

Livelihood of the Bamboo base: Challenges and Opportunities

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Abstract

Bamboo is a versatile input and is used as building material, paper pulp resource, scaffolding, agriculture implements, weaving material, plywood and particle board manufacture, basketry, furniture, pickled or stewed bamboo shoots, medicines, etc. Resource management and technical improvements can convert this fast-growing grass into a durable raw material for construction purposes and a wide range of semi-industrialized products. New industrial applications and modern construction design have both demonstrated bamboo's huge potential.

The combined value of internal and commercial uses of bamboo in the world is about Rs 50,000 crores annually. This is supposed to double by 2015. In India archaic legislation and lack of awareness have inhibited the bamboo based industrialization process. The biggest impediment towards a bamboo based sector from developing has been the irregular and scant supply of bamboo for entrepreneurial use. An efficient regulatory institution is essential for markets to grow in a sustainable manner, especially where environment concerns are coupled with business development. Transaction costs must be minimal, information availability maximal with a clear focus on maintaining the forest cover. Unfortunately, the regulatory structure as regards the bamboo industry has remained caught in the quagmire of archaic forest laws. Therefore, what is definitely needed is the linkages that industrialization of the bamboo sector can provide, given the huge linkages with rural livelihood. However, only when there is a viable entrepreneurial activity of any bamboo based product, will the market tend to provide the supply and demand linkages and it is only then that livelihood benefits will accrue.

Introduction

Although recorded history finds mention about the various uses of bamboo as early as 7th century AD during the days of Kingdom. Yet in India, no quantified information is available regarding the actual bamboo base policy for any of these products except for the paper and pulp industry, and the contribution of bamboo in the family income of various categories of consumers. On the resource front also there is no quantification regarding bamboo availability from non-forest land. Being essentially a forest based material, bamboo, although a non wood fibre source is included with wood, in all Indian studies, including those pertaining to raw material for the pulp and paper industry. In the national statistics, therefore it is often difficult to separate the contribution and role of bamboo fibres. On the other hand, non-wood forest products, including bamboo, do not have standard classifications. They are usually classified according to their structure (roots, leaves, bark) or the end use (medicine, food, beverages, utensils, etc.). Bamboo product classification is even more complicated due to the multi-functionality. Most of the economic activities related to bamboo are not recorded officially. Accurate statistical information on trade in Bamboo is also difficult to find, and even internationally. The main reason for this is that international trade statistics suffer from outdated customs codes.

Bamboo – Its Characteristics and Uses

The many characteristics of bamboo make it an enduring, versatile and highly renewable resource. Bamboo has more than 1,500 documented uses, ranging from fuelwood to light bulbs, medicine, poison and toys to aircraft manufacturing. Over 1,000 million people live in houses made of bamboo or with bamboo as the key structural, cladding or roofing element.

- Its biological characteristics make it a perfect tool for reducing carbon dioxide levels in the atmosphere. It generates more oxygen than equivalent strands of trees, lowers light intensity, protects against ultraviolet rays and is an atmospheric and soil purifier.
- Bamboo is an enduring and versatile natural resource. The great diversity of species makes bamboo adaptable to many environments.
- Bamboo grows very fast and has a short growth cycle. Bamboo not only grows much faster than wood, it also needs relatively little water. It is the fastest growing canopy, growing three times faster than most eucalyptus species. Commercially important species usually mature in four to five years (versus 10 to 25 years for most soft woods). Annual harvests are subsequently possible.
- Bamboo prevents soil erosion. Its anti-erosion properties create an effective watershed, stitching the soil together along fragile river banks, deforested areas, and in places prone to earthquakes and mud slides. The sum of stem flow rate and canopy intercept of bamboo is 25% which means that bamboo greatly reduces rain run-off, preventing massive soil erosion. Thus, bamboos help control landslides, keep flooded rivers along their natural course and slow the speed of the water flow.

- Bamboo is foremost in biomass production, with up to 40 tonnes per hectare per year in terms of culms only in managed stands. An estimated one-quarter of the biomass in tropical regions and one-fifth in subtropical regions comes from bamboo.
- Bamboo is one of the world's best natural engineering materials. Due to its high tensile strength, it is an essential structural material in earthquake architecture and is one of the strongest building materials. Its strength-to-weight ratio is better than that of teak wood and mild steel. Bamboo's tensile strength is 28,000 lb per square inch versus 23,000 for mild steel. This makes bamboo wood a potential alternative, at least in some applications, to steel which requires more energy for manufacturing/production. Its strength and flexibility make it a viable material for building shelters that offer protection against hurricanes and earthquakes. * In Bangladesh, 73% of the population lives in bamboo houses. Bamboo based pre-fabricated houses also can be constructed quickly with new and emerging techniques and is thus an important post-disaster relief material. It is extensively being used in Tsunami rehabilitation in India. Bamboo reinforcement in concrete piles is used by the Indian Railways.
- As a food source, bamboo shoots have provided nutrition for million of people worldwide. In Japan, the antioxidant properties of pulverized bamboo bark prevents bacterial growth and it is used a natural food preservative. Taiwan alone consumes 80,000 tons of bamboo shoots annually constituting a \$50 million industry.
- Bamboo is a viable replacement for wood. Its qualities of strength, light weight and flexibility make it a viable alternative to tropical timber that is used in the furniture and building materials industries.
- It is a critical element of the economy. Bamboo and its related industries provide income, food and housing to over 2.2 billion people worldwide. There is a 3-5 year return on investment for a new bamboo plantation.
- Bamboo is a renewable resource for agro-forestry products. Bamboo is a high-yield renewable natural resource. Ply bamboo is now being used for wall panelling, floor tiles, for paper making, briquettes for fuel, raw material for housing construction, and rebar for reinforced concrete beams. It can be used to produce many items of daily use that are currently made out of plastic or other less eco-friendly materials.
- Bamboo is being used as an input or raw material in certain industries. It has been primarily been used in the paper industry in bulk quantities as a raw material for paper pulp. Bamboo is also used in manufacturing wood substitutes, composites, utility products including Agarbatti (incense sticks).

