Bamboo plantation diversity and its economic role in North Bihar, India

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Abstract: To understand the cultivation potential of bamboo in Araria district, North Bihar a study was carried out in ten villages in 2002-03. Seven species of bamboo were cultivated in the farmer's fields. *Bambusa bambos* (Ban Bans) was dominated being cultivated in nine villages followed by *Bambusa nutan* (eight villages) *Bambusa tulda* (six villages), *Bambusa balcooa* (three villagers) whereas *Dendrocalamus giganteus*, *Melocanna baccifera* and *Bambusa strictus* were planted by one village each. The productivity of *Dendrocalamus giganteus* per year per clump was maximum (55) followed by *Bambusa strictus* (18 clums / clump/ year). *Bambusa bambos* (Ban Bans) (15 clums/clump/year), *Bambusa balcooa* (13 clums/clump/year). *Bambusa nutan* (12clums/clump/year) respectively. Undergrowth study was also carried out and it was observed that the under story sheltered many medicinal plants viz, *Tinospora cordifolia*, *Eclipta alba*, *Centella asiatica* etc. It is evident that *Dendrocalamus giganteus* is dominating in productivity whereas this species is planted by only one village. This species need motivation to adopt by every villager for mass cultivation and to use bamboo under story to cultivate medicinal and other economical plants to boost their economy.
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Key words: Bamboo cultivation, village, clump, productivity, under growth

1. Introduction

Bamboo is woody grass belonging to the sub family Bambusoideae of the family Poaceae. Bamboo is fast growing species and therefore, known as **"Green Gold"**. This green gold is sufficiently cheap and plentiful to meet the vast needs of human populace from the "*child cradle to the dead man's bier*" that is why some times known as "*poor man's timber*." World wide there are more than 1,250 species under 75 genera of bamboo, which are unevenly distributed in the various part of the humid tropical, sub tropical and temperate region of the earth (Subramaniam, 1998). India is very rich in bamboo diversity. There are 124 indigenous and exotic species under 23 genera, found naturally and or under cultivation (Naithani, 1993). An estimated 8.6 million ha forest area of the country contains bamboo (Rai and Chauhan, 1998) Bamboo generally forms the understory in the natural forests. It is found to grown practically in the tropical sub-tropical and temperate region where the annual rainfall ranges between 1,200 mm to 4,000 mm and the temperature varies between 16^{o}C and 38^{o}C. The most suitable conditions for the occurrence of bamboo are found between 770-1,080 meter above sea level. However, two thirds of the growing stock of bamboo in the country is available in the north-eastern states with supports about 50% of the total genetic resources of bamboo being tropical moist region. The people of Asia, Africa and South America are dependent on it for their house construction and agricultural implement. It is mostly used in paper industries, domestic commodities in cottage industries. Bamboo shoots are also eaten as vegetable mostly in South-East and East Asian countries. Bamboo plantations conserve soil and water, improve soil fertility and local climate, Liese (1992) pointed out that 2.5 billion people depend on or use bamboo materials valued of US$ 7 billion per annum. India is one of the leading countries of the world, second to China in bamboo production with 32, 30,000 tonnes per year (Pathak, 1989). Climatically bamboo prefers regions of high rainfall ranging from about 1270 mm to about 6350 mm or even more. Rainfall plays a very important and dominating role in the distribution and growth of different species. Araria district of North Bihar receives high rainfall with recurring flood by Koshi river and fall under tropical moist deciduous region (Champion and Seth, 1968) and therefore suitable for bamboo cultivation. Farmers of the Araria district are cultivating bamboo in their homesteads and agriculture lands for their day to day domestic requirements vis-à-vis as cash crop. To understand the cultivation potential of bamboos in North Bihar, Araria district was selected as a case

study to carry out in ten villages of five households each in winter of 2002-03.

Araria district of Bihar state is located in north and lies at Lat. 26°52' and' north and Long 87°52' east at 47m. altitude. Total geographical area of the district is 2,830 sq. km. with 21, 58, 608 population as per 2001 census. The climate is tropical monsoonal with distinct wet (April to October) and dry (November to March). Average rainfall was 1411.5mm.which shows highest rainfall of Bihar state. July to September are wettest month in the district Temprature is highest in May when it reaches upto 45.5 c0 and lowest in January when it is 8.8 c0.

