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Economic analysis of bamboo cultivation in Nagpur district

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Abstract

The present study was undertaken to analyze the cost and returns of Bamboo cultivation. The proposed study was undertaken in Nagpur district of Vidarbha region. The data was pertained for the year 2019-2020. The total area under forest and under bamboo in Maharashtra were 947992 hectares and 474915 hectares respectively during the year 2017-18. Highest forest area and highest area under bamboo in Maharashtra State was observed under the circle of Gadchiroli. Average family size of selected cultivator was 5 members. All farmers selected for the study are educated. The total land holding was 4.60 hectares. The gross cropped area was 4.78 hectare and cropping intensity was 112.74 per cent. Area under bamboo cultivation was 40.59 per cent. The total up to 5th years per hectare man days requirement for cultivation of bamboo was 478.36 days. The total cost required for establishment of bamboo up to 5th year was Rs. 308920.64/ ha. Number of clums per clump was increasing from 4th year to 9th Year onwards i.e. from 20 to 32 clums per plant, where as number of clump per hectare was 1110 and weight in Kg/culm was 18. Biomass per hectare was increase from 4th year to 9th year onward i.e. 400 tonnes to 644 tonnes. The gross returns per hectare was also increasing from 4th year to 9th years onwards was Rs. 313286 to Rs. 504551. The Yield in tonne/ha and Gross Return Rs/ha was increasing from 4th year to 9th year onwards. The positive value of NPW indicate that, the bamboo cultivation is a profitable venture. The B-C ratio was arrived 1: 1.91 indicate that, the bamboo cultivation is a profitable venture. The IRR is more than double (24.50) as compare highest discount factor i.e. 11 %. IRR indicate that, the bamboo cultivation is a profitable venture for long term. Hence it is suggested that, Government may promote the bamboo cultivation as "block plantation" on farmers as well as Government fallow land of the state, which will help to enhancing the income of the farmers, It also help to maintain the ecology of the region.

Keywords: Cost, return, net present worth, benefit–cost ratio, internal rate of return

Introduction

Bamboo (Botanical name: *mbusa vulgaris* Family: Poaceae) is play significant role in the socio-economic development of India. It greatly contributes to the economy of the country. Bamboo is largely created by the north-eastern states of the country. It's projected that, the annual turnover in the bamboo farm in the country level to Rs. 9,000 crores. The demand of bamboo in India is about 26 million metric tonnes approximately and is expected to rise in the near future. The multipurpose utilization of bamboo is now a universal source for the rural population and its demand is ever- growing. To support this demand the government of India has established the National Bamboo Mission', under the Ministry of Agriculture to promote the growth of the bamboo industry. 'National Mission on Bamboo Program', has been launched from the Department of Science and Technology to provide technical aid in the bamboo sector. The Cane and Bamboo Technology Centre (CBTC) has designed a project for the sustainable development of the bamboo businesses to create a livelihood for people in India. Such initiatives can bring an organized bamboo cultivation structure within the country and ease more income for the rural population as well as contribute tremendously to the national economy. Bamboo is one of the commercially cultivated crops in India and it is also considered as 'poor man's timber'.

India constitutes largest area under bamboo in the world, estimated around 15.69 million hectares. India is the second largest producer of Bamboo in the world after China. The yearly bamboo production in the country is estimated at around 189 million tons. In Asia, bamboo is the most integrated part of the culture and is used as a substitute to woods. The northeastern states are the major bamboo producing states in the country. Madhya Pradesh has maximum bamboo bearing area of 1.8 m ha, followed by Maharashtra 1.6 m ha (ISFR 2017). The bamboo bearing area in Maharashtra has shown increase of 4462 sq. km. in bamboo bearing area. Although there are around 136 species of bamboo across 23 genera that exist in the country, still only some of them are commercially feasible.

