# Bamboo Productivity in Forest and Non – Forest Areas A review of bamboo based agroforestry models developed in different parts of India, productivity and marketing aspects

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# A review of bamboo based agroforestry models developed in different parts of India, productivity and marketing aspects

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## Preamble

Bamboo as a traded commodity has excellent potential to contribute to inclusive development, foreign trade balance as well as in building resilience in the context of climate change. As the domestic bamboo production area and the productivity have been on the decline, alternate strategies for augmentation of domestic bamboo production have been contemplated in the domain. The paper reviews the potential roles of agroforestry in enhancing domestic bamboo production and discusses about the productivity of different bamboo incorporated agroforestry models along with potentials for trade in the domestic as well as in international markets.

*Key Words: Bamboo production, agroforestry models, marketing.*

## Introduction

Bamboo represents a community of woody perennial grass that occur in the tropical and subtropical evergreen and deciduous forest formations of Asia-Pacific. The major consumers of bamboo resources include paper and pulp industry, fuel, food, feed, house construction and scaffolding sectors, producers of several articles of domestic applications, besides its role a significant provider of a host of ecosystem services. India, China and Myanmar have 19.8 million hectares of bamboo reserves which represent 80 % of the world's bamboo forests. India represents the global bamboo growing landscape with 136 species, 23 genera spreading over 13.96 million ha; which makes it, the second largest bamboo growing country in the world (FSI, 2011). But ironically India's share in global bamboo trade and commerce is only 4 % though it possesses 45 % of global bamboo growth. As per the policy statements, the Government of India would like to see its bamboo industry, concentrated in the northeast of the country, to hold 27 % of the world market by 2015; when the international bamboo trade is expected to touch $ 950 billion. However the recent developments in the sector with greater application of technology such as development of strand-woven bamboo lumber opened up new markets that were traditionally the exclusive preserve of timber wood (Banik, 1997).

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As per the reports, there has been a wide gap in the demand and supply scenario so far as the bamboo based resources are concerned. The total demand for bamboo products has been estimated at 26.9 million tonnes against a supply scenario of 13.47 million tonnes (Salam, 2013). The state wise distribution of bamboo in India is given at figure 1.