* In Limon, Costa Rica, only the bamboo houses from the National Bamboo Project stood after their violent earthquake in 1992.

- Bamboo is also a source of energy. Gasifiers can produce electricity using bamboo as fuel. These can also be used for thermal applications replacing furnace and diesel oil. Charcoal and its processed form in powder and briquettes can also be manufactured. It is superior to other sources of charcoal in terms of calorific value. Bamboo charcoal can also be used as a raw material for activated carbon manufacturing which is used as adsorbent in different industries like vegetable oil, beverage, pharmaceuticals etc. Goldsmiths prefer bamboo charcoal in making jewels.

In sum, bamboo's excellent growth, environmental, mechanical and engineering properties make it a fine alternative to tropical timber. Its potential for different value added products and application make it an extremely important material for dispersed employment generation and economic activities. Perhaps these properties and potential usage coupled with increased urgency of environmental issues ought have been sufficient to change the attitude towards bamboo, and solved the problems of tropical deforestation. However it is not so. "Bamboo of the poor man" (India), "friend of the people" (China) and "brother" (Vietnam), bamboo is a wonder plant that grows over wide areas of North Eastern India. Millions of people depend on this plant for their livelihood. It has become so much a part of the culture and memory of societies that the existence of a Bamboo Age has not been ruled out. Its use in food and cooking goes far back in history" representing a social stigma.

Bamboo based Products – An Appraisal

Literature regarding the multiple uses of bamboo highlights the utility of bamboo for house construction, bamboo ply, agricultural implements, handicraft, irrigation, brooms, medicine, food, fuel, fodder, paper & pulp etc, especially bamboo as a perfect substitute for some wood based products. The products that can be made from Bamboo can be broadly be categorized into:

1. Wood Substitutes and Composites,
2. Industrial Use and Products,
3. Food Products,
4. Construction and Structural Applications.

Apart from this broad classification various handicraft and cottage industry products are also made from bamboo. However, this category of products is not discussed as bamboo based industrialization and its prospects limit the scope of the study. Also the input of bamboo as a resource raw material in the paper and pulp industry is also not explicitly dealt with as a bamboo based product but discussed in the next chapter under the resource situation in North Eastern Region.

Wood Substitutes and Composites

This category of products essentially comprises of boards and sticks of varying descriptions and uses, and which can further be used to manufacture finished products like wooden floors or blinds or goes into another industry as an input like incense sticks.

Bamboo Based Panels: China started producing bamboo panels in the early 19th century. At present more than 20 different types of panels are produced in Asia. Bamboo fibre is longer than wood fibre, which gives bamboo some technological advantages. The panels are widely used in modern construction as structural elements or as forms for concrete mouldings. They are also used for flooring, roofing, partitions, doors and window frames. Bamboo panels have some advantages over wooden board due to their rigidity and durability. Various types of bamboo veneers, panels and boards can be broadly classified as follows: veneers, strip boards, mat boards, fibreboards, particle boards, medium density boards, combinations of these, and combinations of these with wood and other ligno-cellulose materials and inorganic substances. Composites of bamboo and jute are also possible to make panels.

Bamboo Flooring: Bamboo flooring is a quality product that can be used widely and has a large, global consumer market. It has certain advantages over wooden floors due to its smoothness, brightness, stability, high resistance, insulation qualities and flexibility. Bamboo flooring has a soft natural lustre and maintains the natural gloss and elegance of bamboo fibre. This flooring is attractive to the demanding markets in Europe, Japan and North America. The estimated annual production of bamboo flooring in China was 17.5 million square metres in 2004, with about 65% being exported (Customs General Administration of China, 2004).

Bamboo Sticks for Blinds and Incense Industry: The art of making screens and blinds from bamboo is not new to India. For centuries, people have woven elegant screens from bamboo that have provided privacy, protection from the sun and added aesthetic appeal to living spaces. Mechanized blind making units can be economically viable enterprises. Again, bamboo sticks making units can substitute the wood that is used in the incense stick, and that industry in North Eastern Region India is estimated to be worth US\$400 million. It can also be used in match sticks.

Bamboo Furniture: Traditional bamboo furniture uses natural round or split bamboo. A new type of 'pack-flat,' 'knockdown' furniture uses glue-laminated bamboo panels. Unlike the traditional design, this furniture may be shipped in compact flat packs, to be assembled on the spot. The new design overcomes many of the problems of traditional bamboo furniture, such as high labour and transportation costs, low productivity, instability, varying quality and susceptibility to insects and fungi. At the same time, it retains the distinct physical, mechanical, chemical, environmental and aesthetic features of bamboo. Export of laminated bamboo furniture is growing rapidly. However, trade statistics currently do not capture the value, owing to the absence of a special code for bamboo furniture. It is usually classified as wooden furniture.

