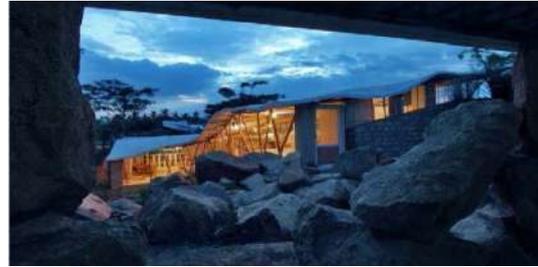
Pegasus Institute of Excellence, Bangalore, 2019-20



Bamboo Museum, Palampur, 2006

Industry Development: This is an essential field of action, since it defines the quality and ease of access of Bamboo by building professionals. Having an agro-based employment scheme and creating an organised supply chain with better coordination between agencies are indispensable to serve construction needs. Also extremely important is the standardization / certification of

bamboo for confident utilization by professionals and clients. Most professionals prefer off-the-shelf bamboo products and components for ready usage in their projects. In countries with wood-based constructions like Europe etc., architects feel value-added products from bamboo like ply, boards, flooring, bamboo wood etc., can be popularized more easily rather than bamboo poles for constructions.



“Bamboo Symphony” Office of Manasaram Architects, Bangalore

Housing & Infrastructure: Bamboo is a strong and versatile material with multiple uses that can be used in different parts of buildings and structures. Its lightweight and flexibility are qualities that will prove it successful in housing projects, both high-rises, and low-rises, much in need in developing countries. At the same time, it has to be encouraged to be used for schools, public buildings, resorts, hotels and even infrastructure buildings.



House of Five Elements, Bangalore



Proposal for Metro Station, Bangalore, 2013

As per our surveys, it was found that the issues need to be tackled from various fronts in a systemic manne, since they are inextricably linked to each other. It is undoubtedly a marathon task. The project needs collaboration from the highest authorities to the grassroots to make it successful. The programs will also need to vertically connect the international and national bodies and policymakers, architects, designers , and other building professionals to the skilled executing artisans on the site and the bamboo-based communities to fulfill the mandate of the project in the true sense of the word.

As per no. 17 of the UN’s Sustainable Development Goals, we have to “Strengthen the means of implementation and revitalise the global partnership for sustainable development”

CGBMT and MANASARAM ARCHITECTS are committed to work with other organisations committed to work in the sector, to take this project to implementation through further detailed action plans with practical timelines to Mainstream Bamboo in the building and related sectors to address the three bottom lines of Sustainable Development- Economic prudence, Environmental protection, and Social justice globally.



DEI Conference Hall - 2, Agra, 2021-22



The Cocoon, Trichy, 2014



Proposal for Police Cultural Center, Bangalore

Ar. Prof Neelam Manjunatha

Proprietrix, Manasaram Architects, Bangalore, India; CEO, Founder and Managing Trustee,
Centre for Green Building Materials and Technology, Bangalore, India

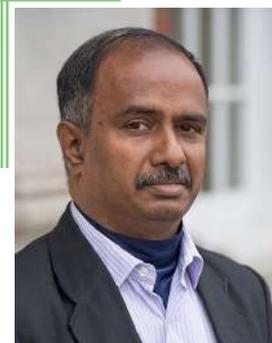
Mobile: +91 99454 66204; Email: mansarch@gmail.com

2. Bamboo sector in Northeast India- prospects and challenges

- Dr R.S.C. Jayaraj, IFS

Introduction:

Bamboo is an integral part of life in Northeast India, which holds one-third of the country's bamboo resources and a rich diversity. While the total number of bamboos is estimated at 1662 species under 121 genera, India has 148 species of 29 genera. Of these, 99 species under 21 genera are distributed in Northeast India. This region is also considered the Centre of origin of some of the tropical woody bamboo, which originated from the Hindustan Centre



comprising Assam and Burma. The North-eastern States have a varying number of species and the maximum diversity is in Arunachal Pradesh with 43-48 species and the minimum in Sikkim with 15-20 species. Bamboo covers 53,485 km² of the area in Northeast India and supports a total of 1792 lakh tonnes of growing stock which is 36% of the total area and 45% of the total growing stock of the country.

Bamboo distribution and growing stock: The State-wise distribution of bamboo in Northeast India and the growing stock in terms of equivalent green weight is tabulated below (Table 1). The bamboo distribution, spread and growing stock have been assessed at the national level as a part of the National Forest Inventory four times, published in the State of Forest Reports of 2011, 2017, 2019 and 2021. A comparison of the decadal variation between 2011 and 2021 shows a steady decline in the bamboo area. The total bamboo-bearing area in the region has reduced from 55,991 km² in 2011 to 53,485 km² in 2021, (5% decline in the area) due to various land use changes and developmental activities. However, the growing stock as indicated in the 2021 report, has shown an increase over the 2019 assessment. The trend of the bamboo area and equivalent green weight is indicated in Figures 1 and 2 below.

Table 1: Bamboo bearing area and growing stock in the Northeastern States.

State	Bamboo Bearing Area (km ²)	Equivalent Green weight ('000 MT)	Number of Species
Arunachal Pradesh	15739	46546	43
Assam	10659	38600	41
Manipur	8377	11321	26

State	Bamboo Bearing Area (km ²)	Equivalent Green weight ('000 MT)	Number of Species
Meghalaya	5007	24745	40
Mizoram	4561	12585	30
Nagaland	3947	32402	21
Sikkim	994	624	15
Tripura	4201	12413	27
Total	53485	179236	

Fig. 1: Trend of the bamboo bearing area in the country and Northeast India

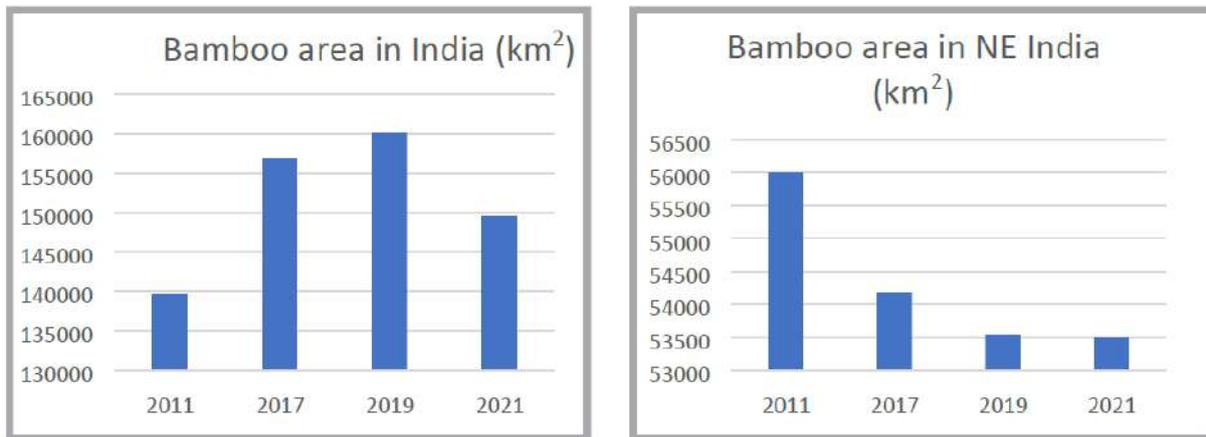
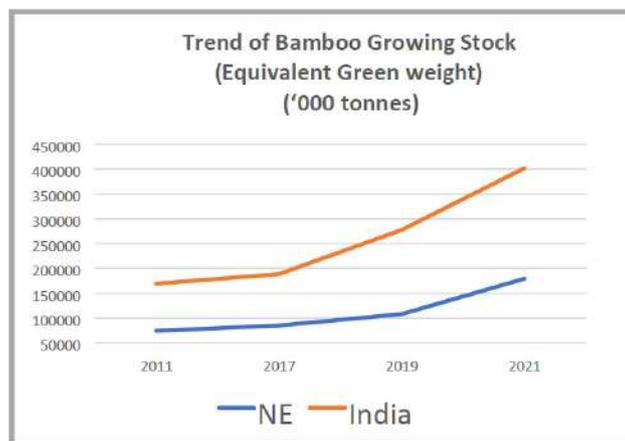


Fig 2. The trend of bamboo growing stock in the country and Northeast India



If the natural distribution of bamboo is considered, nine out of the ten prioritized bamboos of the Restructured National Bamboo Mission are found in this area, with a high degree of variability, providing scope for selection and improvement. The priority bamboos naturally found in the region include *Bambusa balcooa*, *B. bambos*, *B. nutans*, *B. cacharensis*, *B. polymorpha*, *B. tulda*, *Dendrocalamus hamiltonii*, *Melocanna baccifera* and *Thyrsostachys oliveri*. The only priority bamboo not found naturally, but under cultivation in a limited area is *Dendrocalamus asper*,

which is an exotic bamboo. The distribution of the priority bamboo in the Northeastern region is indicated in the Table below:

Species	Assam	Arunachal Pradesh	Meghalaya	Manipur	Mizoram	Nagaland	Tripura	Sikkim
<i>Bambusa balcooa</i>	+	+	+	-	-	+	+	+
<i>Bambusa bambos</i>	+	+	+	+	+	+	+	
<i>Bambusa nutans</i>	+	+	+	+	+	+	+	+
<i>B. cacharensis</i>	+						+	
<i>Bambusa polymorpha</i>		+	+				+	
<i>Bambusa tulda</i>	+	+	+	+	+	+	+	+
<i>Dendrocalamus asper*</i>	+							+
<i>D. hamiltonii</i>	+	+	+	+	+	+	+	+
<i>Melocanna baccifera</i>	+	+	+	+	+	+	+	+
<i>Thyrsostachys oliveri</i>	-	-	-	-	-	-	+	

* exotic bamboo introduced in the region

Bamboo utilization:

The predominant use in the region is for domestic purposes, mainly for housing in rural areas, scaffolding for cement concrete buildings, manufacture of household articles, or use of shoots as food. There is limited industrial utilization in the region, and much of cultivated bamboo is transported out of the region. It is estimated that nearly 1000 MT of bamboo is transported daily by road, out of North East region to other parts of the country. Besides this nearly 22004400 MT of bamboo is sent by rail every month, to various pulp and paper industries in the country. It is also estimated that nearly 1.7 million tonnes is smuggled annually to Bangladesh, Myanmar and Nepal.

However, the industrial use is picking up and new ventures are emerging. There are three industrial units producing bamboowood, located at Agartala (Tripura), Jagi Road (Assam) and Kolasib (Mizoram), which is a novel product with export potential. Assam Biorefinery Pvt. Ltd., is coming up at Numaligarh, which will use bamboo as the raw material for production of ethanol. It has plans to use 5 lakh tonnes of bamboo annually to produce 6 crore litres of ethanol and other byproducts. There are a few factories manufacturing bamboo plywood, in Assam, Tripura and Mizoram.

While the high-value addition through industrial use drives innovation and private investment, the low-value addition activities, such as handicrafts, agarbatti, charcoal, etc., generate direct income and contribute to growth in rural areas, sustaining families and villages. Any business development strategy should be a combination of both industrial use and domestic use.

Demand and supply:

The demand for bamboo is likely to increase due to arise in urbanization and an increase in living standards, which will spur the demand for bamboo furniture. Bamboo as a construction material will be in demand for rural housing schemes as well as ecotourism projects. The demand for bamboo flooring exists in Europe and USA. The novel uses are the use of bamboo composite as a reinforcement. There is a need to attend to the Supply side while expanding the Demand for bamboo, which is often lost sight of. The growing stock reported in the statistics of the Forest Survey of India is of 99 species of bamboo and spread over the entire region, mostly in Arunachal Pradesh which is relatively inaccessible with steep slopes. Therefore, there is a need to differentiate between what is physically available on the ground and what is accessible for use. Further, out of 99 species, only about 15 species are commercially useful, and their distribution is limited to tropical and subtropical areas. Only species-wise resource mapping can give the real picture on the availability of usable bamboos. Thus, there is always the danger of overestimation of available bamboo, while planning for large-scale industrial use. Nearly, 85% of bamboo is available in forest areas, and is naturally grown, mostly scattered as undergrowth among trees. These have low productivity due to biotic interference, only to the order of 2-3 MT/ha. Therefore, there is an urgent need to expand the cultivated bamboo, especially in the Brahmaputra valley, Barak valley, and the plains of Tripura, which have a great potential for cultivation.

Bamboo cultivation:

While going for cultivation, it is necessary to use the fast-growing high-yielding genotypes available with research organizations, as they yield at least 15-20% more than the routine stock. One major bottleneck is the availability of quality planting material. There is a need to establish more nurseries, which can macro-proliferate micro-propagated elite material. The use of routine seed-based material needs to be discouraged, replacing them with selected high-yielding genotypes multiplied clonally. Intensive silviculture combined with the use of appropriate planting stock can boost plantation productivity up to 50 MT/ha.

