Vertical Soak Diffusion

for

BAMBOO

Preservation

ENVIRONMENTAL BAMBOO FOUNDATION

Environmental
Bamboo Foundation

The Environmental Bamboo Foundation (EBF) is an Indonesian non-profit organization started in 1993 by designer and environmentalist, LINDA GARLAND. The EBF strives to protect tropical forests by promoting and demonstrating the many conservation and development opportunities that bamboo offers. The mission of the Environmental Bamboo Foundation is to encourage, through research and education, the sustainable planting and utilization of bamboo in an effort to promote its many environmental benefits and protect the world's remaining tropical forests and mangroves.
Based in Bali, Indonesia, the EBF has affiliate non-profit organizations in the United States and in Holland.

Acknowledgements

Initial research on modified Boucherie Teatment was done by Prof. Dr. W. Liese, Universität Hamburg, Germany, and later adapted by the Environmental Bamboo Foundation with Don Longuevan under a grant from IESC International Executives Service Corp. Laboratory testing was performed by Koppers-Hickson in New Zealand.

We thank Ben Brown of Mangrove Action Project for providing valuable help and insight during the testing period and providing translation services for the Indonesian edition.

We appreciate the advise/comments made by Prof.Liese along the development of the VSD treatment.

Many thanks to Emerald Starr of Sacred Mountain Sanctuary in Sideman, Bali, who used a high percentage of experimental VSD treated bamboo timbers when building his resort. Seven years later, the bamboo he used is still in excellent condition.

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Preface

The use of bamboo products requires often its protection against biodegradation by chemical treatment. Its application is hindered by the structure of the culm, the need for larger technical installations and the danger of environmental side-effects. The VSD method developed by EBF is obviously an efficient method to obtain well treated culms, safe to be handled. Its wider application, also to other species, will strengthen its base.

Walter Liese
Universität Hamburg, Germany

Introduction

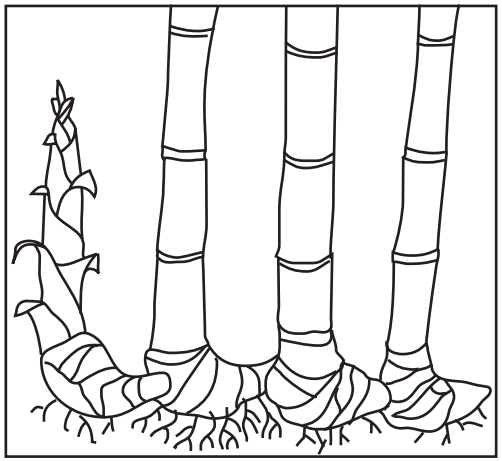
Bamboo culms are a natural material susceptible to insect and fungal attack. Without treatment products made from bamboo can be expected to last for only up to 3 years.

There are many different techniques for curing and treating bamboo culms in order to prevent splitting,insect infection and fungal growth. In this booklet we present the Vertical Soak Diffusion (VSD) method which uses minimally toxic borates as preservatives. The method has been tested in Indonesia using three species of bamboo:
*Dendrocalamus asper**
*Gigantochloa apus**
*Gigantochloa atter**
If you are intending to use other species of bamboo, follow the methodology in this booklet to treat a small section (1-2 internodes) and observe the rate of penetration of the red dye discussed in step 14, page 18.

Whereas bamboo treated by the modified boucherie system (a pressure system introduced by Prof. Dr. Liese, Hamburg, Germany) is appropriate for large scale plantations growing bamboo for construction timber, furniture, and some crafts the VSD system works well with small-plantation situations , and community development work in rural villages

