

# Vertical Soak Diffusion

for  
**BAMBOO**  
Preservation  
Vs. 3



ENVIRONMENTAL BAMBOO FOUNDATION



Environmental  
Bamboo Foundation

Third Edition: October 2005

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 Treatment 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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First Edition published 2-1-2003 by: LINDA GARLAND  
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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*

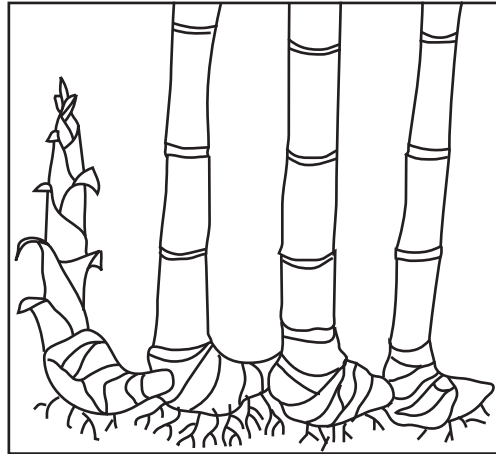
*Gigantochloa atter*

see local names in Appendix.

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 insect attack.

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.

# Managing Bamboo

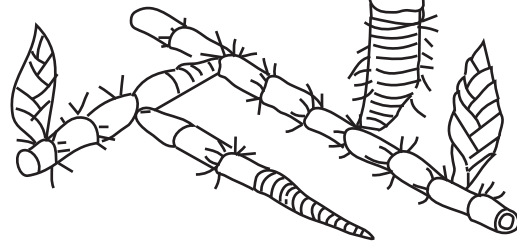


Clumping Bamboo

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.

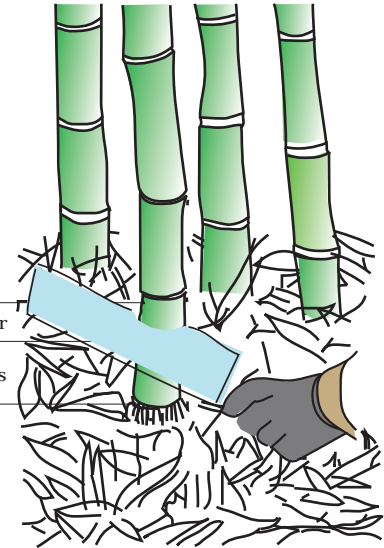
## Running Bamboo

is more prevalent in temperate climates, can be extremely invasive, great for erosion control.

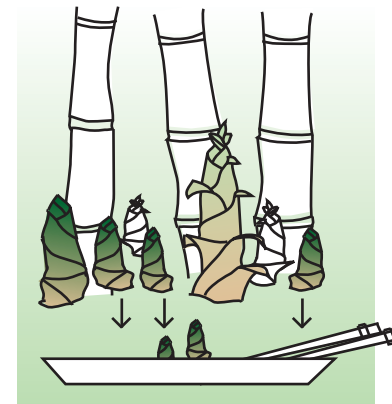


In the dry season, almost all culms that are 3 years or older can be removed from a clump by cutting them just above a node about 20cm above the ground. Some of the younger ones should remain for further nourishment of the rhizome.

10-15cm buffer  
cut 20cm above roots

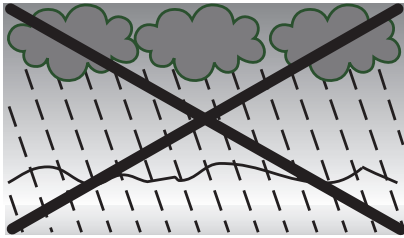


Use a marking pen to date young culms when they first appear, that way you will know when they are at least 3-4 years old without having to guess.

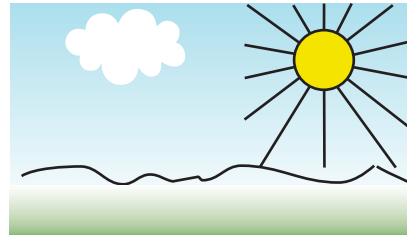


In the shooting season, remove any shoots that are going to create overcrowding (many species are edible, cooked). Leave only the shoots of good diameter which have potential to produce straight strong poles for timber use.

