
Bamboo Preservation Treatment (Boric acid-Borax Method)

Location	Tamenglong, Tamenglong district, Manipur state, India
Suitability	Community organizations, Self-help groups
Benefits	Generates cash income – Gender neutral – Preserved bamboo pole
Level	Small-scale enterprise
Capacity	12,000 poles per year
Keywords	Bamboo – Preservation – Boric acid – Borax

Introduction

Tamenglong district is located in the west of Manipur state at an altitude of 1,290 m above sea level and covers a total area of 4,391 sq. km. The population of Tamenglong in the 2001 census was 111,493, predominantly the Zeliangrong Naga tribes and a number of sub-tribes. Population density is very low at 22.6 people per square km (compared to 273 average over the whole of India) and is distributed relatively evenly over the district. A substantial number of them live in poverty, chiefly because their main economic activity of slash-and-burn cultivation has become non-remunerative. Industrial development has passed Tamenglong by, largely because of the lack of infrastructure, and its remoteness and difficult terrain.

The total afforested land spreads over 3,884 sq. km, with 1.5 billion standing bamboo culms occupying 563 sq. km (*Melocanna baccifera* is the predominant species) and rattan contained in patches over 1,033 sq. km. Bamboo is one of the major natural resources in Tamenglong. It is highly renewable resource, allows annual harvesting and is a good source of timber. Bamboo is widely used by the tribal communities for a variety of purposes. Despite this, however, bamboo is not looked upon as a material of value owing to its perishability: biological deterioration is a major deterrent to the use of bamboo in longer duration applications. Preservative treatment of culms is therefore the primary value-adding step.



Bamboo in preservation tank (the culm pieces across the tank help keep the culms submerged)

The Enterprise

The forest stocks of *Dendrocalamus hamiltonii* in Tamenglong underwent gregarious flowering in 2003, creating a need for the optimum utilization of the dying bamboo stocks and for the regeneration of the bamboo stock. One of the resultant initiatives was a community-owned and managed enterprise that provides preservative treatment for bamboo culms. It is a step that makes bamboo timber at par with wood timber for applications such as construction.

The enterprise was set up by the Tamenglong Bamboo and Cane Centre (TAMBAC) – a Section 25, community-oriented company set up by the Centre for Indian Bamboo Resources and Technology (CIBART) – to provide treated bamboo to the community. As such, profit is not the main

interest in this case. However, the enterprise is amenable to being run as a commercial, profit-making unit.

There are several preservative treatment regimes developed for bamboo poles. Among these, a process that employs boric acid and borax was chosen for the enterprise owing to the simplicity of the process and the low toxicity of the chemicals used. The treated poles are fit for use for a variety of purposes, including construction.

The treatment cycle is of 48 hours wherein 100 poles of 11 feet length and 3-4½ inches diameter are treated. In a month, ten cycles are possible, making an annual output of 12,000 treated poles.

The Process



Preservation treatment facility

The process basically involves dipping bamboo poles in a water-borne preservative for several hours. The preservative used – a mixture of boric acid and borax – is non-fixing type, that is, the preservative is leachable. Mixing of boric acid and borax in a specific proportion results in the formation of disodium octaborate, which is easily soluble in water. Boron salts, in concentrations of 5% to 10%, protect against fungi, borer insects and termites. The process is recommended for bamboo culms that would not be exposed to water or excessive moisture.

Beneficiaries

The key beneficiaries of the enterprise are self-help groups and micro-scale entrepreneurs who have bamboo-based businesses. It would also benefit communities, as users of preserved bamboo poles for purposes such as house construction. As

the process is neither capital- nor labour-intensive, and does not require constant attention, the enterprise is suitable for women.

Key Financial Data

Cost price per culm	: INR 3.70
Sale price per culm	: INR 4.50
NPV of the plantation	: INR 68,860.00
IRR	: 118.40%
Benefit-cost ratio	: 1.31

The price cited above does not include the cost of the bamboo pole, which is supplied by the customer. Land cost is taken as nil, as the enterprise is set up on community land.