* see local names in Appendix

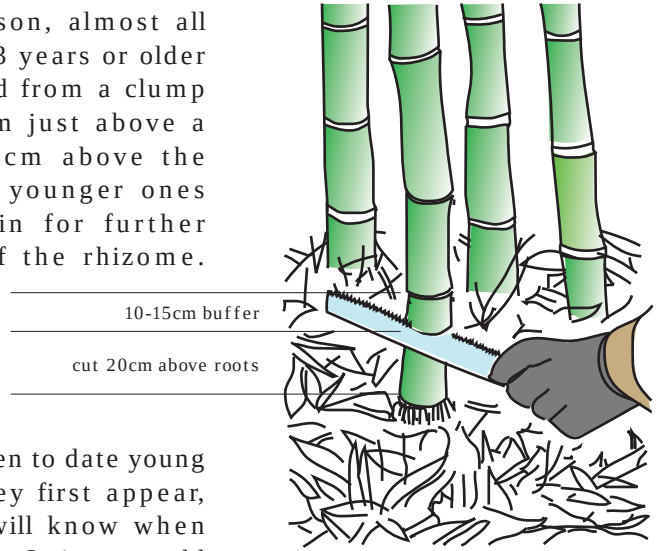
Managing Bamboo



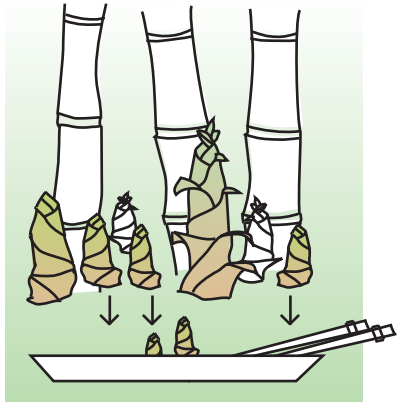
Clumping Bamboo

Clumping bamboos are non-invasive. They do not ruin buildings, they grow very fast when young and the culms are larger than those of the running bamboo. They require little maintenance, although simple clump management will benefit both the grower and the bamboos.

In the dry season, almost all culms that are 3 years or older can be removed from a clump by cutting them just above a node about 20cm above the ground. Some younger ones have to remain for further nourishment of the rhizome.

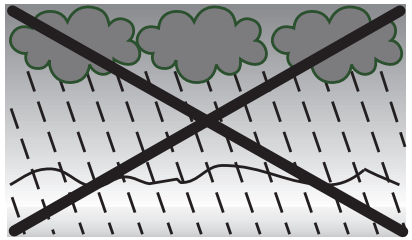


Use a marking pen to date young culms when they first appear, that way you will know when they are at least 3-4 years old without having to guess.

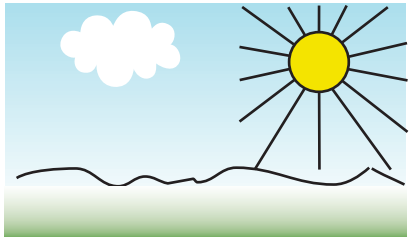


In the shooting season, remove any shoots that are going to create overcrowding (many species are edible, cooked). Leave only the shoots of good diameter which have potential to produce straight strong poles for timber use.

Harvesting Bamboo



Wet Season



Dry Season

Harvest bamboo during the dry season

The best season for harvesting is after the rainy season when starch content in the bamboo sap is low. Starch is the favorite food for pests. Don't harvet during shooting season! Cut bamboo that is 3-5 years old. Bamboo older than 5 years is harder and the inner culm wall becomes impermeable to the BORAX BORIC ACID Solution.

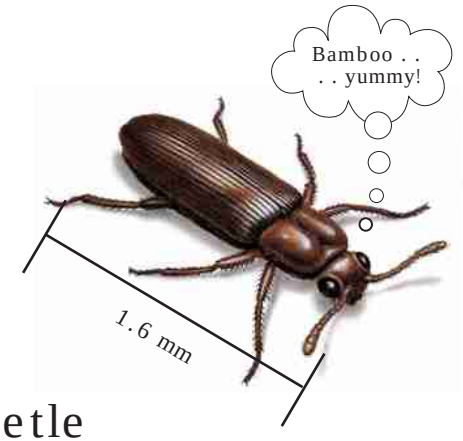
There are 2 different ways to tell the age of bamboo culms:

1) Mostly, culms at the inside of a clump are the oldest.

2) Label the new shoots, this is the safest method.

The culms should be treated soon after having been cut, but can be left for a few days standing upright, placed on a stone. Due to the ongoing transpiration by the leaves the culm will loose some of its moisture and also starch, which is the food for the pest, i.e. the Powderpost Beetle. But don't wait too long, since moisture is required for the following diffusion process.