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Mechanical properties of bamboo

1. Specific gravity: 0.575 to 0.655
2. Average weight: 0.625 kg/m
3. Fibre stress at elastic limit: 390 to 1000 kg/cm²
4. Modulus of rigidity: 610 to 1600 kg/cm²
5. Modulus of elasticity: 1.5 to 2.0 x 10⁵ kg/cm²
6. Ultimate crushing stress: 320 to 720 kg/cm²
7. Average tensile stress @ yield point: 1400 to 2800 kg/cm²
8. Ultimate compressive stress: 794 to 864 kg/cm²
9. Safe working stress in compression: 105 kg/cm²
10. Safe working stress in tension: 160 to 350 kg/cm²
11. Safe working stress in shear: 115 to 180 kg/cm²
12. Bond stress: 5.6 kg/cm² (which can be increased up to 10 kg/cm² i.e. equal to that of steel with concrete after suitable treatment)

Hence, the present study was undertaken with a view to study per unit cost and returns, and to work out the B-C ratio, NPW and IRR.

Objectives

1. To study the Socio-economic Characteristics of Selected farmers.
2. To estimate the cost and return of Bamboo cultivation
3. To workout the B-C ratio, NPW and IRR

Methodology

The present study was undertaken to analyze cost and return of Bamboo cultivation. The proposed study was undertaken in Nagpur district of Vidarbha region. The data was pertained for the year 2019-2020.

The simple tabular analysis i.e. Percentage, Average etc were carried out to accomplish the objectives of present study.

The cash flow are yearly net benefits accrued from the project, they are weighted by discount rate, then it become discounted cash flows. These discounted cash flows are the best estimates to decide on the worth of the project.

Net Present Worth: This is simply the present worth of the cash flow stream. Sometime, it is referred to as Net Present Value (NPV). The selection criteria of the projects depends upon the positive value of the Net Present Worth when discounted at opportunity cost of the capital.

NPW of the project is estimated using the following equation.

$$NPW = \frac{P_1}{(1+i)^1} + \frac{P_2}{(1+i)^2} + \dots + \frac{P_n}{(1+i)^n} - C$$

Where,

P₁ = Net cash flow in First Year,

i = Discount rate

t = Time period, and

C = Initial Cost of Investment

Project with positive NPW are given weightage in the selection compared to those with negative present value, while zero NPW makes the investor indifferent.

Benefit–Cost ratio: Here, we compare the present worth of costs with present worth of benefits. Absolute value of the cost - benefit ratio will change based on the interest rate choosen, while ranking the projects, depending upon the B-C ratio, the most common procedure of selecting project is, to

choose the projects, having B-C ratio of more than one, when discounted at opportunity cost of capital. Finally the given project is opted for implementation, among alternatives based on the highest B-C ratio.

$$B-C \text{ Ratio} = \frac{\sum_{t=1}^n \frac{B_t}{(1+r)^t}}{\sum_{t=1}^n \frac{C_t}{(1+r)^t}}$$

Where

B_t = Benefit in each year

C_t = Cost in each year

t = 1, 2,n

n = Number of years

r = Interest (discount) rate

$$B-C \text{ ratio} = \frac{\text{Present worth of gross return}}{\text{Present worth of cost}}$$

Internal Rate of Return: In the computation of Internal Rate of Return (IRR), time value of money is accounted. The method of working IRR provides the knowledge of actual rate of return from the different projects. Thus IRR is known as marginal efficiency of capital or yield on the investment. The IRR is found out using the following formula,

$$IRR = \text{discount rate} + \frac{\text{Difference between the two discount rate}}{\text{Present worth of cash flow at the lower discount rate} - \text{Present worth of cash flow at the higher discount rate}} \times \text{Present worth of cash flow at the lower discount rate}$$

Results and Discussion

Bamboo forest in Maharashtra

The data regarding bamboo forest in Maharashtra is presented in Table 1.

