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Economics of bamboo cultivation: A case study of Uttarakhand

M. S.Gusain[1], S. T. S. Lepcha[2], C.J. Singh[3] and Munesh Kumar[4]
[1]*State Medicinal Plants Board, Uttarakhand, Dehradun*
[2]*Department of Forests, Govt. of Uttarakhand, Dehradun*
[3]*Ministry of Environment and Forests, New Delhi*
[4]*H.N.B. Garhwal University Srinagar (Garhwal), Uttarakhand*

Abstract: An area of 0.139 million hectares is covered by bamboo forests in the State of Uttarakhand, India. The demand for bamboo is increasing at the State level as a raw material for the paper and pulp mills. The Uttarakhand Bamboo and Fiber Development Board (UBFDB) is also taking up plantations of bamboo both at forest and non-forest areas. There is lack of information regarding the actual cost involved in the plantation or cultivation of bamboo. The study consisted of assessing the cost benefit of bamboo plantation in the State along with finding out problems in this sector. Of the two kinds of bamboo plantations, in the commercial method, the cost of raising bamboo farm is Rs. 27,350/ha. In the conventional method, there is not much input cost involved. Overall commercial cultivation of bamboo is viable option in the State. Bamboo cultivation can be an excellent way of livelihood for poor. In hills, bamboo could be grown along the boundaries of agriculture fields, stream banks, waste lands *etc*. There is good scope for bamboo cultivation in the State of Uttarakhand. Commercial cultivation of bamboo will not only meet industrial raw material demand but also alleviate poverty. Plantation of bamboo in the form of windbreaks or along bunds is also a viable option.

INTRODUCTION

India is one of the leading countries of the world, second only to China in bamboo production with 3,23,000,00 tonnes per year. There are about 125 indigenous and exotic bamboos falling under 23 genera in an area of 10.03 million hectares. This constitutes 12.80 per cent of total forest area of forest cover in India. About 66 per cent of the growing bamboo is in North Eastern states and remaining 34 per cent in the rest of the country (Bensal and Nath, 2002). The annual bamboo production in the world is estimated to be more than 20 million tonnes, while corresponding figure for India is 4.6 million tones (Tiwari, 1992; Oberoi and Lepcha, 2004).

The diverse geographical nature of Uttarakhand allows seven species of bamboo to grow naturally including *Dendrocalamus strictus* (lathi bans) and *Arundinaria* spp.

* To whom correspondence should be addressed; E-mail.gusainmfri@gmail.com

(Ringal), which are found in 1,39,000 ha of reserve forests besides *Bambusa nutans* (Chay bans) and *D. hamiltonii somdevi* (Kanko bans) which are found mainly in homesteads. In Uttarakhand, *D. strictus* is the main species growing in the forest. *B. bambos* occurs to a very limited extent naturally in Haldwani Forest Division, West Tarai, Central Tarai and East Tarai Forest Divisions. Other species cultivated in homsteads area are: *B. nutans* and *D.hamiltonii*. Bamboo is also extensively found in sub Himalayan, *Tarai* and *Bhabar* tracts of Uttarakhand. An area of 0.139 million hectares is covered by bamboo forests in the State at present.

Bamboo plays an important role in several major economic sectors, such as housing, pulp and paper, textile, wood products, agriculture, fisheries and sericulture. Also the production of bamboo is labour intensive, resulting in job creation. It has been estimated that 1 ha of intensive labour plantation with 500 culms generate 384 workdays. The demand for bamboo is increasing in the State as a raw material for paper and pulp mills too. The State has got many paper mills located in the Tarai regions like, Century Paper Mill at Lalkuan, J K Paper Mill at Rudrapur, which have demand for bamboo as a raw material. The production of bamboo in the State was of the tune 54,480 tonnes in the year 2000-01 (Anonymous, 2003).