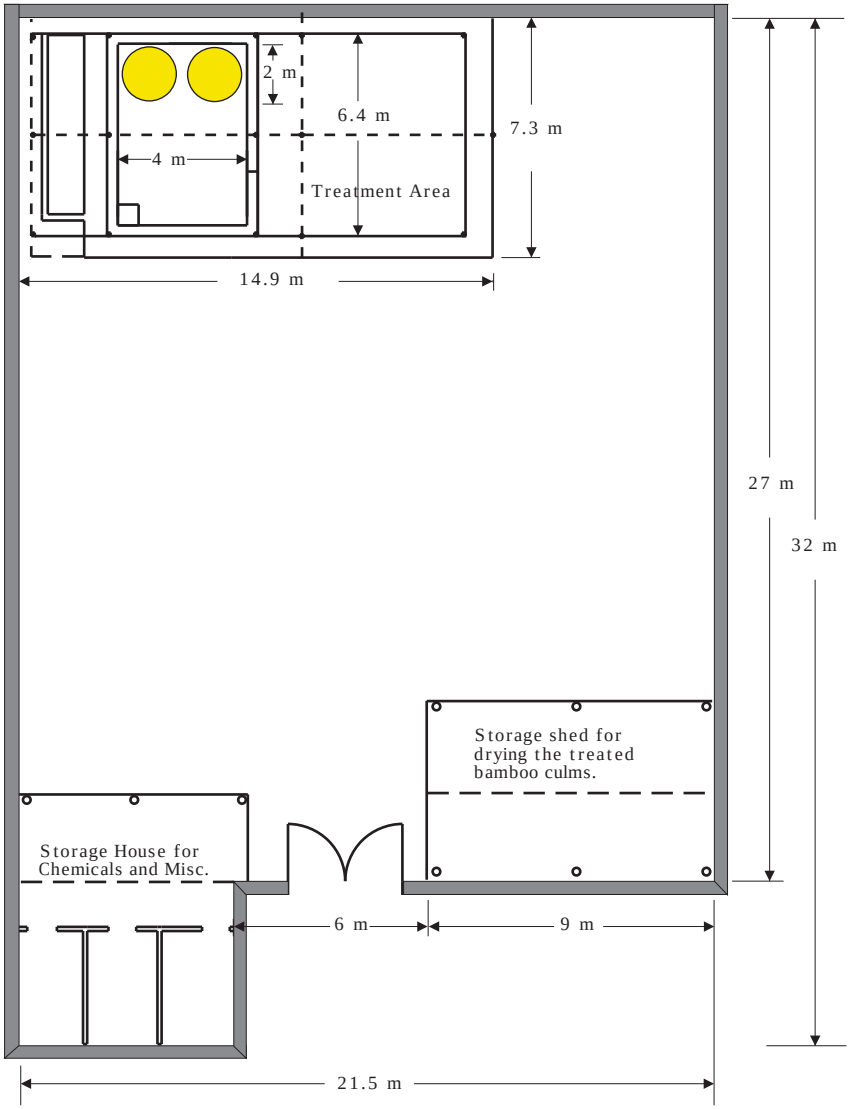
Stored bamboo is endangered by beetle infestation which can be recognized in the form of a talcum-like powder and small holes in the area of the nodes and along the internodes.

