



FONDATION FOR
MSME CLUSTERS



An Analysis of Bamboo Standards Situation in India

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Foundation for MSME Clusters (FMC)

Address: USO House, 2nd Floor, USO Road, 6 Special Institutional Area, Off Shaheed Jeet Singh Marg, New Delhi – 110067

Contact Details: +91-1140563323/24

Email: info@msmefoundation.org

Website: www.fmc.org.in

Small Industries Development Bank of India (SIDBI)

Address: SIDBI Tower, 15, Ashok Marg, Lucknow - 226001, Uttar Pradesh

Contact Details: 0522-2288546/47/48/49, 0522-4259792

Email: elsc_lucknow@sidbi.in

Website: www.sidbi.in

Common Wealth Educational Media Centre for Asia (CEMCA)

Address: 7/8 Sarv Priya Vihar New Delhi-110016

Contact Details: +91-11-26537146/47/48, 26516681

Email: admin@cemca.org

Website: <https://www.cemca.org/>

Copenhagen Business School (CBS)

Address: Copenhagen Business School Solbjerg Plads 3 DK-2000 Frederiksberg

Contact Details: +45 3815 3815

Email: cbs@cbs.dk

Website: <https://www.cbs.dk/>

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**An Analysis of Bamboo Standards Situation
in India**

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1. Ecological Importance Of Bamboo: Bamboo belongs to the grass family *Poaceae*, and sub-family *Bambusoideae*. India hosts around 148 species in 29 genera of bamboo, of which, maximum concentration of species is found in the deciduous and semi-evergreen regions of Northeast and the tropical moist deciduous forests of North and South India. (Sharma et. al., 2015¹). Bamboo is commonly known as ‘poor man’s timber’ since it is used by the rural population and because of its global demand and varied uses in housing and other useful items.

Bamboo species have a high regeneration capacity, high-density leaf canopy, and extensive but evenly distributed root system, considered to be very effective to arrest soil erosion and restoring degraded lands (Kaushal et al., 2020 a,b^{i ii}). Bamboo is a renewable bioresource that has a short gestation period with a high CO₂ fixation rate. A study done in Vietnam suggests that shift in land use from annual crops to bamboo provides an annual net gain of soil organic carbon of approximately tons ha⁻¹. Some studies at national level e.g., that undertaken in Barak Valley of Assam suggests that Carbon assimilation ratio, an index to evaluate C sequestration potential per unit of C stock, exhibited bamboo farming as an efficient C sequester than from other pure plantations or natural forests (Nath et al. 2011)ⁱⁱⁱ.

Bamboos are incrementally being used in many product lines and are utilized in many ways, from construction materials, food profiling, and musical instruments to the production of paper pulp, fencing, basketry, textile and now biofuels as well (Hossain et al, 2016)^{iv}. As bamboo is now being used in multiple product lines there are a large number of players associated with it, arranged in complex bamboo value chain(s).

2.0 Mapping (Structure) of the Bamboo Value Chain in India

As Bamboo is being used for different purposes in India, there are varied long and short value chains around respective product lines, but a generalised value chain model modified from (Baksey 2013)² is given here.

The value chain starts at the cultivators’ level who are generally tribals or farmers who grow bamboo on field margin or at a corner of their field. Ever since the forest department has been strict on restricting harvest of forest resources from Natural Forests, Bamboo harvest from forests has reduced, but many experts say that under informal trade there are chances that it may be still harvested in small quantities from buffer areas. Most of the harvest happens from outside forest areas but in either case for most of the time harvest is not done systematically. The biggest challenge at producers’ level is that they only get marginal price for their harvest and so it is not attractive for them to do Bamboo cropping at commercial level. Till date there is not specialised cultivation and harvest protocol that is followed up. The tools used to cut the harvest and the way to harvest is not in a scientific way.

The Cultivator supplies the Bamboo produced to aggregator between 10 to 15 culms per farmer which get aggregated as several hundreds. Aggregator may do some bit of processing at this level but mostly not and that is why a higher-level processors and manufacturers complain that

¹ M.L., Sharma & Chongtham, Nirmala. (2015). Bamboo Diversity of India: An update.

² Baksey, Aniket. (2013). The Bamboo Industry in India: Supply Chain Structure, Challenges and Recommendations. SSRN Electronic Journal.

they do not get raw material as per specification which leads to a high wastage. Aggregators are responsible for the collection of Bamboo and sorting of this Bamboo depending on its grade in terms of quality but despite of having a standard on grading and sorting Bamboo especially for structural purpose, there is no knowledge of ISO 19624:2018 and so no application. Aggregators sell these to town level trader who then takes a higher volume to manufacturer.

Manufacturers purchase the Bamboo at up to 300 to 400% of the price received by the cultivator (Khan et al, 2007). The bamboo they receive is, in general, poorly sorted, unprocessed and variable in quality. The manufacturer has to then take care of rest of processing and converting it into a finished good, that could be sold by him on his own. Especially in case of housing projects, the orders are received by clients before hand and there is further no other middle man or retailer in between, thus on finished projects manufacturers are able to cover their costs and earn decent profits. But there are many complexities involved in this business, as the manufacturer is many a times unsure if he will get required quantity in right time, right species with right specification is always doubtful, the artisans/craftsmen are quite few in number and if they are in emergency then the project is in uncertainty to be delivered.

Depending on the product the buyers of products may not be ultimate users but wholesalers and retailers who then sell it to ultimate consumers.

2.1 Key Sustainability issues at each node of the Value Chain

	Value Chain Nodes				
Parameters	(i) Production, Plantation (Farmers, Community)	(ii) Collection, Trading, Supply	(iii) Processing and Manufacturing	(iv), Seller Retailer/ Wholesaler)	(vi) Waste Reuse/Recycle and/or Post Consumption Use (going back to Processing and Manufacturing)
Economic	(1) Lack of attractive prices (2) Marginal resources and machinery to harvest	(1) Credit Facilities largely missing (2) No proper data base of suppliers and buyers making it difficult to project demand and supply and competitive price	Credit Facilities largely missing to support small businesses (2) No proper data base of suppliers and buyers making it difficult to project demand and supply and competitive price	Muted demand of bamboo products beyond handicraft and poles for construction and agriculture. (2) Export potential has not been explored significantly. Some quantity goes out in Asian countries.	Waste Management, Recycling is only in Theory and there are more than 70% of wastages in many value chains
Environment	(1) Lack of Quality plant material (2) Bamboo grown in an area does not allow another crop		(1) At the moment there is no dialogue on Occupational Hazard and Health Safety, Environment (HSE) issues but processing workshop highlights on them.	Different species are required for different end uses but not necessary that desired Bamboo grow best in all agroclimatic zones of India	
Social	(1) Farmer Producer Groups absent to ensure FPO advantages		(2) The processor is overly dependent on few Bamboo artisans, if they are not around business fails.	Absence of organized big/ large size markets.	

4.0 Bamboo Sector Competitiveness

The total bamboo-bearing area in the country is estimated to be around 15.69 million hectares, and bamboo is found in almost all parts of India (FSI, 2017)³. Despite the abundant natural resource base of bamboo in India, trade statistics reveal exports of bamboo are very low while imports have consistently been rising 83% of which happens around Bamboo raw material followed by bamboo flooring (6.3%). It is estimated that imports are 33 times than that of exports. All this has created a trade deficit situation, which was almost US\$34 million (World Bank 2020)⁴. It is difficult to estimate the overall size of this industry in India as although there are more than 1,500 documented uses of bamboo, most of them are working in the informal sector.

3.1 Application of Bamboo in multiple industries

a) *Furniture:*

With the growing trend in environmental awareness, many wood processing industries have recently come to embrace bamboos for sustainable building materials and furniture design. Global Bamboo Furniture Market size was worth USD 8768 million (2021) and is projected to reach USD 10715.67 Mn by 2028, exhibiting a CAGR of 2.91% during the forecast period⁵. According to CSIL, India is the 4th largest furniture-consuming country and the 5th largest furniture producer at a global level. Although at the moment Bamboo is believed to be catering to 2% of total domestic furniture market⁶, the Indian domestic furniture market is expected to expand at a CAGR of 12.91% during 2020- 24. ⁷Countries like India, China, and the United States are anticipated to hold 58% of the market share as these countries are the largest market for bamboo growers. Demand for Bamboo furniture is growing in high demand both domestically and internationally. Companies like Pepperfry, Urban Company, and others are working around multiple innovative design significant revenue through online platforms.

Godrej Interio, a leading furniture company, introduced processed bamboo in the formal furniture market in India under its green eco-friendly line of furniture, and this

³ FSI (2017), Bamboo Resources in India, Indian State of Forest Report 2017.

⁴ Kathuria, Sanjay, and Priya Mathur, eds. "Strengthening Cross-Border Value Chains: Opportunities for India and Bangladesh." Development Knowledge and Learning. World Bank, Washington, DC. License: Creative Commons Attribution CC BY 3.0 IGO

⁵ MarketWatch (2022), Press Release: "Bamboo Furniture Market Size 2022 to 2028 | Global Industry Demand, Share, Top Players, Future Growth | Top Countries Data" , <https://www.marketwatch.com/press-release/bamboo-furniture-market-size-2022-to-2028-global-industry-demand-share-top-players-future-growth-top-countries-data-2022-08-08> Retrieved on August 9 2022.

⁶ National Consultation on Opportunities and Challenges for Bamboo in India, 25-26th February 2021 retrieved from https://nbnm.nic.in/Documents/pdf/Proceedings_Edited_V3.pdf

⁷ National Consultation on Opportunities and Challenges for Bamboo in India, 25-26th February 2021 retrieved from https://nbnm.nic.in/Documents/pdf/Concept_Note_Bamboo_25&Feb.pdf

is being retailed through its large network of showrooms and dealers.⁸The expansion is expected to be driven by increased awareness of the benefits of using this material for sustainability. In India bamboo furniture is a sector which can grow immensely given appropriate assimilation of technology and design and has a large market waiting to be tapped. *Dendrocalamus strictus* is the most commonly used species in the furniture industry.

b) Paper and Packaging Material:

The global demand for paper and cardboard has increased significantly in recent years, partly due to the ban on plastic. In response to the expanding forests that require time to grow, the timber industry has produced new forests. Bamboo paper, for example, is not only a welcome but also a required addition to our environmentally friendly assortment.

The global Bamboo Pulp market size is estimated to be worth USD 2402.3 million in 2022 and is forecast to a readjusted size of USD 5245.3 million by 2028 with a CAGR of 13.9% during the forecast period 2022-2028.⁹ Globally paper mills produce 146 million tons of pulp, including 2 million tons of bamboo pulp. Although bamboo has various advantages, the current proportion of bamboo pulp papermaking is not very high.¹⁰

India's domestic paper industry is worth INR 80,000 crore. On average, Indians consume 14 kg of paper a year, a number that is expected to become 17 kg by 2024-2025. However, most of this demand is met through imports. In the last nine years, the import of paper and paperboard has risen at a CAGR of 11.34 percent in value terms, from INR 3,411 crore in 2010-11 to INR 8,972 crore in 2019-20.

