KFRI Research Report No. 456 ISSN No. 0970 - 8103

Livelihood improvement of marginal bamboo dependants: artisans and farmers of selected clusters

K K Seethalakshmi
S Sanker
R C Pandali
E M Muralidharan
T K Damodharan
V P Raveendan

Kerala Forest Research Institute
(An Institute of Kerala State Council for Science, Technology & Environment)
Peechi 680 653, Thrissur, Kerala

July 2012

KFRI Research report No. 456 **ISSN No.0970 - 8103**

Livelihood improvement of marginal bamboo dependants: artisans and farmers of selected clusters

K K Seethalakshmi [1], S Sankar [2], R C Pandalai, [3]
E M Muralidharan ,[4] T K Damodharan [5] and VP Raveendran [1]
Divisions of [1] Sustainable Forest Management, [2] Forestry and Human Dimension
[3.] Extension and Training, [4] Forest Genetics and Biotechnology and
[5] Wood Science and Technology

Kerala Forest Research Institute
(An Institute of Kerala State Council for Science, Technology & Environment)
Peechi 680 653, Thrissur, Kerala

July 2012

Contents

	Page No.
Acknowledgements	
Abstract of the proposal	
Introduction	1
Chapter – 1. Cluster development	4
Identification of clusters	5
Identification of master trainers	9
Training for artisans	10
Development of appropriate tools and design	14
Establishment of Coordination centre	16
Chapter – 2. Bamboo Resource development	18
Establishment of new plantations	18
Conclusions	22
Appendix 1– Training Manual in Malayalam	24
Appendix 2 –Species suitable for cultivation in Kerala	36

ACKNOWLEDGEMENTS

We are deeply indebted to Dr. K. V. Sankaran, Director, Kerala Forest Research Institute and to Dr. J. K. Sharma and Dr. R. Gnanaharan former Directors, for providing facilities and encouragement. The financial support was received from Government of Kerala through the grants provided to Kerala State Council for Science, Technology and Environment (KSCSTE) and we are grateful for this valuable support. We are especially thankful to Drs. Thomas P. Thomas, V. Anitha and M. Sivaram for the editorial comments which contributed for the improvement of the report.

We duly acknowledge and place on record our sincere gratitude to the whole hearted support received during the implementation of the project from (a) the selected clusters in organizing the training programme and (b). the farmers and collaborative institutions in the establishment of new plantations. The project was completed with technical assistance from Mr. R. Ratheesh and Mr. M. S. Santhosh Kumar and we are specially thankful to them.

Abstract of the proposal

Title: KFRI 498/06: Livelihood improvement of marginal bamboo dependants: artisans and farmers of selected clusters

Objectives

1. To identify clusters of marginal bamboo dependants and assess current status with regard to income and employment.

2. To organize and conduct training programme on bamboo cultivation and management for farmers.

3. To organize and conduct training programme on designing and manufacture of premium bamboo products to artisans.

4. To identify master trainers and provide intensive training in processing, design and development of value-added products.

5. To identify species suitable for different value added products jointly with artisans and establish model plantations of selected species with farmers.

6. Establish a coordination centre with facilities for purchase and storing of bamboo raw material, mechanized preliminary processing, preservative treatment and distribution of semi-processed material to artisans for manufacture of value added products and their marketing.

Investigators

Dr. K K Seethalakshmi - Sustainable Forest Management

Dr. S Sankar - Forestry and Human Dimension

Dr. R C Pandalai - Extension and Training Centre

Dr. E M Muralidharan - Forest Genetics and Biotechnology

Dr. T K Damodharan - Wood Science and Technology

Mr. V P Raveendran - Sustainable Forest Management

Duration: April 2006 to March 2009

Budget: 15.83 lakhs

Funded by: Kerala State Council for Science, Technology and Environment

INTRODUCTION

Kerala, one of the bamboo rich states of India has about 27 bamboo species. The agro-climatic conditions are suitable to grow most of the priority species selected for cultivation at the national level. Although there are skilled bamboo artisans due to a paradigm shift in land use and cropping pattern, i. e., paddy cultivation to other crops, such as, banana and coconut in the agricultural sector and the introduction of a wide variety of household items made of plastic and rubber, the demand for routine traditional products made by the skilled craftsmen dropped drastically. When a preliminary assessment was done in some of the selected clusters of artisans in Palakkad and Thiruvananthapuram districts of the state, it was found that daily per capita income is less than Rs. 50/. Similarly, farmers having bamboo in their homesteads were unaware of the potentials for value addition, scientific methods of management and harvesting.