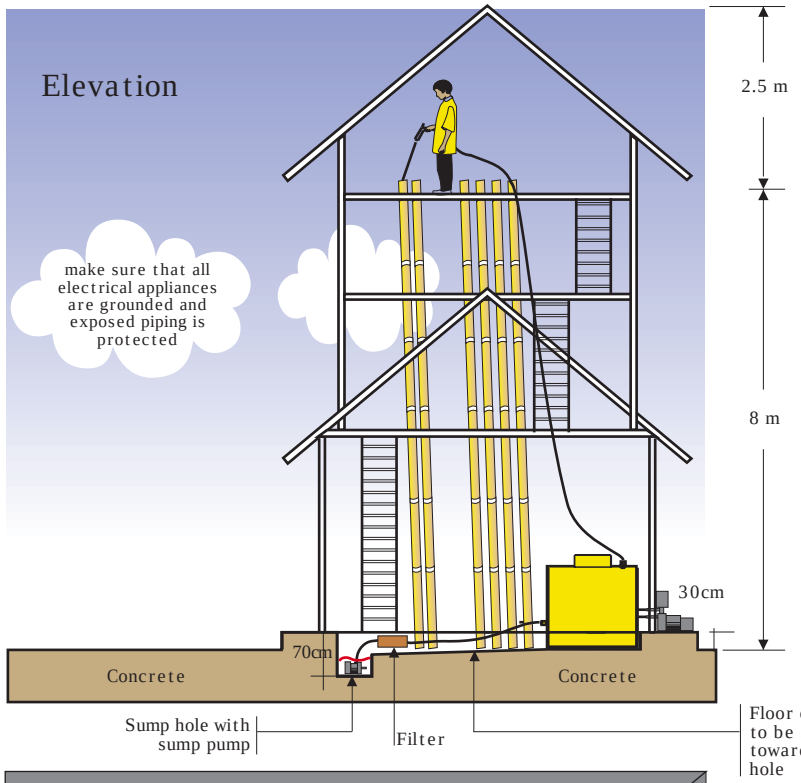


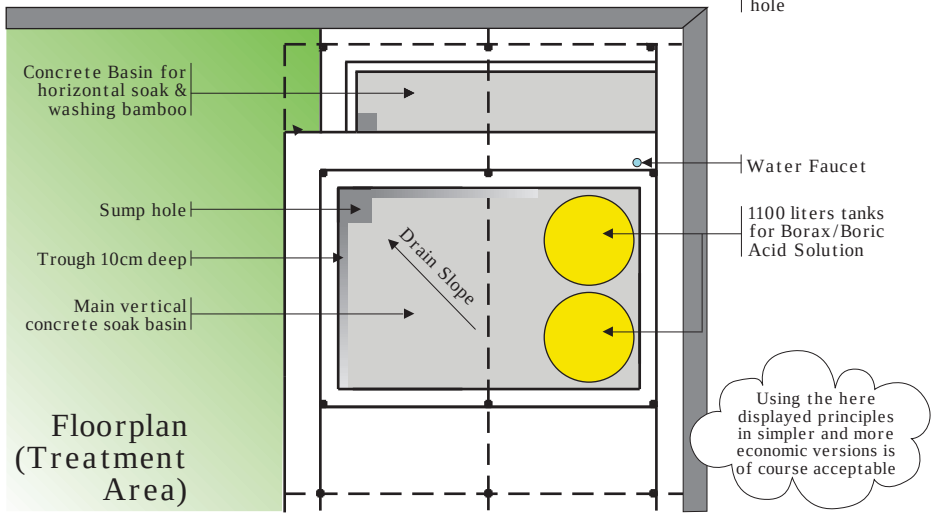
The Powderpost Beetle

Planning a Treatment Center

Floorplan







List of Tools & Materials

Eye Protection

Rubber Gloves

Rubber Boots

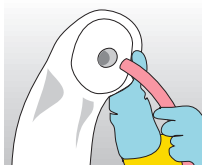
Borax & Boric Acid

Plastic Containers for Mixing & Measuring

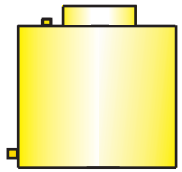
Red Textile Dye, Aniline, high quality

Water

Filter



Plastic Containers for Solution



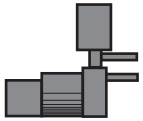
Hacksaw

hex nut

Iron Rod with attached (preferably welded) Hex Nut

Length depending on the culm to be treated

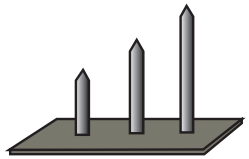
Flat, broad Bamboo or Wooden Stick for Mixing



Pump, plastic and/or stainless steel

Small Sum Pump

Plastic or Rubber Hose



Bamboo Node Punch

Scale: 1.000 - 1.050 for salt solutions

Hydrometers

(can be found in aquarium stores)

Brushes for Cleaning

Rope (for tying Culms)

Mixing the Borax Solution

STEP 1

Calculate the internal volume of the culms.
There are 3 different ways to do this:

1. Volume in liters = inner radius squared x 3.1416 x height in cm of culm divided by 1000
Example: bamboo with radius = 6cm, height = 400cm ((6x6) x 3.1416 x 400)) / 1000 = 45 liters
2. Fill one punctured culm with water and simply measure how many liters it takes to fill it up. Multiply by the number of culms.
3. Fill one average internode; measure the amount in liters and multiply by the number internodes and by the number of culms.

STEP 2

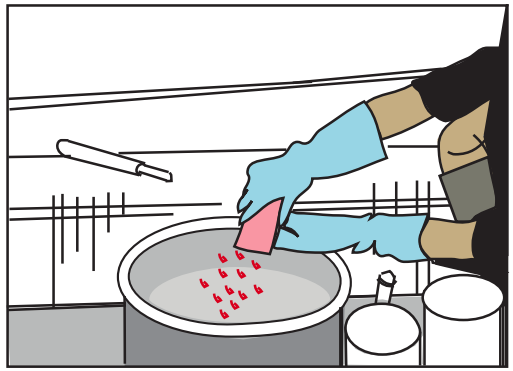
Mix 3 kg of BORAX with 2 kg of BORIC ACID and add 45 liters water. This gives a 9 to 1 or 10% solution

