International Journal of Multidisciplinary Research and Development
www.allsubjectjournal.com
Online ISSN: 2349-4182, Print ISSN: 2349-5979, Impact Factor: RJIF 5.72
Received: 05-02-2021, Accepted: 28-02-2021, Published: 01-04-2021
Volume 8, Issue 4, 2021, Page No. 01-05

Cost-benefit analysis of bamboo cultivation: Case study of Dimapur and Mokokchung districts, Nagaland

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Abstract
A cost benefit analysis of Bamboo cultivation for Nagaland state has been undertaken, with the data generated from the sample survey conducted in two districts, *viz*., Dimapur and Mokokchung, using personal interview and scheduled questionnaire. The results showed that bamboo cultivation is beneficial as the BCR is greater than 1 in both the districts. The Net Present Value was estimated at Rs 231604/ha/year in Dimapur and Rs 218773.70/ha/year in Mokokchung and an estimated average NPV of Bamboo plantation in Dimapur gives best rate of return (42%) as compared to Mokokchung district (36%), with an estimated average rate of return of 37% for Nagaland.

Keywords: cost, benefits, bamboo cultivation, BCR, NPV, IRR

Introduction
Bamboo has its name from Bambusoideae and and ropogoneae/Poaceae family, known for its fast growing species and gets matured within five years and is ready to be used (Scurlock *et al*., 2000). The multiple uses of bamboo have received increasing attention recently. Bamboo being used widely especially in Asian countries have shown that it can be useful as a valuable and sustainable natural resource (Dannenmann *et al*., 2007) [2]. Since time immemorial Bamboo have played an important role in human society and commonly known as 'poor man's timber' is known as 'The Green Gold' of the 21st century and today over a billion people worldwide it depends on bamboo for its subsistence needs (Salam, 2008) [9].
As per FAO report (2007) 1200 species and 90 genera of bamboo can be found worldwide. And in India about 125 indigenous and 11 exotic species of bamboo are found from 23 genera. The major bamboo genera found in India are Arundunaria, Bambusa, Chimono bambusa, Dendrocalamus, Dinochola, Gigantochloa etc. According to FSI (2019) the bamboo resources of the country, more than 50% of its resources is in the North Eastern States and West Bengal. With the abundance of resources in the state it becomes important to know cost and benefit to encourage the farmers regarding cultivation of bamboo and provide information about profitability of cultivation

Objective
To analyse the Cost and return of bamboo cultivation in Dimapur and Mokokchung Districts, Nagaland.

Study Area
Nagaland which is one of the states of India has a geographical area of 16,579 sq km and constitutes 0.50% of the geographical area of the country. The states lies between 25º60' N to 27º40' N latitude and 93º20' E to 95º15' E longitudes and is bordered by Arunachal Pradesh in the north, Manipur in the south, Assam in the west and shares the international border in the east with Myanmar. Nagaland has thirteen districts, out of which, two districts were selected to represent the State in the current study, *viz*., Dimapur and Mokokchung. These two districts have the highest bamboo plantation in Nagaland (NBDA, 2014) [7].
Mokokchung district has a geographical area of 1,615 sq. km with a total population of 194,622 and the density is 121 persons per sq. km. (Census, 2011). Forest occupies about 83.53% (FSI, 2011) of its total area, and 6009 hectares were under bamboo cultivation in 2012.
Dimapur district has a geographical area of 927 sq. km with a population of 378,811 and the density is 409 persons per sq. km. Forest occupies about 51.72% (FSI, 2011) of its total area, and 2530 hectares were under bamboo cultivation in 2012 (Statistical handbook, 2013).

Methodology
Sources of Data and Sample Design
The study is based on primary data, which are collected through sample survey covering two districts of Nagaland, *viz*. Dimapur and Mokokchung.
From each district, three villages were purposefully selected. Thus, the survey included 6 (six) villages and a total 250 households of bamboo cultivators, who were randomly selected from those villages. The data were collected using interview and questionnaire methods.

Data Analysis
The analysis of bamboo cultivation was carried out using Benefit-Cost Ratio (BCR), Net Present Value (NPV) and Internal Rate of Return (IRR). "The information and data on cost of production and return are important to farmers as it reveals the input output relationship and bring out the differences in unit cost between the less and most efficient farm enterprises" (Roy, 2007) [8]. "Discounting reflects the balance between present and future welfare" (Philbert, 1999). "The present value is calculated using the method of compound interest using discount rate" (CASA, 2007) [1].