Table 1: Bamboo forest in Maharashtra

Sr. No.	Circle Name	Forest area in hectares	Bamboo area in hectares
1	Nagpur	79048	40408
2	Gadchiroli	523569	330580
3	Chandrapur	100148	67214
4	Amravati	56298	16608
5	Pune	9865	3425
6	Thane	8724	2516
7	Kolhapur	5712	3188
8	Dhule	7038	4044
9	Nashik	15716	10356
10	Aurangabad	0	0
11	Yavatmal	0	0
	Total	947992	474915

It was observed from Table 1 that, total area under forest and under bamboo in Maharashtra were 947992 hectares and 474915 hectares respectively during the year 2017-18. Highest forest area in Maharashtra State was observed under the circle of Gadchiroli followed by Chandrapur circle, Nagpur Circle, Amravati circle and Nashik circle i.e. 523569, 100148, 79048, 56298 and 15716 hectares respectively. Similar trend was observed under the bamboo area in Maharashtra State i.e. 330580, 67214, 40404, 16608 and 10356 hectares respectively.

The data regarding bamboo area under cultivation in Maharashtra is presented in Table 2.

Table 2: Bamboo cultivation in Maharashtra

Sr. No.	Year	Bamboo area under cultivation (In Ha.)
1	2010-11	3702
2	2011-12	3851
3	2012-13	4006
4	2013-14	4259
5	2014-15	3159
6	2015-16	3794
7	2016-17	3972
8	2017-18	4486.

However the area under bamboo cultivation in Maharashtra was decline on the year 2014-15 but thereafter area was increased It was observed from Table 3 that, bamboo area under cultivation in Maharashtra was increasing from the year 2010-11 to 2013-14 i.e. 3702 hectare to 4259 hectare then Bamboo area under cultivation in Maharashtra for the year 2017-18 was highest i.e. 4486 hectares.

Socio-economic status of sample farmers

The tabulated and analyzed data on socio-economic characteristics of the sample farmers is presented in Table 3.

Table 3: Average family size of selected cultivator

Sr. No.	Particulars	No. of farmer N=10
1	Male	2 (40.00)
2	Female	2 (40.00)
3	Children	1 (20.00)
	Total	5 (100.00)

(Figures in parentheses are the percentage to the total family members)

It was observed from Table 3 that, average family size of selected cultivator was 5 out of which, 2 male, 2 female and 01 children.

Educational status of sample farmers was estimated and presented in Table 4.

Table 4: Educational status of the sample farmers

Sr. No.	Educational Status	No. of farmer N=10
1	Illiterate	0.00(0.00)
2	Primary	1.00 (10.00)
3	High school	2.00 (20.00)
4	Graduation	7.00 (70.00)
	Total	10.00 (100.00)

(Figures in parentheses are the percentage to the total family members)

It was observed from Table 4 that, all farmers selected for the study were educated. Maximum farmers completed their education up to graduation (70.00%) followed by High school (20.00 %) and only 10 per cent i.e. only one farmer completed their education up to primary level. As for as the bamboo cultivation is concern illiterate farmers was not observed.

Table 7: Per Hectare Man days requirement for cultivation of Bamboo

Sr. No.	Items	Number of Man Days					Item Total
		I Year	II Year	III Year	IV Year	V Year	
2	Digging & refilling of pits	30.16	9.44	0.00	0.00	0.00	39.60
3	Planting & Staking	6.88	6.67	0.00	0.00	0.00	13.55
4	Plant Protection/Year	6.09	6.67	15.00	18.94	3.75	50.45
5	Weeding	39.39	26.39	40.00	25.30	16.25	147.33

Land Use Pattern

The land use pattern of the selected farmers is shown in Table 5.

Table 5: Land use pattern of selected farmers

Sr No.	Particulars	Area in ha
1	Total Land Holding	4.60 (100.00)
2	Fallow land	0.36 (7.83)
3	Net Cultivated area	4.24 (92.17)
4	Area sown more	0.54 (11.74)
5	Irrigated area	3.14 (68.26)
6	Gross cropped area	4.78
	Cropping Intensity	112.74

(Figures in parentheses are the percentage to the total land holding)

It was observed from Table 5 that, the total land holding was 4.60 hectare, in which 0.36 ha (7.83 per cent) was fallow land and 4.24 hectare was net cultivatable area. Area sown more than once was 0.54 hectare and irrigated area was 3.14 hectare. The gross cropped area was 4.78 hectare and cropping intensity was 112.74 per cent.