Costs for the enterprise include fixed capital of INR 46,125 – including a one-time cost of INR 7,000 for erecting a shed, INR 35,100 for the treatment tanks (life time a tank is two years) and INR 1,725 for the saws and drill) – and 6-year operating costs of INR 296,000, which include costs of labour and materials.

Annual returns from preservation treatment of 12,000 poles are INR 54,000 – a total of INR 324,000 over the six-year period. Break-even point is reached with a return on INR 35,859, equivalent to annual treatment of 7,969 poles. No tax is taken into account, as the enterprise enjoys tax exemption in Tamenglong.

Key Benefits

- A simple, yet important value-addition step for bamboo.
- The enterprise generates cash income.
- Poverty alleviation.
- Opportunity for women and the aged to generate cash income.

Key Requirements

- Availability of bamboo poles nearby the treatment area, as the poles need to be treated before the culms start drying.
- Land for the enterprise being available free of cost.
- Preservation treatment commanding a minimum charge of INR 4.50 per pole.
- Local demand for preserved bamboo poles.

The Environment

Manipur, one of the eight states in North-East India, covers a total geographical area of 22,327



sq. km. Of the total area, about nine-tenths constitute the hills which surrounds the remaining one-tenth valley. Manipur is bounded by the states of Nagaland on the north, Assam on the west and Mizoram on the south. Along the east, it shares a 352 km long international boundary with Myanmar. The state lies between 94° 31' to 94° 78' E and 23° 83' to 25° 68' N and lies from 550 to 3,600 m above sea level. It has mainly hilly terrain (92%), surrounding a saucer-shaped valley of 1,856 sq. km, called Imphal Valley. The area has monsoon rainfall with an average annual rainfall of 2,100 mm and temperatures ranging from -1°C to 38°C.

The 2001 Census puts Manipur population at 2.39 million, with a density of 107 people per sq. km and annual growth rate of 3%. Meitei, which constitutes around 57% of the total population of the state, is the major ethnic community. There are altogether 29 ethnic tribal communities dominated by Nagas and Kukis (about 30% of the population). The Meitei lives in the plains, while the Nagas and Kukis prefer the hills.

The forests of Manipur belong to five ecological types: tropical wet evergreen forests; tropical moist deciduous forests; subtropical broad-leaved hill forests; sub-tropical pine forests; and mountainous wet temperate forests. Teak, Pine, Oak, bamboo and rattan are among the key forest species. Most bamboo species found in north-eastern India are present in Manipur state. Pure bamboo brakes constitute 3,268 sq. km area (18.6% of the total forest cover). More than 700 000 bamboo culms are extracted every year in Manipur. It also has more than 13 species of rattan under three genera. Both bamboo and rattan (cane) find multi-purpose economic uses.

Agriculture is the mainstay of the Manipur's economy. It engages 76% of the workers. The size of the cultivated area is, however, only 9.41% of the total geographical area of the State. Of this total cultivated area, 52% is confined to the valley. In the hills, jhum (slash-and-burn) cultivation is widely practiced but the returns are uneconomical and unsustainable.

A high rate of unemployment exists in Manipur, particularly among the educated youth. There are more than 400,000 unemployed persons as per the live register of the Employment Exchanges. Manipur has more than 650,000 people below poverty line.

The per capita net income of the State based on an estimate at current prices is INR 11,370 for 1999-2000 compared with the all-India average of INR 16,047. The average annual growth rate of the State Domestic Product (SDP) is 10.52% in 1999-2000 as against 8.03% of the manufacturing sector.

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The Population density is very low at 22.6 people per square km (compared to 273 average over the whole of India) and is distributed relatively evenly over the district. There are 171 villages in the district. Slightly more than one third of these have fewer than 200 people, one third have between 200-499 people and slightly less than one third have between 500-1999 people. There are only two villages with more than 2,000 inhabitants. The female: male sex ratio is 0.923. Literacy is 67% among men and 50% among women.

Each Naga village is a "village republic" – an independent democratic unit. The sense of community and cooperation is very strong. Each village has a village authority. The village authority, established under the Village Authority Act, is equivalent to the village panchayat (council) elsewhere in India. It has administrative, development, judicial and defence functions and is empowered to settle civil and criminal cases.