"Present value estimates of income are based on market and discount rates" (Groom and Palmer, 2012) [6]

Benefit Cost Ratio (BCR)

BCR is the proportion between the discounted cash inflows and discounted cash out flows and for an investment to be considered economically efficient in terms of resource use the ratio must be unity or more. It can be expressed as

$$BCR = \sum_{i=1}^{n} \frac{Bn}{(1+i)^n} / \sum_{i=1}^{n} \frac{Cn}{(1+i)^n}$$

Net Present Value (NPV)

NPV is the discounted sum of cash flows during the project life. For a project to be economically feasible NPV must be positive.

$$NPV = \sum_{i=1}^{n} \frac{Bn - Cn}{(1+i)^n}$$

Where,
Bn = Benefit in the n^{th} year
Cn = Cost in the n^{th} year
n = number of n years
i = Discounted year.

Internal Rate of Return (IRR)

IRR is the rate of return which compares the discounted benefits with the discounted costs. IRR ranks different projects and the highest value of IRR indicates the first choice of preference. The IRR should be greater than the discount rate for any project to be profitable. It is represented as below:

$$IRR = \sum_{t=1}^{n} \frac{Bt - Ct}{(1+i)^n} = 0$$

Where,
Bt = Benefit in the nth year
Ct = Cost in the nth year
n = number of n years
i = Discounted year.

Result and Discussion

The total cost on bamboo plantation in Dimapur and Mokokchung districts was mainly accounted for land preparation, plantation and maintenance. The cost and benefits have been estimated at 2017-18 prices (local) in the two districts. Even though the productive cycle of bamboo is very long, yet the analysis has been conducted for a period of 10 years only. A discount rate of 6 per cent was adopted to estimate the financial analysis of plantation, as this was the bank interest rate during the period. The basic data used for estimating cost of cultivation of bamboo in two districts is presented in table 1.

Table 1: Basic data for cultivation of bamboo

Descriptions	Dimapur	Mokokchung	Nagaland (average)
Spacing (m×m)	5×5	5×5	5×5
No. of plants / ha	400	400	400
Mortality replacement (%)	25	25	25
Seedling price (Rs/seedling)	20	30	25
Labour wages (Rs/mandays)	300	350	325
Sale price per bamboo pole (Rs)	60	50	55

Source: Field Survey, 2017-18

Bamboo is planted at 5m×5m spacing as it is a perennial plant which propagates with cutting or from shoots. The spacing provides good space for bamboo clump to grow in the following years and the number of plants planted per hectare is 400. The study suggested 25% mortality replacement. On average, the cost per seedling is Rs.25, labour wages per day is Rs. 325 and the average sale price per bamboo pole is estimated at Rs 55 in Nagaland.

Among the two sample districts, Dimapur exhibits a lower cost (price of seedling and labour cost) and higher selling price (per bamboo pole) as compared to that of Mokokchung. One of the reasons being Dimapur having connectivity with trains, availability of labour as it is highly populated as compared to other districts and Nagaland Bamboo Development Agency established in Dimapur.

Table 2: Unit cost of cultivating 1 hectare bamboo plantation in Dimapur and Mokokchung districts and Nagaland (2017-18 prices).

Particulars	Dimapur				Mokokchung				Nagaland			
	Unit	Days	Rate (Rs)	Amount (Rs)	Unit	Days	Rate (Rs)	Amount (Rs)	Unit	Days	Rate (Rs)	Amount (Rs)
1st year												
Jungle clearance	5	4	300	6000	5	4	350	7000	5	4	325	6500
Pit digging and planting per sapling	400		20	8000	400		20	8000	400		20	8000
Seedling price	400		15	6000	400		20	8000	400		17.5	7000
Transportation cost	1		2000	2000	1		3500	3500	1		2750	2750
Maintenance cost	5	3	300	4500	4	3	350	4200	4	3	325	3900
Total				26500				30700				28150
2nd year												
Weeding/Tending (2 times)	5	2	300	3000	4	4	350	5600	5	3	325	4875
Casualty replacement 20%	3	2	300	1800	2	3	350	2100	2	3	325	1950
Maintenance and mounting(LS)	4	4	300	4800	4	4	350	5600	4	4	325	5200
Total				9600				13300				12025
3rd year												
Weeding	5	2	300	3000	4	2	350	2800	4	2	325	2600
Thinning	4	4	300	4800	4	2	350	2800	4	3	325	3800
Monitoring & evaluation(LS)				5000				5000				5000
Total				12800				10600				11400
4th year												