Cropping Pattern

Cropping pattern of sample farmers was presented in Table 6.

Table 6: Cropping Pattern of Sample Farmers

Sr No.	Particulars	Area in ha
I	Kharif	
1	Cotton	0.86 (17.99)
2	Tur	0.14 (2.93)
3	Soybean	0.42 (8.79)
5	Vegetables	0.22 (4.60)
	Total	1.64 (34.31)
II	Rabi	
1	Wheat	0.31 (6.49)
2	Gram	0.27 (5.65)
3	Bamboo	1.94 (40.59)
	Total	2.52 (52.72)
III	Horticulture	
1	Orange	0.18 (3.77)
2	Sweet Orange	0.44 (9.21)
	Total	0.62 (12.97)
V	Gross cropped Area	4.78(100.00)

The Table 6 revealed that, the percent share of area under *kharif* crop was 34.31 per cent, *rabi* crop 52.72 per cent and under horticulture 12.97 per cent respectively. In *kharif* crops the higher percentage observed in Cotton (17.99 per cent) followed by Soybean (8.79 per cent), Tur (2.93 per cent), and Vegetables (0.22 per cent), respectively.

In *rabi* season highest percentage observed in Bamboo cultivation (40.59 per cent) followed by Wheat (6.49 per cent), & Gram (5.65 per cent) respectively.

In Horticulture, sweet orange occupied highest area 0.44 ha (9.21 per cent) followed by orange 0.18 ha (3.77 per cent) respectively. Grossed Cropped Area was 4.78 ha.

Physical input units for bamboo cultivation

Per hectare man days requirement for cultivation of bamboo are presented in Table 7.

6	Bed Preparation	23.28	29.17	39.00	31.06	30.00	152.51
7	Pruning	13.59	17.50	10.00	12.58	21.25	74.92
	Total	119.39	95.84	104.00	87.88	71.25	478.36

It could be observed from Table 7 that, the total up to 5th years per hectare man days requirement for cultivation of bamboo was 478.36 days out of which for 1st year, 2nd year, 3rd year, 4th Year and 5th year per hectare man days requirement were 119.39, 95.84, 104.00, 87.88 and 71.25 days respectively. Out of total man days up to 5th years majority of the man days required for preparation of bed, followed by weeding, pruning, plant protection per year, digging and refilling of pits

and planting and staking were 152.51, 147.33, 74.92, 50.45, 39.60 and 13.55 man days respectively.

It is concluded from the above table that, the per hectare requirement of man days for bed preparation and weeding were more in case of cultivation of bamboo.

Cost of cultivation

Per hectare cost of cultivation of bamboo are estimated and presented in Table- 8.

Table 8: Cost of cultivation per hectare (Rs.)