# Harvesting Bamboo



Wet Season



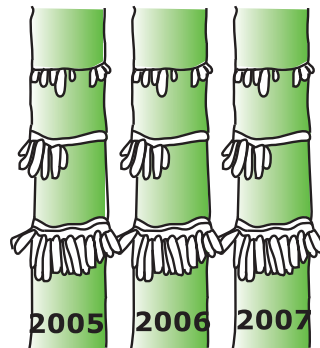
Dry Season

## 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 harvest 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 treatment solution. If the poles are not regularly harvested, they push each other and this causes the development of bent poles.

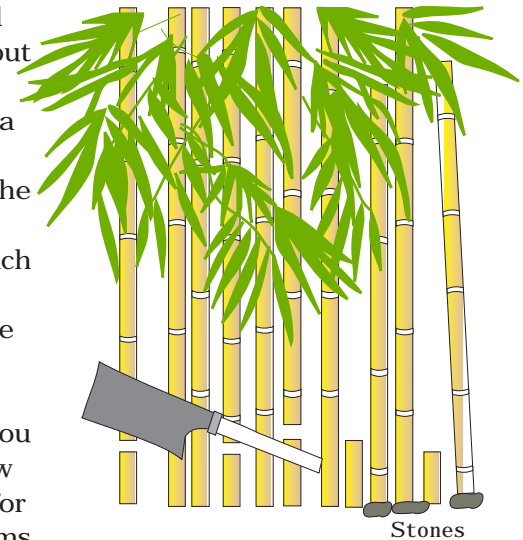
There are 3 different ways to tell the age of bamboo culms:

- 1) Mostly, culms at the inside of a clump are the oldest.
- 2) Label the new shoots; this is the safest method.
- 3) If you are an experienced bamboo harvester you will know the age by knocking on the culm and observe the different sounds.

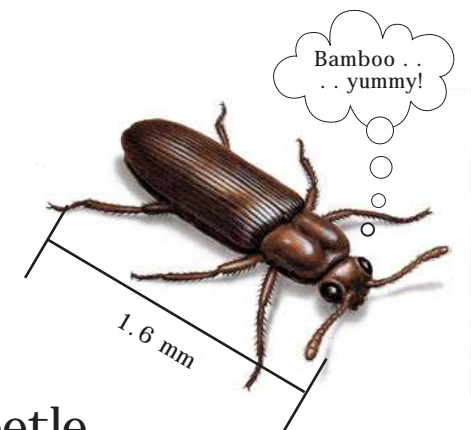


The culms should be treated soon after having been cut, but can be left for a few days standing upright, placed on a stone. Due to the ongoing transpiration by the leaves the culm will lose some of its moisture and also starch, which is the food for the pest.

But don't wait too long, since moisture is required for the following diffusion process. If your bamboo is very dry you can soak it in water for a few days to reopen the vessels for treatment. In case of split culms cut the cracked pieces off, treat them in the horizontal basin.