BORAX 3 kg 

BORIC ACID 2 kg 

Water 45 liters 

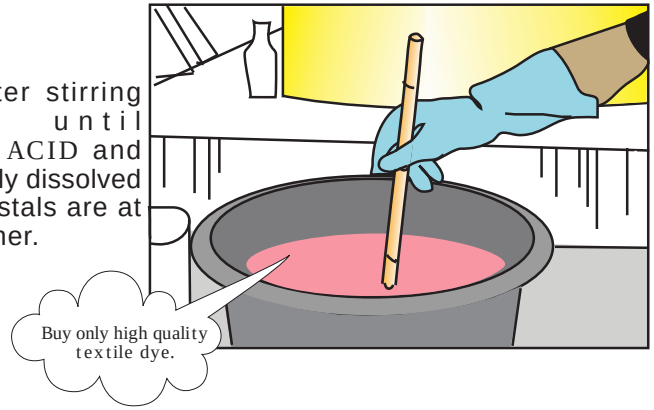
STEP 3



Add red analyn textile dye. It should completely penetrate the tissue of the culms from the inside all the way to the outside skin. If the particles of the dye are too large they will only partially dissolve and "plug" the openings in the tissue thus preventing penetration of the preservative.

STEP 4

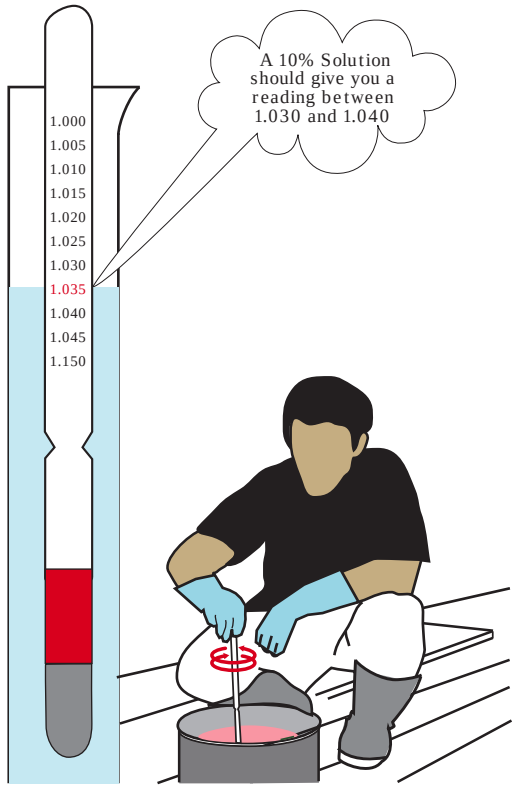
Slowly add water stirring constantly until BORAX/BORIC ACID and dye are completely dissolved and no more crystals are at bottom of container.



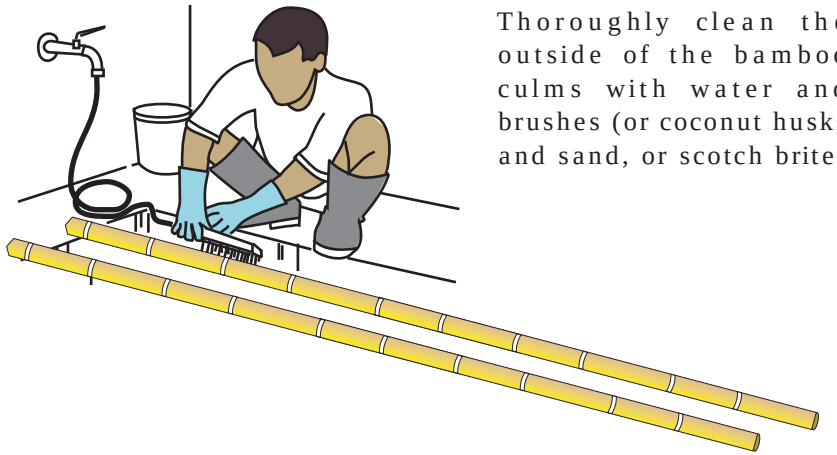
STEP 5

Test the solution with a hydrometer under normal temperatures of your region.
Fill a small test container with the Borax/Boric Acid solution slowly, so as to not form air bubbles.

Lower the Hydrometer into the container and give it a quick twirl like spinning the top. This will get rid of air bubbles that might have accumulated on the hydrometer.
Then read the number where the solution crosses the scale on the hydrometer, like reading a thermometer: 1.035 (or whatever a close number is) will be your benchmark for re-testing the solution later.

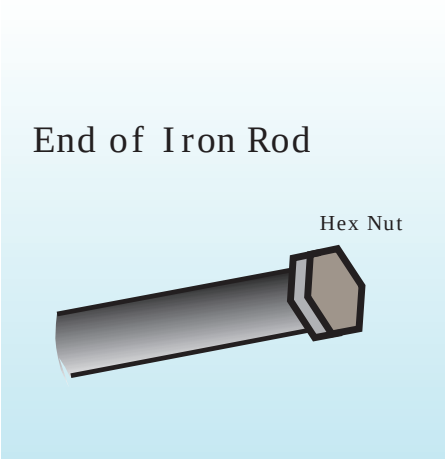


Treatment



STEP 6

Thoroughly clean the outside of the bamboo culms with water and brushes (or coconut husks and sand, or scotch brite)



STEP 7

Weld hex nut to one end of iron rod. With this rod you can punch holes through the diaphragms. The hex nut will create large diameter holes thus preventing air bubbles from forming in the culms during the filling procedure.