Sr. No.	Items	I Year	II Year	III Year	IV Year	V Year	Total
1.	Ploughing (I Year)	3281.25	5131.94	0.00	0.00	0.00	8413.19
2.	Harrowing (For Weed removal)	1203.13	2500.00	0.00	0.00	0.00	3703.13
3.	Planting Material + Transportation	23203.13	0.00	0.00	0.00	0.00	23203.13
4.	Mortality Replacement in II Year	0.00	2291.67	0.00	0.00	0.00	2291.67
5.	Manures	7226.56	5961.11	11300.00	13181.82	5625.00	43294.49
6.	Bio-Fertilizer	6933.59	4250.00	25900.00	5621.82	7500.00	50205.41
7.	Plant Protection	992.19	1666.67	3000.00	1287.88	5620.50	12567.24
8.	Irrigation	5343.75	3750.00	6600.00	3281.82	3750.00	22725.57
	Sub Total (A)	48183.60	25551.39	46800.00	23373.34	22495.50	166403.83
1.	Digging & refilling of pits	9046.90	0.00	0.00	0.00	0.00	9046.90
2.	Planting & Staking	2062.50	0.00	0.00	0.00	0.00	2062.50
3.	Plant Protection/Year	1828.00	2305.56	4500.00	1545.85	2250.00	12429.41
4.	Weeding	8609.38	7916.67	10350.00	4787.88	4375.00	36038.93
5.	Bed Preparation	6984.38	8750.00	11700.00	9318.18	9000.00	45752.56
6.	Pruning	4078.13	5250.00	3000.00	3772.73	6375.00	22476.00
	Sub Total (B)	32609.29	24222.23	29550.00	19424.64	22000.00	127806.30
	Total (SubTotal (A)+Sub Total (B))	80792.89	49773.62	76350.00	42797.98	44495.50	294210.13
	Contingencies @ 5%	4039.64	2488.68	3817.50	2139.90	2224.78	14710.51
	Grand Total	84832.53	52262.30	80167.50	44937.88	46720.28	308920.64

It was observed from Table 8 that, total cost required for establishment of bamboo up to 5th year was Rs. 308920.64/ha. Out of total operation, ploughing, harrowing for weed removal, planting material and transportation, mortality replacement, digging and refilling of pits, planting and staking these operations could not be carried out from 3rd to 5th years.

The total amount required for cultivation of bamboo were highest for 1st year, followed by 3rd year, 2nd year, 5th year and 4th Year i.e. Rs. 84832.53, Rs. 80167.50, Rs. 52262.30, Rs. 46720.28 and Rs. 44937.88 per hectare respectively. The amount required for purchase of inputs i.e. Bio-fertilizer and

manure were Rs. 50205.41 and Rs. 43294.49 per hectare respectively. The amount paid for preparation of bed and weeding were Rs. 45752.56 and Rs. 36038.93 hectare respectively.

It is concluded from the above table that, cost of cultivation was more during in that period as compare to 4th and 5th year.

Returns from Bamboo Cultivation

Expected yield from bamboo from 4th year onwards was estimated and presented in Table 9.

Table 9: Expected yield from bamboo from 4th years onwards

Year	IV Year	V Year	VI Year	VII Year	VIII Year	X Onwards
No. of Culms per clump	20	22	24	27	29	32
No. of Culm per ha	1110	1110	1110	1110	1110	1110
Weight in Kgs/Culm	18	18	18	18	18	18
Biomass/Ha tonn	400	440	484	532	585	644
less Moisture 60%	160	176	193	213	234	257
less Wasteges30%	112	123	135	149	164	180
Yield in tonne/ha	112	123	135	149	164	180
Rate /tonn rs.	2800	2800	2800	2800	2800	2800
Gross Return/ha	313286	344615	379077	416984	458683	504551

It was observed from Table 9 that, usually bamboo harvesting can be done from 4th years onwards and can continue beyond 9th yeas onwards depending on the species.

Compare to other forest product like wood, the vegetative cycle of bamboo is much short. The bamboo can grow up into grove in 3 to 5 years and can sustain harvest for many years,

Since the grows are self renewing, there is no need to undertake re-cultivation or replacing. Thus bamboo has better chance of generating higher income.

It was observed from table 9, that Number of clums per clump was increasing from 4th year to 9th Year onwards was 20 to 32. Where as number of clump per hectare was 1110 and

weight in Kg/culm was 18. Biomass per / ha was increase from 4th year to 9th year onward i.e. 400 tonns to 644 tonns. After deducting less moisture 60 per cent and less wastage 30 per cent the yield in tonne per hectare for 4th to 9th Year onwards were 112, 123, 135, 149, 164 and 184 tonne/ ha. The gross returns per hectare was also increasing from 4th year to 9th years onwards was Rs. 313286 to Rs. 504551 per hectare.