Industrial Products

Traditionally the industrial use of bamboo has been in the paper and pulp industry. Apart from this, the industrial products from Bamboo, essentially comprises of converting into fuel or electricity through gasification. Through pyrolysis, bamboo can be converted into three valuable products - bamboo charcoal, oil and gas. Changing the pyrolysis parameters can change the product shares depending on the purpose and market conditions. Bamboo based producer gases can be used as a substitute for petroleum. Bamboo charcoal is an excellent fuel for cooking and barbequing. There can also be the use of activated charcoal. This is used as a deodorant, purifier, disinfectant, medicine, agricultural chemical and absorbent of pollution and excessive moisture. The industrial use is using bamboo waste for gasification and thereby producing electricity.

Bamboo for Paper and Pulp: Several bamboo-producing countries, such as China, North Eastern Region and India, use bamboo in paper and pulp. Bamboo paper has practically the same quality as paper made from wood. Its brightness and optical properties remain stable, while those of paper made from wood may deteriorate over time. The morphological characteristics of bamboo fibres yield paper with a high tear index, similar to that of hardwood paper. The tensile stiffness is somewhat lower compared with softwood paper. The strain strength is between that of hardwood and softwood papers. The quality of paper may be improved by refining the pulp.

Bamboo Charcoal for Fuel: Bamboo charcoal is traditionally used as a substitute for wood charcoal or mineral coal. It can serve as a fuel, absorbent and conductor. The calorific value of bamboo charcoal is almost half that of oil of the same weight. Activated bamboo charcoal can be used for cleaning the environment, absorbing excess moisture and producing medicines. The absorption capacity of bamboo charcoal is six times that of wood charcoal of the same weight. China is a leader in its production. At present, Japan, the Republic of Korea and Taiwan Province of China are the main consumers, but its importation is rapidly expanding in Europe and North America. There are three main reasons contributing to the success of bamboo charcoal in international trade:

- Bamboo grows faster and has a shorter rotation compared with tree species;
- The calorific value and absorption properties of bamboo charcoal are similar to or better than those of wood charcoal; and
- It is cheaper and easier to produce.

Bamboo Based Gasifier for Electricity: Gasification of bamboo can produce energy and a range of valuable by-products. It reinforces a commitment to clean and renewable electricity and thermal energy. It can utilise waste generated by processing operations, substitute the use of fossil fuels, and lower operating costs. Bamboo can be cut into small pieces and used in the Gasifier. The requirements for the gasification units are a small proportion of the total availability. A 100 Kw Gasifier would

require only about 1000 tonnes per annum, the equivalent of a truckload every three days on the average. An added advantage of gasification of bamboo is that 15% of the biomass would also be available as a by-product in the form of high grade charcoal. In the case of a 100 Kw Gasifier, around 135 tonnes of charcoal would be available each year to meet local needs of fuel. It is clean, cheap & renewable source of energy. Further, it does not depend on quality, species, and maturity of bamboo.

Bamboo based fibre and fabric: The most recent advancement in bamboo is the manufacturing of fibre for making yarn and into various fabrics. There are several spinning mills using 100 per cent bamboo yarn, and Indian companies such as Raymond, BSL Ltd of Bilwara group and Paramount Textile Mills Ltd, Madurai, have already launched fabrics made out of bamboo. Bamboo fabrics are naturally anti-microbial and due to the presence of micro pores in the fabric absorb, they three times more moisture than cotton, making it a superior product. Apart from the ones outlined above, bamboo extracts contain valuable elements that can also used an input in several industrial products. For example, bamboo can be used in pharmaceuticals, creams, and beverages. Traditional medicines like Chawanprash use bamboo extracts.

Food Products

Under this category, it is essentially bamboo shoots that are consumed after being cooked. Bamboo shoots carry the potential of value added economic activity at the entrepreneurial and community level through cultivation, processing and packaging. Its use in food and cooking goes far back in history. China earns US\$130 million annually from exports of edible bamboo shoots. About 200 species of bamboo can provide edible and palatable bamboo shoots. **Fresh bamboo shoots are delicious and healthy, with high fibre content. Bamboo vegetables can be found in Chinese grocery stores and restaurants worldwide. After cooking the shoots are still crisp, because cooking does not destroy their texture. Cooked bamboo shoots can be stored in containers and shipped worldwide. In North Eastern Region on Bamboo Shoot units: Luit Vally, Jorhat (Assam), DIMROO Food Industry, Tura (Meghalaya), L Doulo Builders & Suppliers, Dimapur (Nagaland), Nagland Fruits & Vegetables Processing Plant, Dimapur (Nagaland), MAGFRUIT, Imphal (Manipur), AEGIES, Imphal (Manipur).

Construction and Structural Applications

Advances in structural engineering and the development of bamboo composites have opened new vistas for lightweight, durable and aesthetic construction for a variety of applications, enabling informed choices for housing, community and functional structures.

** Bambusa balcooa, Dendrocalaimus B.brandisii, Dendrocalaimus giganteus, Dendrocalaimus hamiltonii, Dendrocalaimus strictus, Melocana bambuisodes, Bamboo Shoots available from the following species are also of good quality - D. tulda, D. hamiltonii, M. Bacifera (Muli).

Bamboo housing: There are three main types of bamboo housing, a) traditional houses, which use bamboo culms as a primary building material; b) traditional bahareque bamboo houses, in which a bamboo frame is plastered with cement or clay; and c) modern prefabricated houses made of bamboo laminated boards, veneers and panels. These buildings are usually cheaper than wooden houses, light, strong and earthquake resistant, unlike brick or cement constructions. New types of prefabricated houses made of engineered bamboo have distinct advantages. They can be packed flat and transported at a reasonable cost. They are better designed and environmentally friendly. Bamboo materials are widely available and can be cultivated at a low cost.