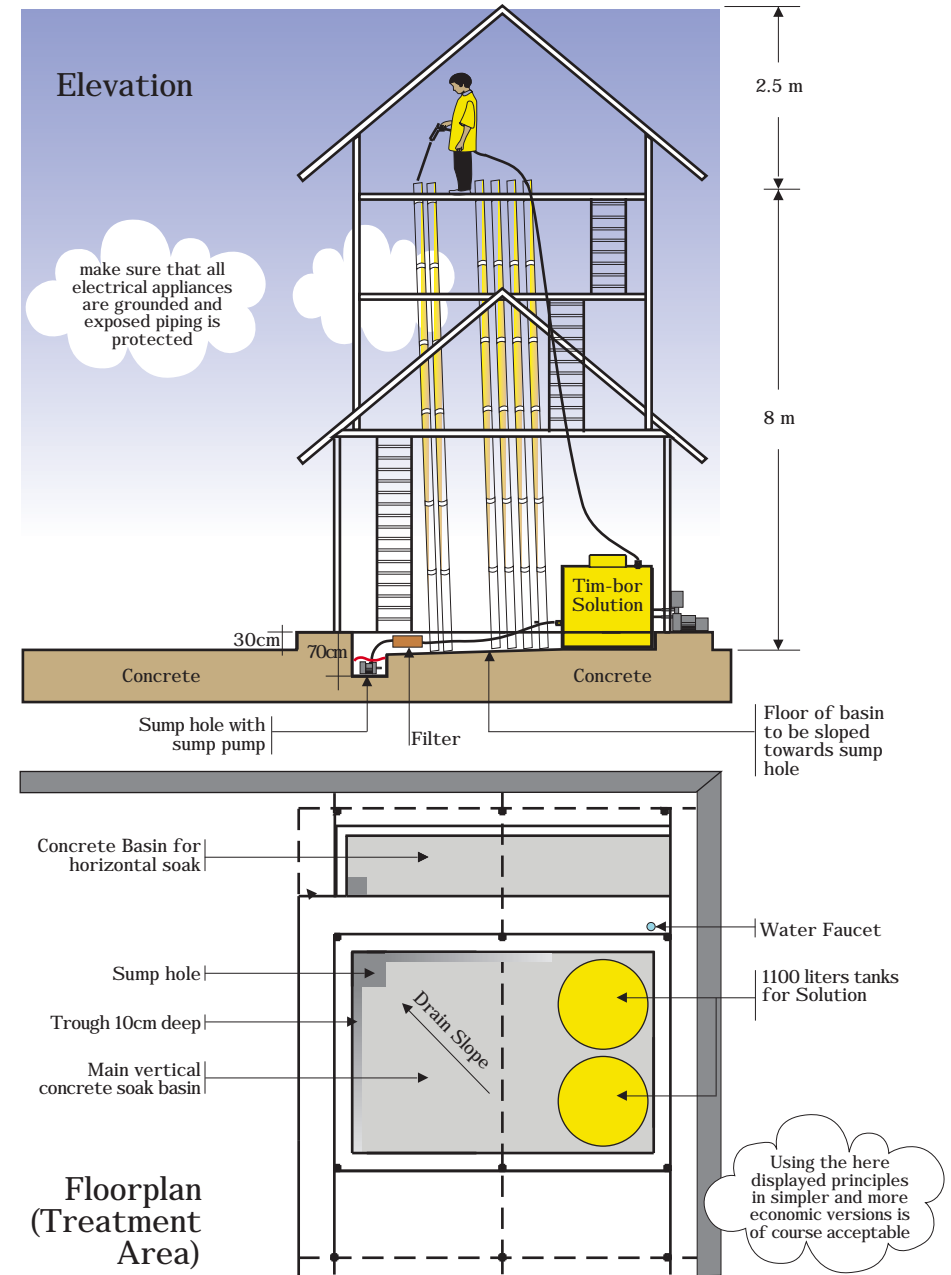
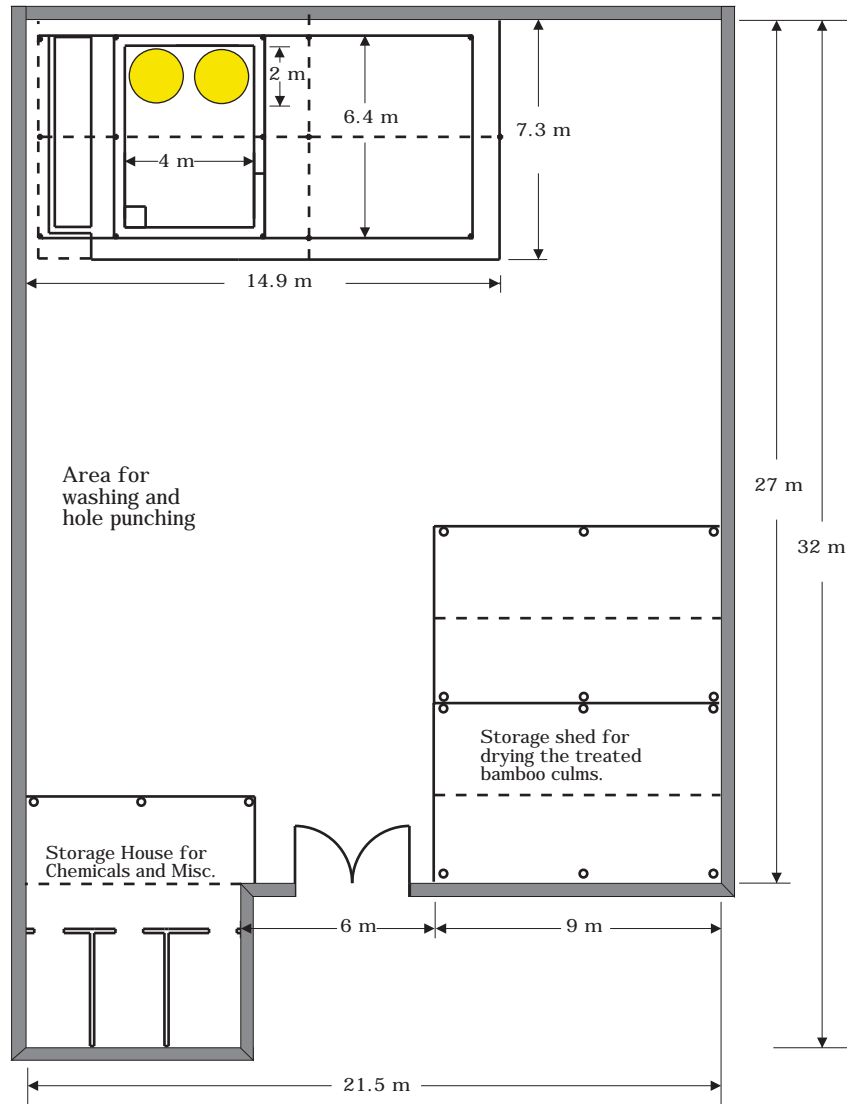
Stored bamboo is endangered by beetle infestation which can be recognized in the form of a talcum-like yellowish powder and small holes in the area of the nodes and along the internodes.