The Planning Commission, Government of India, subsequent to the launching of National Mission on Bamboo Technology and Trade Development in the year 2002, developed an action plan to give maximum emphasis for promotion and development of bamboo during the tenth plan (Planning Commission, 2003). Creation of 8.6 million jobs in the bamboo based development programmes with an intention to enable 5.01 million families to escape poverty on a sustainable basis, upgradation of skills of craftsperson, food and nutritional security through consumption of bamboo shoots, among others are proposed for livelihood and nutritional security. The action plan envisages laying down a foundation of a modern bamboo economy with input from science, technology, people's participation, industrial application and strong linkage with market capable of meeting global competition. While a national level attempt for integrated development of bamboo sector is made in a mission mode, the percolation of the benefits to the rural poor is very slow. One important reason being marginalised community being outside the

main stream of development with large number of new entries in the field. Besides this, procurement of the raw material and lack of marketing avenues for the traditional products manufactured by the artisans also are major constraints. Kerala Forest Research Institute was actively involved in network projects which have contributed to the development of bamboo and cane artisans through transfer of technologies and improvement of the raw material supply. Upgradation of skills for production of marketable items through training can definitely improve the livelihood of marginal bamboo dependants. One pilot project implemented in a cluster of traditional artisans in Thenkurussi Panchayath, Palakkad district with this objective was successful.

This project envisages a larger study covering 10 clusters in selected Panchayths rich in bamboo resources and artisans with the following six objectives.

1. To identify clusters of marginal bamboo dependants and assess current status with regard to income and employment.

2. To organize and conduct training programme on bamboo cultivation and management for farmers

3. To organize and conduct training programme on designing and manufacture of premium bamboo products to artisans.

4. To identify master trainers and provide intensive training in processing, design and development of value-added products.

5. To identify species suitable for different value added products jointly with artisans and establish model plantations of selected species with farmers.

6. Establish a coordination centre with facilities for purchase and storing of bamboo raw material, mechanized preliminary processing, preservative treatment and distribution of semi-processed material to artisans for manufacture of value added products and their marketing.

Training on the manufacture of value added products was implemented to traditional artisans. Species suitable for cultivation in the area was selected and planting stock was distributed to farmers. The farmers were given training for establishment of bamboo plantations. Since the homesteads of many farmers contain bamboo and the prominent species is *Bambusa bambos,* information was provided for scientific management of existing bamboo clumps. The details are provided in the report.

Chapter – 1. CLUSTER DEVELOPMENT

CHAPTER -1

CLUSTER DEVELOPMENT

The major traditional bamboo artisan community in Kerala are the community "Kavaras" belonging to Scheduled Caste category. They earn their livelihood by producing traditional bamboo products, such as, winnows, baskets and mats. Most of the products were used for processing paddy and other grains. Due to several reasons, the extent of paddy cultivation is reduced in the State and the land is converted to either banana cultivation or other perennial crops like the coconut and areca nut plantations. The demand for conventional bamboo products became very less resulting in reduction of income of the traditional artisans. It then became necessary for them to find alternate sources of employment in other sectors, like in construction and agriculture. Lack of availability of bamboo and increase in cost along with the introduction of substitute items which are more durable added to this problem. As a result, the younger generation today is reluctant to learn the traditional art of weaving and other handicraft work from their parents as done earlier. If this trend continues traditional bamboo craft will become extinct from the State. The socio-economic studies highlight that the "Kavaras" do not give necessary importance to higher education. It is so because they are not aware of the types of benefits/opportunities available to them. Hence with the livelihood improvement projects support should be given to create awareness among them on higher education, importance of their traditional knowledge and culture and the necessity to save for a better future. In this context, along with a socio-economic assessment among the Kavaras, KFRI also organized a one-month training programme on the manufacture of value added bamboo products in demand in the market in the selected clusters.

Identification of clusters

Based on the number of families, five clusters of traditional artisans were identified for providing training in manufacture of value added bamboo products, four in Palakkad (Kuthanoor, Mundur, Nemmara, Vadakkunchery) and one in Wayanad District (Begur). The current status of three clusters namely Eyyankadu, Ezakadu and Nemmara padam in Palakkad District was assessed through a socioeconomic survey (Table 1). Training for one month was provided to artisans.

Table 1. Details of the clusters selected for training

Location of the Cluster and distance from nearest town	No. of families	No. of artisans	History	Present status
Eyyankadu, Kuthanoor, Palakkad 17 km from Palakkad town	24	131	Settled in Kerala over three-four generations	Main source of livelihood is daily wage employment in the construction and agriculture sector.
Ezhakad, Mundur, Palakkad 17 km from Palakkad town	95	447	"	"
Nenmmara Padam, Nemmara, Palakkad 14 km from Vadakkunchery twon	10	55	Not known	"

Profile studies

The demographic profile of the cluster indicated a preponderance of males over females and this was highest in the Nammeara Padam Cluster (9.72%). Of the different age groups, the higher numbers were found in the adulthood and

middle age groups (Table 2). Less than 10 per cent were recorded in the age group classes of infancy, early childhood, and old age in all the clusters.