Table 10: Net Present Worth (NPW) for Bamboo Cultivation (In Rs./Ha.)

Year	Cost (Rs.)	Returns (Rs.)	Net Income (Rs.)	Discount factor @ 6 %	NPW (Rs.)
1	84832.53	--	-84832.53	0.943	-80030.69
2	52262.30	--	-52262.3	0.890	-46513.26
3	80167.50	--	-80167.5	0.840	-67310.18
4	44937.88	313286	268348.12	0.792	212556.8
5	46720.28	344615	297894.72	0.747	222604.3
				NPW=	241306.98

It was observed from Table 10 that, highest cost was observed for 1st Year (Rs. 84832.53), followed by 3rd Year (Rs. 80167.50), and 2nd Year (Rs. 52262.30), The net returns from 1st year to 3rd year was nil. After multiplying of Discount factor @ 6 % with net income the NPW was arrived 241306.98, The positive value of NPW indicate that, the

It was concluded from the above table that, the yield and Gross Return were increasing from 4th year to 9th year onwards.

Net present worth for bamboo cultivation for 5 years was estimated and presented in Table 10.

bamboo cultivation is a profitable venture.

It was concluded from the above table that, the positive value of NPW indicate that, the bamboo cultivation is a profitable venture.

Benefit Cost Ratio (B-C R) for bamboo cultivation for 5 years was estimated and presented in Table 11.

Table 11: Benefit Cost Ratio (B-C R) for Bamboo cultivation (In Rs./Ha.)

Year	Cost (Rs.)	Returns (Rs.)	Discount factor @ 6%	Present worth of cost (Rs.)	Present worth of Gross return (Rs.)
1	84832.53	--	0.943	80030.69	0
2	52262.30	--	0.890	46513.26	0
3	80167.50	--	0.840	67310.18	0
4	44937.88	313286	0.792	35595.01	248151.9
5	46720.28	344615	0.747	34912.11	257516.4
			Total	264361.25	505668.23
			B-C Ratio	1:1.91	

It was observed from Table 11 that, highest cost was observed for 1st Year (Rs. 84832.53), followed by 3rd Year (Rs. 80167.50), and 2nd Year (Rs. 52262.30), respectively. The returns from 1st year to 3rd year was nil. After multiplying of Discount factor @ 6 % with cost and Discount factor @ 6 % with returns the Present worth of cost and the Present worth of Gross return was Rs. 264361.25 and Rs. 505668.23

respectively. The B-C ratio was arrived 1: 1.91 indicate that, the bamboo cultivation is a profitable venture.

It was concluded from the above table that, the B-C ratio greater than one indicate that, the bamboo cultivation is a profitable venture for long term.

Internal Rate of Return (IRR) for bamboo cultivation for 5 years was estimated and presented in Table 12.

Table 12: Internal Rate of Return (IRR) for Bamboo Cultivation (In Rs./Ha.)

Year	Cost (Rs.)	Returns (Rs.)	Net Income (Rs.)	Discount factor @ 6%	NPW (Rs.)	Discount Factor @ 11%	NPW (Rs.)
1	84832.53	--	-84832.53	0.943	-80030.69	0.901	-76425.7
2	52262.3	--	-52262.3	0.890	-46513.26	0.812	-42417.26
3	80167.5	--	-80167.5	0.840	-67310.18	0.731	-58617.79
4	44937.88	313286	268348.12	0.792	212556.8	0.659	176769.22
5	46720.28	344615	297894.72	0.747	222604.3	0.593	176786.02
				NPW=	241306.98	NPW=	176094.49
				IRR	24.50		

It was observed from Table 12 that, highest cost was observed for 1st Year (Rs. 84832.53), followed by 3rd Year (Rs. 80167.50), and 2nd Year (Rs. 52262.30), respectively. The returns from 1st year to 3rd year were nil. After multiplying of Discount factor @ 6 per cent with net income the NPW was arrived 241306.98 and after multiplying of Discount factor @ 11 per cent with net income the NPW was arrived Rs. 176094.49, respectively. The Internal rate of return was arrived 24.50 indicate that, the bamboo cultivation is a profitable venture, it is more than double than the highest discount factor i.e. 11 per cent.