According to Singh and Naithani (2008), in India bamboo was once used in 70% cases to make paper and board but is currently only used in 10% cases.¹¹ Mainly because bamboo has relatively higher ash and silicon contents compared with wood materials

⁸Kathuria, Sanjay, and Priya Mathur, eds. "Strengthening Cross-Border Value Chains: Opportunities for India and Bangladesh." Development Knowledge and Learning. World Bank, Washington, DC. License: Creative Commons Attribution CC BY 3.0 IGO retrieved from <https://documents1.worldbank.org/curated/ar/346271574838409991/pdf/Strengthening-Cross-Border-Value-Chains-Opportunities-for-India-and-Bangladesh.pdf>

⁹ GLOBAL BAMBOO PULP MARKET RESEARCH REPORT 2022 <https://www.industryresearch.co/global-bamboo-pulp-market-20563677>

¹⁰ National Consultation on Opportunities and Challenges for Bamboo in India, 25-26th February 2021 retrieved from https://nbnm.nic.in/Documents/pdf/Concept_Note_Bamboo_25&Feb.pdf

¹¹ Singh, S. P. and S. Naithani. 2008. Bamboo as a raw material for pulp and paper. Indian Forester Journal 134(9): 1157-1164

(Sharma et al. 2011)¹², which can negatively impact the recovery process for alkaline spent liquor and the quality of some high-grade pulp products such as dissolved pulp. Another reason is from the view of the pulping process, when the bamboo slices are cooked, the air is trapped inside the bamboo ducts, which hinders the penetration of the liquid. The sand is mixed with silt and gravel, and it is difficult to remove by screening. **As a result, increased equipment wear and tear affect the pulp quality.**

Despite the limitations of bamboo pulp and paper making, advanced production techniques can overcome some of the process and equipment challenges in bamboo pulping. At global level *Moso bamboo (Phyllostachys edulis*, which is also called *Phyllostachys pubescens*) is an ideal species to be considered for the pulp and paper industry while in India *M. baccifera (Roxb) Kurz* and *B. nutans Wall ex. Munro* are used for paper pulp.

c) Handicraft industry: (baskets, mats, fish traps, coffee mugs, lamps, trays, jewelry holders, toys, decorative items, etc.)

Bamboo crafts play an important role in the economy of India's North East region and are one of the region's major industries. The demand for these eco-friendly crafts is enormous, both in domestic and international markets.

Despite growing international markets for bamboo products and the existence and/or establishment of several government and non-government organizations in India for developing bamboo economies in the North Eastern Region, the bamboo handicraft sector remains underdeveloped. Lack of technological innovation, combined with insufficient policy support, has resulted in the industry's steady stagnation. Bamboo crafts are fairly priced.¹³

As per the annual report of Barpeta Cane and Bamboo Craft Cluster, 2010 the bamboo craft works has led to the income enhancement of the artisans over the year. Some exercises were run to see the profitability from different bamboo handicraft items produced by the artisans. The profit per unit is substantially greater in case of heavy products like sofa, chairs, bed, etc. but it requires a heavy investment in the part of the artisans. Therefore, it is not possible for the poor artisans to specialize in the production of such profitable products.

¹²Sharma, Arvind & Dutt, Dharm & Upadhyaya, J. & Roy, T.. (2011). Anatomical, morphological, and chemical characterization of *Bambusa tulda*, *Dendrocalamus hamiltonii*, *Bambusa balcooa*, *Malocana baccifera*, *Bambusa arundinacea* and *Eucalyptus tereticornis*. *Bioresources*. 6. 10.15376/biores.6.4.5062-5073

¹³ *Mridusmita Phukan. A Study on Cane and Bamboo Handicraft Industry in North-East India. Res. J. Humanities and Social Sciences. 2018; 9(4): 901-904. doi: 10.5958/2321-5828.2018.00151.1*

The fundamental challenge faced by the local artisan is that often less than 5% of the end price goes to the artisans - the middlemen get the rest.¹⁴ As per the CIBART's Annual Report 2017-18 artisans lack access to raw material, do not have infrastructure and are unaware of the market needs. On an average, the monthly income of the Bansfod community is around Rs. 5,800 in Bahraich and Rs.6,700 in Gorakhpur district (Uttar Pradesh, India). In terms of market related challenge there is a shift in consumer choice from artisanal goods to factory made ones. Also, the current volume-to-cost ratio, the North East region attracts a disproportionately high transportation cost, owing to its geographical and political location¹⁵. Bamboo is also susceptible to fungus, insects, and borers. Traditional conservation techniques cannot be applied to bamboo handicrafts for new applications.

d) Fashion industry:

The global eco fiber market is valued at USD 48.6 billion in 2016 and is expected to reach USD 135.5 billion by the end of 2026, growing at a CAGR of 10.8 % between 2018 and 2026.¹⁶ Bamboo fiber is prepared from bamboo pulp, which is removed from the bamboo leaves and stems through wet spinning, comprising a procedure of alkaline hydrolysis and multi-phase bleaching. ***The bamboo species used for clothing is called Moso bamboo.***

Bamboo fiber production technology is more expensive than that of other materials like cotton, which is anticipated to limit market expansion. Furthermore, the industry is expected to be hampered by strict norms and regulations governing the chemical processing of bamboo fibers.

In the global market for bamboo fiber, Asia Pacific is the largest eco fiber market followed by North America and Europe in 2016. Asia Pacific is expected to be the largest player during the forecast period in the global eco fiber market. Asia Pacific holds 38% market share in 2017 and is projected to hold 50% market share in the global eco fiber market by 2026.¹⁷

e) Energy/ Biofuel:

In general bamboo can be utilized as a biofuel and for bioenergy. Many studies have reported that bamboo, as a forest product, has potential for use as a biofuel, along with other woody plants. Bamboo is known to be a promising plant for a feedstock for

¹⁴ V.Anitha (2009): 'Structure and functioning of bamboo handicraft industry in south india', BTSG R&D Project, sponsored by the National Bamboo Mission, Government of India

¹⁵ Khataniar, R. (2017). Cane and Bamboo based Industrial Cluster in Assam-Profitability and Vulnerability. International Journal of Humanities and Social Science. 6(11), 5-9.

[http://www.ijhssi.org/papers/v6\(11\)/Version-3/B0611030509.pdf](http://www.ijhssi.org/papers/v6(11)/Version-3/B0611030509.pdf)

¹⁶ Eco Fiber Market Report <https://www.prosharemarketresearch.com/eco-fiber-market-report/>

chemical products such as lactic acid and fuel ethanol due to its high sugar content. It can be utilized as biogas as well.

As per the studies each dry ton of bamboo contains the potential to extract 143 L of ethanol. While the process of producing 1 kg ethanol requires 8.5 kg of sulfuric acid, 65.8 L of process water, and 6.2 kg of bamboo. Indian oil companies are investing in biofuel refineries to boost ethanol production from non-molasses sources such as agricultural residues and even petrochemicals. But usage of the contemporary fuel has been slow to catch on. Just 2.1% of gasoline is being blended with ethanol, while very little biodiesel is mixed with diesel. **As per 2018 reports, the biofuels industry is set to explode into a \$15 billion market by 2020 with government backing.**¹⁸

India will build the world's first bamboo-based ethanol refinery plant, with a daily capacity of 30,000 gallons, following an agreement signed between a Hyderabad based company and a farmers' company in Maharashtra. This startup will not only offer ethanol at competitive prices but also produce livelihood opportunities to farmers who can grow bamboo for the plant. The central government in India has pledged to blend 20% ethanol with petrol by 2025 this will create a huge opportunity for using bamboo-based ethanol.¹⁹ *Bambusa emeiensis* and *Phyllostachys pubescens*, are potentially suitable to be used as a fuel in biomass-fed combustion plants.

f) Building and Construction Material: (scaffolding, bridges, houses, buildings, bamboo boards, bamboo veneers, bamboo mat corrugated roofing sheets, etc)

The bamboo building materials have been used abundantly in traditional houses is because it grows abundantly in eastern parts of India and some of the southern parts of India. Bamboo as a building material is utilised in the construction of scaffolding, bridges, and towers, as well as houses. Bamboo fibers are also utilized as a natural fiber in concrete to generate Bamboo Fibers Reinforced Concrete (BFRC), which has several beneficial qualities. Bureau of Indian standards (BIS) has given standards relevant for physical and mechanical properties of bamboo (ISO 22157: 2004).²⁰ Its strength and flexibility make it a viable material for building shelters that offer protection against hurricanes and earthquakes and due to their physical and mechanical performance in terms of hardness, stability and strength are gaining attention with large opportunities in emerging markets.

However, the durability of bamboo is subjected to attack by fungi, insects and for this reason, untreated bamboo structures are viewed as temporary with an expected life of

¹⁸ <https://www.coherentmarketinsights.com/market-insight/eco-fiber-market-886>https://www.business-standard.com/article/companies/bamboo-to-ethanol-india-s-biofuel-industry-to-explode-into-a-15-bn-market-118040300588_1.html

¹⁹ Biofuels International (Jan 2022): Indian refinery to produce bioethanol from bamboo <https://biofuels-news.com/news/indian-refinery-to-produce-bioethanol-from-bamboo/>

²⁰ Development Alternatives (2016): Bamboo Green Construction Material, A Report <https://www.apn-gcr.org/wp-content/uploads/2020/09/1654f846a58279adea4aeb44a881321b.pdf>

not more than 5 to 15 years.²¹ Due to its poor decay resistance, it can only be used for handicraft goods and tools. There is a pressing need to produce environmentally friendly preservatives that will extend the shelf life of bamboo and its products, allowing bamboo to become a desirable material for the housing and construction industries.

Bamboo tiles, Bamboo wood has huge potential and the maximum amount of value addition in bamboo is done for bamboo wood. Use in Govt works – mandate 15-20% to give a boost to production and thereby fulfill demand India has very recently started using bamboo for building airports, viz Bengaluru Airport. NBM has approached all major consuming Ministries and interacted also with NBCC, CPWD, architects, designers, etc.

In 2016, IPIRTI discovered bamboo lumber and based on further testing, approved its expanded use. The Central Building Research Institute in Roorkee has also tested engineered bamboo for strength and longevity and found its potential to be promising. This has been beneficial to India's booming construction industry that is widely dependent on teakwood and which has also needed to import timber to meet its demands. At INR 3,600 per cft, teakwood is also more expensive than engineered bamboo lumber which costs INR 2,700 per cft. This holds tremendous promise for bamboo in India's construction sector which is experiencing a boom. With a CAGR of 15.7 percent, it is expected to reach USD 738.5 Bn by 2022²²

g) Edibles:

From a long time ago, bamboo shoots have been a tasty food with a high fiber content and bamboo shoots are consumed all across the world, with yearly consumption exceeding 2 million tons. The total revenue from bamboo shoots is about \$1.2 billion, while other bamboo-based items generate around \$3 billion. Bamboo shoots are consumed as a popular food in Asian countries such as China, Thailand, Korea, Taiwan, and Japan. Bamboo shoots rank second in annual vegetable production volume in Taiwan, with *Dendrocalamus latiflorus* and *Bambusa oldhamii* being the two most consumed edible bamboos.