Land ownership in Tamenglong is mostly with important families in each individual village. These families decide who uses the land and for what

purpose it is used, and collect a small fee from the users in the form of a small quantity of produce (usually one or two tins of rice per year). Each year, the village authority decides the location for swidden cultivation. Land for terrace paddy, horticulture and housing is negotiated between the inhabitants and the landowners, subject to approval by the village authority. There are no controls on farming or harvesting other than that agreed by the village committees.

The road network is highly underdeveloped. The Imphal-Tamenglong road (state highway) and the Tamenglong-Khongsang road (part of National Highway 53) are the only roads that are motorable throughout the year. There are no railways and the nearest airport is at Imphal, 153 km away. Only 48% of the villages have an electricity supply but most do not receive it regularly. Currently, there is only one working commercial bank in the district which is in Tamenglong.

The office of the Deputy Commissioner is in charge of all government activities in Tamenglong district as well as law and order and administration.

Bamboo Preservation Enterprise

Bamboo is an inalienable part of a Manipuri's life, as it finds use in many ways and for many purposes. House construction is one area where it finds major use. Bamboo, with starch-rich culm, is very susceptible to biological degradation. This is a factor that curtails the value and wider application of bamboo, despite its strength and beauty. Rural bamboo houses have a life of 3-5 years, after which they have to be reconstructed.

While this has been an accepted norm in rural areas, the easy perishability of bamboo needs to be addressed to elevate the status of bamboo as a standard, modern structural material, at par with wood and good for longer-term applications.

Although there are several preservation methods formulated, these are seldom used widely because of lack of know-how, non-demonstration of techno-economic advantages and absence of treatment facilities. The 2003 gregarious flowering of *D. hamiltonii* bamboo in the forest provided the impetus needed to set up treatment facilities. An enterprise catering basically to community needs was set up, as a model unit, by TAMBAC.

Inputs

- Covered shed for treatment & drying
- Preservation tank
- Bamboo poles (*D. hamiltonii*) to be preserved
- Boric acid
- Borax
- Water

Process Details

1. The bamboo poles to be treated are cross-cut to 11 ft length.
2. Using a drill, small holes are drilled on the internodal parts of the poles for better preservative penetration.
3. Tank for the preservation process is made by welding together, end to end, four cut-off oil (petroleum) drums. Four such drums welded together lengthwise would make a shallow tank long enough to accommodate 11-ft long poles.
4. Boric acid and borax are mixed in 1:1.4 ratio, made into a solution with water and poured into the preservation tank.
5. Bamboo poles are placed inside the tank for 48 hours. One tank will hold 30-40 poles of diameter 3-4 inches.
6. The treated poles are removed from the tank and kept in slanted for quick drying.
7. Preservative solution is recharged after four cycles by adding water and the chemicals.



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The production of this catalogue has been supported by:



BAMBOO PRESERVATION ENTERPRISE : ON-FARM MODEL

A. PARAMETERS

Local currency unit: INR

Interest rate
 - working capital (without project) 6% per year
 - working capital (with project) 20% per year
 - fixed capital (without project) 6% per year
 - fixed capital (with project) 20% per year

Loan period
 - working capital (without project) 1 year
 - working capital (with project) 6 years
 - fixed capital (without project) 1 year
 - fixed capital (with project) 6 years

Item	Unit	Without project		With project													
		Y1-Y6		Y1		Y2		Y3		Y4		Y5		Y6			
		Quantity	Total	Quantity	Rate	Quantity	Rate	Quantity	Rate	Quantity	Rate	Quantity	Rate	Quantity	Rate	Total	
B. FIXED CAPITAL																	
Shed for storage (bamboo hut)	No.	0	0	7,000	7,000	0	0	0	0	0	0	0	0	0	0	0	0
Shed repair*	No.	0	0	3	3,900	11,700	3	3,900	11,700	3	3,900	11,700	3	3,900	11,700	3	3,900
Preservation tank** (made using 4 oil drums each)	No.	0	0	2	75	150	1	75	75	1	75	75	1	75	75	1	75
Saw	No.	0	0	1	1,500	1,500	0	0	0	0	0	0	0	0	0	0	0
Drilling machine	No.	0	0	1	1,500	1,500	0	0	0	0	0	0	0	0	0	0	0
Total		0	0	20,350	20,350	75	75	12,775	12,775	75	75	12,775	12,775	75	75	12,775	12,775

Notes:

* Substantial repair carried out every 2 years.