It was concluded from the above table that, the IRR was more than double (24.50) than the highest discount factor i.e. 11 per cent. The IRR indicate that, the bamboo cultivation is a profitable venture for long term.

Scope for land utilization under Bamboo cultivation

It is essential to study district wise land utilization in Vidarbha Region of Maharashtra State because its influence the land under different category ultimately related to agricultural production and it is presented in Table 13.

Table 13: District wise land utilization in Vidarbha Region (Area in '00' ha.)

District/ Division/State	Geographical Area	Forest	Cultivable area	Net area Sown	Cultivable west land	Current fallow	Other Fallow	Total Fallow land (6+7+8)
1	2	3	4	5	6	7	8	9
Buldhana	9671 (100.00)	917 (9.48)	7295 (75.43)	6522 (67.44)	263 (2.72)	240 (2.48)	252 (2.61)	755 (7.81)
Akola	5429 (100.00)	301 (5.54)	4496 (82.81)	4296 (79.13)	30 (0.55)	104 (1.92)	53 (0.98)	187 (3.44)
Washim	5131 (100.00)	365 (7.11)	4122 (80.34)	3814 (74.33)	53 (1.03)	162 (3.16)	89 (1.73)	304 (5.92)
Amravati	12217 (100.00)	3099 (25.37)	8125 (66.51)	7493 (61.33)	92 (0.75)	334 (2.73)	144 (1.18)	570 (4.67)
Yavatmal	13519 (100.00)	2374 (17.56)	9527 (70.47)	8547 (63.22)	228 (1.69)	378 (2.80)	258 (1.91)	864 (6.39)
Amravati Division	45967 (100.00)	7056 (15.35)	33565 (73.02)	30672 (66.73)	666 (1.45)	1218 (2.65)	796 (1.73)	2680 (5.83)
Wardha	6289 (100.00)	618 (9.83)	4441 (70.62)	3441 (54.71)	165 (2.62)	535 (8.51)	204 (3.24)	904 (14.37)
Nagpur	9864 (100.00)	1550 (15.71)	6424 (65.13)	5587 (56.64)	337 (3.42)	209 (2.12)	213 (2.16)	759 (7.69)
Bhandara	3420 (100.00)	618 (18.07)	2025 (59.21)	1758 (51.40)	116 (3.39)	57 (1.67)	11 (0.32)	184 (5.38)
Gondia	5859 (100.00)	2074 (35.40)	2151 (36.71)	1818 (31.03)	166 (2.83)	106 (1.81)	46 (0.79)	318 (5.43)
Chandrapur	10918 (100.00)	3881 (35.55)	5287 (48.42)	4558 (41.75)	368 (3.37)	148 (1.36)	114 (1.04)	630 (5.77)
Gadchiroli	14916 (100.00)	10984 (73.64)	2540 (17.03)	1749 (11.73)	214 (1.43)	467 (3.13)	78 (0.52)	759 (5.09)
Nagpur Division	51266 (100.00)	19725 (38.48)	22868 (44.61)	18911 (36.89)	1366 (2.66)	1522 (2.97)	666 (1.30)	3554 (6.93)
Vidarbha	97233 (100.00)	26781 (27.54)	56433 (58.04)	49583 (50.99)	2032 (2.09)	2740 (2.82)	1462 (1.50)	6234 (6.41)
Maharashtra State	307582 (100.00)	52199 (16.97)	207509 (67.46)	169429 (55.08)	9239 (3.00)	13656 (4.44)	12623 (4.10)	35518 (11.55)

(Figures in parenthesis indicates the per centage to the geographical area)

It was observed from Table 13 that, total Geographical area for Maharashtra state was 30758200 ha. In which forest, cultivable area, net sown area, cultivable west land, current fallow and other fallow were 521900, 20750900, 16942900, 923900, 1365600 and 1262300 ha. respectively.

