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Bamboo: A Boon for Rural Livelihood

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ABSTRACT

Bamboo is a member of grass family with woody growth habit. It is having a huge diversity which is distributed throughout the world. Diverse nature and widespread availability of this plant gives rise to its numerous uses. Rapid propagation, high rate of growth, low cost of extraction and low-cost processing make them important for subsistence. Bamboo is quickly changing its image from the “poor man’s tree- to a high-tech, industrial raw material and substitute for wood. Bamboo is also being consumed in many different ways. Inclusion of bamboo would certainly help in restoration of land, protecting forest covers, establishment of rural small scale industries and can check the migration of rural workforce to the urban areas in search of livelihood.

Key words: Bamboo, Sustainable growth, Food source and Economic development

Introduction

During the last century, forests were mainly assessed in terms of the commerce values of timber. Whereas, the other forest components were rarely considered to be of economic importance (Ogunjinmi *et al.*, 2009). During 19th century, vast areas of tropical forests were denuded of timber for exportation and local use leaving behind bamboos and other non-timber forest products (NTFPs). However, in 21st century there has been a growing consensus that NTFPs are not only crucial to ecosystem, but are also invaluable to the sustainable foreign exchange and are being regarded as valuable commodity around the world.

Bamboo is a versatile crop and is an integral part of forestry being one of the major NTFPs in the tropical and sub-tropical forests in Asia and also in some private lands (Ram *et al.*, 2010). It is estimated that around 80 per cent of bamboo forest lies in Asia with India, China and Myanmar having 19.8 million hectares of bamboo. Bamboo is commonly known as

“the poor man’s timber” in China, “the friend of the people” in India and “the brother” in Vietnam (INBAR, 2003).

Bamboo is a long tree like woody grass belonging to family Poaceae and subfamily Bambusoideae. It is an exceptionally diverse plant and unevenly distributed in various part of humid tropical, subtropical and temperate region of the earth where the annual rainfall ranges between 120 to 400 cm and temperature varies between 16 °C to 38 °C (Nirala *et al.*, 2017). Globally, more than 1,250 species encompassing under 75 genera of bamboo are found, which are unevenly distributed in the various part of the humid tropical, sub-tropical and temperate region of the globe (Subramaniam, 1998; Chaomao *et al.*, 2006). However, in India 136 species under 20 genera were recorded (Selvan and Tripathi, 2017).

Bamboo is considered as “Green Gold” of the 21st century as it is available at the much lower price compared to wood and is as strong as strongest wood. Therefore, it provides an alternate source to depleting and costly wood resources. Bamboo is

widely spread outside the forests, including farmlands, riverbanks, roadsides and urban areas. Bamboo being one of the fastest-growing plants on earth, gaining approximately 121 cm in 24 hrs (Adhikari, 2008) has an ability to grow rapidly on marginal and waste lands. Its rapid growth habit, low cost extraction, low-cost processing and multifarious uses make them important for subsistence and income needs of rural communities, especially those with few alternative resources or employment opportunities. Due to its multifarious uses and rapid availability bamboo is quickly changing its image from the "poor man's tree- to a high-tech, industrial raw material and substitute for wood (Souvanpheng *et al.*, 2008). Bamboo has many small but important uses such as manufacturing of fishing rods, flutes, fishing traps, handicrafts, walking sticks, packing cases for tea and fruits, cages for poultry, pipes for water supply and irrigation, cradles, cart yokes, bullock carts, ladders, winnows and sieving for cleaning grains (Das, 2002). Hence, bamboo plays a major role in the growth and development of many countries with over 2.5 billion people globally depending upon it for survival and livelihood (INBAR, 2014). Therefore, this review has been designed to assess the economic benefits of bamboo for the rural communities to supplement their livelihood.

An Overview: Bamboo

Bamboo is a group of perennial grass with large woody stem belonging to the family *Poaceae* and subfamily *Bambusoideae* (Chaowana, 2013). Bamboo is an evergreen monocotyledonous plant which produces primary shoots without later secondary growth. Bamboo plant is a complex system consisting of the distal aerial part called as culm, a proximal ground level part known as culm neck and a subterranean part called the rhizome. Culms consist of nodes and internodes from where culm sheaths and branches rise due to the presence of the meristematic tissues (Kleinhennz and Midmore, 2001). The bamboo consists of two sets of axes, i.e. one above and other below the ground surface and each segment consists of a series of internodal segments defined and demarcated by nodes. The primary above ground axis consists of cylindrical stems known as culms whereas, the secondary axes occur in the form of branches that develop laterally and extend outward from the culms. The cluster of culms of a sympodial bamboo is known as clumps. Culm sheaths, are modified form of leaves that

plays the similar function of photosynthesis, are the sheathing organs that are attached to the nodes. When the sheath is old, it is usually separated from the node leaving behind the scar. Culm sheaths are more or less distinctive in their appearance, size, texture and shape in different bamboo species and their blade is considered as a good character for distinguishing the species.