There has been a growing interest in the cultivation of bamboos and the demand for good quality bamboo has gone up due to its recent commercial and industrial uses. At the national level, National Mission on Bamboo Application and National Bamboo Mission are generating awareness on this regard (Gupta, 2008). At the State level, Bamboo Development Agencies of respective States are making their effort. In the State of Uttarakhand, the Uttaranchal Bamboo and Fiber Development Board (UBFDB) is responsible for coordinating various activities related to the cultivation, conservation, research and industrial application of bamboo (Anonymous, 2005). The National Bamboo Mission envisages covering over 1.7 lakh hectares in bamboo plantation.

Bamboo can play an important role in uplifting the livelihood of the people in the State. It can also meet the raw material demand for various wood-based industries within the State and outside too. There is a lack of information regarding the actual cost involved in the plantation or cultivation of bamboo. There has been very meager studies done on this regard. Such type of study should give a foresight of cost involved and future benefits to a interested cultivator. A study was carried out in four districts of the newly formed State of Uttarakhand with the objective of finding out the economics of bamboo cultivation. The study also highlights problems accustomed in this sector.

MATERIAL AND METHODS

The study consisted of assessing the cost-benefit of bamboo plantations in the State alongwith finding problems in this sector and potential bamboo areas. Four districts

surveyed for this work, were Dehradun, Pauri Garhwal, Nainital and Udham Singh Nagar. Survey was conducted by randomly selecting clusters having bamboo plantations in non-forest land. Farmers in each district were surveyed with a well structured question schedule. It included question relating to cost of land preparation, maintenance, felling and transportation. The revenue obtained by the grower was also ascertained. Averages of the rate was taken to find overall cost-benefit of plantation. Physical verification was also done of these plantation.

RESULTS AND DISCUSSION

While carrying out the survey in the State, two kinds of bamboo cultivation were encountered. The first type can also be called as commercial cultivation, its prominent features were a large area under plantation, facility of irrigation, and cultivators having sound economic background. This kind of bamboo plantation had a commercial outlook. Such plantations mainly occur in areas having level land *viz.*, Ramnagar in Nainital, Udham Singh Nagar and Dehradun. The second type of cultivation (conventional) is carried out by people having small pieces of land and not having a sound economic background. Such type of plantations are found in the districts of Pauri Garhwal and Dehradun. Under such plantations the cultivator had raised few clumps of bamboo along the boundary of his agriculture fields or in some wasteland, along the boundary of small *nullah etc*. They were maintaining the bamboo clump by felling few culms each year for their household use or for selling at local market.

Tables 1 and 2 show the cost of different inputs required for cultivation of bamboo in commercial and conventional methods. In the commercial method the cost of raising bamboo plantation is Rs. 27,350/ha. This is due to high input cost born by the commercial farmer, like quality planting material, use of manure, fertilizer and pesticides, use of tractors for land preparation and protection costs. The cost for commercial farmer decreases significantly in subsequent years as there is only need of irrigation, fertilizer and protection. The additional harvesting and transportation cost is incurred when the crop becomes mature *i.e.* after fourth year of planting. On an average, per clump yield increases in proportion of 5:7:10 culms in subsequent years. At 10 culms per clump, stabilization occurs in sixth year of planting. The returns fetched per culms on site is about Rs. 40.

In the conventional method of bamboo farming, there is not much input cost involved. Cost is only incurred in field preparation and purchase of planting material. The cultivator does not carry out maintenance operation after planting. Some cost is incurred in mulching operation. The harvesting cost per culm in the conventional plantation mostly in hills is very high, nearly twice than that in the plain areas. And most of the time the cultivator has to sell his crop to contractors fetching low price when compared to prevailing market prices. The return they fetch is between Rs. 20-25 per culm at plantation site.