Thinning	4	4	300	4800	4	3	350	4200	4	3	325	3900
Monitoring & evaluation(LS)				5000				5000				5000
Total				9800				9200				8900
5th year												
Thinning	4	4	300	4800	4	3	350	4200	4	4	325	5200
Monitoring & evaluation(LS)				5000				5000				5000
Transportation cost	2		3000	6000	2		4000	8000	2		3500	7000
Cutting and sizing	5	2	300	3000	5	2	350	3500	5	2	325	3250
Loading & Unloading	3		300	900	4		350	1400	3		325	975
Total				19700				22100				21425
6th year												
Thinning	4	4	300	4800	4	3	350	4200	4	4	325	5200
Monitoring & evaluation(LS)				5000				5000				5000
Transportation cost	2		3000	6000	2		4000	8000	2		3500	7000
Cutting and sizing	5	2	300	3000	5	2	350	3500	5	2	325	3250
Loading & Unloading	3		300	900	4		350	1400	3		325	975
Loading & Unloading	3		300	900	4		350	1400	3		325	975
Total				19700				22100				21425
7th year												
Thinning	4	4	300	4800	5	2	350	3500	4	3	325	3900
Monitoring & evaluation(LS)				5000				5000				5000
Transportation cost	3		3000	9000	3		4000	12000	3		3500	10500
Cutting and sizing	6	2	300	3600	8	2	350	5600	7	2	325	4600
Loading & Unloading	4		300	1200	5		350	1750	5		325	1625
Total				23600				27850				25625
8th year												
Thinning	4	4	300	4800	5	2	350	3500	4	3	325	3900
Monitoring & evaluation(LS)				5000				5000				5000
Transportation cost	3		3000	9000	3		4000	12000	3		3500	10500
Cutting and sizing	6	2	300	3600	8	2	350	5600	7	2	325	4600
Loading & Unloading	4		300	1200	5		350	1750	5		325	1625
Total				23600				27850				25625
9th year												
Thinning	4	4	300	4800	5	2	350	3500	4	3	325	3900
Monitoring & evaluation(LS)				5000				5000				5000
Transportation cost	3		3000	9000	3		4000	12000	3		3500	10500
Cutting and sizing	6	2	300	3600	8	2	350	5600	7	2	325	4600
Loading & Unloading	4		300	1200	5		350	1750	5		325	1625
Total				23600				27850				25625
10th year												
Thinning	4	3	300	3600	4	2	350	2800	4	2	325	2600
Monitoring & evaluation(LS)				5000				5000				5000
Transportation cost	4		3000	12000			4000	16000	4		3500	14000
Cutting and sizing	8	2	300	4800		2	350	8400	10	2	325	6600
Loading & Unloading	5		300	1500			350	2100	5		325	1625
Total				26900				34300				29825

Source: Field survey, (2017-18)

LS-Lump sum (expenditure incurred for the year)

The table above shows that the first year of cultivation and the 10th year of cultivation incur the maximum expenditure. The maximum amount is spend on labour wages for jungle clearing and pit digging and planting. Farmers in the state use traditional method of jungle clearing and no machineries are used. The labour wages in Dimapur is Rs 300 and Rs 350 in Mokokchung district. In the 10th year maximum amount of expenditure is incurred in transportation cost. Because of the distance to bring the bamboo pole to the market place transportation cost is high. Again transportation cost is more in Mokokchung district as it is hilly areas compared to Dimapur district.

Table 3: Yield and Income of bamboo plantations in Dimapur and Mokokchung Districts and Nagaland

Year	Yield (poles/ha)			Gross Income(Rs/ha)		
	Dimapur	Mokokchung	Nagaland	Dimapur	Mokokchung	Nagaland
V & VI	960	960	960	57600	48000	52800
VII to IX	1600	1600	1600	96000	80000	88000
X	3200	3200	3200	192000	160000	176000

Source: Field survey, (2017-18).

The harvesting starts from the fifth year onwards, where the average selling price per pole is estimated at Rs 55 for Nagaland, while it is Rs. 60 and Rs. 50 for Dimapur and Mokokchung districts, respectively. From the fifth and sixth year 3 (three) good poles per clump taking an average can be harvested every year and 5 (five) mature poles every year

from the seventh to ninth year and 10 mature poles in the tenth year. A gross income of Rs 52800/ha could be realized in 5th and 6th year in Nagaland and Rs 57600/ha in Dimapur and Rs 48000/ha in Mokokchung respectively. This increased to Rs 88000/ha in 7th, 8th and 9th year in Nagaland and Rs96000/ha in Dimapur and Rs80000/ha in Mokokchung. This further increased to Rs176000 in the 10th year in Nagaland with Rs 192000 /ha in Dimapur and Rs 160000 /ha in Mokokchung.