2. Material and Methods

Ten villages located in different locations of Araria district were randomly selected. Five house holds from each villages were surveyed. Mostly bamboos are cultivated in the homestead and farms in line and block plantations. Areas of the each species were measured. Growth parameters, i.e. height DBH and number of old more than one year and new of one year old culms in each clump were recoded for determination of productivity (Table-1) Local price of each of the bamboo were also surveyed by questioning farmers. Superior propgules were marked with + sign. Information regarding expenditure production and harvesting per hectare have been gathered (Table-2&3). Profit from one hectare bamboo cultivation calculated by subtracting expenditure amount from income amount by sale (Table- 4). Several quadrats of 1x1 m were laid out under bamboo block plantations to understand undergrowth structure and its frequency, density and abundance Mishra (1968), (Table-5). Procedure, economics value of each species presented in Table-6.

Table1.Distribution growth parameter, productivity and local price of village cultivated bamboos of Araria district (North Bihar)

S.No	Name of Species	Local Name	No. of village cultivating	Total area of occurance (ha)	Av. Height (m)	Av. DBH (cm)	Total No. of clump	Total No. of old clum	Total No. of new clum	Productivity (culm clump^{-1} yr^{-1})	Local Price (culm^{-1}) Rs.
1.	*Bambusa bambos*	Ban Bans	9	1.078	22-26	4-5	270	10181	3934	15	40-50
2.	*Bambusa nutan*	Makala	8	0.803	19-23	5-6	114	5445	1356	12	60-70
3.	*Bambusa tulda*	Jawa	6	0.780	15-20	4-7	151	5274	1465	10	40-45
4.	*Bambusa balcooa*	Harnaut / bhalku	3	0.344	30-35	8-10	79	2744	998	13	70-90
5.	*Dendrocalamus giganteus*	Assami	1	0.0082	40-45	9-20	1	245	55	55	120-150
6.	*Bambusa strictus*	Baijnatni Lathi	1	0.003	2-3	3-4	3	96	53	18	5-10
7.	*Melocana baccifera*	Muli / mulu	1	0.0005	5-6	4-8	1	2	6	6	-

Table 2. Expenditure ha^{-1} on Cultivation of bamboo

SlNo.	Particulars of work	Mandays	Rate	Amount in Rs
1.	Preparation of land	70	70.00	4900.00
2.	Pit digging(400nos)	25	70.00	1750.00
3.	Cost of chemical & fartilizers			3000.00
4.	Cost of Rhizom	400	30.00	12000.00
5.	Planting	20	70.00	1400.00
6.	Maintanance 1st year	360	70.00	25200.00
7.	Maintanance 2nd Year	360	70.00	25200.00
TOTAL				**73450.00**