## The Powderpost Beetle

# Planning a Treatment Center

Floorplan



# List of Tools & Materials

Eye Protection



Rubber Gloves



Rubber Boots



Tim-bor

see Appendice page 23



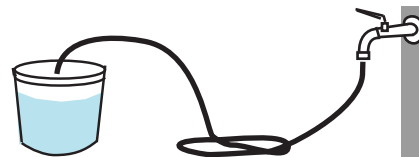
Plastic Containers for Mixing & Measuring



Red Dye



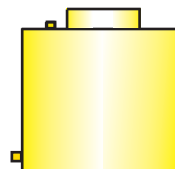
Water



Filter



Plastic Containers for Solution



Handsaw

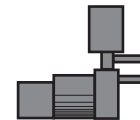


T-Bar with attached (welded) Spear Head

Length depending on the culm to be treated



Flat, broad Bamboo or Wooden Stick for Mixing



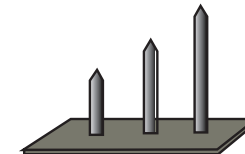
Pump, plastic and/or stainless steel



Small Sum Pump



Plastic or Rubber Hose



Bamboo Node Punch



Hydrometer

(can be found in aquarium stores)



Brushes for Cleaning  
or coconut husks



Rope (for tying Culms)



# Mixing the Tim-bor Solution

## STEP 1

Figure out the internal volume of the culms.