China is the leading exporter of edible shoots, earning over \$4 million per year, with Thailand coming in second. Bamboo shoots had the greatest trade value of all bamboo goods shipped from China between 1998 and 2002. In India, bamboo shoots are consumed mainly in Northeast India where they are integral part of many popular tribal cuisine. Despite its abundance of bamboos, this region only produces 5685 tons of bamboo shoots every year. Singh reported a gross annual income of \$1.3 million from

²¹ P. Sharma, K. Dhanwantri and S. Mehta, "Bamboo as a Building Material", International Journal of Civil Engineering Research, 5(3), (2014) https://www.ripublication.com/ijcer_spl/ijcerv5n3spl_08.pdf

²² National Consultation on Opportunities and Challenges for Bamboo in India, 25-26th February 2021 retrieved from https://nbn.nic.in/Documents/pdf/Concept_Note_Bamboo_25&Feb.pdf
https://nbn.nic.in/Documents/pdf/Concept_Note_Bamboo_25&Feb.pdf

the bamboo shoot trade, which included both fresh and processed bamboo shoots, across eight Northeastern Indian states.²³ The bamboo shoot sector generates a net yearly income of \$0.7 million, showing that it is one of the region's potentially successful economic opportunities.

g) Medicinal Purposes:

The health benefits associated with the bamboo are diverse, bamboo leaves have been discovered to help in controlling blood sugar levels, strengthening hair, detoxifying the body, and even eliminating ulcers and other interior wounds, according to several studies conducted over the years.

The bamboo shoot-derived products such as bamboo salt and bamboo vinegar are also used in medicine for the treatment and control of cholesterol and diabetes. Bamboo is a less explored plant with high therapeutic potential. Bamboo, being a healthy plant with a high fiber content, plays an important part in the food chain of people and animals alike. More research is needed in order to recognize the prospects and limitations of the various species and to utilize the potentials in the best ways.

3.2 Key Standards

There are a number of key standards that can help in improving the performance and therefore the demand for Bamboo among the users. Below is a discussion on Bamboo Standards. As standards are tested and tried protocols also given in form of guidelines to ensure uniformity in process and quality in delivery. Standards in case of Bamboo based industry can be discussed linking three broader set of commercial activities – Pre-Processing Operations (Plantation, Harvest and Post-Harvest Treatment); Processing to Manufacture of final goods and, marketing processed and final goods in external markets.

I a) Standardization in Plantation for Quality Production: (Process Standard)

An important step in developing Bamboo based industry is to ensure enough bamboo plantation, that too of the right species, depending on the visualized end use. This need has been highlighted by a large number of entrepreneurs and industry experts working in different parts of India. As per to E.M. Muralitharan Senior Principal Scientist (Retired) Kerala Forest Research Institute & Consultant, INBAR Chair, Task Force on Sustainable Bamboo Management, while one of the mandate of Bamboo Missions in different states is to ensure increase in acreage, productivity and quality of bamboo, poor multiplication rates and scale of

²³ K. A. Singh, "Prospect of edible bamboo shoot farming in North-East India," *ICAR News*, pp. 5–8, 2002.

production are still hurdles for mass multiplication in many of the important species and there is a great need of streamlining of the mass propagation techniques²⁴.

In nature, bamboos propagate both vegetatively through rhizomes and sexually through seeds. New sprouts emerge from rhizomes during the rainy season and rapidly grow into tall culms within a year. Plants are also propagated by culm cuttings, branch cuttings, offsets, rhizomes and seedlings. However, these methods suffer from various limitations such as high cost, labor intensiveness, low quality planting material, difficulty in transportation for establishing large scale plantation and low seed viability (Banik, 1987). Vegetative propagation has proved useful for only small-scale production of clonal planting material and is of limited value. In contrast, micro-propagation is one of the most effective supplementation to conventional methods of vegetative propagation. This method is one of the fastest ways of getting healthy, disease-free and genetically uniform planting material en masse. It is the only reliable method for mass scale propagation of plants where >500,000 plants yr are involved (Gielis et al., 2002). The complete protocol on micro-propagation of *Bambusa arundinacea* syn. *B. bambos* from seeds (Mehta et al., 1982) laid the foundation of bamboo micro-propagation for replenishment of natural stands and conservation. Several efficient protocols have been successfully developed for many genera/species where various explants, since then. However, factors such as season and stage of explant collection, cultivars/genotypes/ecotypes, process of surface sterilization, culture media and process of hardening and acclimatization had to be extensively standardized different bamboo species. **At CSIR-IHBT, highly efficient micro-propagation protocols were developed from nodal segments of important bamboos such as *B. balcooa*, *B. bambos*, *B. tulda*, *B. nutans*, *D. asper*, *D. hamiltonii*, *D. membranaceus*, *D. giganteus*, *Guadua angustifolia* and *Phyllostachys pubescens***

Besides, shoot cultures, somatic embryogenesis was also attempted by various workers; and successful protocols were established. **But a detailed and comprehensive BIS standard for micro propagation published by BIS could not be found, however there are a few developed by Department of Biotechnology's National Certification System for Tissue Culture Raised Plants (NCS-TCP)²⁵, by INBAR²⁶**

Mr. Subhash Bhatia, a seasoned bamboo practitioner, entrepreneur and ex. Member of the Bamboo Mission advocates for quality plant material of species as per end usage and highlights that India being divided in different agro climatic zones species production may see difference in production quality and quantity. Although it is not a big science to cultivate species and there are broad guidelines given in different web articles but Mr. Anand Fiske CEO, GREEN PLANET SOCIAL FOUNDATION during his NITI Ayog presentation highlighted that there

²⁴ Murlidharan E M (2022): Bamboo Tissue Culture and Micro Propagation, Presentation in Niti Ayog Meeting https://www.niti.gov.in/sites/default/files/2022-02/Bamboo_Presentations/Technical_Session_1_Bamboo_Tissue_culture_and_Micropropagation_Dr._EM_M_uralidharan.pdf

²⁵ Department of Tissue Culture: Bamboo Tissue Culture Standards <https://dbtncstcp.nic.in/Portals/0/Images/Bamboo.pdf>

²⁶ INBAR (2020): Bamboo Micro Propagation (Tissue Culture) Planting Material Production <https://www.inbar.int/wp-content/uploads/2020/05/1543379203.pdf>

are many species with numerous climatic growth requirements. This makes it difficult to characterize the agro-climatic bamboo demands, in order to define areas suitable for its cultivation. There's an urgent need to setup a study which would work on the aspect of selection of the right species based on agro-climatic regions to prepare **a standard detailed guide for plantation of Bamboos as per agro-climatic regions. Such a standard could be seen developed by some other countries like Jamaica.**²⁷

Practitioners have also raised their concern that sometimes where mother plant's information was lacking, a newly gawn plantation was also seen flowering (subsequently dying) at its young age as the mother plant must have aged at some other location. It is therefore important to do DNA print tagging while and providing full and transparent information about the Quality Plant Material to farmers and producers.

b) Standards on Harvesting and Post- Harvest Treatment

There are two levels in the harvest cycle of bamboo: one is the cycle of each bamboo stand or culm, the other one is the cycle of the entire plant, through its rhizome development. The culm reaches maturity three years after the development of its shoot and dries after five or six years. This is therefore the window for harvesting depending on the quality of bamboo that is being sought (young, mature or dry culm). The plant sexual cycle is difficult to predict: but generally, bamboo flowers every 40 to 50 years, leading to the death of the rhizome and the development of bamboo seeds and new seedlings. It is also to be noted that seeds fallen after flowering are good resource that can be utilized to grow plants but are short lived and if simply spread on ground unprotected may also result in rodent attacks.

Many practitioners and experts working in North east, Madhya Pradesh and Maharashtra mentioned that proper harvest of Bamboo clumps as per the requirement of the business does not happen as well as the treatment that is required to be given to Bamboo for reducing insect/ termite attack and to enhance the life of Bamboo is also not done. This enhances wastage of Bamboo multiple times.

BIS guidelines could not be found for Bamboo matured clumps harvesting but for harvesting shoot.

c)IS9096:2006 Indian Standard (Process Standard): GUIDELINES FOR STORAGE AND TRANSPORTATION OF BAMBOO SHOOT briefly discusses the Bamboo harvest process suggesting that it should be harvested during the season of sprouting, soon after emerging out of the earth. The tender shoots should be harvested prior to the substantial fiber development. Harvesting time depends on the species, harvesting should be done during the months of monsoon. The shoot should be harvested when they are 35.7 cm (15“) -to 45 cm (18“) above the ground surface. Harvesting should be done with the sheath intact; care should

²⁷ BUREAU OF STANDARDS JAMAICA (2020) Jamaican Standard Code of Practice for Bamboo plantation https://www.bsj.org.jm/sites/default/files/Draft%20Jamaican%20Standard%20Code%20of%20Practice%20-%20Bamboo%20Plantation_public%20enquiry_13Dec2020%20to%2012Feb2021.pdf

be taken not to damage the outer sheath. Once harvested the cut portion should be suitably covered to minimize the -chance of any infection and dehydration.²⁸

Some guidelines have been developed by INBAR on Ethiopian lowland bamboo cultivation (INBAR 2009),²⁹ on sustainable harvesting of matured Bamboo Clumps.

In a clump, the culm needs to be selected wisely according to the age and a number of mature culms needs to be left in the clump. If the bamboo has been planted, then harvesting small culms for thinning should be done starting three years after planting. Harvesting the culm needs to be done from the center of the clump as this is where the oldest culms are located. Potential harm to young culms should be avoided. Ideally the tool used for harvesting (e.g., machete or a small curved hand saw) should be sharp and disinfected, although it is not always easy to do for farmers. The cut should be done right above the first node to avoid accumulation of water and possible infection by parasites. Harvest should be avoided during rainy season for the same reasons. The best time to harvest is at the end of the rainy season and harvest should be avoided at the end of the dry season, when the culm is full of carbohydrates, useful for the development of new shoots.

INBAR under NTFP Sustainable Harvesting and Resource Management Protocol, has also developed thumb rules for harvest and post-harvest treatment.³⁰

Challenges:

One of the challenges is that there is no BIS standard on harvesting the Bamboo. While discussing with the practitioners it was found that whatever stock that is being harvested is harvested in absence of standard practices. Although businesses for their different products have identified different species and specifications to minimize waste and optimize quality, but this could not motivate harvesters to comply with the specifications. Practitioners suggest that bamboos difficult to be harvested are not harvested as the bamboo clumps are also scattered and harvesting is not mechanized. Moreover, the harvesters or aggregators also do not treat it appropriately, which can otherwise enhance its life by multiple years.

²⁸ BIS (2006) Indian Standard Guidelines For Storage And Transportation Of Bamboo Shoot
<https://law.resource.org/pub/in/bis/S06/is.15691.2006.pdf>

²⁹ Boissière M., Beyessa M., Atmadja S. 2019. Guiding Principles for Sustainable Bamboo Forest Management Planning: Benishangul-Gumuz Regional State (BGRS). Rome, FAO. 32 pp <https://www.un-redd.org/sites/default/files/2021-10/ca3700en.pdf>

³⁰ NTFP Sustainable Harvesting and Resource Management Protocol

Thumb Rules of Bamboo Harvest (INBAR under NTFP Sustainable Harvesting and Resource Management Protocol)

- The harvest of bamboo shoots depends on the season and other factors. Such species as the *Bambusa longissima* should not be harvested from June to September (Vietnam).
- For some bamboo species, old rhizomes should be removed for the new rhizomes to emerge; however, this is not advisable for clumping species such as *D. asper*, *B. bamboos*, and *B. blumeana*.
- Cut the culm in three pieces according to buyer specifications:
 - In Indonesia, from the ground: 3.5 meters, 5–6 meters, 5–6 meters.
 - In Malaysia, from the ground: 4 meters, 4 meters, 4 meters.
 - In Cambodia, from the ground: 3.5 meters, 5 meters, 5 meters.
 - In Vietnam, from the ground: 2.5 meters, 3 meters, 4 meters, 5 meters.
- In general, culms harvested during the rainy season are suitable for biomass, handicraft, scaffolding, and other short-term uses. However, these are not suitable for pillars and buildings. Some farmers do not harvest 7-year-old culms to prevent soil erosion and provide protection to emerging shoots (Bukidnon, Philippines)

Post Harvest Treatment of Bamboo

Sometimes bamboo is preserved by muddy river to prevent insect attacks by washing out starch. Bamboo has been transported by river to lower transportation costs.