Table 1. Unit cost of bamboo cultivation of commercial model
Species: *Dendeocalamus asper,* spacing: 5x5m, total plants: 400/ha

S.No	Items	Units	I year	II year	III year	IV year	V year	VI year onwards
A	Material							
1	Planting material including 10% casualty replacement @ Rs. 15/Plant		6600	-	-	-	-	-
2	Fertilizer	LS	1200	1200	1200	1200	1200	1200
3	Manure	LS	2400	2400	2400	2400	2400	2400
4	Plant protection	@ Rs. 10/ plant	4000	2000	2000	2000	2000	2000
5	Irrigation thrice a year	@ Rs.800	2400	2400	2400	2400	2400	2400
	Sub Total		16,600	8,000	8,000	8,000	8,000	8,000
B	Labour							
1	Land preparation	LS	4000	-	-	-	-	-
2	Digging pits	@ Rs. 5/ Pit	2000	-	-	-	-	-
3	Planting and filling pits	@ Rs. 5/ Pit	2000	-	-	-	-	-
4	Transportation of planting material	@ Rs. 2.5/ Plant	1000	-	-	-	-	-
5	Weeding only Ist year	LS	1000	-	-	-	-	-
6	Mulching	@Rs.1.25/ Plant	500	500	500	500	500	500
7	Pesticides and insecticides	LS	250	250	250	250	250	250
8	Harvesting cost	@ Rs. 5/ culm	-	-	-	10000	14000	20000
9	Transportation and marketing	@ Rs.7.5/ culm	-	-	-	15000	21000	30000
	Sub Total		10,750	750	750	25,750	35,750	50,750
	Grand Total		27,350	8,750	8,750	33,750	43,750	58,750

The comparison of net benefits shows that commercial and conventional crop is fetching Rs. 8,12,116ha and Rs. 3,11,852/ha respectively at 6 per cent discount rate for 30 years. The benefit cost ratio is also high for commercial plantation *i.e.*, 2.23 whereas in case of conventional cultivation it is 1.46. The internal rate of return is 60.61 per cent for commercial plantation and 80.30 per cent for conventional plantation (Tables 3 and 4). It is high in the case of conventional cultivation as there is very low cost involved in this. Overall commercial cultivation of bamboo is viable option in the State. The initial cost of plantation can be shared with the grants, subsidies and loans given in the government sponsored schemes. The plantation once established could fetch good returns in future. In hills, clusters of bamboo can be developed as land availability is less and people are also not economically sound.

Table 2. Unit cost of bamboo cultivation of conventional model
Species: *Bambusa nutans*, spacing: 5x5m, total plants: 400/ha

S.No	Items	Units	I year	II year	III year	IV year	V year	VI year onwards
A	Material							
1	Planting material including 10% casualty replacement @ Rs. 5/Plant		2600	-	-	-	-	-
2	Fertilizer	-	-	-	-	-	-	-
3	Manure	-	-	-	-	-	-	-
4	Plant protection	-	-	-	-	-	-	-
5	Irrigation thrice a year	-	-	-	-	-	-	-
	Sub Total		2,600	0	0	0	0	0
B	Labour							
1	Land preparation	LS	1000	-	-	-	-	-
2	Digging pits	@ Rs. 2.5/ Pit	1000	-	-	-	-	-
3	Planting and filling pits	@ Rs. 2.5/ Pit	1000	-	-	-	-	-
4	Transportation of planting material	@ Rs. 2.5/ Plant	1000	-	-	-	-	-
5	Weeding only Ist year	LS	-	-	-	-	-	-
6	Mulching	@Rs.1.25/ Plant	500	500	500	500	500	500
7	Pesticides and insecticides	-	-	-	-	-	-	-
8	Harvesting cost	@ Rs. 10/ culm	-	-	-	12000	20000	32000
9	Transportation and marketing	@ Rs. 10/ culm	-	-	-	12000	20000	32000
	Sub Total		4,500	500	500	27,500	40,500	6,45,00
	Grand Total		6,700	500	500	27,500	40,500	6,45,00

Problems accustomed by bamboo sector in the State

In the newly formed State of Uttarakhand, people have been using bamboo and its products in a subsistence way in the past. They have never thought of increasing their production in such a way so that they can link themselves to markets. The commercial outlook is missing in this sector. That is why one will not find large-scale plantation of bamboo in the State. People are growing few clumps for their own use. Bamboo cultivation can be an excellent way of livelihood for poor. Some of the problems faced by this sector include:

Table 3. Financial analysis of commercial cultivation of bamboo in one hectare

Year	Cost in Rupees	Discount at percent 6	9	12	Benefits in Rs.	Discount at percent 6	9	12
1	27350	25801.89	25091.74	24419.64	0	0	0	0
2	8750	7787.47	7364.70	6975.45	0	0	0	0
3	8750	7346.67	6756.61	6228.08	0	0	0	0
4	33750	26733.16	23909.35	21448.74	66250	52476.21	46933.17	42103.07
5	43750	32692.55	28434.50	24824.92	96250	71923.60	62555.90	54614.83
6	58750	41416.43	35030.71	29764.58	141250	99575.68	84222.76	71561.65
7	58750	39072.11	32138.26	26575.52	141250	93939.32	77268.59	63894.33
8	58750	36860.48	29484.64	23728.14	141250	88622.00	70888.61	57048.51
9	58750	34774.03	27050.13	21185.84	141250	83605.66	65035.42	50936.17
10	58750	32805.69	24816.63	18915.93	141250	78873.26	59665.53	45478.72
11	58750	30948.77	22767.55	16889.22	141250	74408.74	54739.02	40606.00
12	58750	29196.95	20887.67	15079.66	141250	70196.92	50219.28	36255.36
13	58750	27544.29	19163.00	13463.98	141250	66223.51	46072.73	32370.85
14	58750	25985.18	17580.73	12021.41	141250	62475.01	42268.56	28902.55
15	58750	24514.32	16129.11	10733.41	141250	58938.69	38778.50	25805.85
16	58750	23126.72	14797.35	9583.40	141250	55602.54	35576.60	23040.93
17	58750	21817.66	13575.55	8556.61	141250	52455.22	32639.09	20572.26
18	58750	20582.70	12454.63	7639.83	141250	49486.06	29944.12	18368.09
19	58750	19417.64	11426.27	6821.27	141250	46684.96	27471.67	16400.08
20	58750	18318.53	10482.81	6090.42	141250	44042.42	25203.36	14642.93
21	58750	17281.63	9617.26	5437.88	141250	41549.45	23122.35	13074.05
22	58750	16303.42	8823.18	4855.25	141250	39197.59	21213.17	11673.25
23	58750	15380.59	8094.66	4335.04	141250	36978.86	19461.62	10422.55
24	58750	14509.99	7426.29	3870.57	141250	34885.72	17854.70	9305.85
25	58750	13688.67	6813.11	3455.87	141250	32911.06	16380.46	8308.79
26	58750	12913.84	6250.56	3085.60	141250	31048.17	15027.94	7418.56
27	58750	12182.87	5734.46	2755.00	141250	29290.72	13787.10	6623.72
28	58750	11493.27	5260.97	2459.82	141250	27632.76	12648.72	5914.03
29	58750	10842.71	4826.58	2196.27	141250	26068.64	11604.33	5280.39
30	58750	10228.97	4428.05	1960.95	141250	24593.06	10646.17	4714.63
	Total	661569.19	466617.06	345358.28	Total	1473685.82	1011229.46	725338.00
					NPV	812116.63	5444612.40	379979.72
					B : C	2.23	2.17	2.10
					IRR	60.61%		

lack of good quality planting material; lack of funds; lack of knowledge about government's initiative; unorganized marketing; existing growers are prospering because of their individual efforts; there has been no inventorisation of growing stockpotential on private land; lack of information on site specific suitability of species; ignorance of economics of cultivation/plantation; high transportation cost.