3. Results and discussion

Seven bamboo species (Table-1) are being cultivated by Araria villages whereas rearly 60 species are cultivated in India (Anon,1988) Bambusa bambos locally known as Ban Bans is cultivated by nine village out of ten village followed by Bambusa nutan (8 village), Bambusa tulda (6 village), Bambusa balcooa (3 village) Dendrocalamus giganteus Bambusa strictus and Melocana baccifera (1 village each). Bambusa bambos are represented by five species whereas rest species are represented by only single species. Bambusa bambos (Ban Bans) was activated in1.078 ha land in nine villages out of ten village followed by Bambusa nutan (0.803 ha.) and Bambusa tulda (0.780ha.) Bambusa balcooa (0.3865 ha). Rest species are cultivated in small area. Clums of all bamboo species complete their growth within 2 to 3 months after the emergence of sprouts from the ground but their diameter and height do not increase after the growth is over (Mc Clure,1966; Banik1980; Ueda, 1981; Shanmughavel, 1995).Maximum DBH (9-20cm) was observed in Dendrocalamus giganteus followed by Bambusa balcooa (8-10 cm) and Bambusa nutan (5-6cm) whereas maximum height was observed in Dendrocalamus giganteus (40-45m) followed by Bambusa balcooa (30-35m) and Bambusa nutan (19-23 m). Total number of clumps and clums were more in case of Bambusa bambos (Ban Bans) followed by Bambusa tulda Bambusa nutan being cultivated by 9-6 and 8 villages respectively. Maximum annual productivity of clums per clump per year was 55 in case of Dendrocalamus giganteus followed by Bambusa strictus (18 clums/clump/year) and Bambusa bambos (15 clums/clump/year). Maximum local price was Rs120-150 per clum in case of Dendrocalamus giganteus followed by Bambusa balcooa (Rs 70-90 per clum) and Bambusa nutan (Rs.60-70 per clum). Least price (Rs.5-5 per clum) was in case of Bambusa strictus being very thin and small bamboo. Expenditure incurred in one ha bamboo cultivation (Table-2) earning amount from sale of bamboo per ha (Table3) and profit on bamboo cultivation per ha (Table4) show that net income was 46,550.00 per ha per year. Balaji (1990) reported that bamboo grown in Seerkazhi of Thanjavur District at 7mx7m espacement at the initial cost Rs.2000-acre can yield from 100-150 clumps upto Rs.20, 000/- per acre once in two years from 7th year onwards. In India the shoots of Bambusa arundinacia, Bambusa glancescens, Bambusa tulda, Bambusa vulgaris, Dendrocalamus giganteus, D. hamiltonii, D. longispathus and Sinobambusa elegans. (Anon, 1988) are picked and also used as vegetable. During survey no any villages were found to pickled Bambusa tulda and Bambusa giganteus which are cultivated in the district. Out of ten major species of bamboo used in India for commercial purposes four species viz Bambusa balcooa, Bambusa nutan, Bambusa tulda, Bambusa giganteus and Melocanna baccifera are cultivated by district Araria villages. (Table-1) Consumption pattern of bamboo (Tewari, 1992) in India is given in Table-5, As per survey rural uses of bamboo was within all India range. During bamboos survey it was found that mostly bamboos are cultivated in block in the farmlands. It was observed that several medicinal plants were growing as undergrowth under bamboo plantation. To assess the ecological status of undergrowth species and its value several quadrats of 1x1 m size were laid out randomly and the result is presented in Table-6 reveals that maximum frequency (75%) was in case of Oplismenus burmanii followed by Clerodendrum viscosum (60.71%).Maximum density per m2 was in case of Oplismenus burmanii (26.57) followed by Imperata cylindrica (20.14). Five trees viz. Albizia lebbeck, Litsaea polyaltha, Murraya koenigii and Streblus asper were distributed as undergrowth under bamboos block plantation. The result reveal that out of 36 species as undergrowth 17 species were medicinal of which 6 species are important medicinal plants in trade viz.Centella asiatica, Eclipta alba ,Tinospora cordifolia ,Piper longum and Syzygium cumini, 6 species were medicinal and fodder, 8 species were fodder one species used as betel and two species used in medicine and spice. . It is evident from the result that several commercially important medicinal plants can be cultivated under bamboos plantation to boost the economy of the bamboos cultivators of the Araria district farmers.

During survey it was found that farmers propagate bamboos by planting offset. This is the easiest and commonest method. One year old clums are cut through with a slanting cut about 90-120 cm from the ground and the rhizomes are dug out along with the intact roots and cut off to a length which is sufficient to include a well developed bud. These offsets are planted out at several spacing 5x5 m, 7x7 m, or as per available space. Sufficiently deep to cover the first 2-3 nodes. The planting out of offsets are done only after pre-monsoon showers. The earth above the ground is well rammed around the offsets to prevent water logging. The top of the clums are cut and sealed with earth or cow dung to prevent rotting or evaporation. Weeding is done during the first season. This method is also mentioned in several literatures (Anon., 1988 and Sanmughavel, et al, 1997). Several plus candidate clums were selected and offset propagation was done in the experimental plots to distribute the clums raised among the farmers.