Bamboo should be treated before using traditional or conventional methods (by drenching it in water for few days) but it can be treated chemically with borax. Use of arsenic-based chemicals such as Chromated Copper Arsenate (CCA) should be avoided as some buyers find this treatment harmful.

(INBAR)

II. Bamboo Standards as per Product Use:

a) Standard for Bamboo Food and Food Contact Material - Bamboo shoot is rich in vitamins, cellulose, amino acids and trace elements and has the same nutritional value as an onion and is a good source of fiber. Bamboo shoot comprises 90 percent water. Bamboos shoots are traditionally consumed more often as a fresh vegetable during their season of availability and are preserved conventionally as salted, fermented and dried products in the North-East regions of India and as salted and pickled products in the Western Ghats of Karnataka. The preservation and processing methods used for bamboo shoots are dry salting, wet salting, preservation in brine, canning and drying.

IS 15691 :2006 Indian Standard GUIDELINES FOR STORAGE AND TRANSPORTATION OF BAMBOO SHOOT describes methods for obtaining conditions for successful preservation,

cold storage and transportation of bamboo shoot intended for consumption, either directly or after industrial processing.³¹

Of late Bamboo is also being seen as a potential alternative to plastic-based food utensils e.g., Spoon, knife, fork, straw, fork, etc and to ensure the food safety The Food Safety and Standards Authority of India has developed standard guidelines for manufacturing, handling and use of Bamboo Food Contact items³².

b) Bamboo Standard for Construction: The Bureau of Indian Standards introduced the first method of testing standard for round bamboo, IS: 6874, to realize the mechanical properties of bamboo in 1973; following that in the late 1990s, a series of test standards for round bamboo were conducted in the Eindhoven University of Technology with the name of International Network for Bamboo and Rattan (INBAR) that lays a foundation for the development of ISO 22156, ISO 22157-1 (Bamboo—Determination of Physical and Mechanical Properties—Part 1: Requirements), and ISO 22157-2 (Bamboo—Determination of Physical and Mechanical Properties—Part 2: Laboratory Manual) which were published in 2004 by the International Organization for Standardization (ISO) and recorded as the first step to standardize the utilization of bamboo for a structural design element [1]. Since then, India has developed multiple other standards as given in the table below

List of major BIS standards around Bamboo

Agency	Standard No.	Title
BIS	IS 10145: 1982 (REAFFIRMED 2015)	Specification for bamboo supports for camouflaging equipment
BIS	IS 13958: 1994 (REAFFIRMED 2014)	Specification for bamboo mat board for general purposes
BIS	IS 14588 :1999 (REAFFIRMED 2018)	Specification for bamboo mat veneer composite for general purposes
BIS	IS 15476: 2004 (REAFFIRMED 2014)	Bamboo Mat Corrugated sheets - specifications
BIS	IS 15912: 2018	Structural Design Using Bamboo Code of Practice
BIS	IS 15972: 2012 (REAFFIRMED 2017)	Bamboo- Jute Composite Corrugated and Semi Corrugated Sheets – A Specifications
BIS	IS 16073: 2013 (REAFFIRMED 2018)	Bamboo Jute Composite Panel Door Shutter Specifications

³¹ BIS(2006) Indian Standard Guidelines For Storage And Transportation Of Bamboo Shoot (<https://law.resource.org/pub/in/bis/S06/is.15691.2006.pdf>)

³²BIS (2006) IS 15691: Guidelines for storage and transportation of bamboo shoot https://www.fssai.gov.in/upload/advisories/2019/09/5d6e4cd671207Letter_Bamboo_Food_Material_03_09_2019.pdf

BIS	IS 1902: 2006 (REAFFIRMED 2016)	Preservation of Bamboo and Cane for Non- structural practices -Code of Practice
BIS	IS 6874: 2008 (REAFFIRMED 2019)	Methods of Tests for Bamboo (Process Standard)
BIS	IS 707: 2011 (REAFFIRMED 2016)	Timber technology and utilization of wood, Bamboo and Cane – Glossary of Terms
BIS	IS 7344: 1974 (REAFFIRMED 2015)	Specification for Bamboo tent poles
BIS	IS 8242: 1976 (REAFFIRMED 2015)	Methods of tests for split Bamboos (Process Standard)
BIS	IS 8295: Part 1: 1976 (REAFFIRMED 2017)	Specification for bamboo chicks: Part 1 Fine
BIS	IS 8295: Part 2: 1976 (REAFFIRMED 2017)	Specification for bamboo chicks: Part 2 Coarse
BIS	IS 9096: 2006	Preservation of Bamboo for structural purpose. (Process Standard)

The Indian standard of bamboo for structural construction involves several components, such as the general principles involved in the design of structural bamboo in buildings in terms of mechanical resistance and structural durability. This standard involves the construction of bamboo (round bamboo, split bamboo, and glued laminated bamboo) and bamboo-based panels joined together with adhesives or mechanical fasteners. It also includes minimum strength details, dimensional stability, grading specifications, and traditional bamboo joints for quality assurance. In addition to the steps required to define and ensure the quality of the material and working standards to comply with the criteria and limitations of the design codes, construction aspects such as work on-site, parts manufacturing, and installation are included.

However, the following elements are believed to be not covered by the structural design using bamboo—code of practice standards: (a) limit state design and structure performance and (b) scientific design of bamboo joints and fastenings. This standard categorizes the tested and recommended bamboo species into three groups based on their strength properties: specific modulus of elasticity (E), modulus of rupture (R), and compressive strength.

The founding principle of bamboo grading for structural application is its strength and stiffness properties. Based on one or a combination of the following parameters, the standard provides a grading of bamboo for structural utilization: (a) diameter and length of the culm; (b) taper of the culm; (c) straightness of culm; (d) internodal length and distribution of nodes; (e) wall thickness; (f) density and strength; and (g) durability and seasoning. From the report of tests included in the standard, the strength of bamboo increases as the moisture content decreases. The optimum moisture content of fibre saturation point for most bamboos is around 25 percent;

however, it depends on the species. The measurement methods for moisture content are in accordance with IS 6874: method of tests for bamboo. Generally, the standard noted that matured culms should be seasoned to about 20 percent moisture content before use.

The *National Building Code of India, 2005*³³ developed a Code of Practice for Bamboo Design (Part 6 Structural Design Section 3). Section 3B of the National Building Code of India (NBCI) specifies strength limits for three classes of bamboo, which reflect species found in India. Although some examples of bamboo joints and connections are given, there is no detailing on measurements and capacity [27]. Although the identification of bamboo species based on anatomical appearance for structural purposes is not yet perfected, it is recommended that experienced sorters use morphological valuation to identify full-standing culms. A total of twenty (20) Indian bamboo species were evaluated systemically, with 16 bamboo species being recommended for structural applications in round form. The code also recommends that bamboo must be mature for at least four years, be used for at least six weeks of the felling duration, and be processed under IS 9096³⁴ as a certification requirement for structural construction.³⁵

Challenges: While multiple of standards have been drafted by the BIS, when multiple of architects, entrepreneurs, and practitioners, were asked about them only few were aware of them and most are not using them. They see that these could be useful in long run if followed by entire supply and value chain but should be kept voluntary till that time. They are clear that consumer in their (domestic) market is not asking for standardised product but low a cost product. Some entrepreneurs like Mr. Sanjiv Karpe, Mr. Battacharya, Mr. Neeraj Mutha and Mr. Debopam Mukherjee have exported their products in international market as well but mostly in Asian countries where they have only faced question about the sourcing of the product and no other test reports against standards.

c) . Bamboo Standard for Handicrafts: See the international section

d) Bamboo Standard for Furniture : Although BIS standard IS 4837 : 1990 (Reaffirmed in 2002) Indian Standard for School Furniture CLASSROOM CHAIRS AND TABLES – RECOMMENDATIONS³⁶, along with IS 5416 : 1988 ‘Methods of tests for strength and stability of chair and stools: Part 1 Strength, and Part 2 Stability’, and IS 5967 : 1988 ‘Methods of test for strength and stability of tables and trolleys: Part 1 Strength, and Part 2 Stability are in public domain, a standard for usage of Bamboo for furniture has not been worked upon but can be developed by taking these and other relevant standards.

³³ BIS (2005) NATIONAL BUILDING CODE OF INDIA 2005
<https://law.resource.org/pub/in/bis/S03/is.sp.7.3.2005.pdf>

³⁴ BIS (2006) PRESERVATION OF BAMBOO FOR STRUCTURAL PURPOSES — CODE OF PRACTICE
<https://law.resource.org/pub/in/bis/S03/is.9096.2006.pdf>

³⁵ Amede, Ermias & Hailemariam, Ezra & Hailemariam, Leule & Nuramo, Denamo. (2021). A Review of Codes and Standards for Bamboo Structural Design. *Advances in Materials Science and Engineering*. 2021
<https://www.hindawi.com/journals/amse/2021/4788381/>

³⁶ BIS (1996) SCHOOL FURNITURE, CLASSROOM CHAIRS AND TABLES - RECOMMENDATIONS
<https://ia600904.us.archive.org/25/items/gov.in.is.4837.1990/is.4837.1990.pdf>

Similarly, BIS has also got IS: 1829 (Part I) – 1978, Indian Standard SPECIFICATION FOR LIBRARY FURNITURE AND FITTINGS. This standard prescribes the requirements for the following items of wooden furniture meant for use in a library: a) Unit book rack, b) Bay guide holder, c) Book trolley, d) Catalogue cards tray and cabinet, e) Catalogue cards box, f) Catalogue cards work tray, g) Control region fittings, h) Charging trays, i) Reading room table, j) Study table, k) Periodicals display rack, l) Chairs, and m) Display stand. This standard can be modified or drafted for Bamboo also to enhance Bamboos application.

Challenges: One key challenge that can be identified over here is that of absence of Bamboo specific Furniture Standard.

e) Bamboo Standard for Aggarbatti: No information Found

III. Standards for International Markets

a) For Furniture: At global level a voluntary standard was developed by the Joint Committee on BIFMA e3 Furniture Sustainability using the consensus process described by the American National Standards Institute (NSI) in order to provide the marketplace with a meaningful and measurable standard for the creation of more sustainable furniture by establishing performance criteria that address environmental and social aspects throughout the supply chain, harmonize sustainability standards for the office furniture industry and help to distinguish environmentally preferable business and institutional furniture.