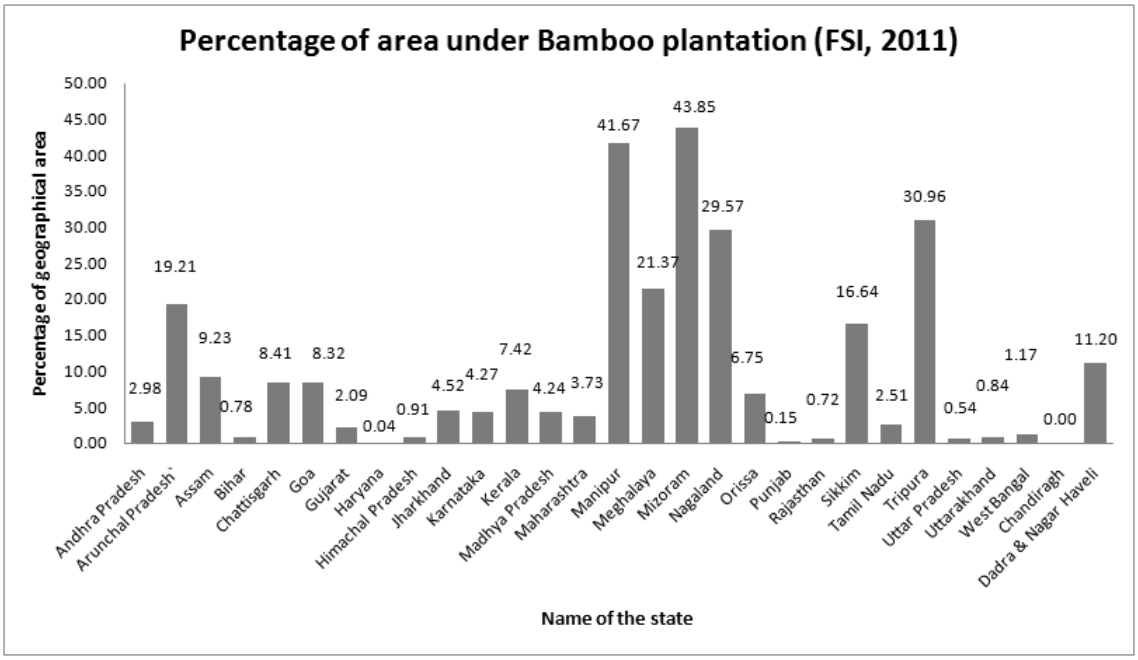


Figure 1. The state wise distribution of bamboo resources in India (Source: FSI, 2011)

Though there exists significant diversity in bamboo species and bamboo growing ecosystems across the states, the reports suggest that both bamboo production as well as area under production in the country has been on the decline due to various issues such as over exploitation by industries, forest fires, grazing, shifting cultivation, species displacement, gregarious flowering etc (NBM, 2007). The prevailing negative trend in the bamboo production has been promoting raw material substitution by the paper and pulping industries, displacement of employment opportunities in the cottage industries as well as loss of foreign exchange in importing the material to meet the domestic industrial requirements.

However, current market demand and supply gap accentuates the actions for active promotion of the cultivation of bamboo outside the conventional or natural growth areas by involving promising agroforestry models which incorporate bamboo as a potential integral forestry crop component.

## 2. Bamboo Integrated Agroforestry Models from India

Agroforestry offers opportunities for landowners to develop portfolios of short and long term investments that allow offsetting financial risks through diversification. While crop diversification

gives financial advantages, it also introduces the need for additional management expertise to deal with the added complexity. The term agroforestry denotes practices ranging from simple forms of shifting cultivation to complex hedgerow inter cropping systems; systems including varying densities of tree stands ranging from widely-scattered *Faidherbia (Acacia) albida* trees in Sahelian millet fields, to the high-density multi storied home gardens of the humid tropics (WAC, 2013).

Table 1: Different Agroforestry models with Bamboo as a forestry component as reported in the Indian Context (Source: Nath *et al*., 2009)

| **Sl.No.** | **Geographic Region / State** | **Models reported in the Indian Context** | **Source** |
|---|---|---|---|
| 1. | Tamil Nadu, Southern Region | Soybean (*Glycine max*) + Bamboo (*D. strictus*) as inter crop | Seshadri (1985) |
| 2. | Kallipatty, Tamil Nadu, Southern Region | Pigeon pea, Soybean & Turmeric + Bamboo *Sp.* | Shanmughavel and Francis, (2001 & 2002) |
| 3. | Konkan, Karnataka, Southern Region | mango, cashew nut, jack fruit, kokum rubber + Bamboo *Sp.* | Wagh and Rajput, 1991 |
| 4. | Degraded agricultural lands, Coorg, Karnataka, Southern Region | ginger + Bamboo *Sp.* | Viswanath, Dhanya, and Rathore, 2007 |
| 5. | Southern Region | Rice, tobacco, Chillies, Sugarcane+ Bamboo *Sp.* | Dwivedi, 1994 |
| 6. | Central Region | wheat, rice, maize, jowar, bajra, pulses, oil seeds etc+ Bamboos of different species | Dwivedi, 1994 |
| 7. | Degraded agricultural lands , Jabalpur, M.P. Central India | Soybean (*Glycine max),* Niger *(Guizotia abyssinica),* Moong *(Phaseolus aureus),* Wheat *(Triticum aestivum),* Urad *(Phaseolus mungo),* Pegion pea *(Cajanas cajan)* and | Behari, 2001 |

| | | | |
|---|---|---|---|
| | | Mustard *(Brassica campestris*)+ Bamboo *Sp.* | |
| 8. | Ghaziabad, UP, Northern region | Vermicompost Earthworm with *D. asper* | Anon, 2006 |
| 9. | North East India | Ginger + Bamboo *Sp.* | Jha & Lalnunmawia, 2004 |
| 10. | North East Region | Paddy (Oryza Sativa)+ Bamboo (*D. hamiltonii*) | Dwivedi, 1994 |
| 11. | Apatanis of North East Region | Bamboo cum pine Home Gardens | Tanjang and Arunachalam, 2009 |