Improved utilization:

On the utilization aspect, there is a need to introduce primary processing to avoid wastage and to

optimize the use of bamboo. Wherever bamboo is used as a structural material or for furniture, there is a need for preservative treatment, to prolong the life of bamboo and to reduce the need for extraction. While most of the bamboo goes for domestic use in housing, fencing, and the production of household articles, industrial use is picking up, especially for the production of agarbatti sticks, bamboo wood, and bamboo boards. Bamboo-based ecotourism structures are also on the rise. There is a need for investment in industries engaged in the production of novel products which are of low volume and high value, besides having an export market.

One neglected sector is the use of bamboo shoots. Most of the shoot harvested is consumed locally and value addition is restricted to preservation for a limited period. If exclusive plantations for shoot harvest are raised, production can be increased, and facilities for canning and export can be introduced.

Research and Development:

Both production of raw material and utilization, especially on an industrial scale, needs a sound research backup. Bamboo-related research in the region needs strengthening, especially in the aspects of productivity enhancement, nursery and plantation silviculture, scientific harvesting, post-harvest management, mechanization of operations, preservative treatment, use of engineered bamboo, bamboo reinforcement in constructions, use of bamboo in carbon capture and bamboo-based ecotourism. If appropriate steps are taken, bamboo can transform the economy of Northeast India.

Conclusion:

The prospects of the bamboo sector in Northeast India are many. Nine out of ten priority species are found in this region, providing ample scope for the selection of high-yielding, fastgrowing genotypes and their cloning for use all over the country. A large number of selections are required, as the use of a limited number of clones is fraught with the risk of failure due to any disease or pest pandemic. The growing conditions in the Northeast region are quite ideal for bamboo, due to rich soil, high humidity, moderate temperature, and high rainfall. Bamboo nurseries can be a profitable venture due to low maintenance costs in rural areas. Bamboo plantations and the primary processing of bamboo can generate employment for rural development. Domestic use is quite high providing scope for employment. Industrial use is less comparatively but is likely to increase due to the new industries that are coming up. However, the challenges are equally daunting. There is no information available on specieswise growing stock, to aid in planning for any major industrial use. The very high diversity of bamboo in the region makes the process of mapping the species distribution and estimation of available growing stock difficult. The land

use changes especially cash crop cultivation and shifting cultivation will bring down the area under bamboo steadily. Most of the bamboos under cultivation is found in homesteads, and not extensive plantations, which makes it necessary to go for collection and aggregation for supply to industries. These challenges need to be addressed to effectively make use of the prospects.

Dr R.S.C. Jayaraj, IFS

PCCF & Director, Rain Forest Research Institute

Mobile: +91 94425 31990; Email: rsc.jayaraj@gmail.com

3. Carbonization Technologies Simplified for Commercial and Sustainable Applications of Bamboo to Support Rural Economy

- Shri Amit J. Agrawal and Shri Vijay Y. Karadbhajne

Introduction:

Bamboo is a group of woody perennial grasses in the true grass family Poaceae, which is a large family with over 10,000 species. In the tribe Bambuseae also known as bamboo, there are 91 genera and over 1,000 species. The size of bamboo varies from small annuals to giant timber. Bamboo is the fastest-growing woody plant in the world. It can grow up to 91–122 centimetres/day (3.8-5.0 centimetres/hr).



Activated Carbon (AC):

In recent years, there has been a rising expansion of the Activated Carbon (AC) global market. According to the Transparency Market Research Pvt. Ltd. (TMR), the product transactions reached, in 2012, 1.913 billion dollars and the predictions are that at the end of 2019 the numbers surpass the mark of 4.180 billion, presenting an annual increase rate of 11.9% in the 2013-2019 period.

Carbon biomass with iodine number between **600 and 1450 mg/gm** is considered activated carbon (ASTM 2011). AC is a highly porous carbonaceous material, with an elevated internal surface area and functional groups in its surface with an adsorption affinity for various contaminants. AC is obtained from **controlled pyrolysis** of a raw material (**Bamboo**), where temperatures vary from 400 to 1200°C, and consequent physical and chemical activation.

Activated carbon can gain a market value of as high as **Rs. 500/kg**.

The most known applications of **Activated Carbon** are:

- Water treatment (remediating bodies of water, effluent treatment and sanitary landfill and water filters lixiviate).
- Air purification (toxic gases and combustion gases removal).
- Food and Drink industries (sweetener purification, edible oils, glycerin, wine, organic and inorganic acids).

-
-
- Pharmaceutical production (color and compounds removal from some drugs).
 - Medicinal use (toxic products elimination; tablets, curatives, odor control filters and masks productions).
 - Soap industry.
 - Automotive vehicles (adsorbing combustible emissions or inside odors from them).
 - Oil refineries as a support for catalysts, gas storage, dehumidification (mold elimination and food conservation);
 - In mining.
 - Electronic industry.

Advantages of Bamboo as a Raw Material for Carbon:

Owing to the market value of Activated Carbon and the abundant availability of Bamboo, commercial production of Activated Carbon from Bamboo can be practiced to achieve the long-term goals of providing employment to the rural public of the region and exploit Bamboo harvesting in a beneficial manner.

Activated Carbon or **Activated Charcoal** prepared from various species of Bamboo has improved surface area and it is suitable for various industrial applications viz. **adsorption, absorption and filtration** as mentioned above. Bamboo is selected for carbonization owing to its following advantages:

- The yield of carbon/ charcoal from the bamboo is higher.
- Carbonization is more rapid.
- Charcoal can be made from species that cannot be processed by traditional methods.
- Industrial Chemicals like Vinegar and Tar and heat energy can be recovered from the smoke given off during Carbonization.
- By recovering by-products from the smoke there is less pollution of the environment.
- Bamboo is a fast-growing grass and it can prove to be a sustainable source of carbon.

Bamboo Carbon Synthesis:

Before the carbonization of Bamboo, a detailed and scrupulous laboratory study was carried out on various species of Bamboo to study its feasibility and efficiency to be converted into activated carbon. In all 35 species of bamboo were studied in the lab for their effective carbonization and activation through thermal processing. Finally, the Iodine number for all the carbonized samples was determined which is the major property of the Activated Carbon.

Bamboo charcoal production process is divided into three stages:

- Raw material preparation,
- Carbonization,
- Finishing process.

As the bamboo is heated in the retort it passes through definite stages on its way to conversion into charcoal. The formation of charcoal under laboratory conditions has been studied and it can be shown through following figures:



a) Original Bamboo



b) Samples cut into pieces



c) Carbonized Bamboo



d) Carbonization Furnace

Efficiency in Carbonization:

The three major factors which influence the conversion yield are:

- (a) The moisture content of the bamboo at the time of carbonization which indirectly affects the amount of fuel utilized and the time for carbonization process.
- (b) The type of carbonizing equipment used.
- (c) The care with which the process is carried out.

Measuring the Yield:

As bamboo is heated gradually carbonization occurs and the total weight required on carbonization, its three times the weight is fed in to furnace, as aforementioned factors along

with human error can vary the yield of carbonized material.

Condensable:

Bamboo Vinegar, the best-known product is obtained from the process which can be further purified and can be sold as a food grade potential product.

Carbon Analysis:

As mentioned earlier, about 35 different species of Bamboo were carbonized and studied in the laboratory for their carbonization efficiency and various other important properties like calorific value of carbon, its conversion and ash percentage were determined. It is observed that bamboo species like *Tulda varstriata*, *Dendrcalamus membrena* cells and *Dendrocalamus hamiltonii* give Iodine number above 1000 which is very good for sophisticated industrial applications. Also, the calorific value for most of the bamboo carbon species is found to be more than that of commercial mining coal.

Product Development:

Following is the short description of the product prototypes developed from the Bamboo Carbon:

1) Air Filter:



As shown in the image simple prototype was prepared from plastic basket containing a layer of Bamboo Activated Carbon of about 1 inch. The air analysis as shown in second image shows pure air obtained from the purifier.

2) Water Filter:

Water filter as shown in the image consists of pre and post carbon filter and the filter was able to purify the water, reducing its total soluble from above 500 to 350 ppm. The TSS was found to fall in drinking water range as per the set standards.



3) Smokeless Briquettes



Carbon Briquettes of the size of a Biscuit were prepared from the bamboo Carbon. As shown in the second image the briquette burnt continuously without any smoke and the small briquette was able to raise the temperature of the cup to 320 OC.

4) Pouches (For Odor & Moisture Removal)



As shown in the image small pouches from bamboo carbon were made. These pouches are capable of removing odor and moisture from the container in which they are kept.

In this manner, various products of industrial importance can be developed from Bamboo

Carbon. Also, the production cost of Bamboo Activated Carbon is much lesser as compared to conventional activated carbon cost. Hence, Bamboo activated carbon can easily replace such carbon.

Designing, Fabrication and Installation of a Commercial Carbonization Kiln

A commercial carbonization kiln with processing capacity of about 1000 kg/ day was designed and installed at Palasgao in Tadoba forest region, for carbonization process.

Highlights of the kiln are as under:

- Kiln works without electricity.
- It proves to be a zero/ minimum discharge technology as there is minimum pollution during its running.
- Carbonization of bamboo in the kiln also yields food grade Vinegar which will be separated and Tar which will be processed for high temperature resistant paint.
- Gases produced during the carbonization are recycled in the kiln itself for accomplishing the carbonisation process.



–From the available information, it is clear that bamboo can prove to be a good source of activated carbon and it has a huge potential of serving the rural people through such technologies. It also proves to be sustainable source of activated carbon synthesis.

Dr. Vijay Y. Karadbhajne

Head Department of Oil Technology

drvijaylit@gmail.com

M- 9822367657

Prof. Amit J. Agrawal

Asstt. Professor

Department of Petrochemical Technology

amitjagrawal@gmail.com

M- 9403148956

4. Bamboo a Versatile Grass for Rural Economy.

- Shri Punati Sridhar, IFS (Retd.)

Introduction:

Bamboo is a collective name for a group of botanical species that all belong to the grass family, the Poaceae (Gramineae) and hence it's called a woody Grass. The larger species can reach up to 40 metres in height and can have 30 cm thick stems, while the smallest types are small bushes that are no more than 1 cm in diameter. Globally Bamboo has about 1250 species and occur naturally in most parts of the world, apart from Europe India, China, and Brazil, have the largest areas of bamboo of a global bamboo cover that is estimated to be nearly 50 million hectares.



Globally Some of the most important bamboo species are:

Phyllostachys pubescens, mainly from China, where it is called 'Moso bamboo'. It is the backbone of the Chinese bamboo industry. *Guadua angustifolia*, which is especially prevalent in Latin America and has thick, large poles that have many uses. *Dendrocalamus asper*, which grows predominantly in tropical regions of South and Southeast Asia, and is used extensively in construction.

Some important bamboo species of India: *Dendrocalamus strictus*, *Bambusa bamboos*, *Dendrocalamus stocksii*, *Bamboosa balcooa*, *Bambusa tulda*, *Bambusa nutans*, *Dendrocalamus giganteus*, *D. hamiltonii*, *Melocanna baccifera*, *Phyllostachys bambusoides*, *Arundinaria spp.*, etc.

Characteristics of bamboo:

Bamboo grows rapidly, regenerates annually, and is selectively harvested annually without harming the ecosystem or contributing to deforestation. It's very fast growing as several species grow up to 90 centimeters a day. It's Cheap as compared to timber and is renewable as culms are produced every year and older culms of 3 years and above can be harvested every year.

It's a versatile species that grows in temperate' to 'tropical' regions and its habit ranges from clumping of rhizomes and culms to running type with rhizomes and culms placed at some space from one another. The runner types are easy to harvest. Some bamboos are thorny and many non-thorny. Some have side branches from the bottom and some have them a few feet above the ground. The thorny ones are difficult to harvest. Clumping bamboo, especially with compact

thick clumps is also difficult to harvest. It's highly resilient to climate changes and natural calamities such as fire, snow, drought, and flooding for short durations as it can regenerate from its subterranean rhizomes even if the bamboo above ground is destroyed. It adapts to poor soil or climate conditions and helps bind soil. Therefore, it's a unique and effective tool to control erosion and ensure slope stability and hence it's planted along river banks to maintain slope stability and restrain erosion. Thus, it's suitable for a range of restoration and land use planning needs. It can grow in degraded lands including saline/alkaline lands and those which get submerged during the rainy season. On account of its widespread rhizomes and rooting it improves the water-holding capacity of the watershed areas by 20% to 25%.