The e3 Standard is divided into four basic elements consisting of various prerequisites and credits that are potentially available to organizations seeking product conformance to the standard. The four basic elements are: 1. materials 2. energy and atmosphere 3. human and ecosystem health 4. social responsibility³⁷

b) Standard to send Bamboo Handicrafts in US markets:

The United States Department of Agriculture Animal and Plant Health Inspection Service (USDA APHIS) in the United States considers

Under 7CFR 319.40, handicrafts products where wood is present. While APHIS has got an agreement with the Chinese government under which an importer from USA can import from suppliers empaneled in a list of suppliers managed by the Chinese Government, APHIS does not provide detailed information for non-Chinese wooden handicrafts suppliers. Importers are recommended to contact APHIS directly when importing wooden handicrafts from other countries, such as Vietnam and India.

The importer needs to take care of some other acts e.g., Lacey Act, especially required for Plant products, wants to make sure that products are sourced from legally harvested woods. FSC

³⁷ About BIFMA: E3 Standard Support Rule <https://www.bifma.org/page/e3standard>

programs, or SGS's Wood & Wood Fiber Product Due Diligence Systems can help as third-party verification.

Importers and manufacturers of wooden furniture should comply with applicable regulations and standards, such as CPSC (Consumer Public Safety Commission) safety standards or ASTM standards (voluntary standards, in order to improve safety and performance) and National Fire Protection Association (NFPA) voluntary safety standards for furniture.

The Toxic Substances Chemical Act Title VI 40 CFR Section 770 sets out rules for the Formaldehyde Emission Standards of Composite Wood Products that are manufactured, imported and sold in the United States.

It specifies the emission limits for different types of composite wood products and requires that covered products must be tested against the ASTM standards. Section 770.15 requires that importers of composite wood products must obtain product certification for their products before they are allowed to sell in the United States. The importers must apply to a Third-Party Certifier (TPC) recognized by the EPA in accordance with the TSCA Title VI.

Challenges: There are only a handful of entrepreneurs who are exporting Bamboo products from India. Most are still struggling with their issues of ensuring bamboo supply, supply of skilled labour and fulfilling small demands of their domestic clients. Entrepreneurs like Mr. Sanjiv Karpe, Mr. Battacharya, Mr. Neeraj Mutha and Mr. Debopam Mukherjee have exported their products in international market as well but mostly in Asian countries where they have only faced question about the sourcing of the product and no other test reports against standards. None of them have great idea of the requirements of USA and European markets except for FSC certification, which they feel is not cost effective for them.

c) Standards / Compliances to export Bamboo to Europe.

Wood and bamboo products imported and manufactured in the EU are subject to traceability requirements, chemicals and substance restrictions, safety standards, and labelling requirements. Examples include European Union Timber Regulation (EUTR), the General Product Safety Directive, REACH, and various EN standards.

d) European Union Timber Regulation (EUTR)

The European Union Timber Regulation (EUTR) prohibits the illegal harvesting of certain wood species in the European Union, in order to reduce deforestation and protect specific tree species. The regulation applies to both imported and domestically produced timber products.

The key requirements can be summarized in three parts:

- a. Information: Importers and manufacturers must be able to provide information about their timber products, such as country of harvest, species, and more.
- b. Risk assessment: Importers and manufacturers must be able to estimate the level of risk concerning the timber they are importing, based on the above information and the criteria mentioned in the regulation

c. Risk mitigation: Importers and manufacturers should have in place measures such as a traceability system, risk assessment, and other risk management procedures.

There are mainly two ways to comply with the EUTR requirements when importing covered wooden products into the European Union.

Option A: Obtain a valid FLEGT or CITES license for your product

Option B: Get assistance from third-party verified organizations such as the Forest Stewardship Council (FSC), or the Endorsement of Forest Certification (PEFC), which provide certificate systems that are aligned to the EUTR requirements.

Protective Measures Against Pests of Plants Regulation ((EU) 2016/2031)

The Protective Measures Against Pests of Plants Regulation is based on the International Standard for Phytosanitary Measures 15 (ISPM 15). It sets out requirements for the import of wooden packaging materials, dunnages, and other wooden products aiming at reducing the phytosanitary risks due to plants' pests.

Covered products must comply with the following requirements before being imported to the EU:

- a. Must be either heat-treated or fumigated according to ISPM15 procedures
- b. Must be marked with the IPPC (International Plant Protection Convention) Mark, which includes the certificate symbol, country code, producer code, and measure applied code.
- c. Must be debarked

General Product Safety Directive (GPSD)

The General Product Safety Directive (GPSD) sets out general safety requirements concerning consumer product safety in the EU. It covers most of the consumer products manufactured, imported, or sold in the EU, which includes wood and bamboo products.

Product Scope

Examples of products that are covered by the GPSD include:

- Wooden chairs
- Wooden tables
- Wooden cribs
- Wooden cradles

Harmonized Standards

Some examples of EN standards relating to furniture, including wooden furniture, that are harmonised under the General Product Safety Directive:

- a. EN 581 – Outdoor Furniture – Seating and Tables for Camping, Domestic and Contract Use
- b. EN 1130-1 – Furniture – Cribs and cradles for domestic use – Part 1: Safety requirements
- c. EN 1130-2 – Furniture – Cribs and cradles for domestic use – Part 2: Test methods

Requirements

The main GPSD requirements and guidelines for importers and manufacturers are:

- a. Create and maintain a technical file, which should include a risk assessment report that records the risks associated with the product
- b. Create user instructions for the product
- c. Conduct necessary tests and obtain valid test reports
- d. Create a product traceability label and affix it to the product or product packaging

Construction Products Regulation

The Construction Products Regulation (CPR) covers general safety, quality, and performance requirements for construction materials and products including wooden doors, panels, floorings, and other building products in the European Union.

Harmonized Standards

Here are some standards relating to wooden construction products harmonised under the Construction Products Regulation:

- a. EN 13986 – Wood-based Panels for Use in Construction – characteristics, Evaluation of Conformity and Marking
- b. EN 14229 – Structural Timber – Wood Poles for Overhead Lines
- c. EN 14342- Wood Flooring and Parquet – Characteristics, Evaluation of Conformity and Marking
- d. EN 14915 – Solid Wood Panelling and Cladding – Characteristics, Evaluation of Conformity and Marking

Requirements

Importers and manufacturers of construction products or materials must prepare the required documents to ensure the technical and regulatory compliance of their products. This includes:

- a. Declaration of Performance
- b. User instructions for the product
- c. Technical documentation
- d. Affix the CE mark to their products or packaging
- e. Create a product traceability label
- f. Conduct applicable lab tests and obtain valid test reports

Food Contact Material Regulation Framework

The Food Contact Material Regulation Framework covers food contact products, including wooden kitchenware and other wooden food contact products. The regulation restricts heavy metals and other toxic substances and sets labelling and documentation requirements.

Paints and coatings

Such substances may not occur naturally in wood and bamboo products. However, paints and coatings can contain excessive amounts of banned substances, such as lead, cadmium, and phthalates.

Composites

Note that the use of wood and bamboo composite materials (i.e., mixed with melamine or other plastics) is not authorized under “Article 5 – Union list of authorised substances” of Regulation (EU) 10/2011 on Plastic materials and articles intended to come into contact with food.

REACH

REACH sets limits on chemicals, heavy metals, and pollutants for consumer products sold in the European Union. Importers must comply with REACH before importing wooden and bamboo products to the European Union.

For example, preservatives such as mercury and creosotes are sometimes used to prevent rot and improve the durability of timber in wooden products. Also, certain restricted chemicals and heavy metals may be found in coatings, paints, treatment substances, and print inks.

Restricted Substances

The European Chemicals Agency (ECHA) provides lists of restricted substances known as the SVHC Candidate List and Annex XVII.

New substances can be added to the lists. However, importers and manufacturers do not need to keep track of the list, instead, testing services companies can provide REACH services with the most updated requirements.

Here are a few examples of restricted substances that are commonly found in wooden products or coatings:

Lab testing

It is not practical for importers to verify every substance in their wooden and bamboo products. As such, third-party lab testing is often the only way to verify REACH compliance. Reputable test companies such as SGS, TÜV SÜD, and QIMA provide comprehensive REACH services for wooden and bamboo products.

It is also important to instruct your supplier on REACH compliance before shipping the product to the European Union. Ideally, the supplier should be able to provide the REACH test report before mass production.

Here are some companies offering REACH testing services:

- QIMA
- SGS
- TÜV SÜD
- Intertek

Risks

Natural materials, such as wood and bamboo, should not contain restricted chemicals and heavy metals. However, coatings, paints, print inks, and treatment chemicals may contain substances exceeding the set limits – resulting in non-compliance with the REACH regulation.

Here are some methods that can help you reduce the compliance risk when importing wood and bamboo products from outside the EU:

- a. Avoid using coatings, treatment chemicals, paints, and print inks altogether
- b. Procure coatings and paints from suppliers that can provide REACH test reports
- c. Inform your supplier that all wood and bamboo products will be subject to third-party lab testing

Packaging & Packaging Waste Directive (94/62/EC)

The Packaging & Packaging Waste Directive restricts heavy metals, such as mercury, and cadmium in packaging materials, printing inks, and dyes. This also includes wooden packaging. Additionally, packaging materials should be built to simplify material recycling, reuse, and collection. The directive states that, by the end of 2025, at least 65% by weight of packaging waste should be recycled, including:

- 25% of wood
- 50% of plastic
- 70% of ferrous metals

3.4 Perspectives of Stakeholders on Standards

As multiple dialogues were done with multiple stakeholders on issues around the Bamboo sector and role of Standards to streamline the business and to create market, following are the observations of experts and practitioners working around Bamboo.

a) Sanjeev Karpe (Konbac Bamboo products Pvt) : Mr. Karpe is Founder & Managing Director of Native Konbac **Bamboo** products Pvt. Ltd, a leading Exporter, Manufacturer, Supplier operating from Maharashtra (India). Mr Karpe suggests that the biggest problem in the Bamboo sector is that of low supply of quality Bamboo, that should be ensured above all. There should be more bamboos grown in the degraded land outside forest that can be periodically harvested by local community and could in turn be used by processors and manufacturers to make bamboo products for the Market. Demand Supply gaps break the chain of business.

