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Bamboo plantation: a step forward in doubling farmer's income in eastern India

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ABSTRACT

Bamboos are the fast growing, durable and versatile natural resources which can be substituted against timber. Bamboo plantations not only can rehabilitate wastelands/ non-arable/ degraded lands but also can play a vital role in improving livelihood and nutritional security of rural people and thereby rural industry too. The direct and indirect benefits from the adoption of location specific bamboo based agroforestry systems or the technologies will lead towards economic prosperity and ecological security of the nation.

Introduction

India is known to be rich in diversity of natural resources. Among all, plants are the major source on which the most of the other living organism depend for their food, energy and shelter. Due to overwhelming population pressure and high demands of the valued resources, farmers get confused about the right selection of the species. On the verge of which, only the species gets valued and selected by the farmers primarily based on their immediate needs either of direct one or of indirect of the measured goods of having high market values and economic returns. The improper selection of species and its management lead to deterioration of the economic yield and greatly affect the trend of productivity per unit area. Many studies reported that, location specific bamboo based agroforestry systems can play vital role in restoration of degraded ecosystem (Pande *et al.,* 2012; Basumatary *et al.,* 2015). But in the contrary, farmers are not willing to expand any area under bamboos just because of higher rate of underground competition with the intercropped crops (Betser, 2000), and the low price of stem or the produces, despite of being having high demand of it's product (Brian, 1998). Now, taking an example of eastern India (comprising the states *viz.*, Bihar, Eastern Uttar Pradesh, Jharkhand, Odisha, Chattisgarh, West Bengal and Asom), where, of the total geographical area, 6.16 m ha, *i.e.*, 8.58% is under wastelands. Among various states, Jharkhand has the highest area under wastelands (14.84%), followed by Asom (11.20%) and Odisha (10.69%) and constitutes widespread poverty in the state (World Bank, 2007). Restoration of such wastelands/degraded lands is need of the hour in Eastern region, keeping in view average size of land holdings for agricultural productions. Eco-restoration of those lands through woody tree plantation is very difficult but instead, bamboo plantation can be another option to manage such lands with less care and manpower and that tolerates extreme precipitation from 30 to 250 inches of annual rainfall (Baksy, 2013). Moreover, economic harvesting from bamboo plantation starts within four to five years (Solanki *et al.,* 2004) when compared to any timber species whose minimum average gestation period is

even more than 10 years. Thus, bamboo plantations not only can easily rehabilitate those degraded lands but also can play a vital role in improving livelihood and nutritional security of rural people.

Bamboo plantations and it's role in economy

Different successful technologies being developed so far by many scientists or the researchers, which then needs to be included, adopted, multiplied and extended in many other parts of the country. These established technologies can easily be adopted for those areas where other woody plantation failed to generate any gains in terms of rehabilitation and monetary (Table 1). Two major types of traditional bamboo plantations are being followed in India.

A. Monocropping system: Bamboos are planted as a single crop for the purpose of obtaining multiple benefits. It can be planted either in the form of block or in line planting or at the boundaries.

B. Bamboo based agroforestry systems: Bamboos are being intercropped with other crops for maximum utilization of land resources, high revenue generation and for sustainability. Many literatures revealed that bamboo based agroforestry systems are more profitable and economically viable than monocropping system. Below mentioned are few need based, purposefully adopted technologies being followed in many areas.

1. Boundary plantation: Bamboo is sometime planted in the boundary of agricultural land (Chaturvedi and Das, 2007) or any other field boundaries. Farmers can earn extra income out of the plantation after selling of the culms or the edible shoots.

2. Block plantation (with intercropping): Solanki *et al.* (2004) reported that a 5 year old block plantation of *Dendrocalamus strictus* having spacing of 5 m X 5 m will generate a minimum B/C ratio of 2.065 at a discount rate of 10 % and reported continuous higher yield and high B/C ration from the next subsequent year. A study conducted by Chandramouli *et al.* (2016) on plantation of *Dendrocalamus asper* (5 years old) for shoot production and reported that shoot production may be a profitable venture for farmers which may generates average minimum B:C ratio of 6.21 at 10% discount rates.

Bamboo based AFS are also prominent in the state of Jharkhand (Sinha, 2009). It was also reported that bamboo based agroforestry models can improve ecological parameters of a highly degraded basaltic tract of Jabalpur (Behari *et al*, 2000). Nath *et al.* (2008) and Banerjee *et al.* (2009) reported wider distance between two bamboo plants which will result into better utilization of sunlight, space, moisture and nutrients by the intercrops with minimum competition among them and between agricultural crops. Raising of shade tolerant crops like turmeric, ginger, pineapple, cinnamon, shade tolerant variety of sweet potatos, *etc.* within a stand of adult bamboo clumps is technically feasible and economically viable (Banik, 1997). In some states like Madhya Pradesh, bamboos (*B. bambos, B. nutans* and *D. strictus*) were successfully intercropped with either maize or soya bean and in Sikkim, species like *D. hamiltonii* and *D. sikkimensis* were successfully grown along the irrigation channels and stream banks of agricultural fields for fodder purpose (Banik *et al,* 2008).