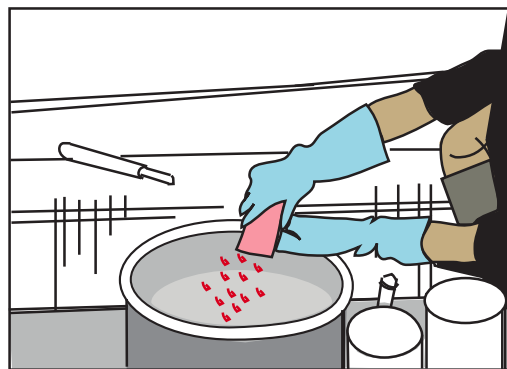
Fill one punctured culm with water and simply measure how many liters it takes to fill it up. Multiply by the number of culms.

## STEP 2

Mix 1 bag of Tim-bor (25kg) with 225 liters of water. This gives a 9 to 1 or 10% weight for weight solution. Keep in mind though that the total quantity of Tim-bor solution is not 250 liters but about 5% less because when 25 kg of Tim-bor are dissolved in water its volume will be reduced.



Please also read page 23.



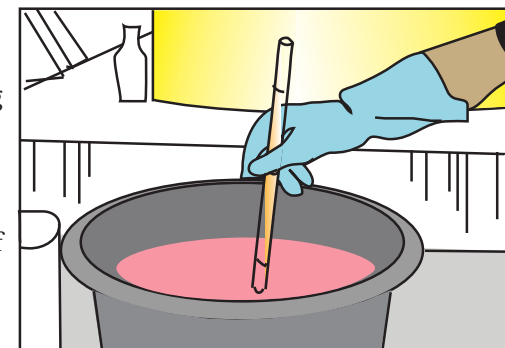
## STEP 3

Add red dye and mix well.

This is done for the purpose of later identifying the treated bamboo poles

## STEP 4

Slowly add water stirring constantly until Tim-bor and dye are completely dissolved and no more crystals are at bottom of container.



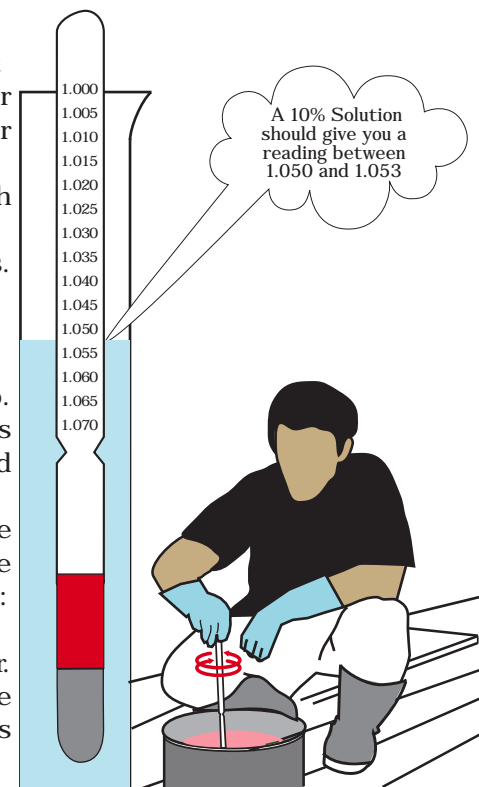
## STEP 5

Test the solution with a salt measuring hydrometer under normal temperatures of your region.

Fill a small test container with the Tim-bor solution slowly, so as to not form air bubbles.

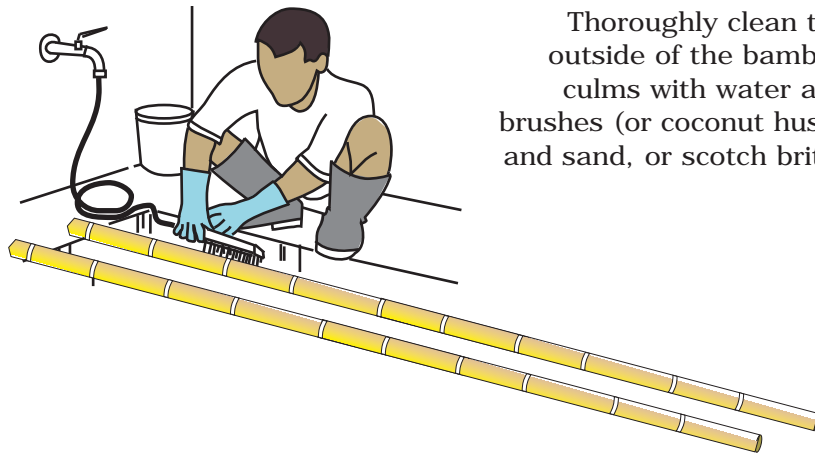
Lower the Hydrometer into the container and give it a quick twirl, spinning the top. This will get rid of air bubbles that might have accumulated on the hydrometer.