It significantly contributes to ecology such as improving wildlife habitats, forest hydrology, forest biodiversity, soil improvement, restoration of degraded lands and improving their productivity, etc

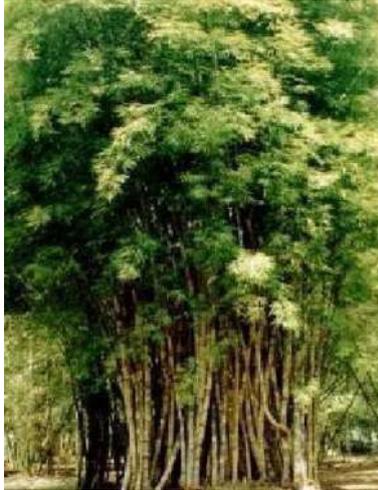
Bamboos reduce the effect of climate change by releasing 30% more Oxygen (320kg/year in the case of *Bambusa bulcooa*) than regular trees and sequesters and store 40% more Carbon (450kg CO₂/year in the case of *Bambusa bulcooa*) from the air than regular trees and fixes it in its body as well as in soil and helps combat climate change. Therefore, large-scale bamboo planting is required for a polluting country to remain carbon neutral.

Though bamboo is lightweight it's known as "vegetal steel" as it has high natural strength in view of higher tensile strength than steel as the tensile strength of bamboo is 28000 pounds/sq inch and that of steel is 23000 pounds/Sq. inch. Therefore, it has traditionally been extensively used for rural housing and is now extensively being used in modern construction replacing steel where ever feasible.

Bamboo has over 1500 uses and applications and hence has great potential for providing opportunities for livelihood development of the rural poor.

I. Following are some of the important Indian Bamboo Species:

- 1. Dendrocalamus strictus:** clumping, ht 6-18m, culm diameter 2.5-8 cm, grows in the dry zone, uses: by medars for making artifacts, in construction, as poles, etc



Strictus

2. **Bambusa bamboos:** thorny, clumping, ht 20-30m, 10-18cm diameter, 20-40 cm internode, rainfall 2000mm, uses: bridges, ladders, construction, paper pulp, leaves as medicine, etc
3. **Melocanna bassifera:** muli/berry bamboo, ht 10-25m, 3-7cm dia, rainfall 2000-3000mm, temperature 15-38 deg C, diffused clump type, culms when mature yellowish brown. Uses housing, weaving, medicine for respiratory diseases, super paper quality, yield about 84 T/ Ha in 3 yrs.
4. **Bamboosa bulcooa:** tight clump, Ht 10-25m, Dia 5-10 cm, Altitude 700-1500mt, temperature 9-32 deg C, Rainfall 700-4500mm, ph 5.5-7.5, drought resistant, max yield under well-managed plantations 40T/ac, uses: construction, biogas, ethanol, poles, paper, mat, etc.
5. **Bambusa tulda:** Indian timber bamboo, ht 6-20 m, diameter 5-10cm, rainfall 1200-2500mm, temperature 4-37 deg C, dense clump, uses: paper, scaffolding, construction, agarbatti.



Nutans

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6. **Bambusa nutans:** tight clump, ht 10-15m, dia 5-10 cm, altitude 700-1500m, temperature 9-32 deg C, rainfall 700-4500mm, ph 5.5-7.5, house, paper, mat, poles, etc.
 7. **Dendrocalamus stocksii:** ht 9m, dia 2.5-5.8 cm, mainly found in the west coast, grows up to 1200m altitude, Uses: furniture, lathi, stakes, agricultural implements, etc.
 8. **Ochlandra travancorica:** elephant grass, found in western ghats, ht 26m, dia 2.5-5cm, undergrowth plant, grows up to 1500 m altitude, grows in areas with > 1500mm rainfall, uses: planted along paddy fields as a soil binder, mats, baskets, super long fiber for paper, fishing rods, etc.
 9. **Bambusa multiplex:** medium-sized clump with slender culms (stems) and dense foliage. This bamboo is suitable for hedges and live fences and ornamentals. Clumping bamboo, Ht 2 - 7 metres. The thin-walled canes are 10 - 30mm in diameter with internodes 20 - 40cm long. Grows in open places; at elevations from 200 - 1,500 metres, Uses edible young shoots, used for weaving for mats, baskets; umbrella handles and for fishing poles, handicrafts such as bookcases, paper making ,etc.
 10. **Dendrocalamus hamiltonii:** Also known as tama or tufted bamboo A giant, evergreen, clumping bamboo native to the northeast Himalayas. culms are often curved and noticeably zig-zag. Ht up to 23 m, Dia 5–18 cm. Internode length is 30–40 cm, and Culm walls are 0.5–1.5 cm thick. It prefers a sunny to a half-shady situation on moist soil. They do not tolerate temperatures below 1°C, mainly used for construction, roofing, handicrafts, and fuel. The tender shoots are also used as food.
 11. **Dendrocalamus giganteus:** it grows in clumps consisting of a large number of closely growing culms, it can grow up to 40 cm per day. H 30-40m, D 10–35 cm young shoots are blackish purple. Internode length is 25–40 cm. lifespan 40-76 years, uses Construction, Paper Pulp, Laminated Lumber, Crafts and Furniture.
 12. **Bambusa polymorpha:** Bengal Bamboo, tufted bamboo with tall, clean stems H: 25-30 m, D: 15 c; internodes gray-green, 40–65 cm, wall thick; branching only from mid-stem up. Found in Bangladesh, India (NE), Myanmar, and Thailand. Use: edible shoots, handicrafts, house construction, pulping.
 13. **Bambusa vulgaris:** moderately loose clumps and no thorns. It has lemon-yellow culms (stems) with green stripes and dark green leaves. Another variety has green culms with yellow streaks. Ht: 10–20 m, Dia: 4– 10 cm, Culm walls are slightly thick, Internodes 20–45 cm. Flowering is not common, and there are no seeds. Fruits are rare due to low pollen viability caused by irregular meiosis. Common bamboo uses, stems as fuel and the leaves

as fodder, small construction, paper making, handicrafts, medicine, etc. The working and machining properties of the stems are poor, as they are not straight, not easy to split, and not flexible, but they are thick-walled and initially strong. Because of high carbohydrate content, stems are susceptible to attacks from fungi and insects such as powder post beetles. as ornamental. Its shoots boiled in water are sometimes used for medicinal qualities. Among all bamboos, only shoots of *B. vulgaris* contain taxiphyllin (a cyanogenic glycoside) that functions as an enzyme inhibitor in the human body when released, but degrades readily in boiling water. It is highly toxic, and the lethal dose for humans is about 50–60 mg.

- 14. *Dendrocalamus brandisii*:** Ht:19-33 m, Dia:13 - 20 cm, internodes 30-38 cm long, dense clumping, Tropical - Subtropical, grows best in wet evergreen tropical forests up to 1,300 meters altitude. Uses: building construction, boat masts, furniture, farm implements, water pots, basketry, handicrafts, paper making. Shoots are edible. Life span 30-100 years. Yields from 3rd year reaches peak production by 6th year ,and yields every year till it flowers.

II. Bamboo Plantation:

Bamboo poles/culms have a short growth cycles (3 to 5 years) with normally 3year-old ones being harvested. Bamboo is self-reproducing as new rhizomes emerge every year during monsoon season despite older ones being harvested. This quality makes it highly financially viable with regular income from 5 Th or 6 Th year onwards when the investment made begins to break even. Also, another specialty of bamboo is that it is low cost in maintenance and regeneration with relatively fewer pests and diseases. Regular post-monsoon watering with twice compost/ fertiliser application and weeding should be enough. Moreover, harvesting can be done at the owner's convenience.

III. Bamboo-Global Scenario

About 50 million ha area of the world (3.2% forest cover); India (30%), China (15%), and Asia (65%). About \$ 72.1 bn market worldwide (2019) India contributes only 5% share of the global market and China 70%. Globally major exporters of bamboo and its products are China, Thailand, Vietnam, and major Importers are India, US, Netherlands, and Spain. The bamboo products' global market share is:

- Woven bamboo products 22%
- Bamboo Charcoal 21%
- Bamboo shoots 19%

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- Furniture 16%
 - Industrial Bamboo products 10%
 - Rest (misc.) 14%

IV. Bamboo India Scenario:

India is blessed with 148 species of bamboo with 29 genera covering 15.69 million hectares of land.

Most of the bamboo is distributed in forest areas. However, India's productivity is very low: in forests, the yield is about 0.3 T/ha / yr, China: 1.25 T/Ha/yr; and in Private farms, it is 10T/ Ha/ yr, Where as in China it is 39 T/ Ha/yr respectively.

V. Versatile Uses of bamboo:

No part of the bamboo plant is wasted.

Shoots are harvested for food; branches for poles; main bamboo pole for fibres/pulp/ charcoal production, lower trunk for construction uses or flooring and engineered bamboo products.

Traditionally bamboo has been used for scaffolding, basketry, food, musical instruments, etc. However presently it's being used for several purposes such as furniture, decor, beverages, engineered bamboo products, activated bamboo charcoal, cosmetics, medicines, tea, chemicals, bamboo textiles, organic pesticides / fungicide, paper, ornaments, toys, bio- plastic granules, replacement for plastic, construction including schools, resorts, hotels, houses, architecture, interior decoration, decoration in vehicles, spectacle frames, helmets, etc., in post disaster housing earth quake areas, coastal areas

Innovative uses -heavy duty drainage pipes and wind turbines. Ecology environment: combat climate change, phytoremediation, Agro forestry, live fencing, dry bamboo fencing, leaf compost.

Description of some major uses of bamboo:

A) Bamboo shoots:

They are crisp and tender, comparable to asparagus, with a flavor similar to corn. Shoots usually develop every year with the beginning of the monsoon season, during which the shoots are harvested. Global edible shoots market is about 1.5 million US\$. The total world trade for bamboo shoot has been estimated at Rs. 3,200 to Rs. 3,400 crores.

Bamboo shoots are not only delicious but are also rich in nutrients and rank among the 5 most

popular healthcare foods in the world Bamboo shoots are one of the very low-calorie vegetables, holding 27 calories per 100 grams of fresh shoots.

Besides, shoots have moderate levels of soluble and non-soluble dietary fiber. 100 g of fresh shoots provide 2.2 grams of roughage. A high-fiber diet can help cut down colon-rectal cancer risk by protecting digestive organs from the toxic compounds in the food. The shoots are also rich in the B-complex group of vitamins such as thiamin, riboflavin, niacin, vitamin B-6 (pyridoxine), and pantothenic acid. Bamboo shoot is plentiful in minerals, especially manganese and copper. Also, it has small amounts of some essential minerals and electrolytes such as calcium, iron, and phosphorus. Bamboo shoots compose excellent levels of potassium.

The following species are used for edible bamboo shoots:

Bambusa bambos *Bambusa balcooa*

B. polymorpha

B. blumeana

B. tulda

B. nutans

B. pallida

D. hamiltonii

D. latiflorus

D. brandis

D. longispathus

D. asper

D. giganteus

Gigantochloa hasskarliana

G. levis

G. pseudoarundinacea

G. rostrata

Melocanna baccifera

Phyllostachys edulis

Thyrsostachys regia

B) Bamboo Fabric:

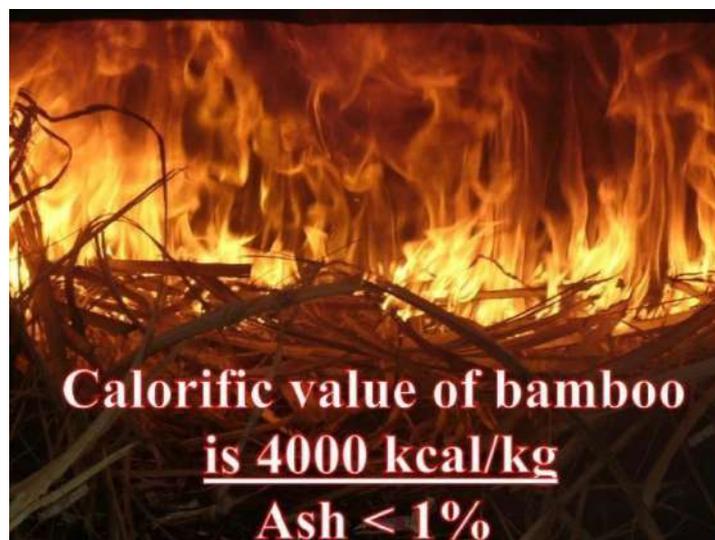
It's soft with moisture-wicking properties, is friendly to the skin and also keeps one dry by drawing moisture or sweat from skin.