** Average operating life of preservation tank is 2 years.

Item	Unit	Quantity per pole	With project														
			Y1		Y2		Y3		Y4		Y5		Y6				
			Quantity	Rate	Quantity	Rate	Quantity	Rate	Quantity	Rate	Quantity	Rate	Quantity	Rate			
C. OPERATING COSTS																	
Raw Materials																	
Bamboo poles	Supplied by customers																
Borax *	g	8.4	101250	0.07	7088	101250	0.07	7088	101250	0.07	7088	101250	0.07	7088	101250	0.07	7088
Boric acid *	g	5.6	67500	0.07	4725	67500	0.07	4725	67500	0.07	4725	67500	0.07	4725	67500	0.07	4725
Labour																	
- Preparation of bamboo pole	Workday per pole	0.0087	104.4	70	7308	104.4	70	7308	104.4	70	7308	104.4	70	7308	104.4	70	7308
- Preparation of chemicals & tank and performing the complete process	Workday per pole	0.0250	300	70	21000	300	70	21000	300	70	21000	300	70	21000	300	70	21000
Power	kW	0.02	240	4	960	240	4	960	240	4	960	240	4	960	240	4	960
Total variable costs			40121		40121			40121			40121			40121			40121
Fixed Costs																	
- Water	lumpsum		600		600			600			600			600			600
- Other expenses	lumpsum		1200		1200			1200			1200			1200			1200
Depreciation			7417		7417			7417			7417			7417			7417
Total fixed costs			9217		9217			9217			9217			9217			9217
Total costs			49337		49337			49337			49337			49337			49337
D. REVENUE																	
Poles/year	1000 poles/month		12000	4.5	54000	12000	4.5	54000	12000	4.5	54000	12000	4.5	54000	12000	4.5	54000
Total			54000		54000			54000			54000			54000			54000

Note: *INR 70.00/kg

Item	Y1	Y2	Y3	Y4	Y5	Y6
E. CASH FLOW PROJECTIONS						
INFLOW						
Sale revenues	54000.00	54000.00	54000.00	54000.00	54000.00	54000.00
Enterprise contribution						
- Fixed capital	20350.00	0.00	0.00	0.00	0.00	0.00
- Working capital (1/5th annual operating cost)	8024.00	0.00	0.00	0.00	0.00	0.00
Total inflow	82374.00	54000.00	54000.00	54000.00	54000.00	54000.00
OUTFLOW						
Fixed capital	20350.00	75.00	12775.00	75.00	12775.00	75.00
Operating costs (less depreciation)	41921.00	41921.00	41921.00	41921.00	41921.00	41921.00
Total outflow	62271.00	41996.00	54696.00	41996.00	54996.00	41996.00
Cash flow	20103.00	12004.00	-695.00	12004.00	-695.00	12004.00
F. FINANCIAL ANALYSIS						
Return on total capital employed						
- Income from sales	54000.00	54000.00	54000.00	54000.00	54000.00	54000.00
- Cash outflow	70295.00	41996.00	54696.00	41996.00	54996.00	41996.00
- Net cash flow	-16295.00	12004.00	-695.00	12004.00	-695.00	12004.00
Discounted cash inflow	292304.00					
Discounted cash outflow	245786.00					
Net Present value – NPV	46518.00					
Internal rate of return – IRR	33.37%					
Benefit-cost ratio	1.19					
Contribution (Sales – variable cost)	13879.00	13879.00	13879.00	13879.00	13879.00	13879.00
Fixed costs	9217.00	9217.00	9217.00	9217.00	9217.00	9217.00
Profit before tax – PBT	4662.00	4662.00	4662.00	4662.00	4662.00	4662.00
PV ratio	25.7	25.7	25.7	25.7	25.7	25.7
Break-even point						
- Turnover (INR)	35859.00					
- Units (no.)	7969					