Table 4: Cost Benefit Analysis of bamboo plantation per hectare in Dimapur

Year	Costs	Benefits	Net Benefits	Discounted cost	Discounted benefits	Net Present Value (6%)
1	26500	-	-26500	25000.00	-	-25000.00
2	9600	-	-9600	8543.97	-	-8543.97
3	12800	-	-12800	10747.13	-	-10747.13
4	9800	-	-9800	7762.52	-	-7762.52
5	19700	57600	37900	14720.99	43042.07	28321.08
6	19700	57600	37900	13887.72	40605.73	26718.00
7	23600	96000	72400	15695.35	63845.48	48150.14
8	23600	96000	72400	14806.93	60231.59	45424.66
9	23600	96000	72400	13968.80	56822.25	42853.45
10	26900	192000	165100	15020.82	107211.8	92190.98
Total				140154.22	371758.9	231604.70

Source: Field survey, 2017-18

Table 5: Cost Benefit analysis of bamboo plantation per hectare in Mokokchung

Year	Costs	Benefits	Net Benefits	Discounted costs	Discounted Benefits	Net Present Value (6%)
1	30,700	-	-30,700	28962.26	-	-28962.26
2	13,300	-	-13,300	11836.95	-	-11836.95
3	10,600	-	-10,600	8899.964	-	-8899.96
4	9,200	-	-9,200	7287.26	-	-7287.26
5	22,100	48,000	25,900	16514.40	35868.39	19353.98
6	22,100	48,000	25,900	15579.62	33838.11	18258.47
7	27,850	80,000	52,150	18521.84	53204.57	34682.72
8	27,850	80,000	52,150	17473.43	50192.99	32719.55
9	27,850	80,000	52,150	16484.37	47351.88	30867.50
10	34,300	2,00,000	1,65,700	19152.94	111679	92526.01
Total				160713.06	379486.8	171421.82

Source: Field survey, 2017-18

Table 6: Cost Benefit Analysis of bamboo plantation per hectare in Nagaland

Year	Costs	Benefits	Net Benefits	Discounted cost	Discounted benefits	Net Present Value (6%)
1	28600	-	-28600	26981.13	-	-26981.1
2	11450	-	-11450	10190.46	-	-10190.5
3	11700	-	-11700	9823.546	-	-9823.55
4	9500	-	-9500	7524.89	-	-7524.89
5	20900	52800	31900	15617.7	39455.23	23837.54
6	20900	52800	31900	14733.68	37221.92	22488.24
7	25725	88000	62275	17108.59	58525.03	41416.43
8	25725	88000	62275	16140.18	55212.29	39072.11
9	25725	88000	62275	15226.59	52087.06	36860.48
10	30600	200000	165400	17086.88	111679	92358.5
Total				150433.6	354180.5	

Source: Field survey, 2017-18

Table 7: Cost Benefit Analysis of bamboo plantation in Dimapur and Mokokchung districts of Nagaland.

Sl. No.	Parameters	Dimapur	Mokokchung	Nagaland
1	Benefit-Cost Ratio	2.65	2.06	2.35
2	Net Present Value(Rs/ha/year)	231604.70	171421.82	201513.3
3	Internal Rate of Return(IRR)	42%	32%	37%

The cost benefit analysis of bamboo plantation in Dimapur and Mokokchung Districts and Nagaland are given in table 7. The data reveals that Bamboo plantation is viable as the BCR is greater than 1 in both the districts with 2.65 in Dimapur and 2.36 in Mokokchung districts and in Nagaland it is 2.35.

The NPV is positive and varied from Rs 231604/ha/year in Dimapur to 218773.70/ha/year in Mokokchung with an average NPV of 201513.3. NPV is higher in Dimapur as compared to Mokokchung which shows that it is more profitable in Dimapur.

In India for agriculture and rural development if IRR is more than 15% it is considered as a profitable project. IRR is found to be 37% in Nagaland and the data shows that bamboo plantation in Dimapur gave best rate of return (42%) compared to Mokokchung (32%).

Conclusion

The people of the state practiced a unique land ownership and management systems which is different from the rest of the states in the country. It is the local customary laws that govern the land. This gives due advantage to take up bamboo plantation as it will generate more income. The analysis which was performed under the framework of cost-benefit analysis shows that BCR, NPV and IRR are economically efficient in terms of resource use. Thus, bamboo cultivation creates an opportunity for income generation and serves as job creation to those who engage in its activities as well as employment to the people in the State. The study also shows that farmers spend more on labour cost and transportation cost. The first year of plantation has more expenditure compared to the other years and till the fifth year there is only expenditure and no profit as harvesting starts from the fifth year only. Even though expenditure on the 10th year is high yet benefit incur is more than the expenditure.

With the passing of a bill in the parliament on 20th December 2017 which exclude bamboo from the definition of tree under the Indian Forest Act, it can be seen as a motivation for Bamboo grower which will encourage the farmer to do more bamboo plantation so that the market does not confine within the state but expand even to the other states of the country thus not helping only in income generation and generating employment but also helping the environment to be green and clean with more bamboo plantation.

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