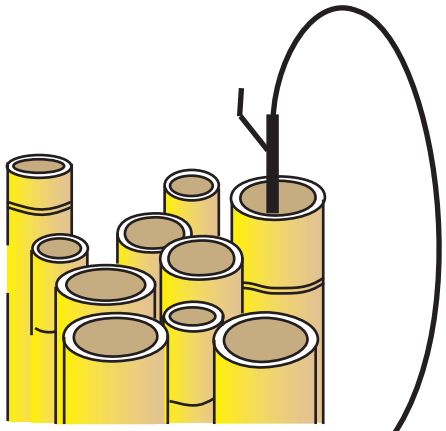
STEP 8

Place the bamboo against a wall. Insert the iron rod and punch holes through the nodes.
Make sure the last node is not punctured.

STEP 9

Move the bamboo to the concrete basin.
Stand up vertically.
Tie culms securely together so that they cannot move when they are being filled with the BORAX/BORIC ACID SOLUTION. Culms become very heavy when filled.

Treatment continued

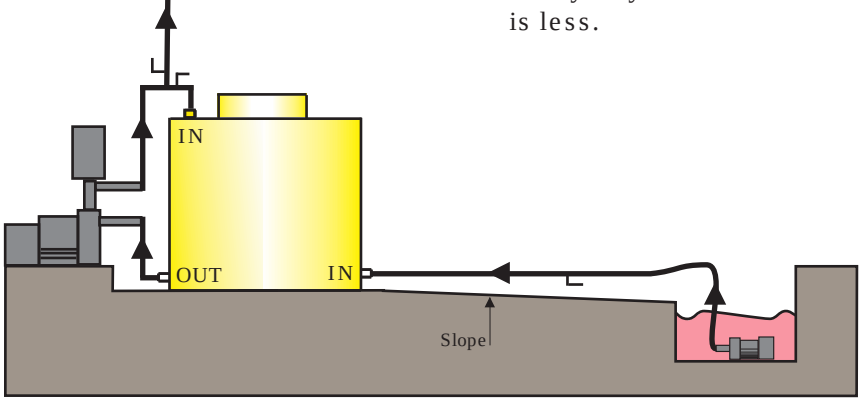


STEP 10

Connect a hose to the container which holds the mixture. Pump the solution into the culms.

STEP 11

Fill the entire bamboo with the solution. Every morning refill the culms which have absorbed approximately 1% of the liquid overnight. Every day absorbtion rate is less.



STEP 12

On Day 13 don't add more solution. Allow the level to go down to avoid overflow when the last node is broken.

Calendar

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Jan	Feb
	1	2	3	4	5	6	Mar	Apr
7	8	9	10	11	12	13	May	Jun
14	15	16	17				Jul	Aug
							Sep	Oct
							Nov	Dec

NOTE:
The time required for complete penetration depends upon the culm wall thickness and its moisture

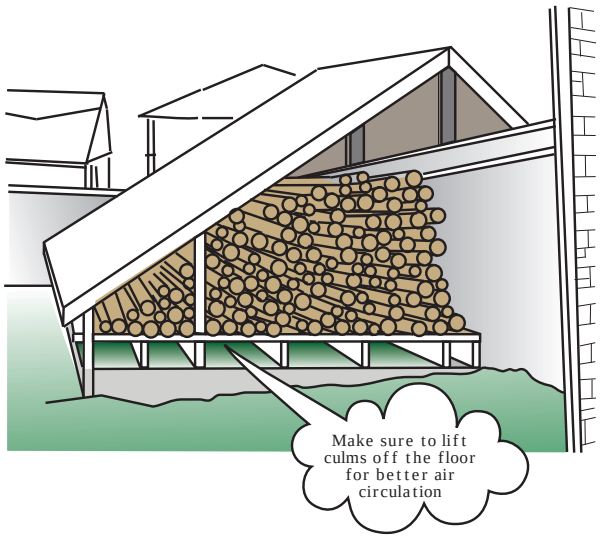
STEP 13

On Day 14, test check the culm by sawing off the upper internode. The fabric dye has now penetrated the culm walls sideways and colored them pinkish. Carefully carry the filled culm close to the sump hole and break the last node using a metal punch. Make sure you wear face protection.
The diaphragms of large culms should be punctured by using the iron rod. The solution will now flow on the sloped basin floor into the sump hole.