On standards he shared that although his products are exported to some African and Middle Eastern countries he was not asked conformity to any specific standard, except for evidence of traceability, asked by Indian customs. He feels that Standard development will have some impact to standardize the products but he sees challenges (a) Not many are aware of standards (b) standards are not being demanded by domestic consumers (c) domestic consumer is cost sensitive and standards will increase the costs (d) Standards will be useful for US/Europe export but India is yet to reach to that stage and should endeavor for.

b) Mutha Industries: Mutha industries, instituted in Tripura, Agartala, is a well-known name in Bamboo sector that operates on multiple product lines and supply their products with name Epitome Bamboowood Products, in both domestic and international market. While Muthas have their own protocols on Occupational Health and Safty as per ISO 18001, Environment Management System ISO 14001 and Quality Management System ISO 9001 and had a certificate under GRIHA and SVAGRIHA norms for their Flooring, Wall Paneling, Door Frame and In Built Furniture, as well as Performance Appraisal Certification by BMTPC when asked about the use of standards, they agreed it is a mark of best practices that makes the business operations easier to be benchmarked and certified. On the question if standards create market and are they beneficial from that perspective Mr. Neeraj Mutha shared that it depends on the context. In country like India, consumers are still looking for low-cost products and only where personal safety is threatened standard marks are demanded. He shared that their assessment of applying Forest Stewardship Certificate costs on their products had a finding

that it would make their products exorbitantly expensive that won't fetch a competitive price in domestic market and as per their capacity to suffice International demands they are able to do so without FSC.

c) Bambune India

Chandan Haldar is a small scale entrepreneur who constructs Bamboo Cottages, Pergolas, Sit-outs. and also design and construct low-cost Bamboo Housing. He indicated that a large number of players whom, I met separately, in Bamboo related workshop in Guwahati and Bhopal, are not aware about the standards and do not feel that Indian market is ready for mandatory standards. He feels that besides making the standards there should be government initiatives to train and educate professionals and consumers on BIS and other standards. Also he emphasized on non-availability of Standardized Bamboo raw material available at a reasonable price in local markets. He in fact highlighted that there is a big supply gap in Bamboo and returns at the moment are marginal.

d) Partho Chatterjee, Agarbatti Manufacturer, Bamboo Integrated Service provider, from Tripura, shares about the multiple complex situations around Bamboo. He says it is still a niche market or largely informal market. He shared that he closed his Agarbatti business around 2012 as the segment faced severe competition from Vietnam suppliers who had advantage of their machinery and value chain setup. Although after Indian government raised the import duty on bamboo sticks the Indian manufacturers are doing well but by then he had shifted to bamboo integrated services. He now supplies Bamboo saplings, round Bamboos as well as other material as per demand for housing or other needs. Some of his stuff also goes to Japan and UK, but as he suggests that the party importing it takes care of regulatory requirements. He and like him many are completely unaware of the standards and don't feel it will add much value in current situations.

e) Dr. Manoharan (ex. FSC)

Dr. Manoharan an expert in Bamboo, wood certification, was also India coordinator of FSC a few years ago. He feels it will not be correct to say that investment on FSC certification and on other standards will not bring benefit. There are environmental, social and governance assurance that best practices are being followed and such benefits will flow to stakeholders. The challenge of financing is a matter that entrepreneurs or project proponents need to find solutions working with venture capital, social impact funders or government departments. However giving an example of Eco-mark³⁸ scheme of Government of India which is largely considered to have failed, he says that sustainability standards will sustain for a long term if they are demand driven and so it is very important to sensitize and educate stakeholder on importance of standards and about their specific features.

³⁸ Eco-mark is a voluntary non-binding scheme that labels consumer products as environment-friendly, based on certain environmental as well as quality parameters. The scheme was launched for easy identification of environment-friendly products. An eco-marked product is given the eco-mark logo — a matka or an earthen pot. Till 2013, only 20 licenses have been granted to 15 companies across four product categories — paper, wood substitutes, finished leather and electrical/electronic goods.

f) Artison Agro Pvt.- Devopam Mukharjee, CEO and MD of Artison Agro Pvt. Ltd, set up a 700 crores company in Madhya Pradesh with a mission to replace timber with Bamboo and thus fight climate change by making, as claimed, World Class furniture manufactured in a sustainable manner. Artison aims to work around PROCESSED ENGINEERED BAMBOO BOARD (PEBB) technology, manufacture Particle Board and MDF from 100% Bamboo. The long term aim of company is to tap the international market opportunities and is open to ideas of complying with standards and necessary certifications.

g) TIMPAC –is one of the leading Bamboo Based Industry in India registered as a micro enterprise under MSME, Govt. of India, manufacturing for more for past many years, "ISI Certified & Marked". Bamboo Mat Corrugated Roofing Sheets (BMCS) as IS:15476-2004 Corrugated bamboo roofing sheets (CBRS Bamboo and Bamboo Mat Board as per IS:13958-1994 Mat Based Products. They have got technology transfer from Indian Plywood Industries Research & Training Institute (IPIRTI), Ministry of Environment, Forest and Climate Change, Govt. of India & Building Material Technology & Promotion Council (BMTPC), Ministry of Housing & Urban Affairs, Govt. of India. Mr. Ghani Zaman, Senior Consultant with TIMPAC, shared on multiple complexities around Bamboo standards, e.g. There are more than 100 species of Bamboo but standards developed from the perspective of a few those have been studied, costing of repeated sample testing, general consumers' priority for low-cost models, standards being voluntary, and many key players in the sector and their workforce do not know or understand standards, standards are lack and standard education is lacking a big way. He however also shared that in TIMPAC their most sold products comply with and market products with IS numbers because most of their customers are government entities who specifically mention in their RFP requestion of compliance to such standards. As far as International Market is concerned, they are clear that as they use an adhesive with Formaldehyde base which is regulated in Europe and USA their product has limited scope of being able to be marketed in those markets and so it does not make sense for them to go for expensive certifications. Surprisingly as he shared, they are able to supply small quantities to Italy even when they do not have many requirements as laid out for Bamboo trade in EU.

h) Architect Hati and Neelam Manjunath

A good number of architects in different parts of India are also showing interest in developing the Bamboo based housing projects and are working under Build Operate and Transfer or as Turnkey projects. But even they accept that not many have awareness and knowledge around Bamboo Technology and about BIS standards around Bamboo. Neelam Manjunath, a Bangalore based Architect shares that while the Bamboo based housing technologies should be taught under the formal curricula of Architectural studies, it is not being taught and she has been running her independent courses around Bamboo based construction technologies. She also accepts that standards are important to ensure the quality of items being used but local context need to be understood to make it mandatory or voluntary.

D) INBAR

Ms. Sangeeta Agasty from INBAR, shared her perspective on standards, highlighting that standards are very important as they provide guidelines towards benchmarked levels, but she

also accepts that in India most of the trade happening is in informal market setup, as such the knowledge and training on how to use the standards is lacking substantially. Also consumers' mindset is to demand standards when there is visible risk of health and safety. She accepts that the volumes at which Indian enterprises are operating are quite low in comparison to felt (and unfelt) demand. She believes standardization also helps in getting better prices but India's bamboo industry, market and standardization system is at evolving stage and so decisions should be taken understanding the local context and comparing pros and cons very well.

j) Indian Plywood Industries Research and Training Institute (IPIRTI)

Amitva Sil, Scientist in Indian Plywood Industries Research and Training Institute (IPIRTI) is an active advocate of Bamboo centric technologies and usage of Bamboo in construction sector. He shares "...even if we don't build our entire house from bamboo, we can still use it for critical components like fencing, furniture, flooring, windows, ceiling or as a support material for super structure. It is also a great material to use in construction of structures like pagodas, farmhouses, resorts, beach houses and eco-tourism camps". He further shared that to promote sustainable use of Bamboo in Construction and related activities, the Bureau of Indian Standards (BIS) has a series of standards on bamboo preservation, testing of bamboo products and structural design of buildings using bamboo. He feels that the standards are important to benchmark the desired quality for desired end use. Especially for Bamboo to be used in construction solely or in combination of concrete or other material, it may be useful to refer relevant standards for structural use of bamboo, as revised and updated in NBC 2016 as well as IS 15912: 2018 (Structural Design using Bamboo - Code of Practice). Mr. Sil was himself a member of Building Construction Practices Sectional Committee, CED 13 and now People can make use of the code in ensuring sound and safe design and construction using this sustainable material. He feels that consumers will start demanding for standards when they feel importance of personal safety and when they realize that standardized products provide that assurance.

k) Century Ply- Century Plyboards (India) Ltd (CPIL) is primarily engaged in manufacturing and sale of Plywood Laminates Decorative Veneers Medium Density Fiber boards pre-laminated boards Particle Board and Flush Doors and providing Container Freight Station services. They comply with multiple BIS standards and certifications--- FSC® (Forest Stewardship Council® FSC-C107444) (Timber sources are sustainable) IGBC (Indian Green Building Council) (Member Products help you gain LEED (Leadership and energy and environmental Design) credit points, which in turn make it easier for construction to get a green rating. Mr. C. N. Pandey an astute advocate of standards accepts that there is also a concern if the BIS standards are relevant based on requirement of regular and comprehensive review for revision but which talks about the scope of work for improvement and not to discredit the standards as a whole. For Bamboo he feels that more standards are required on options where silica is suitably reduced/replaced while making the ply/manufactured particle board. On missing standards for Bamboo based school and library furniture, he indicated those are under revision and perhaps the groups work on them need to be highlighted for this requirement. He feels the purpose of standards is not to build or enhance market opportunities—it could be a byproduct, but the true purpose is market refinement and standardization. On the question about the demand of BIS to make BIS standards mandatory for all products in market, he accepts that

it may wipe out smaller players but it may also push them to improvise their business operations and product standards, which will favor consumer and market in long run. When asked if Indian consumers, who prefer low-cost products, would embrace the new norm, he suggests, it is subjective that this will not work as consumers will sooner or later gradually understand that by buying cheap but low-quality products they are at loss in longer term.

4. Good practices from other countries and lessons for India

4.1 Case of Vietnam: Vietnam ranks fourth in area under Bamboo and has around 1.5 million hectares of bamboo forest, of which 71,000 hectares are covered with planted/cultivated bamboo (WWF, 2015). The total bamboo area accounts for around 15% of natural forest, with 216 bamboo species in 25 genera (Oxfam Hong Kong, 2006). The bamboo-rattan industry in Vietnam provides approximately 3.4 million jobs, with an export value in 2018 of \$348 million. (MOIT, 2019; MOARD, 2019). Till few years back, Bamboo sector in Vietnam was facing many development problems, such as outdated technology, lack of capital, weak innovation, low investment in production and marketing, lack of certification, and lack of practical supporting policies from the government. Viet Nam that used to produce high-quality bamboo mats and composite floorings despite of cheaper prices for bamboo raw material wage labor (approx. half of those costs in China, they gradually lost business to Chinese exports. The key reason that was identified was low utilization rate of the bamboo plant, resulting in the need to import multiple additional intermediates and to bear the cost of wasted material. Vietnam addressed this situation by gradually increasing utilization rates as it imported more than 100 production lines and focused on the strategic development of its bamboo industry. It diversified into bamboo sticks, pressed lumber, engineered boards, shoots, charcoal, construction, furniture and handicrafts, and was able to build a sector valued at US\$250 million by 2010 (Zhaohua and Wei 2018). There was also a challenge that bamboo forest resources were fast getting depleted and a resource on which many depend was getting degraded, but now under program FLOURISH ‘offset planting’, to aid restoration efforts, and project on Sustainable and Comprehensive Development of the Clam/Bamboo Value Chain in Vietnam (SCBV) is being implemented under which more than 12,000 small-scale farmers in the bamboo chain have improved their capacity to apply appropriate production techniques and implement sustainability standards (FSC). Viet Nam in last few years had reached to second in order county to export Bamboo products with an estimated value of US\$13.4 million.³⁹

4.2 Case of China

China has of course largest bamboo resources but has several other reasons for which it is biggest supplier for many countries. Some of the reasons are as below:

³⁹ UNCTAD (2022): COMMODITIES AT A GLANCE Special Issue On Bamboo
https://unctad.org/system/files/official-document/ditcom2021d3_en.pdf

- Strong Domestic and International Demand, easy credit and low capital requirement for Small and Micro units to initiate industrial production system.
- Structured and specialized Value Chain- Producers to Processors to manufacturers where specialization is higher and each node is worry less of others job.
- Development of Technical Capacities- Specialization has allowed to bring in innovation further lowering down the cost of technology and the cost of operation.
- Extreme levels of Productive Efficiency – Minimal wastage, different parts go to manufacturers of different products in the way they want and there marginal manufacturing cost. Competition for raw material compel manufacturers to continuously innovate to further lower down the wastage.
- The presence of Economies of Scope and Scale- Availability of large pool of semi-skilled and skilled workers.