The properties and uses of bamboo vary at different stages of growth and its appropriateness at different stages of growth is as follows:

Up to 30 days - Bamboo shoots to be used as food

Between 6-9 months - for basketry

Between 2-3 years - for laminates and boards

Between 3-6 years - for construction

Bamboo gradually loses strength after the sixth year and up to 12 years.

Bamboo based Industrialization – Prospects and Problems

This natural resource has played a major role in the livelihood of rural people and in rural industry, especially in tropical regions. Over 2.2 billion people the world over are dependent on bamboo and its related industries for income, food, and housing. Although the rural communities have traditionally been using bamboo, the utilisation has been highly localized as bamboo has often been viewed as an inferior substitute of timber. For example, although over 1 billion people in the world live in bamboo houses, yet there has been little effort to build such houses (using pre-fabricated structures or otherwise) commercially. Traditionally, bamboo has been harvested in the natural forest and its use has been limited to temporal constructions and low-quality utensils prone to rapid decay. Consumption or utilisation has therefore been direct and restricted to poorer people with low income and low purchasing power. Market linkage has as a consequence been weak or non-existent in most countries including India.

Yet, bamboo, as noted, has versatile uses as building material, paper pulp resource, scaffolding, agriculture implements, weaving material, plywood and particle board manufacture, basketry, furniture, pickled or stewed bamboo shoots, medicines, etc. Resource management and technical improvements can convert this fast-growing grass into a durable raw material for construction purposes and a wide range of semi-industrialised products.

New industrial applications and modern construction design have both demonstrated bamboo's huge potential in NEA, but the bamboo sector in China is the only one reported to be thriving. The Chinese has been able to successfully industrialize the use of bamboo by integrating the bamboo sector with domestic and international markets. In the last 20 years China has established an integrated chain of bamboo plantations, its semi-processing and industrial product manufacturing such as bamboo flooring, furniture, furnishings, charcoal and fresh bamboo shoots for the domestic and export markets. Its focused intervention to harness bamboo's potential has led to increase in its productivity by more than 10 times since 1970 when it was 2-3 tonnes/ha/annum. The combined value of internal and commercial uses of bamboo in the world is about rupees 50,000 crores annually. This is supposed to double by 2015. More than half of the world's consumption of bamboo is in China. China's export of bamboo products is close to rupees 10,000 crores. As against this, India's size of the domestic bamboo economy is estimated at rupees 2043 crores. The market potential was, however, estimated at rupees 4463 crores, which could grow to rupees 26,000 crores by 2015 (Planning Commission, 2003).

The bamboo sector in most other countries is still a part of the informal and backward rural economy. There has been an inability to grab the large potential, which has been successfully demonstrated by the Chinese bamboo industry. This raises the question of the bottlenecks facing bamboo development. Many of these inhibiting factors are at the policy level and are additional to a lack of knowledge among the important stakeholders and a widespread stigma of bamboo as a poor man's timber. In India it has been no different. Both the law and lack of awareness about its industrial application has been the primary bottleneck inhibiting a bamboo based industrialization process from taking shape. Presently it is underutilized and found in abundance.

The biggest impediment towards a bamboo based sector from developing has been the irregular and scant supply of bamboo for entrepreneurial use. The paper and pulp industry in India, which has been traditionally using bamboo for over half a century, has constantly innovated to reduce the use of bamboo in its manufacturing process due to this uneven and scant supply. And after the consumption of the paper mills (who usually have long term contracts with the forest departments), very little is left for any other application. This pattern is true for all Indian states. The present regulatory regime in India is the unambiguous culprit for this irregular and inadequate supply.

An efficient regulatory institution is essential for markets to grow in a sustainable manner, especially where environment concerns are coupled with business development. Transaction costs must be minimal, information availability maximal with a clear focus on maintaining the forest cover. Unfortunately, the regulatory structure as regards the bamboo industry has remained caught in the quagmire of archaic forest laws, whereby bamboo is defined to be a tree, and therefore felled bamboo is classified as timber. This is subject to transit and trade restrictions.

Bamboo is also subject to harvesting permissions in many parts of the country if grown on private lands and which then becomes the basis for imposing the need for transit permits. This has resulted in throttling of the bamboo sector and has discouraged private plantations. The irregular and scant supply of bamboos for processing, despite the world's largest area under bamboos has been a natural corollary. Clearly the expansion of a bamboo based sector has not happened due to the restrictions in place.

If the restrictions are removed, the sector still might not grow, but can impact livelihood benefits percolating down. This should justify an initial policy initiative through subsidies, incentives and other handholding measures. Economic subsidy can be justified when social benefits outweigh private benefits. So in the bamboo sector the understanding of livelihood benefits is crucial understand.

The economic and social benefits for example, from activities related to bamboo based value added products and applications was worked out to be 8.6 million jobs (new) in the Tenth Plan, besides building up large bamboo resource and market opportunities worth rupees 6,500 crore with an investment of rupees 2,600 crore, enabling 5 million families of artisans and farmers crossing the poverty line, according to the ***National Bamboo Mission. The expansion of handicraft, cottage and tiny sector can potentially create 3 million jobs, according to estimates of the Planning Commission (2003). On the other hand, generation of power through gasifiers using bamboo resources exemplifies assiduous application of technology that can alleviate the present power shortage in most states and thus help improve the overall economy.