Then read the number where the solution crosses the scale like reading a thermometer: 1.052 should be reading on an well-calibrated hydrometer. If this not available make sure you measure the ingredients correctly.





# Treatment



## STEP 6

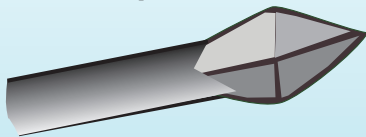
Thoroughly clean the outside of the bamboo culms with water and brushes (or coconut husks and sand, or scotch brite)

## STEP 7

Weld a spear head to one end of iron rod. With this you can punch holes easily through the diaphragms and pieces of the diaphragms don't clog the inside of the culm. Larger diameter holes will prevent air bubbles from forming during the filling procedure. The holes will not diminish the strength of the culm (Prof. Liese).

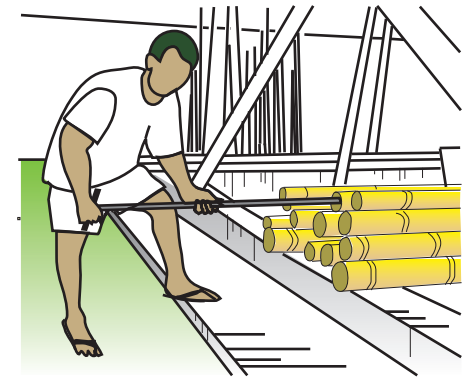
### End of Iron Rod

Spear Head



## 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.

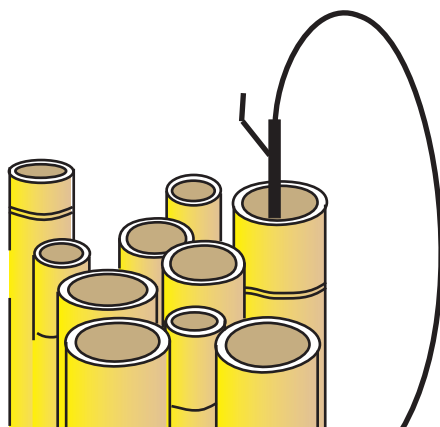


## STEP 9

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 solution. Culms become very heavy when filled.



## Treatment continued

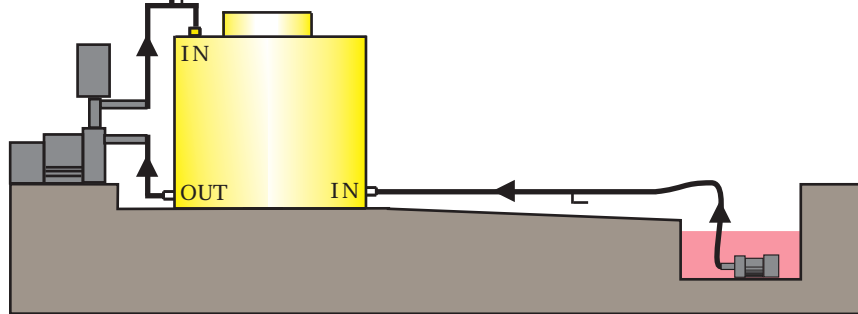


### STEP 10

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 with more of the solution. The culms will have absorbed approximately 1% of the liquid overnight. Every day absorption rate is less.