On standard front something that has further helped China is close to 87 quality standards around Bamboo use for different purposes, a large number of bamboo related businesses with FSC certification, framework of Timber Legality Standard that China is working and Bilateral agreements with USA and Europe as preferred destination with respective requirements complied with in the production process.

5. Conclusive Observations: This subject is so vast and complex that there could be many dimensions still to be covered but as far as requirement of standards is concerned, it is clear as shared by Mr. C. N Pandey (Century Plywood) that Standards are for ensuring quality and other parameter benchmarking. It can act as a market expansion stimulus if it is demand driven and if higher standards can fetch premium price as well as result in leaving behind its different competitors. For this the Bamboo value chain actors as well as the government will have to work on multiple fronts. As highlighted by Ms. Neelam Manjunath and many others, there are still many players who do not have awareness and education about these standards. Even in the case of learned architects and builders, they do not have professional courses and detailed handbooks on codes to be worked upon. Multiple experts have highlighted that relevant agency should detail out on existing and new standards for newly found uses (textile, Biofuel) and area where they are missing (eg Micro Propagation and Sustainable Harvesting of Bamboos, Timber Legality Assurance, School and Library Furniture), seeing them that they are benefitting the larger value chain. Additionally, and more importantly agencies should run capacity building and education programs for practitioners in multiple cities. It is equally important that campaigns to generate rightful demand for standardised products among consumers for quality and other multiple environmental, social and governance benefits should be implemented, to make a demand driven concept in domestic market. Standards are useful but to avoid any unintended negative impact on MSMEs they should be kept voluntary and at initial level exempted for micro and miso levels players.

For international market learning from China's experience, government of India / Bamboo mission should build relations with relevant agencies in other countries to get trade agreements and to find way outs to fulfil requirements of these countries and become their one of the most favoured destinations to source Bamboo.

Annexure 1:

Sustainability Standards for Bamboo Production and Products:

	Housing	Construction Material	Lifestyle				Energy	Food
			Furniture	Kitchen utilities	Packaging material	Decorative items		
Micro Propagation to Grow Bamboos in large quantities	A detailed and comprehensive BIS standard for micro propagation published by BIS could not be found, however there are a few developed by Department of Biotechnology's National Certification System for Tissue Culture Raised Plants (NCS-TCP) ^v , by INBAR ^{vi}							
Guidelines to sustainably harvest Bamboos	Some guidelines have been developed by INBAR on Ethiopian lowland bamboo cultivation (INBAR 2009), ^{vii} on sustainable harvesting of matured Bamboo Clumps. INBAR under NTFP Sustainable Harvesting and Resource Management Protocol, has also developed thumb rules for harvest and post-harvest treatment. ^{viii} , but a BIS standard has not been found on this.							
Raw material	FSC Certification: Forest Stewardship Council (FSC) is a globally recognised certification system under its forest conservation standards. FSC uses a voluntary, market-based system in which forests, companies anyway associated to timber related products are audited against principles and criteria of FSC. The performance-based standards encompass environmental, social and economic values/parameters , and are framed to ensure that the forests are managed sustainably. FSC ensures traceability of products from the forests to the point of sale. Products that are manufactured							

	from responsibly harvested forests are identified with the FSC logo, which is considered the “gold standard” of forest certification by major environmental groups. (This is applicable for all product categories of Bamboo)							
	BIS: Indian Standard (IS) number 6874 : 1973- talks about Method of tests for round bamboos (standards on economic and environmental parameters)							
Pre-Processing & processing	BIS National Building Code (NBC) Part 6, section 3B covers the use of bamboo in structural aspects such as “minimum strength data, dimensional and grading requiremen	BIS: IS no. 8242 : 1976- Methods of tests for split bamboos						

	<p>ts, seasoning, preservative treatment, design and jointing techniques with bamboo which would facilitate scientific application and long- term performanc e of structures. It also covers guidelines so as to ensure proper procurement, storage, precautions</p>								
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	and design limitations on bamboo” (2005, NBC). (standards on economic and environmental parameters)								
Final Product	ISO standards: 1. Structural Design ISO 22156:2004 applies to the use of bamboo structures, i.e. structures made of	GRIHA (The Green Rating for Integrated Habitat Assessment): Of the 34 Criteria under the rating system, Criteria 17 pertains to use of low energy material in construction. The CPWD commitment	BIFMA is the not-for-profit trade association for business and institutional furniture manufacturers. BIFMA is the industry leader in developing furniture safety, durability, and sustainability standards that ensure product performance and inspire confidence. BIFMA Standards BIFMA sponsors the	FSSAI notification -Sept 2019 for Bamboo Cutlery (Spoon, fork, knife, straw, stirrer, cup, etc. made out of bamboo. Guidelines for	BRCGS Global Standard for Packaging and Packaging Materials Certification from SGS – demonstrate	Established in 2006, the Craftmark initiative by AIACA helps denote genuine Indian handicrafts,	SGS Standard (Global) and certification on: Mechanical and physical properties <ul style="list-style-type: none"> • Flammability • Hazardous 		IS 15691 :2006 Indian Standard GUIDELINES FOR STORAGE AND TRANSPORTATION OF BAMBOO SHOOT describes methods for obtaining conditions for

bamboo (round bamboo, split bamboo, glued laminated bamboo) or bamboo-based panels joined together with adhesives or mechanical fasteners. ISO 22156:2004 is based on limit-state design, and on the performanc	towards this criteria states the following: “Minimum 70% in each of the three categories of interiors (internal partitions, panelling/false ceiling/interior wood finishes/ in-built furniture door/window frames, flooring) from low-energy materials/finishes to minimize the usage of wood”. BIS • 13958 : 1994- Specificat ion for bamboo	development and maintenance of furniture safety, performance, and sustainability standards that impact people's lives. level® is the multi-attribute, sustainability standard and third-party certification program for the furniture industry. ISO/TC 136- Furniture ISO 4211-2:2013 Furniture — Tests for surface finishes — Part 2: Assessment of resistance to wet heat	manufacturing, handling and cleaning ISO 3055:1985 Kitchen equipment — Coordinati ng sizes: Defines sizes for component s of kitchen equipment in dwellings. Specifies also, in annex A, the sizes of zones for hot and	compliance in hazard and risk management, hygiene, product safety and quality systems. The BRCGS standard is recognized by the Global Food Safety Initiative (GFSI), a program that aims to harmonize international food	develop sector-wide minimum standards and norms for labelling a product as a handicra fts product, and increase consume r awareness of distinct handicra ft tradition s. Under	chemical s • Electrical propertie s There are number of global voluntary standards for toy Indian Standards for imports of Toys: A certificate that the toys being imported conform to the standards prescribed		successful preservation, cold storage and transportation of bamboo shoot intended for consumption, either directly or after industrial processing. ⁴¹
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⁴¹ <https://law.resource.org/pub/in/bis/S06/is.15691.2006.pdf>

<p>e of the structure. It is only concerned with the requirements for mechanical resistance, serviceability and durability of structures.</p> <p>2. Determination of physical and mechanical properties: Part 1: Requirements</p>	<p>mat board for general purposes</p> <ul style="list-style-type: none"> • 14588 : 1999- Specification for bamboo mat veneer composite for general purposes • 15476 : 2004- Specification for bamboo and corrugated sheets • 9096 : 2006 - 	<p>1. Although BIS standard IS 4837 : 1990 (Reaffirmed in 2002) Indian Standard for School Furniture CLASSROOM CHAIRS AND TABLES – RECOMMENDATIONS⁴⁰, along with IS 5416 : 1988 ‘Methods of tests for strength and stability of chair and stools: Part 1 Strength, and Part 2 Stability’, and IS 5967 : 1988 ‘Methods of test for strength and stability of tables and trolleys: Part 1 Strength, and Part 2 Stability are in public domain, a</p>	<p>cold water and waste and gas pipes in kitchen cabinets and certain appliances. Applies to all components of kitchen equipment, for example cabinets, work-tops, sink units and appliances.</p> <p>SGS has a global network of laboratories</p>	<p>safety related standards with the support of the world’s top retailers, food and packaging manufacturers. GFSI recognition means you can use the BRCGS global standard for food packaging materials to meet the requirements of these</p>	<p>this initiative, AIACA licenses the Craftmark logo for use by Craft-based businesses, cooperatives and NGOs for use on product tickets and labels.</p>	<p>by Bureau of Indian Standards (BIS)</p> <p>a) IS: 9873(Part 1) - Safety of toys: Part – 1 Safety aspects related to mechanical and physical properties (Third Revision).</p> <p>b) IS: 9873(Part 2) – Safety of Toys: Part – 2 Flammability (Third Revision)</p>			
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⁴⁰ <https://ia600904.us.archive.org/25/items/gov.in.is.4837.1990/is.4837.1990.pdf>