There has been a growing awareness in recent years about the importance of bamboo being an important means of economic growth and of improving the socio-economic conditions of the rural poor. Bamboo as an industrial material can substitute wood to a great extent and that too at low cost. Bamboo has been traditionally harvested from forest lands in India and the homesteads which may have a few clumps of one of the many species of bamboo for household use but very little intervention in terms of purposive planting has been done in the past. Convincing and informing users and policymakers of bamboo's versatility may fit in with a strategy of poverty alleviation and reducing pressure on tropical forests. Smallholders at the forest fringe can, in particular, improve their livelihood by processing bamboo or growing it in their backyard.

Bamboo as a resource needs to be seen as a form of development, with the primary value addition done closer to the resource in order to reap the livelihood benefits. At the same time, a large stock of bamboo contributes to broader environmental goals of erosion control, reforestation and watershed management.

***See <http://agricoop.nic.in/bamboo/bamboomission.htm>

In India, bamboo is mostly found in the forests. As per Forest Survey of India (1999) estimates, 9.6 million hectares forest area of the country contains bamboo amounting to 12.8% of the forest cover. India has the largest area under bamboo in the world, which is estimated around 11.36 million hectares. India is also very rich in bamboo diversity. It is the second richest country in the world in terms of genetic resources, after China.**** Sharma (1987) reported 136 species of bamboos, across 22 genera, occurring in India. Out of these, nineteen are indigenous and three are exotic. Naithani (1993) reported 124 indigenous and exotic species, under 23 genera, to be found naturally and/or under cultivation in India.

The distribution is, however, not uniform. The rich areas are confined to the North-Eastern parts of the country. The North-East is the richest source. Fifty-eight species of bamboo belonging to 10 genera are distributed in the North-Eastern States alone. Around two-thirds of the growing stock or 66% of the growing stock of bamboo in India is found in the North- Eastern States, but with just 28% of the total area under bamboo in the country. Madhya Pradesh has the second highest area under bamboo, estimated at 20.3% of the area and with 12% of the growing stock. The details of the bamboo growing areas (in forests) and growing stock of major states is given in Table 1.

Table 1: Major States by Area under Bamboo.

State	Area (percentage)	Growing stock (percentage)
North East Region	28.0%	66%
Assam	7.54%	16.23%
Arunachal Pradesh	4.21%	11.91%
Mizoram	8.45%	13.18%
Manipur	3.39%	13.88%
Meghalaya	2.89%	5.34%
Nagaland	0.70%	4.43%
Tripura	0.86%	1.04%
Madhya Pradesh	20.3%	12%
Others	20.2%	5%

Source: Madhab Jayanta (2003) and the National Horticulture Mission at (http://agricoop.nic.in/AgriMinConf/National_hort_Mission.ppt.)

Clearly from the table above, states like Manipur and Arunachal Pradesh, within the North East and otherwise, have much higher productivity than rest of the states.

****China with 300 species is leading in genetic diversity of bamboo.

Productivity in India

The annual yield of bamboo per hectare varies around 2 tonnes per hectare per annum, depending upon the intensity of stocking and biotic interferences. It is however, known that yield in rain fed areas can be increased 4 to 5 times in five years if protection from grazing is ensured and proper management practices (soil working, fertilisation and thinning) are adopted (Lakshmana, 1994).

The yield per hectare is very low compared to other countries such as Japan, China, Taiwan and Malaysia. As compared to China and Taiwan, India's productivity is one fourth to one fifth. India has a long way to go on scientific cultivation of bamboo. Unfortunately, bamboo has no parent in the governmental set up. Only in the homesteads, farmers take care of bamboo. But the lack of scientific approach to cultivation prevents higher productivity.

With regard to the potential productivity of bamboo from forest areas in India, two observations can be made. Firstly, the present actual productivity is far less than the potential and in either case less than what is noticed in the homesteads. Moreover, even in the homesteads, bamboo cultivation is seldom accorded the attention and silvicultural requirements, which would come in when bamboo plantations are undertaken.

Traditionally the forest department's bamboo harvesting policy systematically maximizes dry bamboo output for paper mills rather than green bamboo output for artisans and mature bamboos (2-4 years old) for the industrial needs (apart from the paper industry). In fact, if bamboo forests are carefully worked and green bamboos/mature bamboos regularly harvested, bamboo output of an average clump would jump. Till date the management of state bamboo resources has many constraints with lack of post harvest treatment and technology for product development, inadequate trained manpower and inadequate infrastructure for large scale harvesting in the event of gregarious flowering.

In India bamboos have been primarily grown in forests, which are government owned land. The exceptions, as noted earlier, were Nagaland and Kerala. Although it is a well established fact that bamboos in India are primarily harvested for supplying to the paper and pulp industry as a raw material, and otherwise used by the rural communities for self consumption, it is very difficult to obtain even rough estimates of the consumption or utilisation pattern. Tiwari (1992) has done the only estimate on consumption pattern and this is given in the Table 2 below. There are two points to note in his consumption pattern outlined. First, the estimates of Tiwari (1992) do not include pre-fabricated houses using bamboo. In the housing sector, bamboo is used in different ways as a building material for roof structure in form of purlins, scaffolding, rafters, reapers, as reinforcement in foundations and in mud walls, flooring, doors/windows, walling, ceiling, water storage tanks, man-hole covers and even for roads in slushy areas. The other point to note is that the estimated percentage used in the paper and pulp industry was 35% in 1992. This fact looks quite circumspect.