Treatment continued

STEP 14

Leave the bamboo for a minimum of one hour in the basin for the solution to fully drain out of culms into the sump hole.
Pump leftover solution back into container through a filter for re-use. The filter should be regularly changed. Test again with the hydrometer and add more BORAX/BORIC ACID if necessary (see appendix page 23). Wipe down the whole culm to remove excess borate.



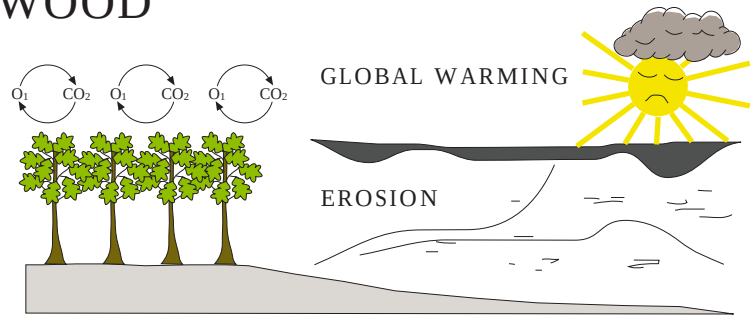
STEP 15

Store the bamboo horizontally or vertically in the shade (hot sun splits it) to slowly dry. Make sure that it is not exposed to rain which could wash out the preservative.

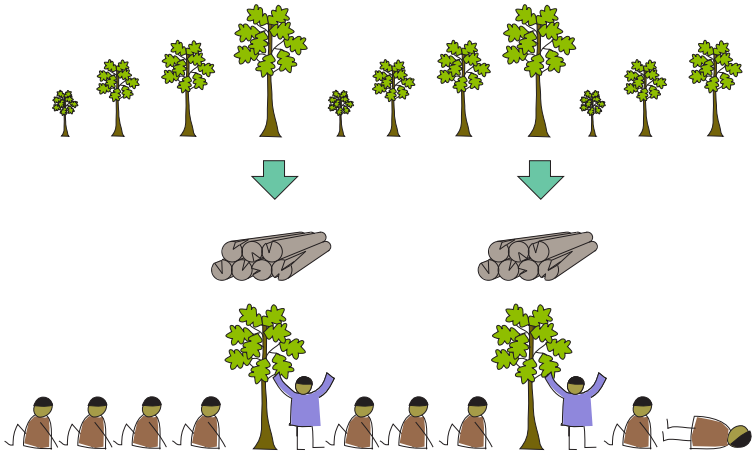
Notes

BAMBOO CONSERVATION - THE ENIBLE WAY

WOOD



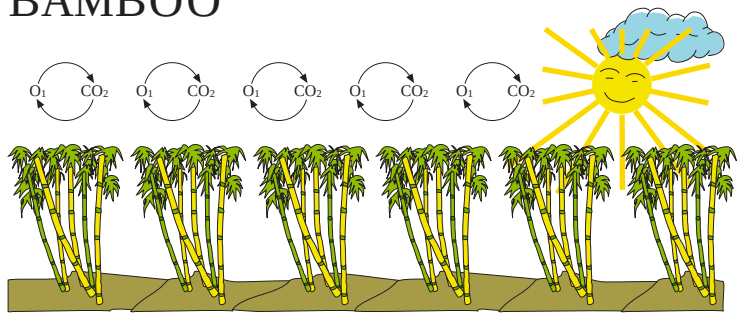
HARVEST ONCE EVERY TEN YEARS



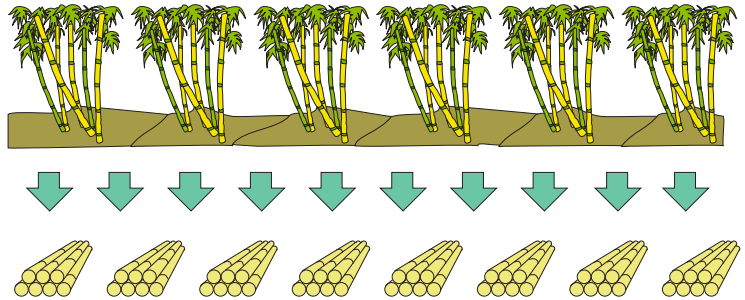
IRREGULAR EMPLOYMENT

IRREGULAR INCOME

BAMBOO



ANNUAL CROP



LABOR INTENSIVE

REGULAR INCOME

0 5 10 15 20 25 YEARS 0 5 10 15 20 25

Appendices continued

B) Information about Borates

BORAX/BORIC ACID is more environmentally friendly than other wood preservatives currently used.