Three types of bamboo fabric are manufactured:

- i) Viscose Rayon Production Bamboo cellulose is extracted from the wood pulp. This involves breaking down wood into small chunks and exposing it to a chemical solvent. The cellulose is compressed from bamboo fibers into sheets, processed using carbon disulfide. Then, the cellulose is pushed through a spinneret which transforms the cellulose into strands. To soften the strands, they are immersed in sulfuric acid. This produces filaments which are spinned into yarn. Finally, machines can weave this into the useful fabric for clothes. This process uses chemical which are not environment friendly.
- ii) Lyocell or Closed-Loop Production closed-loop method. No harmful chemicals are used and hence, doesn't chemically change the cellulose structure. It creates a fabric that is natural and organic. Also, these factories dispose of the solvents used to make bamboo rayon in the viscose rayon process as it is classified as waste. Thus, solvents in this process are reused in viscose process, whereas solvents used in viscose process cannot be reused and are disposed as waste. Thus, Lyocell process is environmentally-friendly.
- iii) Mechanically-Produced fabric: It's most environment friendly. No chemicals are used. Bamboo plant is mechanically crushed and natural enzymes are added, then the fibers are washed and spun into bamboo yarn. Such bamboo fabrics are quite costly as the process is labour-intensive and hence its availability is limited in the market.

C) Bamboo as fuel:

GoI mandated that biomass should replace coal to the extent of 5% in power industries. This is to



be operationalised from October 2022. Thus, a great potential is generated for using agricultural waste as well as bamboo and bamboo waste for the purpose. Bamboo has good Characteristics for use as fuel:

1. Total Moisture: 12 to 15%
2. Ash content: 0.4 to 1.0 %
3. Volatile Matter: 80 to 83%
4. Fixed carbon: 5 to 6 %
5. Total sulphur: 0.05 to 0.06%
6. Carbon: 48 to 52%
7. Gross Calorific value: 4116 Kcal/Kg to 4571 Kcal/Kg
8. Bulk Density: 0.4 ton/m³
 - Advantages of Bamboo fuel: Low ash of $\leq 5\%$, Low tar. Can be continuously harvested every year.
 - Plant once and harvest for 30 -100 years based on species life cycle.
 - Cost of cultivation is Rs 1000 / Ton

D) **Bamboo Charcoal, Activated/Nano Charcoal:** has much more surface area as compared to conventional activated/nano charcoal.

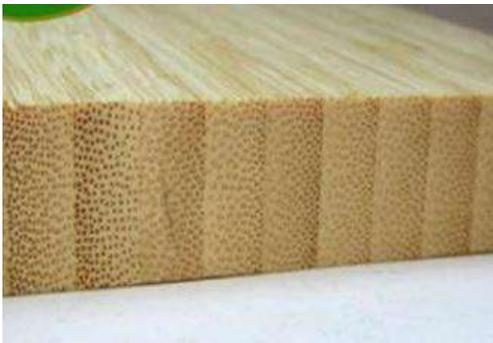


Bamboo activated charcoal is used for Kidney health by filtering out undigested toxins and drugs and also in absorbing intestinal gas and control of diarrhea. Other uses are teeth whitening, oral health, Skin care, Deodorant and in water filtration etc

E) Bamboo in construction and interior designing:



Construction



Lumber



Plyboard

its use in construction is picking up in view of its high tensile strength and durability. Its Lumber and plyboard are being now used in construction and interiors which is gradually gaining popularity. Bamboo board flooring is also picking up in the market.

F) Bamboo Ethanol:

An efficient process for the production of fuel ethanol from bamboo consists of hydrolysis with concentrated sulfuric acid, removal of color compounds with activated carbon, separation of acid and sugar, hydrolysis of oligosaccharides and subsequent continuous ethanol fermentation and development. The highest sugar recovery efficiency was 81.6% when concentrated sulfuric acid hydrolysis was carried out under the optimum conditions. using an improved simulated moving bed (ISMB) system 98.4% of sugar and 90.5% of acid were recovered. After oligosaccharide hydrolysis and pH adjustment, the unsterilized saccharified liquid was subjected to continuous ethanol fermentation using *Saccharomyces cerevisiae* strain KF-7. The ethanol concentration, the fermentation yield based on glucose and the ethanol productivity were approximately 27.2 g/l, 92.0% and 8.2 g/l/h, respectively. One dry tonne of bamboo can produce about 143 litres of

Ethanol. Bamboo biomass has key characteristics such as low lignin and high cellulose content and is suitable for the production of bioethanol. Producing 1 kg ethanol requires 8.5 kg of sulfuric acid, 65.8 L of process water, and 6.2 kg of bamboo.

With important characteristics such as the alkali index and low ash content, bamboo can be a good alternative for other woody plants for biofuel purposes. Bamboos need pretreatments, such as an alkaline peroxide treatment to remove rigid lignin and these pretreatments can also optimize enzymatic saccharification for the production of sugars.

High temperature, acid concentration, and time can increase the sugar yield of bamboo, which is obtained by conversion of lignocellulosic biomass in bamboo species to butanol. Butanol has ability to produce higher energy without blending with gasoline and the ability to transport it in existing gasoline pipelines and its energy content is higher than that of ethanol. In Maharashtra a 30000 litres per day medium-scale bamboo-based ethanol plants is being set up with an investment of Rs 65 crore. As many as 60,000 tonne bamboo grown over 1,500 acres would be needed annually to meet the raw material requirements of the ethanol plant. Thus, there is tremendous scope for establishing such industries in the country.

G) Bamboo Biogas:



Gasifier

The government's plan to set up 5,000 compressed bio-gas plants by 2023-24 would give a boost to the country's bamboo production and promote the industry as the commodity can be used to produce the gas. The process of generating compressed bio-gas (CBG) from biomass like

raw material for structural composites such as Oriented Strand Board (OSB), Glue Laminated Timber (GLT), Parallel Strip Lumber (PSL) and Oriented Strand Lumber (OSL) although there are several differences between bamboo and wood for example macroscopic and microscopic characteristics, chemical composition, physical and mechanical properties.

J) Phytoremediation:

Bamboos, can clean up polluted soils and can also accumulate silicon in their bodies to alleviate metal toxicity, and this accumulation in nature is up to 183 mg·g⁻¹ of SiO₂. Studies have shown it can absorb high levels of Chromium from soil. Bamboos are known to be successful plants at absorbing wastewater from agriculture, industry, animal breeding, and pollution, which can be related to the neutral characteristic in resistance to stresses. Biochar can lead to the immobilization of heavy metals such as Cu, Cd, Pb in the soil thus have potential to detoxify soils contaminated with heavy metals with the characteristics of high metal tolerance and extreme biomass production. Studies have shown the successful use of bamboo for removing Chromium from soil polluted by discharge from tanneries and also used for cleaning sewage water.

K) Bamboo Biochar:

Is a good ingredient for soil amendment.

Bamboo as a fine biochar had a positive impact on increasing the microbial community, impacting C cycling by decreasing their soil enzyme activity. Biochar is a good application for emendation and decontamination in soil. Bamboo charcoal has an important role in adjusting soil pH, enhancing nutrient absorption, and improving soil structure. Biochar improves the carbon of soil besides acting as a store house of carbon, reducing Carbon foot print.

L) Bamboo for Reducing Carbon Footprint:

Bamboo is a renewable bioresource that can have a short period of growth with a high CO₂ fixation rate. Bamboo can absorb approximately 3.73 cubic meter of CO₂, which means it can absorb the equivalent of carbon dioxide emissions from approximately 2 cars in one day and 1.83 kg carbon in less than one month. Among bamboo species, moso bamboo, has a high ability for carbon sequestration. Carbon in the bamboo rhizome system can be transferred to new culms and aerial organs.

M) Bamboo replacing plastic:

Bamboo cloth bags
Bamboo toothbrush/straw



There is a great scope for replacing plastic with bamboo bags, bamboo tooth brush, Bamboo bottles, bamboo crockery, bamboo toothpicks, etc

VI. Scope for Rural Livelihood:

Over 2.2 billion people dependent on Bamboo for housing, food, products and income. Over 8.6 million people in India depend on Bamboo for their livelihood and has potential to generate over 516 million mandays/year. India with twice the Bamboo area of china, can increase its share in world market several fold from 3.5 billion \$ to 7-10 billion \$ giving scope for livelihood for much more people (over 10 million) with proper policy and support from Govt. eg, June 2020 imposition of import duty of 25% on Agarbatti sticks helped domestic market and mainly local players. This step helped in increase of rate of Agarbatti sticks per bundle.

VII. National Bamboo Mission:

First phase focused on resource generation through plantation in Forest areas. 2nd phase started in 2018-2019 focused on plantation in the areas out-side of forest land so that rural people could get more financial benefit from bamboo resources. Government have recognized bamboo as 'grass not a tree, can cut and transport bamboo growing outside forest areas without permission from the government. Subsidies for planting and industries have been provided.

VIII. What needs to be done to strengthen bamboo sector and help increase scope for livelihood and economy:

- a. Basically, right policies need to be formulated for the sector along with provision for investment which is urgently needed.
- b. There is an urgent necessity is to establish a full-fledged Institution for Bamboo such as Bamboo Board on the lines of the Coir Board/Tea Board for promoting Bamboo based economic enterprise.

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- c. Create and Develop Bamboo Special Economic Zones in bamboo resource rich areas or states.
 - d. Create an accurate bamboo resource inventory on bamboo farmers, nurseries, industries, artisans, traders and major users on the net and create a platform for interaction among all stakeholders for the exchange of technical information, issues, suggestions for development and trade and marketing
 - e. Coordinate with different ministries supporting bamboo activities
 - f. Zone-wise suitable species to be specified along with a package of practices for cultivation for each category of use/ industry needs to be provided.
 - g. Improve R&D in bamboo by introducing incentivization in the system where at least 30% to 40% of patent revenue is shared with the Scientists doing the R&D.
 - h. GOI should incentivize Bamboo industries by giving tax holidays for such products for 2 to 3 years.
 - i. The Bamboo industry generates above 80% of waste. Need to incentivize such industries to convert waste into innovative products.
 - j. Assessment of stocks, market and technology research, innovation, and standard-setting need to be carried out.
 - k. Establishing value chains accessing local, regional, and international markets by way of appropriate standards setting and quality control.
 - l. Encouraging bamboo technology innovation and research and exchange of know-how.
 - m. Consider amending the national building codes to enable the use of bamboo by architects, designers and construction engineers.
 - n. Standards to be set and adhered to, provide for certification, monitoring and enforcement of regulations.
 - o. Government should list bamboo products in governmental procurement specifications.
 - p. Subsidies should be provided to ancillary industries to process bamboo waste.
 - q. Government should include bamboo in national climate change mitigation and adaptation plans.

Shri Punati Sridhar, IFS (Retd.)

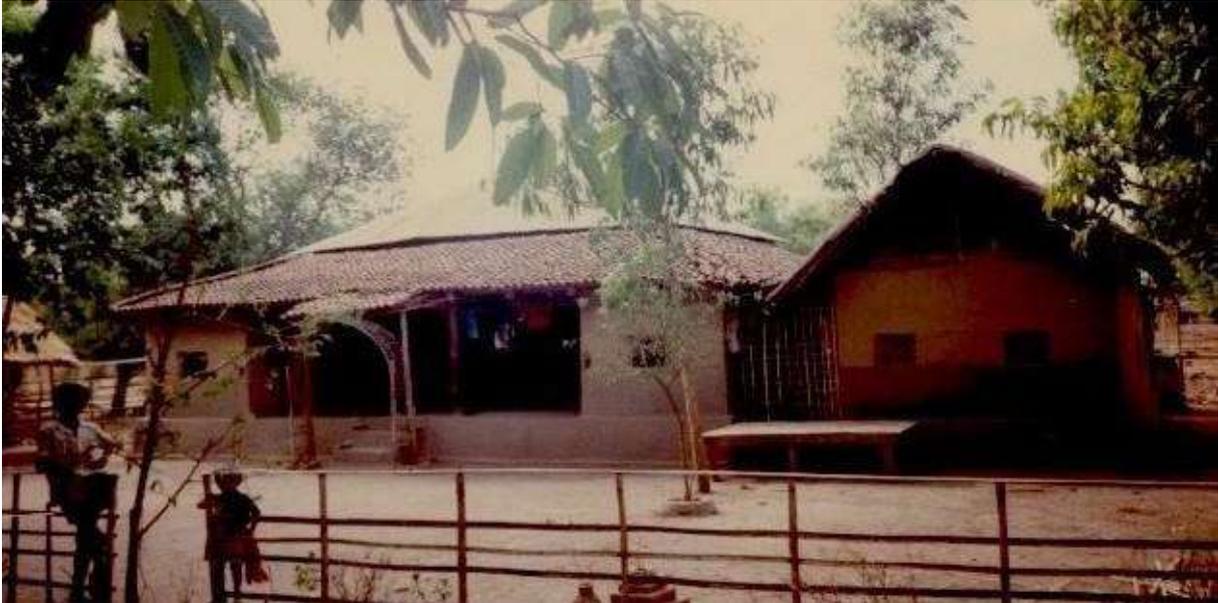
Chairman, Bamboo Society of India Bengaluru.