Table 4. Financial analysis of conventional cultivation of bamboo in one hectare

Year	Cost in Rupees	Discount at percent 6	9	12	Benefits in Rs.	Discount at percent 6	9	12
1	6700	6320.76	6146.79	5982.14	0	0.00	0.00	0.00
2	500	445.00	420.84	398.60	0	0.00	0.00	0.00
3	500	419.81	386.09	355.89	0	0.00	0.00	0.00
4	24500	19406.29	17356.42	15570.20	35500	28119.33	25149.09	22560.89
5	40500	30263.96	26322.22	22980.78	59500	44461.86	38670.92	33761.89
6	64500	45469.95	38459.25	32677.71	95500	67323.73	56943.53	48383.27
7	64500	42896.19	35283.71	29176.53	95500	63512.96	52241.77	43199.35
8	64500	40468.10	32370.37	26050.47	95500	59917.88	47928.23	38570.85
9	64500	38177.45	29697.59	23259.35	95500	56526.30	43970.85	34438.26
10	64500	36016.46	27245.49	20767.28	95500	53326.70	40340.23	30748.44
11	64500	33977.80	24995.86	18542.21	95500	50308.21	37009.39	27453.97
12	64500	32054.52	22932.00	16555.54	95500	47460.57	33953.57	24512.47
13	64500	30240.11	21038.53	14781.73	95500	44774.13	31150.06	21886.13
14	64500	28528.41	19301.40	13197.97	95500	42239.74	28578.04	19541.19
15	64500	26913.59	17707.70	11783.91	95500	39848.81	26218.38	17447.50
16	64500	25390.19	16245.60	10521.35	95500	37593.22	24053.56	15578.12
17	64500	23953.01	14904.22	9394.07	95500	35465.30	22067.49	13909.03
18	64500	22597.18	13673.59	8387.56	95500	33457.83	20245.41	12418.78
19	64500	21318.09	12544.59	7488.88	95500	31563.99	18573.77	11088.20
20	64500	20111.41	11508.79	6686.50	95500	29777.35	17040.15	9900.18
21	64500	18973.02	10558.52	5970.10	95500	28091.84	15633.16	8839.45
22	64500	17899.07	9686.73	5330.44	95500	26501.73	14342.36	7892.36
23	64500	16885.92	8886.90	4759.32	95500	25001.64	13158.12	7046.75
24	64500	15930.12	8153.12	4249.39	95500	23586.45	12071.67	6291.74
25	64500	15028.41	7479.93	3794.10	95500	22251.37	11074.93	5617.62
26	64500	14177.75	6862.32	3387.59	95500	20991.86	10160.48	5015.73
27	64500	13375.24	6295.71	3024.64	95500	19803.64	9321.54	4478.34
28	64500	12618.14	5775.87	2700.57	95500	18682.68	8551.88	3998.51
29	64500	11903.91	5298.97	2411.22	95500	17625.17	7845.76	3570.10
30	64500	11230.10	4861.43	2152.87	95500	16627.52	7197.94	3187.59
	Total	672989.96	462400.55	332338.91	Total	984841.81	673492.28	481336.71
					NPV	311851.86	211091.74	148997.82
					B : C	1.46	1.46	1.45
					IRR	80.30%		

Potential areas of bamboo cultivation in the State

During the course of study, it was found that large-scale cultivation of bamboo could not be done in farm lands as people are dependent on them for growing agriculture crops. In hills, bamboo could be grown along the boundaries of agriculture fields, stream banks, waste lands, *etc.* In plain areas, plantation can be raised in the form of wind breaks as done in Chadda Farm, near Kaladhungi, Ramnagar. Block plantation

can also be taken up in less productive lands as done by Pryagya Farm near Kichha, Udham Singh Nagar. Some of the potential areas where bamboo farming could be beneficial are mentioned in Table 5. There is a good scope of bamboo cultivation Uttarakhand. Commercial cultivation of bamboo will not only meet industrial raw material demand but also alleviate poverty. Plantation of bamboo in the form of windbreaks or along bunds is also a viable option. In a nutshell, one can say that bamboo is one of the links to increase the socio-economy of the people in this newly formed State.

Table 5. Potential bamboo production areas in the four districts

S.No.	District	Areas of potential bamboo production	Preferred species
1	Dehradun	Kalsi, Sahaspur and Viskasnagar	*B. nutans, B. bambos, D. strictus, D. hamiltonii*
2	Nainital	Ramnagar and Haldwani	*D. asper, D. balcooa*
3	Pauri Garhwal	Kotdwar, Dugadda, Dhumakot, Yamkeshwar	*B. nutans, B. bambos, D. hamiltonii*
4	Udham Singhnagar	Lalkuon, Kitcha	*B. nutans, B. balcooa, D.strictus.*

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