Table 2. The age-wise classification of the members of the clusters

Category	Kuthanoor	Mundur	Nemmara
Values in percentage			
Male Female Ratio	52.67 (47.33)*	50.34 (49.66)*	56.36 (43.64)*
Infancy (0-2 Years)	2.29	3.58	3.64
Early Childhood (2-4 Years)	4.58	4.7	5.45
Childhood (4-10 Years)	16.67	10.74	14.55
Adolescent (10-19 Years)	21.37	18.34	20.09
Adulthood (20-30 Years)	28.24	27.52	18.18
Middle age (31-60 Years)	20.61	27.07	25.45
Old age (61 Years and above)	6.11	8.05	3.64

* Percentages of females in parenthesis

Bamboo usage

On an average per month five numbers of bamboo are used in Eyyankadu cluster. The cost of bamboo is about Rs. 75 – 100 and it depends on size of the bamboo. Usually *Bambusa bambos* and *Dendrocalamus strictus* are used. Raw material is procured from adjacent homesteads or natural forest. On an average from one bamboo they make products worth Rs. 400 and it fetches an average income of Rs. 1449.46/ month.

In Mundur cluster, the average use of the resource is eight bamboos and three bundles of reed (*Ochlandra travancorica*). When reed is not available at subsidised rates they depend on bamboo. Raw material is sourced from adjacent homesteads or purchased from depots or collected from the natural forest. On an average from one bamboo they will make products worth Rs. 350. Their average income per month from bamboo is Rs. 2024.59.

In Nemmara, the average use of bamboo and reed per month is 5 and 100 respectively. Cost per bamboo is Rs. 75 – 150. *Bambusa bamboos*, *Dendrocalamus strictus* and *Ochlandra travancorica* are commonly used by them. Bamboo is collected from their nearby places and reeds from Nelliyampathy forest. From one bamboo products Rs. 350/- worth is made. The average income per month

from bamboo and reed is Rs. 1955.56. In all the clusters, bamboo products are marketed by visiting houses. On an average the artisans work for 20-25 days in a month and there is no fixed time for work.

Table 3 depicts the details of number of members per family, type of houses, source of drinking water, toilet facilities and electric connection along with the percentage of people below poverty line.

Table 3. Details of families

Name of the Cluster	Average No/family	Housing/ type of houe	Source of Drinking Water	Toilet facilities (%)	Electric connection (%)	Under BPL (%)
Kuthanoor	5	Own, tiled - 18, RCC – 3, thatched roof -3	Public or Panchayath well.	80	62..5	75
Mundur	5	Own, tiled - 78, RCC – 12, thatched roof -4, Sheet - 1	Public taps	91.58	36.84	73.68
Nemmara	5.5	Own, tiled - 8, RCC – 2	Public taps	60	60	70

Education level

In general, majority of the members do not avail higher education. The main reasons being lack of interest and financial problems. At Kuthanoor, 66 per cent of members dropped out their studies due to lack of interest and 24 per cent due to financial problems. In Mundur, it was 54.74 per cent and 4.21% respectivelySixty per cent of members dropped out their studies due to lack of interest and financial problems in Nemmara.

Financial liabilities

In Kuthanoor and Mundur clusters more than 50 per cent had financial liabilities either with bank or private money lenders. At Kuthanoor, 58 per cent had debt from banks and private money lenders. In Mundur only a few (12.63%) were

indebted to the banks and private money lenders. Alcoholism is one of the major social evils in this cluster. In Nemmara, 70% are indebted to banks and private money lenders.

Hygiene and information about health schemes

Except in Mundur cluster, the others had enough information about hygiene and Centre. Members of Kuthanoor cluster depend on the nearest primary Health Centre (PHC) at Kuthanoor and Panchayath. A few families also depend on private medical facilities. Inhabitants of Mundur cluster do not have adequate hygiene and health information. Government organization or persons have not exposed them to health education. For their health needs, they usually depended PHC at Mundur and private clinics and hospitals. In Nemmara, people depended on the Primary Health Centre (PHC), Nemmara and the Panchayath. Here also a few families depend on private medical facilities.

Infra structure and participation in meeting of Grama Sabha

All the three clusters have adequate infrastructure like road, water, electricity, and street lights. In Kuthanoor, 70.83 per cent and in Mundur 95.79 per cent and in Nemmara about 100 per cent are actively participating in Grama Sabha meeting.

Alternate employment and shift from traditional work

In all the clusters, most of the traditional workers especially younger generation are going for alternate employment sources of daily wages in construction or agriculture sector. In Kuthanoor, 87.5 per cent are going for other employment. In this cluster, income from NRI sources such as gulf money was also observed. In Mundur, more than 85 per cent had found alternate employment, while it was up to 90 per cent in Nemmara. The present artisans acquired the skill for traditional work from their parents and grand parents.

In brief, major constraints are faced by the clusters among the younger generation to take up the traditional activity to earn their livelihood. This is mainly due to various reasons like lack of raw material and high cost, low demand for traditional products and low cost, difficulty in marketing and low status in society in comparison with other jobs. Traditional artisans have good skill in processing of bamboo when compared to others. If enough training is provided for the manufacture of value added products and partial mechanization along with assured supply of raw material this sector can be at least sustained. Organized marketing of the premium products manufactured by the artisans is also required.