Former PCCF (HoFF) Karnataka.

Mobile: +91 94481 05097; Email: poonatis@gmail.com

5. Versatile Uses of Bamboo

- Dr. Soham Pandya



Versatile Uses of Bamboo

Introduction:

There are about 76 genera embracing some 1,200 species of bamboo throughout the world. Of this genetic wealth of bamboo 186 species occur in India. Most bamboo grows in the forest and propagates through natural regeneration.

Types of Bamboos

- i) *Bambusa arundinacea*
- ii) *Bambusa polymorpha*
- iii) *Bambusa tulda*
- iv) *Dendrocalamus hamiltonii*
- v) *Dendrocalamus strictus*
- vi) *Melocanna bambusoides*
- vii) *Ochlandra travancorica*.

Habitat:

Bamboos form the most important component of tropical forests.



They form the understory of the evergreen and deciduous forests. Bamboo grows luxuriantly and attains its maximum development in monsoon forests But at high altitudes and in temperate climates some species look almost like grasses.

Habit:

Bamboo has several distinct parts known as Rhizome; Culms; Sheaths; Leaves and Roots

The Rhizome:

A rhizome is an underground knot-like part which is neither a root nor a stem. Based on the morphology of the rhizomes bamboo can be distinguished in to two types namely monopodial and sympodial. Sympodial rhizome is a baffling entangle bunch of rhizomes and it makes an underground body of the bamboo plant.



The Culm:

The Culm is a part of the bamboo plant which is known as clump. Organically all the culms of a clump are interconnected with each other with the help of an underground rhizome. It is because of this reason they are called the fingers of a hidden hand. Removal of a single mature Culm has no adverse effect on the growth and development of new culms from the rhizomes.



In different species, the length of the Culm varies considerably (i.e. few Cm to about 30 meters). Similarly, the width of the Culm also differs considerably from finger-thick stem in some cases while 300 mm in giant bamboo species).

Sheaths:

Node on each and every part of the bamboo plant bears a protective sheath. The rhizome protects the meristematic region and allows the growing rhizome to slide with minimum friction. The sheaths of the rhizomes are simple but in the case of Culm and Branches.



Leaves:

The clump possesses a thick crown of leaves and the size may vary from species to species. In summer leaves are shed by all the clumps across the forest and the leaf fall is so voluminous that it creates a pad having thickness of about 100 mm thickness. This large photosynthetic surface area makes it possible for bamboo culms to grow at incredibly rapid speed during its shooting phase. Leaf litter can be used productively by making mulching pads which can be used in the fields to decrease the loss of moisture due to solar radiation, it almost eliminates the growth of weeds in the farms and fields, and slowly and steadily biomass decomposes in the field and increases humus contents of the soil. Areas below the mulching pad create favourable conditions for deep burrowing earthworms and their number increases considerably (5 earthworm burrows per square meter).



Roots:

Roots emerge from the rhizome nodes and at times from the Culm nodes. Roots, unlike rhizomes and Culm, do not have nodes and internodes. If the Culm falls on the ground the roots present on the nodes ensure its regeneration in the forest.

Growth:

Bamboo is the fastest-growing plant species attaining a height of about 1 meter in a span of 24 hours. Some of the buds present on the rhizome emerge from the surface of the soil to form a new Culm. The thickness of the Culm remains the same for its entire lifespan. However, the length of the Culm keeps on increasing for about 6 months.

Flowering:

Bamboo is a monocarp plant meaning it flowers once in its lifetime. Once flowering takes place the whole plant dies. Bamboo flowering is not regulated by seasonal changes but it is engraved in the genetic makeup of the plant.

Properties of Bamboo:

Dimensions: Bamboo Culms vary in diameter and height. Some bamboos grow to a height of

36 meters. The diameter varies from 1 to 30 Cm. The variability between species is far greater than variability within species.

Splitting: Bamboos have a tendency to split easily (more so in the region of internodes which have a lower coefficient of shear than the nodes).

Durability: Bamboos are highly susceptible to destruction by wood-eating fungi, insects, and fire. Within the Culm, the middle and tip portions are less resistant than the bottom portion. Considerable variation is reported in durability between different species. Untreated bamboos are generally less durable (life span 22 to 41 months). Bamboo under cover and not in contact with the ground may last from 2 to 7 years.

Moisture Content: The moisture content of the bamboo Culm is more in the lower portion than in the above portion. Similarly, it also varies from the age of the Culm

- Older culms (6 to 9 years) have less moisture than the younger ones (3 to 4 years). While drying bamboo culms shrink in diameter (3 to 12 % in matured culms).

Weight: Bamboo is light in weight compared to construction timber. The specific gravity of bamboo varies from 0.5 to 0.79 with a median of 0.65. This would make the weight of bamboo 648 Kg per cubic meter.

Strength: It has been reported by scientists that variation in strength between species is greater than variation within the individual species and that strength varies with species, age, growth conditions, moisture content, disposition of nodes, and position along the culms. The modulus of elasticity of matured air-dried Culm ranges from 125,000 to 195,000 Kg per square centimetre (average 160,000 Kg / square cm). Tensile strength of some bamboo (2,629 Kg / square cm = 28,843 psi) compares very favourably with the allowable tensile strength of steel (1,375 Kg / square cm = 22,000 psi). The modulus of rupture varies from 900 to 1,700 kg / square cm (average 1,300 kg / square cm = 18,460 psi). The compressive strength parallel to grain ranges from 315 to 725 Kg / square cm (average 520 Kg / square cm = 7,384 psi). The strength of bamboo generally increases until maturity. With few exceptions after the age of 5 years, the increase in strength is usually not significant. The strength of bamboo doubles after drying it completely.

The Culm has a tubular structure stiffened at intervals by the cross wall of the nodes which prevents its buckling and collapse. The disposition of the nodes is significant in the bending strength of bamboo but is not material in its crushing strength.

In a static bending test, specimens with a node at the loading point showed a higher strength but lower stiffness than those having the load point between two nodes.

Bamboo, because of microfibre structures with lignin and hemicellulose (lignin-carbohydrate

complex (LCC)), has a greater strength than concrete and steel by weight, and this strength is due to the thickness of the fibre in the sclerenchyma tissue. The diameter of the fibres at the site of the nodes is another factor in the stiffness and bending of the bamboo so that the fibres wrapped in it hold.

Bamboo, because of low density (1.4 g/cm^3) and high mechanical characteristics, can show high tolerance against pressure and bending.

The results of some studies have reported that the strength of bamboo is related to thickness, diameter, moisture content, and density, which increase with age, so that the age between 2.5 and 4 years has optimal strength, and then it will decrease after this age. Bamboo is one of the strongest tropical plants, with comparable strength to cement and steel.

Flexibility and fracture toughness of bamboos come from the special cellular material in these plants. Bamboo structure consists of fibre, which covers internal structures such as vascular bundles of parenchyma cells and the epidermis. They are also pathways for the growth of the cracks in longitudinal and radial directions.

Epidermis, as thick sheaths, surround bamboo, while vascular bundles with longitudinal tissues play an important role in the transport of water and nutrients in the bamboo body by organs such as vessels and phloem.

On the other hand, other parts are occupied by aerenchyma. However, all of these structures are covered by unidirectionally oriented fibres, which include 40% of a bamboo culm. Bamboo fibre is mainly three parts, including lignin, cellulose, and hemicelluloses, which have an important role in mechano-physical characteristics of bamboo in flexural strength and are related by chemical linkage and physical binding. Therefore, lignin, hemicelluloses, and phenolic acids are involved in the strength of concentrations and covalent bonding in layers of the cell wall, and this bonding, in addition to increasing the mechanical strength, can lead to the resistance of the cell wall to biological degradation and can be vital for the rigidity of lignin in the cell wall, leading to the flexible character in bamboos.

Cutting, Curing and Storage of Bamboo:

The Culm of the bamboo matures after two to six years. The Culm having larger diameter takes more time to mature. Cutting is worked on a cycle varying from 3 years to six years. The culms are cut 25 to 50 CM above ground. The cutting is generally done by hand with axes, machetes or saws. The annual yield varies greatly depending on the species. On an average the annual yield ranges from less than 1 to 7 air dried tons per hectare. Some species are reported to yield as much as 30 to 40 tons per hectare. For making bamboo less attractive to insects, they should

be harvested when the starch content is minimum in the culms. In India, the best season for harvesting bamboo is October to February. The Culm is raised above the ground on a stone or brick to prevent fungal and termite attacks. Bamboo culms are stored after properly drying them for a period of 6 to 12 weeks. It increases its strength and avoids cracking. Kiln seasoning can do the same job in 2 to 3 weeks. However, this kind of seasoning should not be done rapidly otherwise it may create cracks on the bamboo surface.

Uses of Bamboo:

Bamboo plays a considerable role in human life, and they cover a wide range of human needs from environmental protection to use as home appliances.

Bamboo plants with more than 40 million hectares around the world are one of the most important plants in improving climate change because of Carbon storage. Bamboo sequesters and captures atmospheric Carbon within its life span which can offset CO₂ emission by storing high concentrations of CO₂ in hollow parts of Bamboo. The bamboo forest acts as a Carbon Sink.

Bamboo Forest is a pollution cleaner. Bamboo is known to be a successful plant in absorbing wastewater from agriculture, industry, animal breeding and pollution. Bamboo through its Phyto remediation potential can clean up polluted soils and can also accumulate silicon in their bodies to alleviate metal toxicity and this accumulation in nature is up to 183 mg. of SiO.

Bamboo Building Components:

A variety of bamboo is used as building components. These components can be full, half, split, board, mat and slab. Each of the various shapes has a number of uses. For example, the board shape may be used for walls, roofs, and flooring. Trusses of Bamboo for building houses Bamboo, as a green and sustainable material, has an important role in new architecture, so in the future, an architecture based on green buildings will be built with bamboo as one of its most important materials.

In this case, bamboo is very familiar among scientists because of its energy savings, zero carbon emissions, and environmentally friendly nature.

Preferable Qualities in Bamboo:

Bamboo, despite having some disadvantages, including the difficulty of moulding due to hard

tissue, a rough texture, and rugged material properties. It is still important for design purposes because of some characteristics such as water resistance, bending resistance, hardness, and environmentally friendly nature.

Bamboo timbers are luxury woody materials used in furniture, flooring, and architecture. Among fibres, bamboo is useful because it is an abundant tropical plant, and its material distribution, micro-structural shapes, low cost, and easy accessibility make it an excellent material to build woody houses throughout the world.

Bamboo scrimber, which is produced during processes such as exposing bamboo to hot dry air, has been reported as a good option for use in outdoor landscaping, garden furniture, decoration, and civil engineering.

there are several reasons for preferring bamboos such as the enhancement of water absorption, width swelling, and thickness in bamboo scrimber.

Bamboo Buildings are Earthquake Proof:

Recent studies have shown that bamboo combined with reinforced concrete can increase building (construction) resistance to earthquakes, which can be an important benchmark for the use of these forest resources in earthquake-prone areas.

The external resistance of bamboo, such as compressive, tensile, and static bending strength, shock and shear resistance, and elastic properties, is related to elements in bamboo including bamboo stalk parts, moisture content, and type of bamboo.



Preservative Treatment against insects, rot, and fire:

Traditional methods which are used to increase the durability of bamboo against beetle include leaching in water and white washing. It is also often necessary to provide further protection to bamboo with chemical preservation. It includes brushing, spraying, swabbing, dipping, hot and cold bath treatment, Boucherie method and pressure treatment.