The bamboo development policy announced by the National Bank for Agriculture and Rural Development clearly identifies bamboo based agroforestry models in the scheme of financing models developed by it for promotion of the bamboo sector with an integrated approach. The strategy focuses on the launching interventions and developing business opportunities in the untapped domain of waste land development with suitable agroforestry or farm forestry interventions. The different agroforestry models with bamboo as a potential forestry component that have been reported in the Indian context are abstracted in the Table 1 given below;

Thus it could be seen that, there have been evidences of development of performing agroforestry models incorporating bamboo as a tree component across different parts of the country. These models could potentially address the issues of inclusive development, rural food security as well as building up the required resilience in the landscape based production systems in the context of the climate change. The different aspects related to the productivity of such models are discussed here below.

## 3. Productivity of bamboo integrated agroforestry systems

As per the reports, the annual incremental biomass production on air-dry basis for a bamboo plantation can range from 10 to 40 tonnes $ha^{-1}$ depending on the species, planting density, soil, and climate, including slope and aspect of a hill. In India, bamboo plantations are normally raised at spacing of 6 X 6 m to meet the increasing demand for bamboo products. There have been reports of the attempts to cultivate agricultural crops in bamboo plantations. The inter cropping of agricultural crops (pigeon pea, soybean, turmeric and ginger) in established bamboo plantations was tested in one of the experiments. The growth, yield and land equivalent ratio (LER) of the agroforestry systems were determined (the land equivalent ratio (LER) which is a convenient method for measuring biological productivity is defined as the land area in a mono cropping system that would be required to produce the same yield as one ha of intercropping). The study results indicate that the LER was 1.2 in the bamboo/ pigeon pea and bamboo/ soybean models, but 1.1 in the bamboo/ turmeric and bamboo/ ginger models. This means that the productivity of one hectare under intercropping is equivalent to that of 1.2 ha or 1.1 ha under monoculture (Shanmughavel and Francis, 2001).

Similar investigations aimed at assessing systematically planted bamboo crop with that of traditional horticultural crops like, mango, cashew nut, jackfruit and kokum (*Curcinia indica*) along with newly introduced crop like rubber in terms of economic products and monetary returns; also resulted in bamboo recording the highest cumulative yield at a density of 418 plants $ha^{-1}$ and ranked first in terms of income per hectare followed by cashew nut (120 plants $ha^{-1}$) and mango (90 plants $ha^{-1}$) during-early growth period (up to 10 years)(Wagh and Rajput, 1991). An economic analysis of bamboo based agroforestry system revealed that the tulsi-wheat combination, irrespective of the bamboo displayed maximum return followed by the aloe vera. Maximum total net return (Rs. 3, 05,540-Rs. 4,86,419 $y^{-1}$) was displayed by tulsi-wheat cropping system under the *Dendrocalamus asper*. The returns were found quite higher in agricultural crop than bamboo species (Bhardwaj, 2007).