Identification of Master Trainers

To conduct the training programmes in selected five clusters master trainers were required. During the previous project in Vakkathara, Thenkurussi, Palakkad, KFRI had trained traditional artisans with the support of resource persons from URAVU and National Institute of Design, Ahmedabad. Some of the artisans had showed excellent skill in the manufacture of premium products and in addition designed some of the innovative products on their own. Six artisans including four male and two female were selected from this group namely Mr. Krishnan, Mr. Velayudhan, Mr. Krishnankutty and Mr. Thankan, Mrs. Thatha and Mrs. Chella. Of these, Mr. Krishnan was given an opportunity to participate in the National Trade Fair at Pragathi Maidan, New Delhi. In the Kerala pavilion he taught weaving (Fig. 1).

Fig 1. Master trainers Mrs and Mr. Krishnan, Then-kurussi Bamboo Consortium monitoring 1. bamboo processing and 2. weaving at the Kerala Pavilion during an exhibition in December 2006 at Pragathi Maidan, New Delhi.

TRAINING FOR ARTISANS

For improving the livelihood of the traditional artisans in the selected clusters, KFRI organized training programmes for a period of one month in the clusters. The objectives of the training were:

1. to rejuvenate the traditional bamboo work.
2. to make the traditional bamboo workers self sufficient.
3. to motivate the younger generation to protect their tradition.
4. to ensure the improvement of their livelihood.

During the training period KFRI provided food, tool kit, raw material and also a stipend as a compensation for the wages they would have earned during these days. Cultural activities were also promoted during the weekends for better interaction among the participants and resource persons. The details of the training programme are given below. Training for duration of one month was provided in five locations, 15 days for twice in Parambikulam and 4 - 5 days duration in seven locations (Table 4 & 5). A total of 356 artisans were trained under this programme (one months training – 133; two weeks training for 39 and 3-4 days training for 184. Although the training programmes were initially envisaged in the clusters of Palakkad district, training was provided as per the demand to clusters from other districts also.

Schedule of training

An inaugural function was organized on day one and the Presidents of Grama and Block Panchayaths, Ward members, other dignitaries from Bamboo artisans association, officials like resource persons from KFRI, District Industries Centre (DIC) and Master craftsmen participated in the inaugural function.

Table 4. Details of one month training programmes organized

No.	Location of the Cluster	Dates	No. of artisans trained
1	Eyyankadu, Kuthanur, Palakkad	14.11.2006 to 19.12.2006	26
2	Ezhakad, Mundur, Palakkad	16.01.2007 to 19.02.2007	16
3	Nenmmara Padam, Nemmara, Palakkad	01.03.2007 to 30.03.2007	33
4	Vadakkunchery, Palakkad	11.05.2007to 10.06.2007	30
5	Begur, Wayanad	01.02.2008 to 02.03.2008	23
		Total	133

Table 5. Details of short-term training programmes organized

Duration of training : 15 days			
1	Parambikulam	15-31.08.2008	24
2	Parambikulam	22-30.06.2009	15
		Total	**39**
Duration of training : 3 - 5 days			
1	Olakara , Thrissur	24 -29.03.2008	25
2	Chimmini dam Palakkad	01–05. 04. 2008	25
3.	Chungam Colony	25-27.07.2008	39
4	Earthdam Colony	28-30.07.2008	16
5	Kadavu colony	31. 07.2008 to 3.08.2008	15
6	Kuriarkutty colony	04-06.08.2008	28
7	Nilambur	17-23.02.2009	36
		Total	**184**

The training for one month was conducted in all the clusters as per the following schedule. A manual was given to the trainees (Appendix 1). For short-term training items as per the demand of trainees were taught.

Day 1: Familiarisation with the tool kits

Day 2: Information about preservative treatment and colouring agents

Day 3 – 7: Weaving: Flower baskets (pookooda)

Day 8 – 9: Weaving: Flower vases

Day 10 – 16: Furniture: Bammooda (Bamboo stool)

Day 17 – 20: Handicrafts: Scale flowers

Day 21 – 24: Handicrafts: Tea trays

Day 25– 29: Handicrafts: organisers for pen/pencil etc

Day 30: Evaluation and feed back

Brief report of training programmes

Kuthanoor

Training programme was inaugurated by Mr. C.M Kuppan, President, Kuzhalmannam block panchayath. Dr. K. K Seethalakshmi, Scientist KFRI, explained the objectives and details of the programme. Mrs. Leela Balan, President, Kuthanoor grama panchayath gave the presidential address. Important personalities from different areas of mainstream society gave felicitations. Dr. S. Sankar, Scientist from KFRI, delivered the vote of thanks. Four mastertrainers Mr. Krishnan, Mr. Velayudhan, Mr. Krishnankutty and Mr. Thankan were selected from Bamboo Consortium, Vakkathara, Thenkurissi, Palakkad and was given the responsibility to conduct the training (Fig. 2).

Mundur

Mr. M. T. Jayaprakasan, President, Palakkad block panchayath inaugurated the programme. Dr. K. K Seethalakshmi, Scientist, KFRI presented an outline of the training programme. Mr. M. Balakrishnan, President, Mundur grama

panchayath, gave the presidential address. Dr. S. Sankar, Scientist from KFRI, delivered the vote of thanks. The master trainers for this programme were Mr. Krishnan, Mr. Velayudhan, Mr. Chellan, Mr. Thankan, Mrs. Thatha and Mrs. Chella from Bamboo Consortium, Vakkathara, Thenkurissi.