### STEP 12

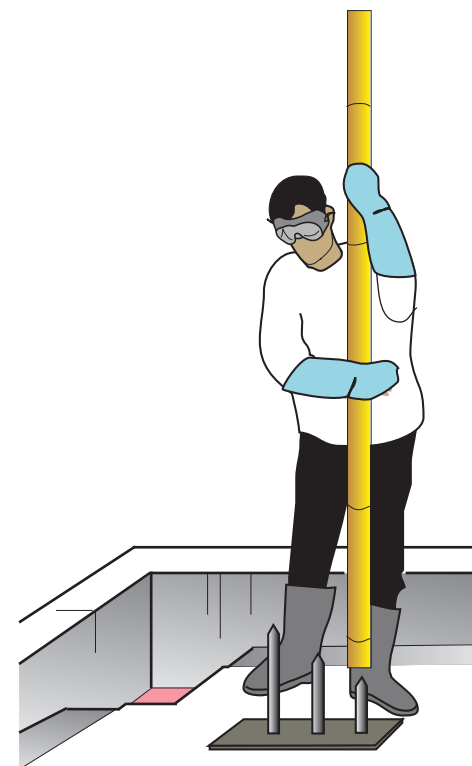
On Day 13 don't add more solution. Allow the level to go down to avoid overflow when the last node is broken.

### STEP 13

On Day 14 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.

## 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



### 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. Hydrometer testing of the re-use solution will be inaccurate because of the added bamboo sugar content (see appendix page 23). Wipe down the whole culm to remove excess solution.

### STEP 15



Dry the bamboo for 4-6 weeks depending on humidity conditions in a well ventilated, covered area. It must be in the shade; hot sun splits the culms. Make sure that they are not exposed to rain which could wash out the preservative.

## Appendices continued

### General Information about Tim-bor

Tim-bor, Disodium octaborate tetrahydrate,  $\text{Na}_2\text{B}_8\text{O}_{13} \times 4 \text{H}_2\text{O}$ , is more environmentally friendly than other wood preservatives currently used. It is a white, odorless, powdered substance that is not flammable, combustible, or explosive and has acute low and dermal toxicity. The product is itself fire retardant and shows no hazardous decomposition,

Tim-bor is superior to BORIC ACID because it diffuses and penetrates bamboo or wood better and faster. Stirring the solution will cause Tim-bor to completely dissolve into the water, resulting in a clear solution which is very stable. Do not use Fertibor ( $\text{Na}_2\text{B}_4\text{O}_7 \times 5\text{H}_2\text{O}$ )

#### Solubility

Substance	Solubility at 20°C	Solubility at 30°C
Tim-bor ( $\text{Na}_2\text{B}_8\text{O}_{13} \times 4\text{H}_2\text{O}$ )	9.7%	21.9%
Boric Acid ( $\text{H}_3\text{BO}_3$ )	5.5%	6.3%

#### Reuse Guidelines

The Tim-bor solution can be used more than once for treating bamboo. 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 leads to inaccurate hydrometer readings. After the 3rd or 4th use add more Tim-bor. 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. For more info, visit [www.borax.com](http://www.borax.com)

EBF is currently researching sap content percentages in re-used solutions and will develop more accurate procedures to deal with this issue.

#### How to mix your own Tim-bor in case you don't find a friendly supplier in your country

Our chemist David Kueper, MSc (Organic Technical Chemistry), MBA, from Switzerland has tested this:

Tim-bor can be made by slowly adding 50KG of Boric Acid and 75KG of Borax to 700 liters of water while stirring the solution. When all crystals are dissolved, you will have the equivalent of a 10% Tim-bor solution.



#### Disposal Guidelines

Tim-bor 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.

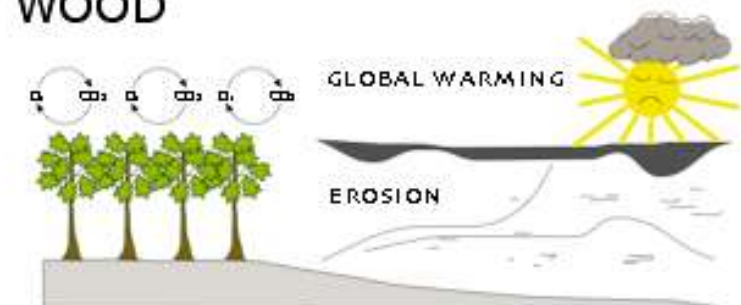
When diluted with more water the discarded solution could be used as a herbicide on terraces and walkways.