The studies done in the mixed home gardens of Kerala, shows that bamboo (*Bambusa bambos*) holds the second position in terms of profitability (Benefit-Cost ratio-BCR) among the crop groups. The high BCR ratio of bamboo was due to negligible inputs and high farm price (Krishnankutty, 2004). Behari (2001) developed successful seven agroforestry models with three bamboos (*B. bamboos, B. nutans* and *D. strictus*). The inter crops tried were: Soybean, Niger, Moong, Wheat, Urad, Pigeon and Mustard. These models were developed to restore the degraded agricultural lands in central India. The studies carried out in the abandoned paddy fields in Coorg, Karnataka planting bamboo (*D. brandisii*) at 6m x 6m spacing, intercropped with ginger showed the highest NPV (net present value) and LEV (Land expectation value). This may be attributed to low input costs associated with bamboo farming and higher market value of the produce over a longer period (Viswanath and Rathore, 2007). These land use systems are characterized by three basic attributes such as Productivity, Sustainability and Adaptability and thus addressing the adaptive requirements of the systems on the face of climate change impacts as well as to provide inclusiveness in the economic and social development of the stakeholders in the context of sustainable development.

The studies in the domain indicate the positive synergies of the bamboo component in the agroforestry models. However, more documentation and analysis will help to improve the domain to develop it as a highly adopted farm production-business model.

**Marketing prospects**

As per the reports, the world market potential for the bamboo products is expected to reach $ 20 billion by 2015. Though Indian landscape represents 45 % of the global bamboo growth, the current market share enjoyed by the Indian bamboo products is to a meager extent of 4.5 % of the global market share. However, the National Mission on Bamboo Technology and Trade Development targets to capture 25 % of the world market by 2015. The National Bamboo Development Policy also envisages comprehensive development of bamboo resources as a marketable commodity with linkage of bamboo farmers with bamboo artisans (NABARD, 2013). As per the estimates of the Planning Commission of India, the market potential for value added bamboo products has been estimated at Rs.4463 crores against the current market size of Rs. 2403 crores (Planning Commission, 2013) with 8.6 million people in India depend upon bamboo resources for their livelihoods. However, reports suggest that, the bamboo value chain in India is suffering from different challenges at different levels of the value chain. The major constraints reported include legal issues, over exploitation, poor regeneration, low productivity, variety management and

biodiversity conservation, lack of market information, base line data deficiencies, labour availability, capital intensive production process, fragmented nature of the industry, undeveloped markets poor quality perceptions and low level of awareness etc. Owing to these constraints, the scenario of bamboo utilization in India is by and large confined to the cottage industries; micro home based enterprises such as handicrafts, and the traditional bamboo consuming paper and pulp industries (Baksy, 2013). It has also been projected that emerging bamboo markets such as wood substitutes, flooring, panels, and new generation furniture underscore potential growth opportunities for bamboo. The other business aspects such as market accessibility, cost effectiveness, economies of scale, etc. also are reported to affect the market attractiveness of the bamboo industry. However accessibility (a combined result of different factors such as price/performance competitiveness, trade conditions, standards and regulations and buyer attitudes) is a major market indicator of the penetrability of the bamboo products in the global market (Ggreenflip, 2013). Nevertheless, with the growing market access, institutional and financial arrangements in place in the national scenario, the market prospects could be expected to provide more buoyancy to the industry by involving different production business models in the ecosystem.

## Conclusions and suggestions

As could be observed from the above review and discussion, bamboo resources position themselves as potential market entities so far as the domestic as well as international trade scenarios are concerned. The bamboo products and marketing have multiple roles to play in the inclusive economic development of the country, especially in the context of the rural populace which dependent heavily on the bamboo resources for their livelihood. The value chain analysis of the bamboo products and consumption also implies that bamboo resources have strong industrial stakes and tremendous potential in pro-poor impact in the development strategies and programmes. The integrated approaches for enhancing bamboo production through multiple strategies including positioning of agroforestry in the production context is expected bridge the demand supply gap in domestic market as well as to promote inclusive development in the context of climate change with multiplayer impacts on employment generation and food security. Though agroforestry based bamboo production models help to bridge the supply gap in the bamboo trade and market to certain extent , there need to be further solid strides taken in the areas of market development, integration, value chain management, skill development, insurance etc in the production and utilization domains..

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