Generally, all the parts of bamboo play an important role in propagation. New bamboo shoots are produced during every rainy season from rhizome buds which attain their full height and diameter in about 3 months in a fully developed rhizome-root system, which occurs in 3 to 7 years after seeding or establishment by seed. They are mature and become ready for utilization after 2 to 3 years of planting. Most bamboo plants flower infrequently, often irregularly or may flower only once in their lifetime (14 to 50 years) and deflowered soon after (Kassahun, 2002). Bamboos are normally wind-pollinated and the flowers are structured accordingly, with feathery stigmas. The flowers do not bear petals but they may have small scale like laps at the base. The size of bamboo fruit varies from that of a grain to that of a small guava. The fruit is indehiscent, one-seeded structure known as caryopsis. Many authors such as Janzen (1976), Tewari (1992), Das and Das (2005) have used the term monocarpy in relation to bamboo flowering. Monocarpy means that the plants bear fruits only once during their life span and then die.

The underground axis is a solid rhizome system consisting of roots and buds which expands laterally under the soil surface. The shape, length and relative morphology changes with the type of bamboo i.e., clump forming (sympodial) and non-clump forming (running or monopodial). Generally, roots grow from the nodes of the rhizome and underground portion of the culm, however, in some species roots may also appear on the above ground portions of culms and branches. However, the root spreading depends upon the porosity and bulk density of the soil.

Species distribution

Sharma (1980), Soderstrom and Ellis (1987) and Upreti and Sundriyal (2002) estimated approximately 1250 species of bamboos under 75 genera spread all over the world, however, Ohrnberger and Georrings (1985) reported 110 genera and 1010 to 1400 species. Tropical Asia is among the most im-

portant part of the world for major center of bamboo diversity which ranges from 45 genera and 750 species (Bishwas, 1988). India being the rich source of genetic diversity of bamboo having 125 species spread over 23 genera (natural and planted) covers an area of around 11.4 million ha distributed over 28 states and union territories which constitute around 16.7 per cent of the total forest area of the country (FAO, 2005). Whereas, Bakshi (2010) estimated 136 indigenous and exotic bamboo species belonging to 22 genera growing naturally or under cultivation in the country. According to Naithani (2010), a total of 20 genera and 115 species of bamboos are present in India. However, according to the assessment of Sharma and Nirmala (2015) a total of about 148 species and 4 varieties in 29 genera grow in India (both wild and cultivated).

India is regarded as the 2nd richest country after China in terms of bamboo genetic resources. The major Indian bamboo growing areas are distributed towards the evergreen and semi-evergreen forests in South, the tropical deciduous forest in North, the dry deciduous forest of central and eastern state and the moist deciduous and semi-evergreen regions of North-east India (Kumar, 1988; Seethalaaxmi *et al.*, 1988; and Thomas, 1988). Bamboo occupies 13 per cent of the total area of the country (Varmah and Bahadur 1980), growing right from the coastal plains and ascending to elevations of 3700 meters in the Himalayas (Mehra and Sharma 1975).

In India, bamboos grow naturally in almost all states except in Kashmir region of Jammu and Kashmir. It is reported that 70 percent species of bamboos in India are reported from the eight Sister States of North-east India and the Western Ghats, which happen to be the two biodiversity hot-spots. The principal bamboo species in these forests are the shrubby bamboos belonging to the genera *Chimonobambusa*, *Drepanostachyum*, *Phyllostachys*, *Thamnocalamus* and *Yushania*. Although bamboo grows naturally in every state, but its frequency varies in different regions, primarily due to variations in climatic conditions. The state-wise distribution of bamboos in India is not completely available for all the states. However, the states rich in bamboo species include: Meghalaya (46-50), Arunachal Pradesh (47), Manipur (40 + 1 var.), Assam (38 + 2var.), Mizoram (33), Sikkim (29-30), West Bengal (32), Nagaland (32), Kerala (22+2var.), Andaman (22+2var.), Tripura (19+1var.), Bihar (19), Odisha (12+1var.), Jharkhand (10+1var.), Karnataka (10), Chhattisgarh

(9), Himachal Pradesh (8), Madhya Pradesh (8), Maharashtra (7+1 var.). The states with the least number of species are: Punjab (4), Jammu and Kashmir (2, only in Jammu area), Rajasthan (2), Gujarat (2), Haryana (2), and Goa (2) (Sharma and Nirmala, 2015).