Reuse Guidelines

The BORAX/BORIC ACID SOLUTION can be used more than once for treating bamboo, as long as the hydrometer reading of the solution is still at the initial level, of approximately 1.035. Keep in mind that, as the bamboo sap gets partially drained out of the culm, the starch/sugar from the sap will move into the treatment solution. This can lead to inaccurate hydrometer readings. After the 3rd or 4th use gradually increase the BORAX/BORIC ACID concentration to 1.040 and 1.050. At the point when the drained solution foams significantly and/or mold is forming on the surface of the solution and on the bamboo culm it is time for the solution to be disposed of.

Disposal Guidelines

BORAX/BORIC ACID is non toxic to the environment, but is highly saline. When a moderate amount of it is absorbed into the ground, the ground filters out the salt to the point where it does not pollute the ground water. However, it is advisable to dispose of it safely and out of reach of children.
When diluted with more water the discarded solution could be used as a herbicide on terraces and walkways.

Where to buy BORATES in Indonesia

PT CHIMIFIN JAYA UTAMA, JAKARTA
Tel 021-424-0202, 424-7141, 425-5563
Fax 420-5588

UD. Saba Kimia, Denpasar,
Tel/Fax 0361-410662

B) Job Sheet

Customer Name

Customer Tel. No.

Bamboo Species

Date Arrived

Date Treatment Started

Date Treatment Finished

	1	2	3
Quantity of Culms			
Length of Culms			
Average Inside Diameter			
Average Outside Diameter			

New Liters Added

Liters of Used Solution in Tank

Day 1	
Day 2	
Day 3	
Day 4	
Day 5	
Day 6	
Day 7	
Day 8	
Day 9	
Day 10	
Day 11	
Day 12	
Day 13	
Total Liters Added	

Liters of Solution Left in Tank

Total Liters Used

Day 14	Drying Period
Day 15	Drying Period
Day 16	Drying Period

Total BORAX Used

Total BORIC ACID Used

Appendices continued

C) Cost Analysis

Start-up Costs

(actual costs from Coastal Community Resource Center, Manado, Indonesia)

Foundation Work	US$	368
Cement & Plaster		680
Structural Wood		200
1 Ladder		23
Roof & Platform		270
Water Pump		51
2 Storage Tanks 1100 ltr		150
Plumbing & Electrical		63
Carpenters' & Constr. Labor		650
Tools, Hydrometers		230
3 Metal Pipes, 8m long		15
Total Startup Costs	US$	2,700

Yearly Running Costs (for 2000 culms, 6m, 6.75cm dia)

Borax & Boric Acid	US$	520
Transportation		500
Tools		100
Labor, 3 workers for 24 weeks		865
Labor during Off Season		335
Admin. Wages		290
Repairs & Maintenance		300
Utilities		230
Loan paid back (5Yrs, 3.5% Int.)		600
Misc.		120
Total Running Costs per Year	US$	3,860

If 2000 treated culms were to be sold for US$ 0.60 a piece this would generate a net profit of 45% of gross sales.

D) Local Bamboo Names

Countries	Languages	*Dendrocalamus asper*	*Gigantochloa atter*	*Gigantochloa apus*
 Indonesia	Indonesian	bambu betung	bambu ater	bambu tali
	Balinese			pring tali
	Madurese		péréng keles	
	Javanese	pring betung	pring legi	pring apus
	Sudanese	awi bitung	awi tenen	awi tali
	Batak	bulu batung		
	Manado	bulu jawa	bulu cina	bulu pagar
	Eastern Indon.		bulu jawa	
 Malaysia	Malayu	buloh beting buloh betong buloh panching		bambu tali
 Philipines	Tagalog Bikol Visaya	bukawe botong butong		
 Singapore		rebong china		
 L a o s		hok		
 Thailand		phai-tong		
 Vietnam		manh tong		
 E.Timor	Tetun	patung	au ora	

BAMBOO USES

Upper Culm (Leaves & Branches):

- Arts & Crafts
- Medicinal
- CO_2

Mid-Culm:

- Houses
- Furniture

Base:

- Construction
- Charcoal
- Furniture

Root System:

- Food
- Water Shed
- Erosion control
- Toxic Cleanup
- Charcoal
- Medicinal

Financing

Loans are given

bamboo forests are planted

houses are built

products are made & consumed

products are sold

bank gets loan back plus interest

village is happy