Various bamboo based agroforestry systems of India are (Bhardwaj and Chand, 2007):

a) Bamboo + crops (soybean, pigeon pea, ginger, turmeric, *etc.*)
b) Bamboo + crops + fish ponds
c) Bamboo + edible fungi (mushroom species like *Dictyphora sp., Pleurotus ostreatus, etc.*)
d) Bamboo + chicken + fish pond + earthworm rearing
e) Bamboo + medicinal plants

3. Windbreaks and Shelterbelts: Bamboos can be planted as windbreaks and shelterbelts on the boundaries of agricultural fields/ orchards for protecting them for high wind speed. In North Bengal, particularly in Coochbehar, Dinajpur, Haldibari, Mayanaguri and Jalpaiguri areas, the clums of *Bambusa balcooa, B.nutans* and *B. bambos* have been found to grow in one to two rows along the north western sides of boundaries of paddy field to protect them from dry and cold winds blowing from Nepal and Bihar (Banik *et al.,* 2008). Similarly, bamboos can also be planted for the purpose of protecting alley crops against frost and other incidences.

4. Bamboos in Homegarden/ homesteads: Need based harvesting of culms is generally done for selling at the rate of Rs. 40 – 100 per plant and the selling price gets varied accordingly based on species type. A study conducted on Carbon storage and sequestration in bamboo-based smallholder homegardens of Barak Valley, Assam by Nath and Das (2011) reported occurrence of bamboos (*viz., Bambusa cacharensis, Bambusa vulgaris and Bambusa balcooa*) in all homesteads coupled with progressive increase in culm density over the years reflects its potential for carbon (C) storage which was ranged from 6.51 (2004) to 8.95 (2007) Mg ha^{-1} with 87%, 9% and 4% of the total C stored in culm, branch and leaf respectively. This kind of studies revealed an indirect role of plantations and its effect on economy of the nation.

5. Other systems:

An economic analysis was carried out by Pande *et al.* (2012) using data from three major ravine systems, *viz*. Mahi, Chambal and Yamuna to examine economic viability of plantation under different soil conditions and recommended bamboo plantation for productive and protective utilization of degraded lands. Their analysis had suggested a cash outflow ranging from Rs. 30550 ha^{-1} to Rs. 48000 ha^{-1} from the 7^{th} year onwards to individual stakeholders in the region with the recommended harvest practice of harvesting one-third old culms per clump of the species *Dendrocalamus strictus* over the life of plantation, which generates an average minimum B/C ratio of 1.83 with 18.60 % Internal rate of return (IRR). Similar technology was also reported by Singh *et al.* (2015) for rehabilitation of Yamuna ravines which can be cost-effective practices to conserve natural resources.

Table 1: Comparative economic benefits of bamboo plantations in India

SI. No.	Agroforestry systems (Technologies)	Species	Plantation age (years)	Result/conclusion	Minimum B:C ratio	Reference
1.	Boundary plantation	Bamboo spp.	For long run	As a boundary and for protection from outside intrusion	*	Chaturvedi and Das, 2007
2.	Block plantation (e.g. for shoot production for tropical humid)	*Dendrocalamus asper*	5 and above	Shoot production may be a profitable venture in humid tropics	6.21 at 10% discount rates	Chandramouli *et al.,* 2016
	Block plantation (for culm	*D. strictus*	5	Culm production may	2.065 at	Solanki *et al.,*

	production)			be a profitable venture	10% discount rates	2004
3.	Windbreaks and Shelterbelts	*Bambusa balcooa, B.nutans* and *B. bambos*	For long run	Protection of paddy field from dry and cold wind	*	Banik *et al.,* 2008
4.	Bamboos in Homegarden/ homesteads (in Barak Valley, Assam)	*Bambusa cacharensis, B. vulgaris* and *B.balcooa*	2 and above	Increase in culm density over the years reflects its potential for carbon storage	*	Nath and Das, 2011
5.	Other systems (productive and protective utilization of degraded lands/ravine systems)	*Dendrocalamus strictus*	7 and above	Recommended bamboo plantation	1.83	Pande *et al.,* 2012

***** Extra income from culms and edible shoots

Conclusion

Bamboo, also known as poor man's timber, is such a versatile resource whose importance and uses had made this unique and had become acceptable alternatives of timbers in the rural folklore. The double or more than double income out of this resource can only be possible based on farmers perceptions and knowledge on selecting the suitable location specific bamboo based agroforestry system or technology, it's adoption, implementation and management.

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Two years old high density bamboo plantation	Eight years old bamboo plantation+intercrops