Uses of bamboo

Bamboo grows three times faster than any *Eucalyptus* spp. besides releasing 35 per cent more oxygen than other forest plants and yield six times more cellulose than fast growing trees. It is estimated that one bamboo can hold 6 m² of soil and one hectare of bamboo forest can absorb 12 tonnes of CO₂ from air and store 1000 tonnes of water. Hence, bamboo provides great benefits to the natural environment and also solves many environmental problems (Nirala *et al.*, 2017). Bamboo has lot of beneficial impact for alleviating many of the social and environmental problems. It has worked as natural protection for environmental restoration and in the production of household handicrafts, arte facts and furniture (Quintans, 1998). Bamboo products like bamboo-ply, floorings, roofing sheet and many other have been key wood substitutes of bamboo in construction and fencing industry world-wide. Moreover, it is also used as food, medicine, charcoal, beverages, natural pesticides and toiletries.

Bamboo is also called the wonder plant of 21st century having multiple uses (Kalaiarasi *et al.*, 2014). Bamboo have been traditionally used in building construction from times immemorial i.e. in foundation, wall partitions, ceiling, doors and windows, roofs and for reinforcement of cement concrete. In addition, bamboo have specific characteristic for environmental emulation such as soil erosion control, soil conservation, soil stabilizer, check dams, bamboo barrier in pond, river banks and slips, water conservation, land rehabilitation and carbon sequestration (Swamy, 2011). The strength of the bamboo culms, their straightness, smoothness, lightness combined with hardness and greater or less hollowness, the facility and regularity with which they can be split; the different size, various length and thickness of the joints make them suitable for numerous purpose which other material would require much labour and preparation (Shrestha, 2008).

Bamboo for economic prosperity

As the demand of wood has been increasing over the time along with increase in the world popula-

tion, there is a sudden rise in pressure on our global resources. As a result, to keep the pace with growth of population and their rising demands and other conventional materials accompanied by rising cost make it imperative to increase the use of bamboo (Li and Mikio, 2004). Bamboo has traditionally been used for a variety of purposes. Due to its rapid growth and sustainability, it has received renewed attention worldwide (Vengala and Lindt, 2013).

Traditionally, bamboo has been used to hold up scaffolding, simple suspension bridges, supplemental or decorative element in buildings. It also serves as a superior material for utensils, weapons, fuel, fodder, food, firewood, furniture, mats, chopsticks, toothpicks, handicrafts, musical instruments etc. (Ghosh, 2008). Recent improvements and processing technologies allow bamboo to be utilized for high end products such as decking, flooring, panels and veneers and structural beams. In modern uses, bamboos are being converted into engineered products such as bamboo mat board, laminated bamboo board, ply bamboo, bamboo curtain board etc. (Bansal and Zoolagud, 2002). It has also been reported that the laminated based panels are superior than wood based panels in almost all performance indexes. In fact, it has been proved valuable from top to rhizomes (Yang and Du, 2010). Throughout the tropical and sub-tropical regions of the world, bamboo, has a long and well established tradition for being used due to its high tensile strength and very good weight to strength ratio. Its tensile strength is around 28,000 lb per sq. inch. as compared to 23,000 for steel (mild) (Swamy, 2011) which supports its application as a resilient material against forces created by earthquakes and high velocity winds.

In sum, bamboo's excellent growth, environmental, mechanical, engineering properties and potential for different value added products and application make it extremely important reliable source for generating greener economy and man power followed by sustainable development.

Bamboo as food source

The bamboo shoots are the new gentle growth of the stem apex into a young culm consisting of compressed internodes sheltered by a number of leathery sheaths. These shoots are usually harvested when they attain an approximate height of 15-16 cm and after eliminating the fibrous sheaths the inner tender portion or meat is thoroughly washed in water and

then cut into pieces. The pieces are usually eaten as vegetable components in curry or soup by mixing with fish or meat and also as pickle. Shoots of both running (monopodial) and clump forming (sympodial) bamboos are utilized as food (McClure, 1996). The value of bamboo shoot as food is based not only on its total fresh weight, but also on the edible portion, which amounts to about 27% (Tripathi, 1998).