Nemmara

Mr. K. Babu, President, Nenmara grama panchayath inaugurated the training. Dr. K. K Seethalakshmi, Scientist, KFRI, gave an outline of the programme. Mrs. T. K Sreemathy, Ward Member, Nenmara Grama Panchayath, gave the presidential address. Dr. S. Sankar, Scientist from KFRI, delivered the vote of thanks. The master trainers responsible for this training were Mr. Krishnan, Mr. Velayudhan and Mr. Chellan (Fig. 3).

The traditional artisans had good knowledge about the bamboo raw material such as different species, optimum maturity, and season for harvesting, traditional methods of processing like smoking among other. They have excellent skill in the processing of bamboo into slivers with their simple tools of two knives, different types of weaving and craft. It was easy to train them for manufacture of value added products. Some of them were even able to make innovative products such as lantern type land shades, bamboodas, baskets and different types of toys which were not taught by master trainers.

Regarding the marketing of products, KFRI was able to assist them for participation in different exhibitions like Kerala Bamboo Fest, temple festivals like *Vallangivela, Kalpathi Ratholsavam* among other in which the products were introduced to public. When bulk order comes the major constraint was non-availability of raw material in the vicinity. KFRI had addressed this by promotion of bamboo cultivation in non-forest areas (details in next chapter).

Fig 2. Training in Kuthanor cluster 1. Inauguration of the training programme 2. Invocation 3. Mr. Kuppan, Block panchayath President addressess the gathering 4 & 5 Different views of gathering. 6. Distribution of the training kit

Fig 3. Training in Nemmara cluster 1. Inauguration of the programme 2. A lampshade made by the master craftsmen 3. Dr. Sankar, resource person, KFRI the conducting socio-economic survey 4 . Artisans learning to make flower-vase

DEVELOPMENT OF APPROPRIATE TOOLS AND DESIGN

One of the limitations was the use of conventional tools for processing of bamboo. Based on the simple hand tools in use by bamboo artisans in China, a set of devices were fabricated locally and tested for acceptability in the bamboo cluster at Vakkathara, Palakkad.

Bamboo splitting tool

This set of tools are used for splitting small lengths of bamboo culms into sections of fixed width. Accordingly the wheel shaped device consisting of a ring shaped handle and a variable number of spokes was fabricated with one side of the spokes sharpened for a cutting edge. The axis of the wheel has a pointed spoke to facilitate puncturing the septa at the nodes. The procedure of splitting which was successfully tested consists of holding a length of culm of about 90 cm vertically on the ground and the wheel with the knife edge pointing downwards used to strike the top cut end so that the tool cuts the culm wall into equal section corresponding to the number of spokes. The culm with the tool in place is hit against the ground so that the splitting process continues until the end is reached (Fig. 4. 1 and 2). The tool reduces considerably the drudgery of splitting bamboo culms when compared to the hatchet or heavy knife normally used by the artisans. The resulting split bamboo is much more uniform. Splitting tools with 3, 4 and 5 spokes each were fabricated and tested by the artisans with very good success and acceptability for both fresh culms as well as air dried culms. The regular use of the tools is expected to improve productivity and quality of products made by bamboo artisans who are struggling to make a livelihood out of the bamboo products in a highly competitive market.

Use of hot melts adhesive for handicrafts

The artisans were applying white glue (fevicol) to affix bamboo handicrafts which was not suitable for all purposes and sometimes spoilt the appearance. The use of hot melt glue that was delivered using a hot gun was suggested as a solution. The alternative resulted in stronger bonds and facilitated bonding of

difficult to attach components without spoiling the appearance of the finished product.

Design of products

Simple designs for three products lamp shade, fruit tray and CD rack was developed using round and split bamboo (Fig. 4. 3-5). This was easily accepted and produced by the artisans.

The hand held simple tools reduce the workload of artisans. It can be used in rural areas easily since they do not require power supply. Innovative designs are the back bone of handcrafts and it increases the acceptability. Only limited attempt was made during since the time was short. There is scope for improvement of tools and designs through research input in this field.

Fig 4. 1. Traditional way of splitting 2. splitting using new wheel-like tool. 3. Design of a lampshade 4. fruit tray and 5 CD rack

ESTABLISHMENT OF COORDINATION CENTRE

A central facility where raw material of bamboo is available along with facility for primary processing is highly useful in the manufacture of quality products at cheaper rate. Attempts to establish a facility i.e, a coordinator centre was made during this project period.

Selection of the cluster with infra structure

An expert team consisting of Drs. R. Gnanaharan, S. Sankar, T. K. Damodharan, and K. K. Seethalakshmi from KFRI and master trainers visited the clusters at Thenkurussi, Kuthanoor, Mundur, Nemmara and Vadakkunchery and inspected the existing infrastructure, availability of bamboo resources in the vicinity and transport facilities. Of the five clusters Vadakkumcherry Industrial handicrafts Society was identified by the team since the cluster had a permanent building, area for storage of bamboos, place for artisans to work and easy accessibility from NH 47. Permission from Kerala State Council for Science, Technology and Environment (KSCSTE) was sought to execute an MOU with this society.