Table 3. Production and harvesting from one ha. Bamboo plantation

Year	Total No. of clums appear	No of clums ready for harvest & sale	Rate	Amount (Rs.)
1st year	400	nil	nil	nil
2nd Year	1200	nil	nil	nil
3rd year after planting	3600	2400	Rs.50.00	1,20,000.00
4th year	7200	4800	Rs.50.00	2,40,000.00

Table 4. Expenditure & profit on bamboo cultivation from one ha plantation

Sl no	Particulars	Amount (Rs.)
1	Expenditure on cultivation till 2nd year	73450.00
2	Income in 3rd year	120000.00
	Net income	**46550.00**

Table- 5 Consumption pattern of bamboo in India

Uses	Percentage Consumption (%)
Pulp	35.0
Housing	20.0
Non-residential	5.0
Rural uses	20.0
Fuel	8.5
Packing including basket	5.0
Transport	1.5
Furniture	1.0
Other wood working industries	1.0
Other including fodders, mats, etc.	3.0

Source: Tewari, 1992

Table 6. Phytosociological attributes of undergrowth under bamboos plantation in Araria district of North Bihar

S.No	Species	Frequency (%)	Density Per (m^2)	Abundance	Uses
1.	*Randia longispina*	39.28	0.53	1.36	Medicinal
2.	*Centella asiatica*	28.57	1.21	4.25	Medicinal
3.	*Smilax prolifera*	14.28	0.50	3.50	Medicinal & Fodder
4.	*Desmodium gangeticum*	42.86	2.03	4.75	Medicinal & Fodder
5.	*Achyranthus aspera*	28.57	1.61	5.62	Medicinal & Fodder
6.	*Paspalum sanguinale*	7.14	1.86	26.00	Fodder
7.	*Cynodon dactylon*	3.57	0.68	19.00	Fodder & Medicinal
8.	*Imperata cylindrica*	17.86	20.14	112.8	Fodder
9.	*Rungia himalensis*	21.43	1.14	5.59	Fodder
10.	*Sida cordata*	10.71	0.18	1.67	Medicinal & Fodder
11.	*Cyperus brevifolius*	14.28	5.43	38.00	Medicinal & Fodder
12.	*Streblus asper*	21.43	0.36	1.67	Medicinal
13.	*Oplismemus burminnii*	75	26.57	35.40	Fodder
14.	*Eclipta alba*	25	0.68	2.71	Medicinal
15.	*Oxalis indica*	17.86	1.82	10.13	Fodder
16.	*Mallotus philippinensis*	39.20	0.82	2.07	Medicinal
17.	*Piper longum*	35.71	0.82	2.30	Medicinal & Fodder
18.	*Clerodendrum viscosum*	60.71	2.82	46.4	Medicinal
19.	*Tinospora cordifolia*	7.14	0.11	1.50	Medicinal
20.	*Lythrus* species	3.57	0.07	2.00	Fodder
21.	*Pouzoilzia hirta*	3.57	0.07	2.00	Medicinal

22.	*Urena lobata*	17.86	0.28	4.00	Medicinal
23.	*Ichnocarpus frutescens*	42.86	1.78	4.12	Medicinal
24.	*Albizia lebbeck*	3.57	0.03	1.00	Fodder
25.	*Dioscorea deltoides*	3.57	0.03	1.00	Medicinal
26.	*Murraya koenigii*	14.28	0.28	1.75	Medicinal & Fodder
27.	*Fern*	21.43	1.95	9.00	Medicinal & Fodder
28.	*Piper hamiltonii*	7.14	0.08	4.00	Medicinal & use as Paan
29.	*Ageratum conyzoides*	10.71	2.82	26.33	Medicinal
30.	*Coffea benghalensis*	3.57	0.43	12.00	Medicinal
31.	*Sonchus asper*	7.24	0.48	6.00	Medicinal
32.	*Solanum nigrum*	10.71	16.07	150.00	Medicinal
33.	*Rumex nepalensis*	3.57	0.03	1.00	Medicinal
34.	*Syzygium cumini*	3.57	0.03	1.00	Medicinal
35.	*Commelina benghalensis*	3.57	0.03	1.00	Fodder
36.	*Litsaea polyantha*	25.00	0.36	1.43	Medicinal

4. Conclusions

It is evident that Dendrocalamus giganteus is most productive and commercial bamboo but is being cultivated by one farmer of only one village from Araria district. This species need motivation to adopt by every villager for mass cultivation It is suggested that genetically superior clums with high productie value should be cultivated as mass multiplication by farmers and they can also use the bamboo under story land for cultivation of medicinal or other economical plants to boost their economy.

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