#### Where to buy Tim-bor or Borax/Boric Acid in Asia

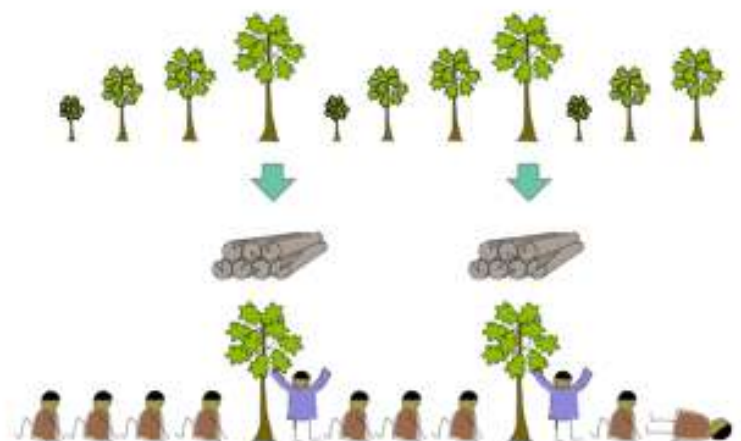
- Pt Chimifin Jaya Utama, Jakarta  
Tel 021-424-0202, 424-7141, 425-5563  
Fax 420-5588
- UD. Saba Kimia, Denpasar,  
Tel/Fax 0361-410662
- Tim-bor distributor in Thailand  
22/2 Moo2, Soi Jadsarntaharnrua  
Chalermprakiet Rama 9 Rd  
Dokmai, Praves, Bangkok 10250, Thailand  
66 2-726-7300 / 7350, contact: Numchai L.

# BAMBOO CONSERVATION

## WOOD



HARVEST ONCE EVERY TEN YEARS



IRREGULAR EMPLOYMENT

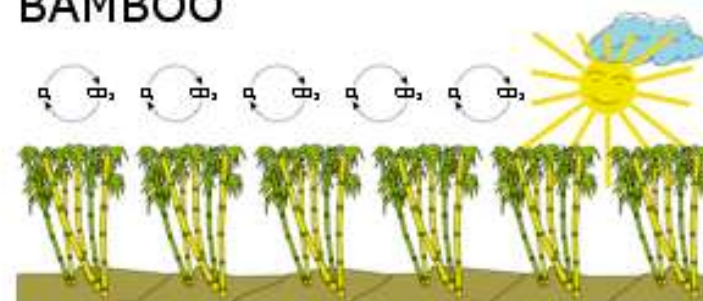


IRREGULAR INCOME

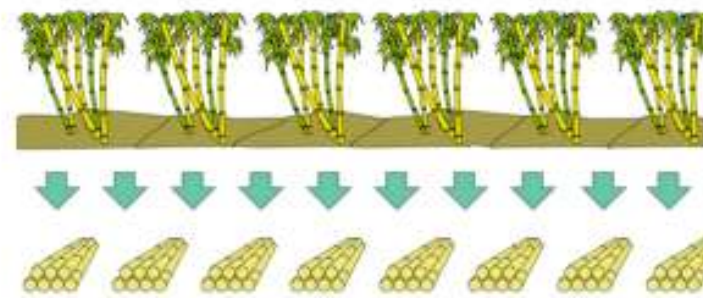
0 5 10 15 20 25

YEARS

## BAMBOO



ANNUAL CROP



LABOR INTENSIVE



REGULAR INCOME

0 5 10 15 20 25

## Job Sheet

Customer Name

Customer Tel. No.

Bamboo Species

Date Arrived  Quantity of Culms  1  2  3

Date Treatment Started  Length of Culms

Date Treatment Finished  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

## Local Bamboo Names

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



## BAMBOO USES

### Upper Culm (Leaves & Branches):

Arts & Crafts  
Medicinal  
CO2

### 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



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