According to Vatsala (2003), in India, shoots of *Bambusabambos*, *B. multiplex*, *B. tulda*, *B. vulgaris*, *D. giganteus*, *D. hamiltonii*, *D. longispathus*, *D. strictus* and *Sinobambusaelegans* are used as vegetables and pickle products. Bamboo shoots are used as a good source of dietary fiber, low in fat and calories for human being. Bamboo shoots contain high protein but less fat, moderate dietary fiber, having essential amino acids, selenium, potassium, a potent antioxidant and minerals for healthy heart (Bal *et al.*, 2012).

Several researchers have analyzed the nutritive values of bamboo shoots (Bhargava *et al.* (1996); Bhatt *et al.* (2003); Bhatt *et al.* (2005); Chen *et al.* (1999); Giri and Janmejey (1992); Kumbhare and Bhargava (2007); Nirmala *et al.* (2007); Nirmala *et al.* (2008); Qiu *et al.* (1999); Satya *et al.* (2009b); Sharma *et al.* (2004); Shi and Yang (1992) and Tripathi (1998)).

Bamboo shoot contains about 88.8% water, more than 3.9% protein and 17 amino acids. Amino acid content of bamboo shoot is much higher than found in other vegetables such as cabbage, carrot, onion and pumpkin. Eight kinds of amino acids that are not synthesized in human body have to be supplied from food items and surprisingly almost all of these are available in bamboo shoots. Bamboo shoot contains 17 different types of enzymes and over 10 mineral elements such as Cr, Zn, Mn, Fe, Mg, Ni, Co, Cu etc. In view of these essential characteristics (low in fat, rich in vitamins, special amino acids, minerals, dietary fibre etc.), bamboo shoot is considered an ideal vegetable for healthy diet (RFRI, 2008).

Bamboo based agroforestry system

Bamboo based agroforestry system has a potential to increase the forest areas and supports short term sustainable development for both rural and urban people as a regular source of income from seasonal harvest of bamboo. Under agroforestry based system having different intercrops, multiple products can be easily obtained even during the early stages of plantations and the income generated is much higher than any other system (mono and multi crop-

ping). The cultivation of soyabean (*Glycine max*) along with *Dendrocalamus strictus* is technically feasible and is economically viable (Seshagiri, 1985). The scope for bamboo in agroforestry in India is very wide because of the uncertain weather conditions and the increasing cost of labour involved in raising agricultural crops on marginal lands rendered the latter option less attractive (Balaji, 1991).

Employment generation

Bamboo has an incredible capacity to provide regular employment and income to large number of people especially suited to women providing flexible working hours. Indian bamboo sector has a potential to generate 48-60 million work days (WDs) during harvesting and 60-72 million WDs for loading, unloading, handling etc. annually. INBAR (2000) has estimated 10 to 25 work days for unskilled labours per hectare for soil working, maintenance of clumps and thinning operation. Similarly, Tiwari (1992) estimated that one hectare of bamboo plantation having 500 clumps can generate 3.9 mandays of employment for unskilled labour and 47.3 mandays for supervisors annually for a period of 30 years. Bakshi (2010) revealed that bamboo sector in India has a potential to generate 43.2 million man days of employment annually and the total demand of bamboo is estimated to be around 26.6 million tons/year, whereas the average supply is 13.7 million tons/year.

About 2.5 billion people in the world depend economically on bamboo and International trade in bamboo amounts to about US \$2.5 million. It is assumed that about 300 companies are engaged around the world in production of various bamboo based products (Xuhe, 2003). Wang *et al.* (1996) have evaluated more than 100 bamboo species growing commercially and that have potential to provide excellent means of income generation in primary and secondary processing with little capital investment. Hence, bamboo plays an important role in biomass production besides playing an important role towards the growth of local and world economies.

Conclusion

Bamboo is a versatile crop and is an integral part of forestry being one of the major NTFPs in the tropical and sub-tropical forests throughout the world. It is an exceptionally diverse plant and unevenly distrib-

uted in various part of humid tropical, subtropical and temperate region of the earth with wide variation in annual rainfall and temperature varies between 16°C to 38°C. Its ease of propagation, rapid growth rate, low cost extraction, low-cost processing and multifarious uses make them important for subsistence. Due to its different uses and rapid availability bamboo is quickly changing its image from the "poor man's tree- to a high-tech, industrial raw material and substitute for wood. Bamboo is also being consumed as vegetable and as pickle. In conclusion, it can be said that inclusion of bamboo in rural livelihood would not only save the depleting forests but would also give boost to various locally sustainable industries and can really tap the potential of rural workforce without the need of migration.

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