List of Preservatives:

- 1) Coal Tar creosote and fuel oil 50:50
- 2) Copper – Chrome - Arsenic composition 3:1:4 (Copper Sulphate $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$; Arsenic Pentoxide As_2O_5 and Potassium dichromate $\text{Na}_2\text{Cr}_2\text{O}_7$)

- 3) Acid-cupric-chromate Composition = 1.68 parts of Chromium sesque oxide (Cr_2O_3), 50 parts of copper Sulphate and 47.5 parts of Sodium dichromate.
- 4) Copper-Chrom-Boric composition = 1.5 parts Boric Acid 3 parts Copper Sulphate and 4 parts Sodium or Potassium dichromate
- 5) Copper-Chrome-Zink-Arsenic composition = 28 parts of Arsenic acid ($\text{H}_2\text{AsO}_4, 1/2 \text{H}_2\text{O}$), 25 parts Sodium Arsenate ($\text{Na}_2\text{HAsO}_4, 12 \text{H}_2\text{O}$), 17 Parts of Sodium Dichromate and 30 parts of Zink Sulphate ($\text{ZnSO}_4, 7 \text{H}_2\text{O}$)
- 6) Chromated Zink Chloride = 1 part of Zinc Chloride (ZnCl_2) and 1 part of Sodium or Potassium Dichromate
- 7) Boric acid-borax 2.5% each
- 8) Copper Naphthenate and Zinc Naphthenate: These are salts of Naphthenic acid and should contain 0.5% of Copper and 3% of Zink by weight, respectively.
- 9) Dieldrin pentachlorophenol emulsions = 1 part of Dieldrin 18% emulsifiable concentrate, 4 parts of PCP 12% emulsifiable concentrate, 75 parts Water, 1 Part Copper Napthenate 1% in emulsifiable form (by weight).
- 10) Water solution containing Borax 2% Sodiumpentachlorophenate 1% and Gammexane 1% by weight.

Fire Retardant Treatment:

- 1) Treating bamboo to make it fire-resistant is possible. Following are the chemicals which are used to treat bamboo for making them fire resistant.
- 2) However, for making the system universally adaptive the cost of treatment is a limiting factor.

Ammonium phosphate	3 parts
Boric acid	3 parts
Copper sulphate	1 parts
Zinc chloride	5 parts
Sodium dichromate	3 parts
Water for making	100 parts

- 3) A few drops of concentrated hydrochloric acid are added to the solution to dissolve the precipitated salts. The pH of the solution should be about 3.5

Bamboo Artisanal Products:

Hundreds of utility and decorative items are being made in South East Asia. Some of these are Furniture - indoors and outdoors. Some artisanal items are listed here 1) Toys for Children; 2) Animal shed; 3) Cups; 4) Blow Gun; 5) Baskets of different kinds; 6) Bullock Cart; 7) Candle Holder; 8) Chicken Cage; 9) Pig cage; 10) Cutlery; 11) Charcoal for a variety of uses; 12) Hand Holding Fans; 13) Artistic wall hangings; 14) Fence (Live and from dry Culms); 15) Flute; 16) Fishing nets; 17) Furniture of hundreds of kinds for interior and exterior uses; 18) Swings of different kinds; 19) Storage Baskets; 20) Containers for transportation; 21) Hats / Caps; 22) Fruit Harvesters; 23) Kanvar; 24) Ladders; 25) Support to trees bearing a huge amount of Fruits; 26) Looms for weaving; 27) Musical Instruments; 28) Bows and Arrows; 29) Trays; 30) Water lifting device; 31) Winnower; 32) Baskets; 33) Glass; 34) Frames; 35) Handbags; 36) Vase; 37) Cards; 38) Water Tank; 39) Green house and 40) Other domestic and decorative items



Modern Products:

Bamboo, as a fast-growing plant with a high yield of lignocellulosic biomass in a short time, is considered a good option for use as a biofuel, such as bioethanol, by the top holocellulose content (high dry weight of more than 70%). Ligno-celluloses have abundant sugar resources such as pentose and hexose and can be converted to fuel alcohol. Bamboo culms are known as resources of bioenergy. Young culms are suitable for the bioconversion process. Among biofuels, butanol is important because of its ability to produce higher energy without blending with gasoline and the ability to transport it in existing gasoline pipelines. In addition, the energy content is higher

than that of ethanol.

Many studies have reported that bamboo, as a forest product, has the potential for use as a biofuel, along with other woody plants. Bamboo, because of the high amount of sugar, is known to be a suitable plant for a feedstock of chemical products, such as lactic acid and fuel ethanol. It can also be used as biogas.

Other modern uses of Bamboo are - 1) Bicycles; 2) Tricycles; 3) Suit Case; 4) Bags with hangers; 5) Hangers; 6) Brushes; 7) Manure from leaf litter; 8) Mulching Pads from leaf litter; 9) Paper; 10) Rags; 11) Rayon; 12) Stainer; 13) Windmill; 14) Fabric; 15) Biofuel etc.

Edible Products:

From a long time ago, bamboo shoots have been a tasty food with high fibre content and have been eaten by the local people in southern Asia. Bamboo shoots are powerful sources of fibre, known as dietary fibre, with low fat and calorie contents. Bamboo also has necessary amino acids, potassium, antioxidants, selenium, vitamins, carbohydrates, and protein. The number of vitamins and mineral content decrease with the increasing age of bamboo.

Thus, a young bamboo culm can be a resource for fibre and starch, which can be used for food applications, such as bamboo flour, pasta, meat products, cheese, yogurt, and bread. Other food products of Bamboo are 1) Bamboo Pickles; 2) Bamboo Murabba; 3) Bamboo Chips; 4) Bamboo Drinks (Fermented); 5) Edible Bamboo Fibres

Bamboo is Edible for Animals:

In addition to humans, bamboo shoots are beneficial and tasty food for animals. Bamboo shoots are a source of food for some rare animals such as African golden monkeys (*Cercopithecus mitis kandti*), mountain gorillas (*Gorilla beringei beringei*), and especially panda, which guarantees the survival of the panda generation

Health Products:

Bamboo shoots are also considered for medical purposes for the treatment and control of cholesterol and diabetes from different products obtained from bamboo shoots, such as bamboo salt and bamboo vinegar. Other uses in this category are 1) Bone setting; 2) Vanshlochan; 3) Dietary Fibres

Construction Industry Products:

1) Bridges; 2) Tree Houses of dozens of types; 3) Bamboo reinforced walls and roofs plastered from both sides with cement and sand mortars; 4) Houses of Bamboo; 5) Doors; 6) Windows; 7) Plywood; 8) Wardrobe; 9) Furniture; 10) Sliding Shutters; 11) Room dividers; 12) Roofing Tiles; 13) Parida.



Bamboo Presents Opportunities:

Bamboo has been known as “poor man’s timber” because **more than 20 million tons of bamboo** is often collected in rural areas by local people, which plays an important role in the local economy.

Bamboo planting worldwide is approaching **220,000 km²**, which produces **15–20 million tons** of products annually

Bamboo Business:

Approximately **US\$2.5 billion** of international trade is related to the bamboo industry every year, which directly or indirectly has provided **2.5 million jobs** around the world.

There is also a small market of bamboo, which is called the traditional market of bamboo, that directly provides income to local people, and these market products include handicrafts, bamboo shoots (food), and medicine.

However, often bamboo businesses have been obtained by emerging markets, which use the woody timber of bamboo for flooring, roofing, construction, architecture, and furniture, which makes it responsible for almost 3–7% of the timber trade in the tropical and subtropical areas.

In general, all these statistical reports represent the important role of bamboo in local economies, as well as in providing job opportunities.

SWOT Analysis

Strength: 1) It is a vast resource; 2) Bamboo from North East are hard and durable; 3) Cane and Bamboo Handicraft have a good market; 4) India has strong roots in Handicrafts; 5) Labor Cost is low.

Weakness: 1) Bamboo in India is less versatile than in China; 2) Finished products from other Asian Countries are superior; 3) Lacks aesthetic appeal and quality controlling cost, quality is low; 4) Product is bulky and transportation cost is high; 5) Industries and cultivators yet to recognise potentials.

Opportunity: 1) Market of Bamboo Gazebo can be developed; 2) Development in the design quality of handicraft products; 3) There is scope for a category product market.

Threats: 1) There will be strong competition from other established Asian Countries like China & Taiwan; 2) Poor treatment procedures may lead to less durability; 3) Treatment should be standardized.



Dr. Soham Pandya,

Chairman,

Centre for Environmental Development,

Maganwadi, Wardha

Mobile: +91 70302 88445

Email: soham.ced@gmail.com

6. Developing Bamboo Market Linkages

- Shri Ranganath Krishnan



Introduction

The global bamboo market size is expected to reach USD 82.90 billion by 2028, according to a new report by Grand View Research, Inc. It is expected to expand at a CAGR of 5.7% from 2021 to 2028. A broader scope of application of bamboo in domestic as well as commercial applications, such as furniture, fabric, food, biofuel, pulp and paper, charcoal, and cloth, is expected to pose high growth potential for the market.



The Asia Pacific accounted for almost 80% of the global bamboo product trade in 2020 owing to the high influence of China, which accounted for almost 71% of the world's export of bamboo products. North America, Central, and South America, and Europe have also emerged as significant traders of bamboo products in recent years owing to the presence of indigenous bamboo species in Brazil, Mexico, Ecuador, Chile, and the Dominican Republic.

Similarly, a 2009 report published by the International Network for Bamboo And Rattan (INBAR) on the Agarbatti Manufacturing industry in Tripura describes the Indian Market valued at over Rs 41.63 billion, with an annual growth rate exceeding 20%. The Indian agarbatti sector, the world's largest, produces close to 208 billion sticks a year (Rao et al,2009).

Overall trends in the export market for Bamboo products appear favourable for the expansion of efficient industrial units into the sector. While China possesses a significant first-mover advantage, as well as several comparative advantages, it is envisioned that Indian industries producing Bamboo products can eventually capture a significant portion of this market owing to the provision of indigenous designs, capitalising on the exoticism associated with tribal crafts and eventually on reputations for best practices and high quality. This is of course contingent on the development of Brand Names, which requires the establishment of a strong industrial structure capable of creating value-added products of high quality at competitive prices.

Bamboo Market:

Key Stakeholders:

The Bamboo industry in India essentially consists of the following stakeholders:

- Arts and Crafts: Highly talented people with special skills who through manual processes add high value to Bamboo through the creation of artefacts.
- Bamboo Food: Bamboo Shoots are high in nutritional value and are a delicacy that can be harvested at a tender stage in Bamboo plantations.
- Bamboo for Construction: Bamboo is used in traditional construction, as well as prefab housing.
- Industrial Usage: High-value usage of Bamboo in (processed or semi-processed) combination with other traditional materials offering big opportunities with high capital expenses, as replacement of traditional wood, especially as wooden doors, flooring, laminated furniture, etc. Medium value processing, which requires less capital-intensive processing than above. Includes chopsticks, mat boards, etc.

Low-value processing, for products involving greatly limited value addition to Bamboo culms, including Charcoal and Paper and pulp industries. Unprocessed Culms, utilised in traditional applications such as Scaffolding and Traditional construction.

Bamboo - India Value Chain:

The value chain usually follows the following structure:

At the initial stage is the Cultivator, who is responsible for growing bamboo or procuring it directly from the forests. This sector is dominated by tribal who either cut Bamboo grown in the forest or by small farmers who grow bamboo plants alongside their regular crops.

The Cultivator provides the Bamboo produced to Aggregator Middlemen, who are responsible for the collection of Bamboo and sorting of this Bamboo depending on its grade in terms of quality. In some cases, very basic levels of processing are performed at this stage too. The cultivator provides only between 10-12 culms to the middlemen, who in turn aggregate this up to the level of several hundred culms (A U Khan.) This level may be characterised by the existence of informal contracts, which are enforced through fear of retribution. (Rao et al, 2009; Dilli Haat Traders)

The Aggregator Middlemen provide Bamboo to traders, who are involved in the transportation of Bamboo to bazaars in large urban centres, where manufacturers are willing to purchase them. Manufacturers purchase Bamboo at up to 300%- 400% of the price received by the cultivator (Khan et al, 2007).

Within the informal value chain, it is suspected the vast majority of bamboo utilisation in the production of value-added goods occurs in the informal and the unorganised sectors lacking in industrial organisation. In these sectors, it is observed that despite the promotion of handicrafts through programmes such as the establishment of dedicated handicraft markets, the formalisation and establishment of appropriate marketing channels in the sector are vastly limited. Most often artisans themselves sell products through informal walking on the streets or through small established handicrafts markets such as Dilli Haat.

Key Factors influencing Bamboo Market Development:

- The reported strong price rises over the last 18 months in several of the main bamboo-producing regions, indicate that demand is already growing quicker than supply. This suggests that there will be a need to increase the production of commercially important species to support the continued expansion of the industry.
- Mechanisms should be developed to deliver 'business advisory services' to rural enterprises in the sector. These should ideally be delivered through private sector suppliers, trade associations, model businesses, and other mechanisms geared to financial sustainability.
- Despite a strong entrepreneurial spirit, many micro- and small enterprises lack important business skills needed to grow into larger more competitive businesses, particularly in terms of accounting, productivity improvement, quality control, investment planning, and marketing.