Identification of processing machineries

Information on various machines available for processing of bamboo was gathered from different bamboo machinery production units. It was found that the following five machines are essential for the Primary Processing Centre.

1. Bamboo Cross Cut Machine
2. Bamboo hydraulic splitter with complete power packs
3. Bamboo Manual slicing machine
4. Bamboo square stick making machine

5. Bamboo internal knot removing machine with skin removal

Although orders were placed for the five machineries for the primary processing centre, several constraints (viz, technical objections in making full payment before the machines were delivered and tested, lack of adequate human resources, delay in processing the permission, resulted in inordinate delay and the machines were not procured. Hence, this component was not completed during the project period.

CHAPTER - 2. BAMBOO RESOURCE DEVELOPMENT

CHAPTER -2
BAMBOO RESOURCE DEVELOPMENT

Limited availability and high price of raw material are the major limitations for livelihood improvement of bamboo artisans. Artisans mainly depends on bamboo and bamboo reeds from forest areas. There were several problems like, maturity of raw material, damage during transport, insect and pest attacks on stored bamboos, among others. Enhancement of resources in the vicinity by establishing new plantations and increasing the productivity of existing bamboo clumps by scientific management are the two ways to increase the raw material supply. KFRI addressed this issue by 1. establishment of new plantations and 2. awareness creation on the potential of bamboo and methods for scientific harvesting.

Establishment of new plantations

Species suitable for cultivation: Although about 18 genera and 134 species of bamboos are reported from India, only less than 20 species are commercially important. Others are rare or restricted in occurrence. Based on the possibility for production of planting stock through seeds or vegetative methods, the growth observed in bambusetum and pilot demonstration plots established by KFRI from 1996 onwards under various projects and multiple uses of species, the following 15 species are suggested for cultivation in homesteads of Kerala. The details of the species are given in Appendix – 2.

1. *Bambusa balcooa* Roxb (*Dendrocalamus balcooa* (Roxb.) Voight).
2. *Bambusa bambos* Voss (*Arundo bambos* L. ; *Bambusa arundinacea* (Retz.)Willd)
3. *Bambusa nutans* Wall. ex. Munro
4. *Bambusa polymorpha* Munro

5. *Bambusa vulgaris* Schrad.ex. Wendl
6. *Dendrocalamus asper* (Schult) Bacjer ex Heyne)
7. *Dendrocalamus brandisii* (Munro) Kurz.
8. *Dendrocalamus giganteus* Munro
9. *Dendrocalamus hamiltonii Nees* and Arn.ex.Munro
10. *Dendrocalamus longispathus* Kurz.
11. *Dendrocalamus membranaceus*
12. *Dendrocalamus strictus* (Roxb.) Nees
13. *Ochlandra travancorica* Benth.
14. *Pseuoxytenanthera stocksii (Oxytenanthera stocksii)*
15. *Thyrsostachys oliveri* Gamble

Production of planting materials: Using different methods standardized by KFRI for propagation such as seedlings, rooted cuttings and offsets, planting stock of about 11 species were produced in four nurseries, two at KFRI (Field Research Centre, Velupadam and KFRI campus, Peechi) and two in collaboration with private farmers in Palakkad District (Mr. Subramanian and Mr. Tony Thomas). Of the 11 species, four (*B. bambos D. giganteus, D. strictus* and *O. travancorica)* were produced from seeds and other eight species (*B. balcooa, B. nutans, B. vulgaris, D. asper, D. brandisii, D. membranaceus P. stocksii* and *T. oliveri)* were produced by rooting cuttings. Altogether about 30000 plants were produced.

Awareness campaigns: To increase the awareness on the potential of bamboo, species suitable for cultivation, technology for establishment of plantation and scientific management of bamboo stands, awareness programmes were conducted in selected panchayaths and institutions. The details are given below.

1. Meeting at Kanhirapuzha Panchayath - November 2007

2. Meeting of farmers at Thenkurussi Panchayath – December 2007

3. Sensitization workshop for Agriculture officers at CADA Office, Kanhirapuzha, Palakkad February 2008.

4. Public function for protection of land at Kalpathy, Bharathapuzha river basin, Akathethara Panchayath, February 2008.

5. National Seminar on Bamboo, Department of Botany, Mercy College, Palakkad - November 2008

Plantations: Some of the farmers and officials from institutions who came forward to plant bamboo in their homesteads/campus were given planting materials free of cost and technical know-how for establishment and management of bamboo plantation. The details are given in Table 6.