In Assam, the overwhelming industrial use for bamboo is still for pulp and paper. The paper mills in the State have a capacity of 800,000 tonnes per annum, met largely from Assam, but to a lesser extent from the neighbouring States. Much of the bamboo utilized in these spheres comes from the forests through a system of contracts, leases and departmental operations. According to a survey report of the State Forest Department of Jharkhand for example, 75% of bamboo is used for pulp and paper, 23% for household and constructional needs, and 2% for bamboo based cottage industries.

Table 2: Consumption Pattern of Bamboos in North Eastern Region and India

Uses	Percentage Consumption
Pulp	35 %
Housing	20 %
Non-residential	5 %
Rural uses	20 %
Fuel (non – industrial)	8.5 %
Packing, including basket	5 %
Wood based Industries and Transport	2.5 %
Furniture	1 %
Others, including ladders, mats etc.	3 %
Total	100 %

Source: Tewari, D.N. (1992)

As noted before, the estimated annual harvest of bamboo in India is 13.47 million tonnes against the current domestic demand of 26.69 million tonnes. Therefore there is already a substantial shortfall in the supply of bamboos in India.

Regulating the bamboo sector

The Central laws pertain to forestland which is the property of the government. In other words, the central laws do not apply to private forests or private plantations. There are three central Acts that govern forest and forest produce. These are the Indian Forest Act 1927, the Forest Conservation Act 1980 and the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006. Before proceeding to understand how these laws affect bamboo plantation, harvesting and transportation, it is imperative to outline the objectives that all these three laws purports to achieve. The Indian Forest Act 1927 is the single most important piece of legislation on forests.

This Act has only minor differences with the 1878 forest Act with the philosophy remaining the same.*****Two fundamental issues can clearly be identified in the Act. The first pertains to the establishment of absolute state property rights over forests. Towards this end, the classification of forests – into reserved forests, protected forests and village forests – and the legal separation of customary rights as well as the procedure for forest settlement in these was an administrative feature characterizing this Act. The second pertained to the control of timber and other forest produce in transit, the duty leviable on them and the collection of drift and stranded timber. The commercial motive and revenue generation remained the guiding principle. Of relevance to this study are the definitional aspects contained in Section 2 and chapter VII of the Act, which contains detailed and wide encompassing provisions empowering the government (more specifically the state governments) in the control of timber and other forest produce in transit by land or by water. The link between Section 2 and chapter VII lies in the fact that whatever got defined as a ‘forest produce’ could be controlled by the state governments through the rules framed by these various state governments in their respective states.

The Forest Conservation Act, 1980, deals with restriction on allotment of ‘forestland’ for nonforest purposes and de-reservation of reserved forests. The Act is a two-page document, consisting of only five sections. The Act clarifies that the term “non-forest purpose” means the breaking up of or clearing of any forest land for the cultivation of tea, coffee, spices, rubber, palms, oil-bearing plants, horticultural crops or medicinal plants, or nay purpose other than reforestation. The Act was a crisis driven response. The objective of enacting this Act was to empower the Central Government in directly managing India’s forests. The Act, is not really a substantive law, it is a delegated legislation, which empowers the Union Minister to make the decisions about how to use the forestlands. Further, this Act only forbids “reserve forests” from being de-notified by the states. The need to promulgate this Act was felt as remote sensing data of the 1970s showed the adverse consequences of large-scale diversion of forestlands to non-forestry purposes (which hit an astounding rate of 150,000 hectares per year prior to the 1980s). Again, after forests were transferred to the concurrent list by the Forty-Second Amendment Act of 1976and the Ministry of Environment and Forests (MoEF) was set up as a nodal central authority in 1980; the Union Government could now directly intervene.

*****The 1927 Act was promulgated to “consolidate the law relating to forests, the transit of forest produce and the duty leviable on timber and other forest produce”. A brief genesis of the Act is in Supplementary Note 1

In particular there is no aspect of the Forest Conservation Act, 1980 that is of relevance to this study. However, the Supreme Court case - T. N. Godavarman Thirumulkpad vs. Union of India and others (Writ Petition No 202 of 1995) – was filed in contravention to this Act and this case has turned out to be a landmark one that has perhaps altered the way bamboo ought to be regulated in future. The other central law is the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, which was notified in the Gazette of India only on January 2, 2007. The rules under this Act are not yet notified. The Act seeks to undo the historical injustice done to forest dwelling communities and vests property rights on forestland in forest dwelling communities thereby addressing their long standing insecurity of tenure and access rights. The Act gives them access to minor forest produce (including rights to sell), and a stake in the preservation of open spaces. The Act provides heritable but non-transferable tenures if they have occupied the lands (up to a maximum of four hectares per family) for three generations from 1930, with December 13, 2005 as the cut-off date. The Act gives the right of jurisdiction of gram sabhas to settle tribal claims. Of relevance to this study is only the definition of bamboo.

There are two kinds of relevance vis-à-vis bamboo that the Central Acts deal with. The first is definitional, which defines bamboo as a forest produce by its origin. The second pertains specifically to the harvest and transit rules applicable to bamboo. The issue of trade regulation is contained in some of the State laws. The issue of harvest of bamboo from private lands or private cultivation is also contained in the State laws. Beginning with the second issue first, that is the harvest and transit in bamboo; it is primarily the provisions of the Indian Forest Act, 1927, that is of relevance.***** Specifically, by Section 26, removal of any forest produce (harvesting of bamboo) is prohibited in reserved forests, except by the forest department (usually in accordance with working plans). In protected forests, (Chapter IV) removal of timber or any other forest produce (including bamboo) is to be done with the written permission of the Forest Officer or in accordance with the rules framed by the State Governments. The rules so framed by the State governments can include among others, granting of licenses to persons felling or removing trees or timber or other forest-produce from such forests for the purposes of trade, and the examination of forest-produce passing out of such forests.