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- Subject to the identification of suitable market opportunities, existing local entrepreneurs (traders, small producers) should be assisted to adopt simple improved technologies and processing techniques to enhance productivity, quality and/or produce new products.
 - Almost all bamboo processing is a micro-scale cottage industry using ancient technology with inefficient utilization of labour and raw materials. Simple technological improvements will have major positive impacts on the returns to women's labour and the seasonal efficiency of producers.
 - Traders should be targeted alongside producers as a key component in the growth and diversification of the existing industry, with an emphasis on measures to facilitate increased trade flows and the development of new markets.
 - Market linkages are "traditional" comprising many steps and with limited information flow or other supply-chain synergies. The bamboo traders represent an important resource of social capital and will play a key role in the development of new markets and the growth of the sector.
 - Information about prices and market opportunities, new technologies, and business skills should be made available through appropriate channels (e.g. webinars, pre-recorded videos posters, free downloadable content, and model sites)
 - The flow of market information is relatively weak in the long, physically dispersed supply chains. This reduces the responsiveness of producers to market changes, inhibits investment and innovation, and creates opportunities for benefits to be captured evenly between supply chain participants.

Lack of Market Information

Bamboo farmers are usually unaware of prevailing market prices and rely upon traders to determine their prices for them (Rao et al, 2009.) This is in contrast to farmers for many other crops including rice and wheat, whose prices are available continuously and are continually updated. Systems leveraged in many parts of India for information regarding crop prices through SMS services are not available for the Bamboo sector. The government-run portal Agmarknet.nic.in, which updates prices of commodities daily across over 1000 markets, curiously fails to analyse Bamboo prices over a wide range of days; data on Bamboo prices is sporadic at best, and the dissemination is minimal. (Rao et al, 2009.)

Insufficient Baseline Data

The Planning Commission remarks that the lack of data regarding resources and usage patterns for Bamboo is usually unavailable, and if available, outdated. This leads to difficulties in adopting concrete plans for Management and Planning for Resource Allocation. In particular, data for the usage pattern of Bamboo is deficient; this critical parameter being unstudied has led to improper resource allocation practices. There is an urgent need to establish a dashboard of the current status of all KRA (key result areas) is necessary to monitor current progress as well measure delta changes.

Low Interest in Commercial Forestry

Outdated policy frameworks, transit pass regimes, and price uncertainties and fluctuations have led to lesser interest among private farming communities, although this scenario is now changing. While the Indian government has amended the age-old 1927 forest act in 2017, several state governments have also followed suit, there are certain pockets where local acts are still being followed which prohibit the felling and transportation of Bamboo. There should be consistent dissemination of guidelines across all channels to ease harvesting and transportation without the need for a transit pass.

Suggestions for Developing Bamboo Market Linkages

- Establishment of Independent Clusters: One of the main reasons for underdeveloped markets is cultivation happens in a few selected regions across India. Value addition happens in another area which may be tangentially opposite geography to the production area. The transportation cost increases the end product cost significantly which makes it difficult to sell the end product. Often the transportation cost is almost 300%-400% of the product cost.
- If we can adopt a cluster-based model, wherein the cultivation, intermediary processing, and final product of one type is all contained within the cluster, it will offer an attractive price proposition to the end customer. Multiple clusters can be done for different product types in the same way,
- Perception and lack of awareness: General perception of Bamboo is viewed as input to tribal handicrafts industries alone. This mindset needs to be changed. While there are more than 1500 documented usages of bamboo, there are more than 5000+ undocumented usages of bamboo across multiple sectors. We need to address only areas which will have high value

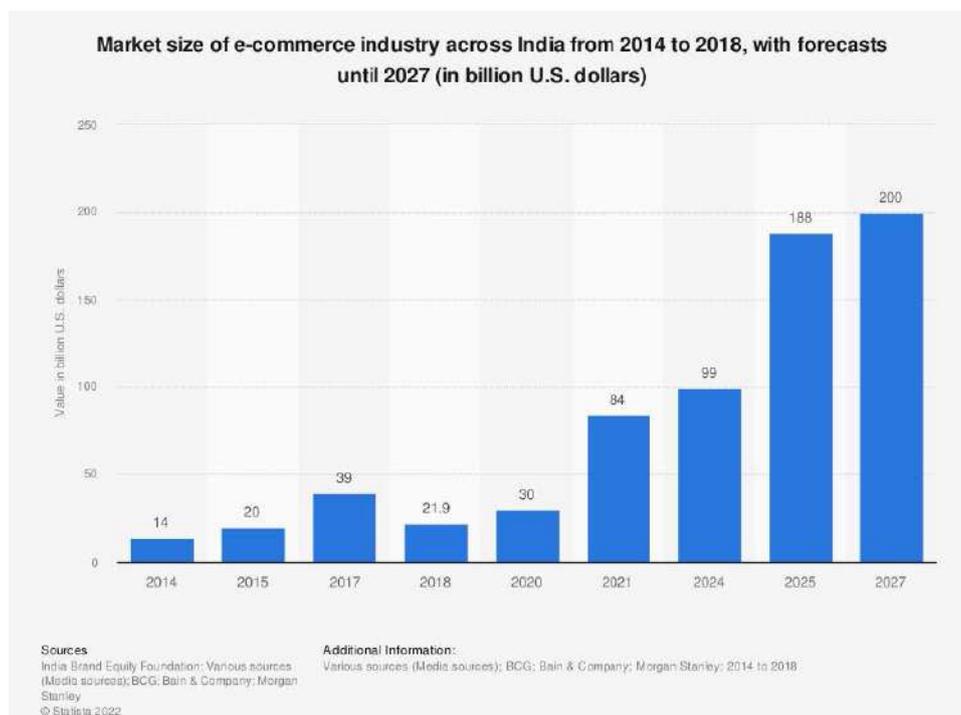
and high impact and spread the knowledge to a wider audience.

- Participation of retail chains: In the offline world, Bamboo products are usually not stocked by premier retail chains, and often work on back to-back ordering mechanisms. With the advent of online marketing, the evolution of digital commerce and social media marketing is seen as a boon for the Bamboo industry.

Emergence of eCommerce

One of the biggest advantages of eCommerce is its constant adapting to technological advancements – and easing business for entrepreneurs.

- A Unicommerce report states that over 65% of brands want to set up their independent website or online store
- A Q3 social bakers report showed that global ad spend increased 56.4% Quarter over Quarter and about 76% of the total ad spend went to Instagram and Facebook main feeds.
- According to Businesswire, about 61% of shoppers prefer buying from retailers who offer AR over those who don't. AR may unlock a large part of the market with its great benefits.
- M-commerce or mobile commerce is on the highest spike post-COVID, with 3/4 of online shoppers preferring it to other eCommerce platforms



As per statistics, India will see a big change in the way traditional business have been conducted. A big shift towards adapting e-commerce is expected in most industries and the Bamboo industry also will go through this adaption. With the penetration of mobile technology in rural areas and farmers adopting modern technology in agriculture or agroforestry, this further strengthens our argument.

Advantages of eCommerce in India

1. **No barriers:** Ever since businesses took a hit during the pandemic, online platforms came to the rescue with one BIG advantage – access to customers beyond borders.
2. **Safe & Secure:** With an online store, you reduce risks and save money on maintenance. Choose an eCommerce website that has a secure payment gateway and is encrypted to prevent hacking or spyware. If you are new to the online space, it is a good idea to start gathering clout on social media. This detailed guide will help you get started with selling on social media.
3. **eCommerce is more affordable:** With an online eCommerce website, you get to keep a team working remotely and managing the business without added expenses. You only pay the basic set-up/subscription fee and you can upload an unlimited number of products to your store.
4. **Marketing is easier:** Simply put, eCommerce offers you the power of enhanced digital marketing.
5. **Find customers before they find you:** When it comes to marketing for eCommerce, you find your customers before they find you. With eCommerce, it is like showcasing your online store to the world.
6. **Metrics and Scorecard:** In a traditional market, it is rather difficult to keep track of people who window shop. But, online it is easy to track people who have added products to their carts and follow up with them further based on responses.
7. **Better Customer Experience:** With the advent of artificial intelligence, it is now possible to offer adaptive customer engagement without trained staff. With every interaction, it is possible to develop and grow this dataset for continuously improve customer engagement and offer top-of-the-line customer experience. Features like setting up auto purchases periodically, specific events like birthdays, etc are additional feathers in the cap favouring eCommerce.

Marketplace

An online marketplace is a platform for both sellers and buyers to join together in massive numbers. It works as the intermediary between different groups, offers a feasible environment and required guarantees. A marketplace app is slightly different from an online store.

A marketplace app is created for easy and smooth shopping on a device like a mobile or a tablet. These apps are different as per the type of products they offer, the size, and the way they advertise themselves. E.g., Amazon fixes all issues of shoppers with online buying apps. The essence of the marketplace lies in accommodating many shoppers and sellers, whereas Internet stores provide a single seller. Here are 3 accessible categories of marketplaces:

- B2B (Business-to-business) platform suits the product exchange between businesses on profitable terms.
- B2C (Business-to-consumer) platform suits for delivering the product from business to the individual. Its primary benefit lies in the wide selection of commercial proposals in a single site. It is a universal webshop where you may find whatever you wish.
- C2C (Consumer to consumer) platform suits the product exchange between consumers, where both sides are even. It helps the individuals to reach an agreement on profitable terms – today you make a purchase, tomorrow you will market your goods or services.

Moreover, there is another classification of marketplaces, where they are divided into the following 2 types:

- Vertical platforms provide similar products from various manufacturers (e.g., Uber, Airbnb).
- Horizontal platforms provide different goods and services with similar features (e.g., Etsy, Handy).

These days, customers have more faith in online marketplaces as they offer a wide variety of products from both small and large sellers worldwide. Online marketplaces don't need to maintain product descriptions, logistics, inventories, and product images as the responsibility are on the sellers.

Sellers also get a fixed space for handling their orders and selling stuff. Buyers access the online inventory and check the real-time data about the goods that are updated timely. With SEO-friendly product listing and catalogue, the marketplace provides a fast way to improve search engine ranking and thereby improve the likelihood that your target audience will know who you are.

A typical marketplace is shown below:



Basic features expected in a Marketplace:

1) Seamless Registration Process

An easy registration process can retain many users on a marketplace app. You need to keep the entire registration process as easy and small as possible so the users don't need to wait patiently to use your app.

2) Social Media Integration

Integrating your app with social platforms is one of the best ways to allow users to use your marketplace app. Apart from the one-touch login facility, the users must get access to your

app with only a few clicks through Facebook, Twitter, Gmail, and other different social platforms.

3) Advanced Search Options

This essential yet simple feature helps you sell your goods efficiently. With effective and advanced search options, users can get many options.

4) Voice Search

This feature is going to transform the search for products and services soon. You must optimize this feature the way that the products' info must be compatible with the voice search parameters.

5) Add to Cart

Add this feature to your marketplace app for the consumers who sometimes don't buy a product immediately but like the add-to-cart option to save the product for future buying.

6) Multiple Payment Choices

Every customer has a different payment choice. Hence, use various payment gateways to offer multiple payment choices to your consumers.

7) Push Notifications

Push notifications keep reminding the users of what products they are missing. This is the best way to keep them stuck with your marketplace app. The application of the right push notification methods defines your app's success. Hence, spend on a good push notification system to retain your customers.

8) Ratings & Reviews

These features are necessary if you want to develop a marketplace app like Amazon. It adds a trust element in the genuineness of your products and services. Moreover, it helps consumers make detailed buying decisions while helping them to understand the things that you need to work on.

9) Photo Shopping

This feature helps buyers find a product even without knowing the brand or the product name. They can just use the picture to search for a product. Presently, many online biggies are using this feature.

10) Augmented Reality

Integrate your marketplace app with AR technology. It helps your app offer visitors the scope to analyze the products and services visually before finalizing the payment.

Typical Functionalities Expected of a Marketplace by different user profiles:

Users	Sellers	Admin
Product Listing	Social sign-up and login	Reports and analysis
Product description page	Offers and discounts	User and admin management
Favorites listing	Notifications	Category management
User profile	Inventory management	Feedback and support
Social sign-up and login	Settlement module	Seller and product management
Questions & Answers	Reports and analysis	Payment and refund management
Add to cart	Feedback and seller support	Discounts and offers management
Shipping and billing addresses	Order and return management	Banner and logistics management
Checkout page	Ratings and reviews	
Order tracking and history		
Delivery status		
Ratings and reviews		

About 'www.bamboo.market'

'www.bamboo.market' is a first-of-its-kind holistic platform for the Bamboo community enabling Trade. It is an initiative by Mr. Ranganath Krishnan who is an agripreneur, tech connoisseur, social activist, and executive committee member at the Bamboo Society of India. When his passion for the upliftment of Bamboo farmers and craftsmen met his extensive industry knowledge, 'www.bamboo.market' happened. The marketplace aims to list over 1000 Bamboo products gradually connecting most of the Bamboo artisans and craftsmen across India. From a B2C standpoint, 'www.bamboo.market' offers a comprehensive platform for Bamboo Craftsmen to sell directly to customers with better margins. The artisans can list their products for free without any subscription. Additionally, 'www.bamboo.market' also arranges microfinance funding for the craftsmen who need help with working capital. From a B2B perspective, 'www.bamboo.market' bridges the supply-demand gap in India by connecting Industrial users with Bamboo Farmers. This way the company gradually mitigates the need for bamboo imports' while empowering local farmers and artisans.