Table 6. Details of Individuals/Institutions collaborated for establishment of bamboo plantations

Particulars	Species planted
Mr. C. Ramakrishnan Thenkurussi	*Bambusa bambos*
Mr. Suresh, FCRI, Kanjikode	*Bambusa bambos, B. balcooa, B. vulgaris T. oliveri*
Mr. Pushkaran,	*Bambusa bambos, B. balcooa, B. vulgaris T. Oliveri,*

Muthalamada	*O. travancorica*
Mr. Balakrishnan, Ottappalam	*Bambusa bambos, B. balcooa, B. vulgaris T. oliveri, D. brandisii, D. giganteus. O. travancorica*
Mr. Vincent, Olavakkode	*B. balcooa, B. vulgaris T. oliveri, O. travancorica*
Vasudevan Namboothiripad	*T. oliveri, D. giganteus*
Dr. Viji, Muthalamada	*D. strictus, D. asper*
Mr. Devadas, Thenkurussi	Bambusa bambos, D. strictus
Mr. Manas, Alanellore, Mannarghat	*T. oliveri*
Ahalya Eye Hospital, Thathamangalam	*B. balcooa, B. vulgaris T. oliveri, O. travancorica*
FCRI, Kanjikode	*B. bambos, B. balcooa, B. vulgaris T. oliveri, O. travancorica*

The support for promotion of bamboo cultivation in non-forest areas is being continued by KFRI through projects supported by National Mission on Bamboo Applications (NMBA) and National Bamboo Mission (NBM). Data on survival, growth and bio-mass is being recorded.

Fig 5 . Growth of different bamboo species in plantations established under collaborative programmes. 1. *D. strictus*, 2. *B. bambos* 3. *B. vulgaris*, 4. *B. balcooa*, 5. *B. bambos* after clear felling 6. Recording observations

CONCLUSIONS

The project mainly envisaged to improve the livelihood of traditional bamboo artisans. They were producing traditional items which were in demand during 1970s when paddy cultivation was common. The recent changes in land use pattern and problems involved in agriculture especially paddy cultivation in particular resulted in lack of demand for the products they were already making. With the project intervention the following improvement were noted.

1. Enhancement of awareness on potential of bamboo and possibility of value addition,
2. Skill development for manufacture of premium products,
3. Development of small and simple tools that are hand operated to reduce the workload,
4. Exposure to market, competition of marketing with the introduction of quality products from China and create quality consciousness among the artisans,
5. Increase the self confidence and the realization that the traditional work is very valuable,
6. Introduce bamboo as a high value crop to farmers,
7. Technology transfer in nursery and plantation technology for bamboos.
8. Establishment of plantation for demonstration purpose in collaboration with farmers.

The major limitations were

1. Lack of good raw material in the vicinity and the high cost,
2. Inability and lack of organization to supply materials in large quantity,

3. Low income compared to other sectors like agriculture and construction,
4. Lack of Interest of youngsters in traditional work and attraction towards white collar jobs,
5. Lack of technology for production of planting material of species preferred by farmers like Rangoon bamboo (*Thyrsostachys oliveri*),
6. Lack of organized marketing for bamboo and bamboo products,
7. Lack of knowledge about scientific management of bamboo,
8. Non-availability of land for large-scale planting.

If there is an integrated effort from Departments of Industries, Forest, Agriculture and Rural Development along with the input of knowledge from R& D institutions bamboo sector can be tremendously improved in the state.

മുള കരകൗശല പരിശീലന പാഠ്യപദ്ധതി

ദൈർഘ്യം - ഒരുമാസം

ദിവസം 1 ഉപകരണങ്ങളെ പരിചയപ്പെടുത്തൽ

മുളയിൽ ഉപയോഗിക്കുന്ന വിവിധ ഉപകരണങ്ങളെക്കുറിച്ച് വിശദമായി പറഞ്ഞു കൊടുക്കണം.

1) പ്രൂണിങ്ങ് സോ - ഇരുവശവും മൂർച്ചയുള്ള പല്ലുകളോടുകൂടിയ ഉപകരണം. മുള മുറിക്കാനുപയോഗിക്കുന്നു.
2) ഹാക്സോ - മുള ചെറിയ കഷ്ണങ്ങളായി മുറിക്കാൻ ഉപയോഗിക്കുന്നു.
3) സ്കിൻ സ്ക്രാപ്പർ - തൊലി ചുരണ്ടിക്കളയുവാനുപയോഗിക്കുന്ന വളഞ്ഞ കത്തി.
4) മൾട്ടി പർപ്പസ് നൈഫ് - എല്ലാ ഭാഗവും മൂർച്ചയുള്ള വിവിധോദ്ദ്യേശ കത്തി.85യു
5) ചിപ്ലി - കമ്പ് ചുരണ്ടുവാനുപയോഗിക്കുന്ന ഉപകരണം.
6) വിഡ്ത്ത് സൈസർ - പൊളിരുകളുടെ വീതി അറിയുവാനും, ഒരു പോലെയാക്കുന്നതിനും ഉപയോഗിക്കുന്ന ഉപകരണം.
7) പ്രൂണർ - മുറിക്കുവാൻ ഉപയോഗിക്കുന്ന കത്രിക.
8) ഗേജ്-പൊളിരുകളുടെ കനം അറിയുവാനും ഒരുപോലെയാക്കുന്നതിനും ഉപയോഗിക്കുന്ന ഉപകരണം .
9) കാലിപ്പർ അളവുപകരണം.
10) സ്കെ യിൽ
11) ടെബ്ലിൻ അളവ് അറിയുവാനും ആവർത്തിക്കുവാനും ഉപയോഗിക്കുന്ന ഉപകരണം.
12) ഡ്രിൽ -തുളക്കുവാൻ
13) സാന്റ് പേപ്പർ/എമരിപേപ്പർ - മിനുസപ്പെടുത്താൻ
14) അരം
15) ബ്ലോലാമ്പ് - ഫിനിഷ് ചെയ്യുന്നതിനും നിറം കൊടുക്കുന്നതിനും ഉപയോഗിക്കുന്നു.
16) നാരായം - പൊളിരുകൾ മിനുസപ്പെടുത്താൻ ഉപയോഗിക്കുന്നു.