The total geographical area for Amravati division was 4596700 ha. In which forest, cultivable area, net sown area, cultivable west land, current fallow and other fallow were 705600, 3356500, 3067200, 66600, 121800 and 79600 ha. respectively. The total geographical area for Nagpur division was 5126600 ha. In which forest, cultivable area, net sown area, cultivable west land, current fallow and other fallow were 1972500, 2286800, 1891100, 136600, 152200 and 66600 ha. respectively. The total geographical area for Vidarbha Region (Amravati division + Nagpur division) was 9723300 ha. In which forest, cultivable area, net sown area, cultivable west land, current fallow and other fallow were 2678100, 5643300, 4958300, 203200, 274000 and 146200 ha. respectively.

The total fallow land (Cultivable west land + current fallow + other fallow) for Maharashtra state was 3551800 hectare in which Amravati division and Nagpur division contributed 5.83 per cent and 6.93 per cent respectively. The total fallow land (Cultivable west land + current fallow + other fallow) for Vidarbha region was 6.23 lakh hectares. If at least 50 per cent total fallow land is brought under cultivation of bamboo, definitely it will help to maintain the ecology of the region and also to provide employment under bamboo industry.

Hence it is concluded from the above table that, If 50 per cent of total fallow land (Cultivable west land + current fallow + other fallow) is brought under cultivation of bamboo, then it

will help to boost bamboo industry in Vidarbha. Hence it is suggested that should promote the bamboo cultivation as "block plantation" on farmers as well as Government fallow land, which will help to enhancing the income of the farmers, as well maintain the ecology of the region.

Conclusions

The conclusions of the study are as below.

- 1) The total area under forest and under bamboo in Maharashtra were 947992 hectares and 474915 hectares respectively. Highest forest area in Maharashtra State under the circle of Gadchiroli i.e.523569 ha. Along with highest area under bamboo was 330580 ha.
- 2) Average family size of selected cultivator was 5 members. All farmers selected for the study were educated.
- 3) The total land holding was 4.60 hectare, The gross cropped area was 4.78 hectare and cropping intensity was 112.74 per cent. Area under bamboo cultivation was 40.59 per cent.
- 4) The total up to 5th years per hectare man day's requirement for cultivation of bamboo was 478.36 days. The per hectare requirement of man days for bed preparation and weeding are more in case of cultivation of bamboo.
- 5) The total cost required for establishment of bamboo up to 5th year was Rs. 308920.64/ ha. The total amount required from cultivation of bamboo are highest for 1st year, followed by 3rd year, 2nd year, 5th year and 4th Year i.e. Rs. 84832.53, Rs. 80167.50, Rs. 52262.30, Rs. 46720.28 and Rs. 44937.88 respectively.

- 6) Number of clumps per clump was increasing from 4th year to 9th Year onwards was 20 to 32, where as number of clump per hectare was 1110 and weight in Kg/culm was 18. Biomass per ha was increase from 4th year to 9th year onward I.e. 400 tonnes to 644 tonnes.
- 7) The gross returns per hectare was also increasing from 4th year to 9th years onwards was Rs. 313286 to Rs. 504551. The Yield in tonne per ha and Gross Return Rs./ha were increasing from 4th year to 9th year onwards.
- 8) The positive value of NPW indicates that, the bamboo cultivation is a profitable venture. The B-C ratio was arrived 1: 1.91 indicate that, the bamboo cultivation is a profitable venture. The IRR is more than double (24.50) than the highest discount factor i.e. 11 per cent IRR indicate that, the bamboo cultivation is a profitable venture for long term.
- 9) At least 50 per cent total fallow land is brought under cultivation of bamboo, definitely it will help to mentain the ecology of the region and also to provide employment under bamboo industry.

References

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