Shri Ranganath Krishnan

National Governing Council Member

Secretary & Treasurer, Bamboo Society of India Bengaluru

Mobile: +91 78999 97761; Email: goldensandsagro@gmail.com

7. Bamboo Plantation to Value Addition

- Ms. Daya Patki

Farming is the backbone of India and agroforestry practices are one of them. There are many species covered under agroforestry practices, in which Bamboo is majorly practiced because it plays important role in livelihood generation and can be cultivated in harsh conditions.

Bamboo is the fastest-growing woody grass with multiple uses. There are around 139 bamboo species found in India in which we have recognized a few species which can be value-added. One should only proceed for bamboo plantation of specific species depending upon the end product. If you take care of the plants for the first three years this crop takes care of you and your generations. Selections of proper species with good planting material and with proper management practices give you good results. Immature harvesting leads to negligible income with bad timber, products won't last longer period and will give a bad name to bamboo and bamboo products. M/S Bamboo Tantra is a seasoned producer of quality bamboo saplings and handicraft articles especially bamboo jewelry and bamboo lamps. The main aim is to increase public awareness about this important natural resource. Bamboo Tantra promotes bamboo artisans for their handmade products to conserve bamboo art skills as well as to give work to hands more than machines.



Five important points while selecting of species one should consider

- 1) Species should be erect and growing
- 2) Uniform internode distance
- 3) Nonbulky node
- 4) Tool friendly, less branching and easy to harvest
- 5) The species should have multiple uses

Below are a few species which we have found can be value added being in the class of farmer, as they carry five essential characteristics which are mentioned above.

- Dendrocalamus brandisii
- Dendrocalamus giganteus

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- *Thyrsostachys oliveri*
 - *Bambusa cacharensis*
 - *Bambusa polymorpha*

Below mentioned species can be harvested depending on the uses at different stages before gaining maturity as well as can be utilized in matured conditions, which ultimately gains more income due to maturity.

- *Melaconna baccifera*
- *Schizostachyum dullooa*
- *Dendrocalamus longispathus*
- *Bambusa tulda*

The gestation period for good timber is six years and value addition always give good returns as compared to raw material. Value addition can be done on a farm with minimum effort and minimum machinery. Bamboo Products can be broadly classified below

- Bamboo poles (Raw as well as treated)
- Traditional products
- Industrial products
- Bamboo furniture
- Bamboo handicrafts
- Food Industry

While considering rural livelihood generation one should always consider what a farmer can do to get maximum returns for the produce. Farmer cannot produce ethanol or bamboo ply at his farm, he can only produce raw material for the industries provided if that industry is located in transportable limits so that transportation costs will be less. For establishing a bamboo industry either it may be an ethanol extraction unit or a Bamboo ply industry a minimum of 1000 ha. of bamboo cultivation should be there in the vicinity of the industry, to run it successfully throughout the year.

Below are a few opportunities for the farmers who wish to value add their agricultural produce.

- Selling edible Bamboo shoots in local marketing
- Processing and canning of bamboo shoots
- Flattened bamboo
- Treated bamboo poles

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- Providing treated bamboo poles of uniform length and diameter required for bamboo construction
 - Selling bamboo internodes to the hotel industry for bamboo biryani or bamboo chicken
 - Extracting slivers for bamboo weaving purposes
 - Producing single-use disposable bamboo cutlery (Plates and spoons) made up of bamboo culm sheath
 - Making Bamboo straws
 - Planting own mother plants and then producing bamboo saplings for bamboo nursery
- So, one should always consider the end product in mind and then select species which can be suitable for plantation. Instead of planting single species of Bamboo, multiple species of bamboo are always profitable and invite the better market appreciation.

Ms. Daya Patki

Bamboo Tantra

Mobile: +91 75887 39163

Email: bambootantrapune@gmail.com

8. Bamboo – Value Addition Opportunities for the Small Manufacturer

- Shri Vaidyanathan Hariharan (Vaidya)

The recent past years, post amendment of bamboo classification as a grass, has seen great thrust toward Bamboo Sector growth initiatives in India.

And yet, India remains virtually a non-starter with regard to bamboo utilisation and implementation of proper facilitation towards rapid growth in the sector. As China touches 2.5 billion in

exports, India is limping at around 150 million in exports with a promising material touted as 'green gold', 'green steel' etc. Many such

statistical data can be presented repeatedly, which is not intended in this small write-up.



Way Ahead in Material Value Addition

There seems to be no near-future solution to the governance & administrative problems faced by India in implementing all the facilitation schemes & proposals. So long as departments do not consider it a necessity, and so long as bamboo entrepreneurs are made to run from desk to desk in the endless mess of administrative scalar chain for various clearances, licences and policy compliances, India is going to find it hard for implementing any major thrust towards serious growth in this sector.

On one side, our Hon Prime Minister Shri Narendra Modiji is relentlessly working toward 'Atmanirbhar Bharat', 'Vocal for Local', 'Green India Mission' & 'Doubling of Farmer Income'. On the other side, we observe experiences of policy delays, banking & finance delays, project clearance delays and the excruciatingly stressful life of small & medium entrepreneurs to involve in their passion and entrepreneurship with full energy.

Where can we expect innovation within such an ecosystem? Where can we expect steady growth & export competitiveness in such an ecosystem? How can we deliver innovations in reality, within such an ecosystem? Where is the time & energy for aspiring bamboopreneurs to engage in product development, creative thinking, and relevant innovations & process development within this endless struggle for everyday survival?

The only probable way might be that passionate bamboopreneurs take it upon themselves to go ahead and make business irrespective of facilitations and/or support from a lackadaisical governance mechanism. This can sadly be achieved only by a very few lucky bamboopreneurs. Waste utilisation remains the most significant aspect of value addition and safe future survival for bamboopreneurs in India, as is the case elsewhere. For example, almost 85% of the material is wasted in the process of making agarbathis. This is one sector where India has been fighting to compete with low-price Chinese imports. Subsidies & financial engineering are not going to help provide long-term solutions.

The only solution is to techno-commercially compete. The problem with the undertaking of new products and processes by small bamboopreneurs is the lack of awareness of the entire bamboo stakeholder chain itself. Even as advanced products like floorboards of luxury cars, sunroofs, etc are being made from natural fibres and natural material composites, we continue to seek proof for the smallest of concepts such as basic moulded utility products. We are simply not ready to accept even basic logical possibilities. Facilitators of bamboopreneurship must open up their minds further for practical market-based product identification & approval. It does not take much work & study to visualise and approve product possibilities already available in the markets with other raw materials. Various organisations within the bamboo sector may come together in order to positively hand-hold bamboopreneurs into creating high-value addition in the sector, without prejudices and psychological constraints whatsoever.

Moulding Projects using Bamboo process wastes

There is no necessity to reinvent the wheel again and again. Moulding is a basic process of manufacturing. Wood powders, mineral powders, lignocellulosic materials, and various fillers are all moulded into different products ranging from buttons to skateboards to bakelite‘hylam’ sheets. It is not a new science or concept at all to convert bamboo process wastes also into ultra-fine powders and then produce appropriately formulated moulding powders/granules for different applications out of the same.



Our country has been wasting a lot of bamboo resources, simply because bamboopreneurs have not been guided to think of moulding powders/granules with bamboo waste as a raw material for hundreds of probable end-user products.

Some of the products that can be made with appropriately formulated bamboo moulding powders are:

Crockery, Cutlery, Bowls, Buttons, Wall tiles, Ceiling tiles, Hylam type sheets, Switches & Boards, Cabling trays & boxes, Frames & Holders, Corporate Gift-wares, Skateboards, Fan blades, Wall hangers & décor, Bottle screw caps, Stair-boards, Knobs, Battery cases, Vehicle number plates, Utility boxes, Small DIY shelves & storages, false-ceiling tiles...and many more such utility products. There is some moulding project for any number of small entrepreneurs.



Moulding Powders – Future of Bamboo Process Wastes

- Bamboo process wastes, as well as non-commercial bamboo species, should become high-value addition raw materials since there is no specificity of raw material within a species for high-pressure powder-mouldings.
- Multiple formulation advantages, designed for specific application requirements.
- Phenolic, Melamine & Melamine-Urea formulations create endless formulation & design capabilities, in addition to thermoplastic granule formulation mouldings.
- Possibility of creating moulding cooperatives & communities.
- Every rural household may take up different job-work activities.
- Bamboo mouldings can become a great self-employment creator.
- ‘Hylam’-like panels with wear-layer & weatherproof laminations have numerous applications ranging from flooring, wall panels, ceilings, roofing, facades, frames, door skins & sandwich RTA (ready-to-assemble) housing.

Bamboo is the most promising material for India which can successfully fit into all the five key visions of our Hon Prime Minister Shri Narendra Modi Ji, towards – ‘Atmanirbhar Bharat’, ‘Vocal for Local’, ‘Increasing Green Cover’, ‘Doubling Farmer Income’, as well as ‘Housing for All’. No other material can claim the possibility of a significant role in all of the 5 vision points as much as Bamboo can. The time to act is, now. Jai Hind!!!

Shri Vaidyanathan Hariharan (Vaidya)

Founder Director

Kalpaka Research & Development Foundation (KRDF), Ernakulam, Kerala

Email: krdfindia@outlook.com

NIRD&PR

The National Institute of Rural Development and Panchayati Raj (NIRD&PR), an autonomous organisation under the Union Ministry of Rural Development, is a premier national centre of excellence in rural development and Panchayati Raj. Recognized internationally as one of the UN-ESCAP Centres of Excellence, it builds capacities of rural development functionaries, elected representatives of PRIs, bankers, NGOs and other stakeholders through inter-related activities of training, research and consultancy. The Institute is located in the historic city of Hyderabad in Telangana state. The NIRD&PR celebrated its Golden Jubilee Year of establishment in 2008. In addition to the main campus at Hyderabad, this Institute has North-Eastern Regional Centre at Guwahati, Assam to meet the NE-regional needs.

The vision of NIRD&PR is to focus on the policies and programmes that benefit the rural poor, strive to energise the democratic decentralization processes, improve the operation and efficiency of rural development personnel, promote transfer of technology through its social laboratories, Technology Park and create environmental awareness. As a “think-tank” for the Ministry of Rural Development, NIRD while acting as a repository of knowledge on rural development would assist the Ministry in policy formulation and choice of options in rural development to usher in the changes.

The mission of NIRD&PR is to examine and analyse the factors contributing to the improvement of economic and social well-being of people in rural areas on a sustainable basis with focus on the rural poor and the other disadvantaged groups through research, action research, consultancy and documentation efforts,

To facilitate the rural development efforts with particular emphasis and focus on the rural poor by improving the knowledge, skills and attitudes of rural development officials and non-officials through organising training, workshops and Seminars.

CIPS

The Government of India has set up the Centre for Innovations in Public Systems (CIPS) in May 2010 as an autonomous body in pursuance of the recommendations of the XIII Finance Commission. In line with its mandate and objectives, CIPS located in Hyderabad, is working with State, Central and District-level Government Departments and functionaries in developing policies and practices for promoting an innovative culture for transforming creative ideas into sustainable practices for improving service delivery.

The vision of CIPS is to provide assistance to the state governments in developing policies for promoting innovative culture for transforming creative ideas into sustainable practices.

The mission of CIPS is to Nurture an ecosystem and develop a culture of Innovations in Public Systems.

The Centre has been contributing in a major way to the activity profile of the Central and State Governments with high visibility programs and projects that reflect the trust and confidence reposed by them and enhance its recognition and reputation for committed, high-quality work in policy advocacy and implementation support. The rich legacy and the reputation that the Centre has built over the years in carrying out projects and programs continue to add to the goodwill, and credibility of the Centre as a dependable think-tank for policy inputs trusted knowledge-source and reliable implementation partner. It is aiding the State Governments in developing policies for promoting an innovative culture for transforming creative ideas into sustainable practices at the local level. The Centre thus helps create a climate to nurture a culture for accelerating and diffusing innovation in public systems.



CIPS

Performing through Innovations

Centre for Innovations in Public Systems

College Park Campus (CPC) of Administrative Staff College of India (ASCI)

Road No. 3, Banjara Hills, Hyderabad - 500 034, India

Phone: +91 40 66720720 | Fax: +91 40 66720721

www.cips.org.in

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