The provisions particularly related to transit are contained in Sections 41 and 42 of Chapters VII.*****Under clause (1) of Section 41, “the control of all timber and other forest-produce in transit by land or water is vested in the State Government, and it may make rules to regulate the transit of all timber and other forest-produce”. The section is fairly detailed in its ambit, and gives the State Governments ample powers including the authority to frame rules for transit, control all river banks (as regards floating timber) and to make rules to prescribe the routes for import, export and other movements of timber or other forest produce from the State or within the State.

*****According to the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, the forest dwellers have the right to “collect, use and dispose of minor forest produce” and which includes bamboo, but there is no explicit mention of trade or transit of either timber or any other forest produce. The word “dispose” is not assumed to mean either trade or transit.

*****Chapter VIII also contains certain related provisions. Chapter VII is titled “of the control of timber and other forest-produce in transit”, while Chapter VIII of the Act deals with the “collection of drift and stranded timber”. There was no particular need to have two different chapters on very similar aspects, and the former chapter was quite sufficient.

Thus the State rules regarding prohibition of such movements without pass, issuing of pass and prescribing fees in respect thereof becomes important and almost all states have laws/rules that guide movement of timber and other forest produce.

As mentioned before, the central laws on forests governed forestlands that were the property of the government. As regards the private forests or private plantations, the state laws, if any, governed the harvesting of bamboo. However, the transit rules applied to bamboo irrespective of its origin as the definition of trees in the Indian Forest Act 1927 makes bamboo a forest produce. Prior to the harvesting or felling of any tree from private lands, a certificate of origin is required from the state forest department, which is issued after due inspection and according to procedures laid out in the State laws that govern private forests for the respective states. Although the procedures vary the methodology follows this pattern. As seen in the following section, bamboo if included under the definition of a tree, and thus if treated as a forest produce even if its harvesting is from private lands would require a certificate of origin, and which would then form the basis of the issuance of the transit permit. So, section 41 and 42 of the Indian Forest Act 1927, and thereby all Rules framed on transit of forest produce by the States, will be applicable to bamboo as long as it is a forest produce.

Conclusion

Despite having fairly detailed estimates on the size and potential of the various market segments of the bamboo based industries or where bamboo is used, and despite they being estimates of a Planning Commission, Govt. of India Document, the appropriateness and reliability of the market potential, along with its availability and method of estimation is circumspect. As a result these estimates, duly quoted, are nevertheless questioned here. The process of consultation with the stakeholders - people associated with the resource use, including government officials and representatives from various bamboo based industry, along with the site visits to get a primary view of the process and the practical difficulties encountered helped us formulate the difficulties encountered.

The most important bottleneck was identified as the regulatory bottleneck, and as long as this was not meaningfully addressed, the sector cannot grow beyond a certain threshold level. In general, there seemed to be a strong promotional role of a governmental organisation, which would help generate

awareness on bamboo products, run a nationalized campaign and help develop product market linkages, apart from handholding the sector in the initial stages. The government initiatives and agencies created for the development of the sector was described and although there seems to be overlapping of jurisdictions, the sector is presently at such a nascent stage of development that there cannot be shortages of initiatives. What perhaps is lacking is a more concerted effort and better planning, and we are of the opinion that either of the National Mission Bamboo Applications, National Bamboo Mission and perhaps the latter, should be converted into a permanent 'Board' for the development of the Bamboo sector in India, in lines of the 'Coffee Board', 'Tea Board' or than 'Rubber Board'. This is especially called for because the report argues for bamboo cultivated in private plantations and it is hoped for that in future bamboo will be treated at par with other plantation crops once the viability of private plantations is demonstrated in different parts of the country.

References:

- Agarbatti Stick Production Under Andhra Pradesh Community Forest Management Project, INBAR-CIBART Documentation Centre, Bangalore, May 2006.
- ASSOCHAM, (2007), "Replace Wood Products With Bamboo's To Help Govt. Save Rs. 7000 Cr. P.A", Mimeo, October 28, 2007.
- Banik, R.L. (1986). Macro-propagation of Bamboos by Pre-rooted and Pre-rhizomed Branch Cutting, *Bano Bigyan Patrika* 13(1/2):67-73.
- Basu, S.K., (1985), "The Present Status of Rattan Palms in India – An Overview", in K.M. Wong and N. Manokaran, (Eds.) "Proceeding of the Rattan Seminar", 77-90, FRI, Kepong, Malaysia.
- Bhatt, K.M, (1992), "Changing Scenario of Rattan Trade in India", in S. Chand Basha and K.M. Bhatt (Eds.) "Rattan Management and Utilisation", Proceedings of the seminar held on 29-31, Jan., 1992 in Trichur, Kerala , pp. 335-339.
- Cane & Bamboo News, Quality bulletin of CBTC, Vol. I. No. 4.
- Champion H.G. and Seth, S.K. (1968). Revised Survey of the Forest Types of India 1-402, Manager, Publications, Delhi.
- Cleuren, H. M., and A. B. Henkemans, (2003), "Development of the bamboo sector in Ecuador: harnessing the potential of *Guadua angustifolia*", *Journal of Bamboo and Rattan*, Volume 2, Number 2 / September, 2003
- CRISIL (2006), "Demand Fundamentals Support Asset Mortgage Quality", *Crisil Insight*, January 2006.
- FAO (1997), "Asia-Pacific Forestry Sector Outlook Study: Country Report – Malaysia", Working Paper No: APFSOS/WP/07. Forestry Department Headquarters, Peninsular Malaysia, Kuala Lumpur, Malaysia and Forestry Policy and Planning Division, Rome. Bangkok, FAO Regional Office for Asia and the Pacific.
- FAO (2006), "Global Forest Resources Assessment 2005: India Country Report on Bamboo Resources", Working Paper No. 118, Forestry Department, FAO, Rome
- Forest Survey of India, (1999), "State of Forest Report 1999", Forest Survey of India, Ministry of Environment and Forests, Dehra Dun.
- Gadgil M., and R. Guha (1992), "This Fissured Land: An Ecological History of India", Oxford University Press, New Delhi.
- Ganapathy, P. M., (1997), "Sources of Non Wood Fibre for Paper, Board and Panels Production: Status, Trends and Prospects for India", Working Paper No: APFSOS/WP/10, Asia-Pacific Forestry Sector Outlook Study Working Paper Series, Asia-Pacific Forestry Commission, Rome.
- Gangopadhyay, P. B., (2003), "Bamboo Resources as a Rural Livelihood Option in Madhya Pradesh, India", Paper submitted to XII World Forestry Congress, Quebec City, March 2003.
- Guha, R., (1990), "An Early Environmental Debate: The Making of the 1878 Act", *IESHR*, 27, pp.65.
- Guha, R., (1991), *The Unquiet Woods: Ecological and Peasant Resistance in the Himalayas*, Oxford University Press, New Delhi.
- ICFRE. (1998). *Timber/Bamboo Trade Bulletin*. March 1998, No. 14. Directorate of Statistics, ICFRE, Dehra Dun. 31 pp.

Kumar, Arun and Cherla B. Sastry, (1999), "The International Network for Bamboo and Rattan", Unasylva, No. 198 on Non-wood Forest Products and Income Generation, FAO Lakshmana, A.C., (1994), "Rattans of South India", Evergreen Publishers, Bangalore.

Madhab, Jayanta, (2003), "The Green Gold: Under Exploited Wealth of the North East India", Dialogue, Volume 5, No. 2, October - December, 2003.

Naithani, H.B., (1993), Contributions to the Taxonomic Studies of Indian Bamboos. Ph.D. Thesis, Vol. I. H.N.B. Garhwal University, Srinagar, Garhwal. National Mission on Bamboo Applications, New Delhi, various documents.

Negi, S.S., (1996), "Bamboos and Canes", Bishen Singh Mahendra Pal Singh, Dehra Dun. Negi, S.S. and Naithani, H.B., (1994), Hand Book of Indian Bamboos, Oriental Enterprises, Dehra Dun.

Pabuayon, I.M. & Espanto, L.H., (1996), "The Philippine rattan sector: A case study of an extensive production system", Bamboo and Rattan Seminar/Workshop, 28 June 1996.

Planning Commission, (2003), "National Mission on Bamboo Technology and Trade Development" Government of India, Delhi

Press Information Bureau, (2004), "The Wonderful Natural Resource", Press Release, March 25, 2004.

Punhani, R.K. and Pruthi, K.S. (1991), "Substitution of Wood in Building some alternative Forest based Materials and their Technology", National Symposium on Substitution of Wood Building (SWOB) Roorkee.

Savur, Manorama, (2003), "And the Bamboo Flowers in the Indian Forests: What did the Pulp and the Paper Industry Do? Vol. I & II", Manohar Publications, Delhi

Shanmughavel, P.; Francis, K. and George, M. (1997), Plantation Bamboo, International Book Distributors, Dehra Dun.

Sharma, S.N., (1988), "Seasoning behaviour and related properties of some Indian species of bamboo", Indian Forester, 114(10): 613- 621.

Singhal, R.M. and Gangopadhyay, P.B., (1999), Bamboo and Its Database in India, ICFRE Publications.

Saxena, N.C., (1997), The Saga of Participatory Management in India, CIFOR Special Publication, Jakarta.

Singh, G., (1995), Environmental Law, Lawman (India) Pvt. Limited, New Delhi.

Singh, K., (1994), Managing Common Pool Resources, Oxford University Press, New Delhi.

Singh, C., (1986), Common Property and Common Poverty: India's Forest Dwellers and the Law, Oxford University Press, New Delhi.

Stebbing, E.P., (1922-27), The Forests of India, Vols. I - IV, John Lane, London. Subramaniam, K.N. (1998). Bamboo Genetic Resources in India. In : K. Vivekanandan, A.N. Rao and V. Ramanatha Rao (Eds.) : Bamboo and Rattan Genetic Resources in Asian Countries, IPGRI-APO, Serdang, Malaysia.

Tewari, D.N. (1992). A Monograph on bamboo. pp 1-498. International Book Distributors, Dehra Dun. Wagh, R. and Rajput, J.C. (1991). Comparative Performance of Bamboo with the Horticultural Crops in Konkan. In : Bamboo in Asia and Pacific. Proc. Ivth Intl. Bamboo Workshop, 27-30 Nov. 1991. Chiangmai, Thailand, FORSPA Publication-6. Canada. IDRC and FORSPA, Bangkok, Thailand, 1994 : 85-86.

Zhong Maogong and Liu Chang, (1999), "Retrospects and Prospects on Development of Bamboo Sector in China", in "Forestry Economy" 1999 No. 3, pp. 51-62.