	<p>ISO 22157-1:2004 specifies test methods for evaluating the following characteristic physical and strength properties for bamboo: moisture content, mass per volume, shrinkage, compression, bending, shear and tension.</p> <p>3. Determinat</p>	<p>Code of practice for preservation of bamboo for structural purposes (first revision)</p> <ul style="list-style-type: none"> • 6874 : 2008 - Method of test for round bamboo (first revision) • 15912 : 2012- STRUCTURAL DESIGN USING BAMBOO – 	<p>standard for usage of Bamboo for furniture has not been worked upon but can be developed by taking these and other relevant standards. Similarly BIS has also got IS : 1829 (Part I) – 1978, Indian Standard SPECIFICATION FOR LIBRARY FURNITURE AND FITTINGS. This standard prescribes the requirements for the following items of wooden furniture meant for use in a library: a) Unit book rack, b) Bay guide holder, c) Book trolley, d) Catalogue cards</p>	<p>that are accredited to test materials, kitchen and dining products in accordance with the international and national safety and quality requirements for cookware, tableware, cutlery.</p> <p>EUROPE</p> <ul style="list-style-type: none"> • Framework Regulation (EC) No 1935/2004 	<p>major players under a single, internationally recognized food safety management system.</p>		<p>c) IS: 9873(Part 3) – Safety of Toys: Part – 3 Migration of Certain Elements (Second Revision)</p> <p>d) IS: 9873(Part 4) – Safety of Toys: Part – 4 Swings, Slides and similar activities Toys for indoor and outdoor family domestic use.</p> <p>e) IS: 9873(Part 7)</p>		
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	<p>ion of physical and mechanical properties: Part 2: Laboratory Manual</p> <p>SO/TR 22157-2:2004 provides informative guidelines for staff in laboratories on how to perform tests according to ISO 22157-1:2004.</p>	<p>CODE OF PRACTICE</p>	<p>tray and cabinet, e) Catalogue cards box, f) Catalogue cards work tray, g) Control region fittings, h) Charging trays, i) Reading room table, j) Study table, k) Periodicals display rack, l) Chairs, and m) Display stand. This standard can be modified or drafted for Bamboo also to enhance Bamboos application.</p>	<ul style="list-style-type: none"> • Legislation on specific materials • Directives on individual substances • REACH • Safety and performance tests (EN 12983-1, ISO 2747, EN 13258...) U.S. • Food Contact Materials Testing: FDA CFR 21 parts 175-189 & FDA CPG 7117.05, 06, 07 			<p>– Safety of Toys: Part – 7 Requirements and test methods for finger paints.</p> <p>f) IS: 9873(Part 9) – Safety of Toys: Part – 9 Certain phthalates ester in toys and Children’s products.</p> <p>g) IS: 1564 – Safety of Electric Toys.</p> <p>(ii) A Certificate that the toys</p>		
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	<p>ISO 22157-1, Bamboo — Determination of physical and mechanical properties — Part 1: Requirements</p> <p>23 October 2018 – A new standard for bamboo structures, developed by INBAR’s Construction Task Force, has</p>			<ul style="list-style-type: none"> • California Prop 65 • Safety and performance tests according to CMA (Cookware Manufacturers Association): Handle torque and fatigue resistance, Strength test (for plastic handle only), Flame / softening test (for thermoplastics), Glass cover breakage resistance, 			<p>being imported conform to the standards prescribed in IS: 9873 Part- 1, Part – 2, Part – 3, Part – 4, Part – 7, Part – 9 and 15644: 2006.</p> <p>(iii) A certificate of Conformance from the Manufacturer that representative sample of the toys being imported have been tested by an independent</p>		
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	<p>been published by the International Standardization Organization (ISO) in September.</p> <p>ISO 19624:2018 deals with the structural grading of bamboo culms for construction. It details the grading procedures for visually and mechanically sorting bamboo</p>			<p>Flatness of pan bottoms Dry boil test</p>			<p>laboratory which is accredited by NABL, India and independent laboratory which is accredited above. The Certificate would also link the toys in the consignment to the period of manufacture indicated in the Certificate of Conformity.</p> <p>The Bureau of Indian Standards (BIS) in Feb</p>		
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	<p>poles for structural applications. These procedures can be used as part of official grading systems, to ensure the safety and quality of bamboo structures.</p>					<p>20, 2019, informed about a range of products for which a future <u>mandatory certification</u> is <u>currently under process in India of which Toy is one.</u></p> <p>Product Safety Improvement Act of 2008</p> <p>Consumer Product Safety Improvement Act of 2008 (CPSIA) is</p>		
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							<p>one of the most comprehensive transformations of consumer-product safety regulations since the 1970s. CPSIA expands the role of the Consumer Product Safety Commission (CPSC) in ensuring the safety of consumer products, especially those designed for children.</p>		
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							<p>Manufacturers, importers and retailers of most consumer products will have to come comply with many provisions of CPSIA, including:</p> <p>Rigorous lead restrictions for children's products</p> <p>A ban on phthalates (chemicals used to soften plastic) in</p>		
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							children's toys Mandatory infant products registration Conversion of a voluntary toy safety standard to a mandatory standard Mandatory third-party testing and certification of toys and children's products beginning with the new lower limits on lead in paint content.		
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Bamboo Products to be exported to USA		<p>wooden furniture should comply with applicable regulations and standards, such as CPSC (Consumer Public Safety Commission) safety standards or ASTM standards (voluntary standards , in order to improve safety and performance) and National Fire Protection Association (NFPA) voluntary safety standards for furniture.</p> <p>The Toxic Substances Chemical Act Title VI 40 CFR Section 770 sets out rules for the Formaldehyde Emission Standards of Composite Wood Products Section 770.15 requires that importers of composite wood products must obtain product certification for their products before they are allowed to sell in the United States. The importers must apply to a Third-Party Certifier (TPC) recognized by the EPA in accordance with the TSCA Title VI.</p>		
Bamboo Products to be exported to Europe	<p>Wood and bamboo products imported and manufactured in the EU are subject to traceability requirements, chemicals and substance restrictions, safety standards, and labeling requirements. Examples include European Union Timber Regulation (EUTR), the General Product Safety Directive, REACH, and various EN standards.</p>			

Annex-2: ISO 23478:2022(en)

Bamboo structures — Engineered bamboo products — Test methods for determination of physical and mechanical properties

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-

governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 165, *Timber structures*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

1 Scope

This document specifies test methods suitable for determining the following mechanical properties of engineered bamboo products:

- a) modulus of elasticity in bending;
- b) shear modulus;
- c) bending strength;
- d) modulus of elasticity in tension parallel to the fibre;
- e) tension strength parallel to the fibre;
- f) modulus of elasticity in compression parallel to the fibre;

- g) compression strength parallel to the fibre;
- h) modulus of elasticity in tension perpendicular to the fibre;
- i) tension strength perpendicular to the fibre;
- j) modulus of elasticity in compression perpendicular to the fibre;
- k) compression strength perpendicular to the fibre and shear strength;
- i) shear strength parallel to the fibre.

In addition, the determination of dimensions, moisture content and density are specified.

This document is applicable to prismatic shapes of glued laminated bamboo and bamboo scrimber intended to resist flexure, shear, axial loads, or combinations thereof.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

- ISO 22157, *Bamboo structures — Determination of physical and mechanical properties of bamboo culms — Test methods*
- ISO 21625, *Vocabulary related to bamboo and bamboo products*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 22157, ISO 21625 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- — ISO Online browsing platform: available at <https://www.iso.org/obp>
- — IEC Electropedia: available at <https://www.electropedia.org/>

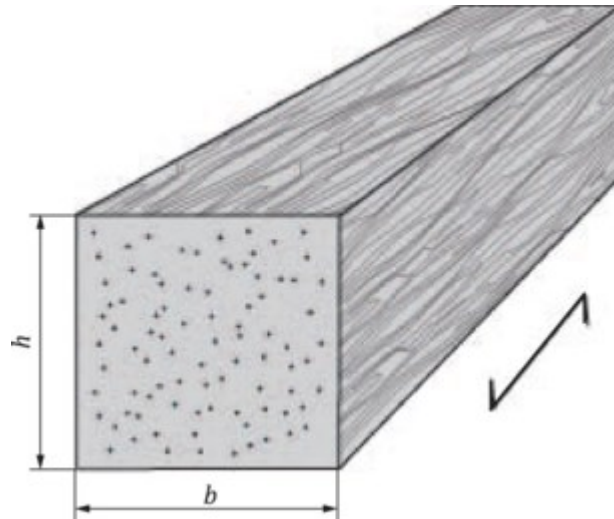
3.1

bamboo scrimber


panel or structural member made of compressed bamboo fibre bundle strips or compressed bamboo fibre bundle sheet

[SOURCE:ISO 21625:2020, 3.2.17]

Figure 1 — Example of bamboo scrimber



Key

- 1 width, b
- 2 depth, h
-  indicates parallel to fibre orientation

3.2

bamboo strip

bamboo piece with outer and inner layers intact, made by cutting bamboo culm in longitudinal direction

3.3

bamboo lamina

thin and flat bamboo piece with rectangular cross-section, processed from **bamboo strip** (3.2) by removing the outer and inner layers of the bamboo culm wall

3.4

engineered bamboo member

assembly of individual elements made of bamboo

3.5

glued laminated bamboo

structural member formed by bonding together **bamboo strips** (3.2) with their fibres running essentially parallel

[SOURCE:ISO 21625:2020, 3.3.1.14]

3.6

non-structural joint

non-structural connection (e.g. butt, hook joint) to support manufacturing process and is not designed to transfer stress across the connection

3.7

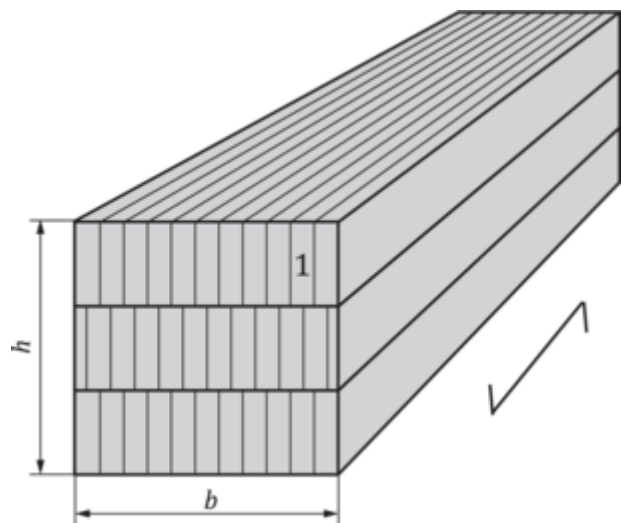
traveller specimen

specimen identical to, and stored and conditioned identically to specimens to be tested used to obtain properties whose testing method affects the specimen

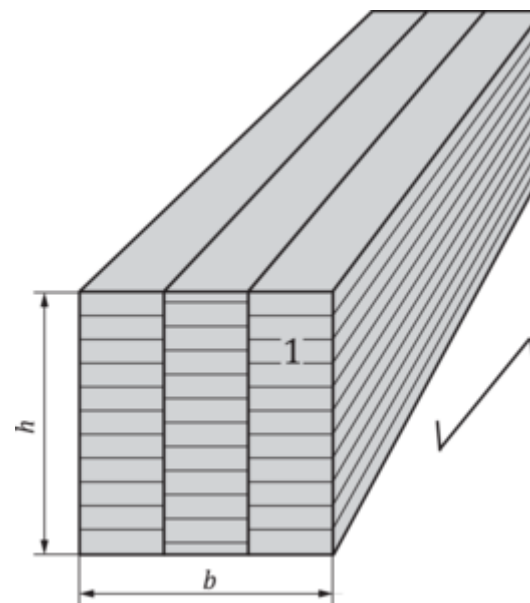
Note 1 to entry: Traveller specimens are usually used for determination of moisture content and density.

[SOURCE:ISO 22157:2019, 3.12]

Figure 2 — Example of glued laminated bamboo



a) Horizontal board orientation



b) Vertical board orientation

Key

- b width, b
- h depth, h
- 1 bamboo lamina
- ↗ indicates parallel to fibre orientation

Only informative sections of standards are publicly available. To view the full content, you will need to purchase the standard by clicking on the "Buy" button.

Bibliography

- [1] ISO 12122-3, *Timber structures — Determination of characteristic values — Part 3: Glued laminated timber*
- [2] ISO 8375, *Timber structures — Glued laminated timber — Test methods for determination of physical and mechanical properties*
- [3] ISO/TR 21141, *Timber structures — Timber connections and assemblies — Determination of yield and ultimate characteristics and ductility from test data*
- [4] ASTM D198, *Standard Test Methods of Static Tests of Lumber in Structural Sizes*
- [5] ASTM D5456, *Standard Specification for Evaluation of Structural Composite Lumber Products*

5. Summarising and collation of performance parameters across product, process, technical and sustainability - What we know and What we don't know (Gap Analysis)

- (i) Complication of existing product, process and technical standards (ISO, BIS, etc. - relevant for India)
- (ii) Possible application of existing sustainability standards (international - e.g INBAR, FSC, PEFC, RSB, etc.)
- (iii) Development of new bamboo sector sustainability standard for India - Can we use NGRBC as a framework for developing a Bamboo-sector Specific set of Guidelines? Has BIS done something that can be built on or incorporated

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^{iv} Hossain, Mohammad & Islam, Md & Numan, Sharker. (2016). Multipurpose Uses of Bamboo Plants: A Review. *International Research Journal of Biological Sciences*. 4. 57-60.

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^{vi} <https://www.inbar.int/wp-content/uploads/2020/05/1543379203.pdf>

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^{viii} NTFP Sustainable Harvesting and Resource Management Protocol