ദിവസം 2 മുളയുടെ വിവിധ ഇനങ്ങൾ

ഭാരതത്തിൽ ഏകദേശം 1600 ഇനം മുളകൾ കാണപ്പെടുന്നു (ഈറ്റകൾ 12 ഇനം).

ഏറ്റവും വലിയ മുള	ആനമുള (ഡെൻഡ്രോ കലാമസ് ജൈജാൻഷ്യസ്)
സാധാരണ കാണപ്പെടുന്നത്	മുള്ളുമുള (ബാംബൂസ ബാംബൂസ്)
സാധാരണ ഈറ്റ	ഒക്ലാൻട്ര ട്രാവൻകൂറിക്ക
പേനയുണ്ടാക്കുന്ന ഈറ്റ	ഒക്ലാൻട്ര സ്റ്റിപ്റ്റോറിയ
ബിലാത്തി മുള	ഡെൻഡ്രോകലാമസ് ബ്രാൻഡിസി
മഞ്ഞമുള	ബാംബൂസ വൾഗാരിസ്
ബുദ്ധാസ് ബെല്ലി	ബാംബൂസ വാമിൻ (ഇടമുട്ടുകൾ വീർത്തിരിക്കുന്ന അലങ്കാരമുള)
എരംകോൽ	കാസർഗോഡ്, കണ്ണൂർ, നിലമ്പൂർ എന്നിവിടങ്ങളിൽ കാണപ്പെടുന്ന അകം പൊള്ളയല്ലാത്ത മുള.

ദിവസം 3 മുള സംസ്കരണം

ട്രീറ്റ്മെന്റ്

- കാസ്റ്റിക് സോഡ
- ബോറിക് ആസി ഡ്

കളറിങ്ങ്

- വസന്ത കളർ
- അജന്ത കളർ
- ഉപ്പ്

5 ലിറ്റർ വെള്ളത്തിൽ 6 പായ്ക്കറ്റ് കളർ പൗഡറും ഒരു പായ്ക്കറ്റ് ഉപ്പും ചേർത്ത് തിളപ്പിക്കണം.

ദിവസം 4

പൂക്കുട

പഠിതാക്കളെ രണ്ടു ഗ്രൂപ്പുകളായി തിരിക്കുന്നു (A,B). പൂക്കുട ഉണ്ടാക്കുവാൻ ആദ്യമായി മുള പൊളിച്ച് $^{1}/_{2}$ ഇഞ്ച് വീതിയിൽ പൊളിരെടുത്ത് കാലുണ്ടാക്കണം. രണ്ടു മില്ലീമീറ്റർ വീതിയിൽ പൊളിരെടുത്ത് അളിയായി ഉപയോഗിക്കാം. രണ്ടു ഗ്രൂപ്പുകളും പൂക്കുട ഉണ്ടാക്കണം.

പൂക്കുട		അളവുകൾ
വ്യാസം		9 ഇഞ്ച്
പൊക്കം		9 ഇഞ്ച്
പൊളിരുകൾ		
കാലുകൾ	നീളം	$1^{1}/_{2}$ അടി
	വീതി	$^{1}/_{2}$ ഇഞ്ച്
അളികൾ	വീതി	2 മില്ലീമീറ്റർ

ദിവസം 5

പൂക്കുട

കാലുകളും,അളികളും ആവശ്യത്തിന് ഉണ്ടാക്കണം. എല്ലാവർക്കും ഒരു പോലെ പൂക്കുട പറഞ്ഞു കൊടുക്കണം.

നെയ്ത്ത് അറിയാത്തവർക്ക് പ്രത്യേകം ചെയ്ത കാണിച്ചു കൊടുക്കണം.

ദിവസം 6

പൂക്കുട

ആവശ്യത്തിന് അളികൾ ഉണ്ടാക്കണം. പൂക്കുട നെയ്ത്ത് തുടരുകയും

ഓരോരുത്തരേയും പ്രത്യേകം നിരീക്ഷിച്ച് അറിയാത്തവർക്ക് ചെയ്യ കാണിച്ചു കൊടുക്കണം.

ദിവസം 7

പൂക്കുട

പൂക്കുട നെയ്യ പൂർത്തിയാക്കാൻ അളികൾ ആവശ്യമുണ്ടെങ്കിൽ അത് തയ്യാറാക്കി പൂക്കുട നെയ്യ പൂർത്തിയാക്കണം.
സംഘം രജിസ്റ്റർ ചെയ്യുവാനുള്ള അപേക്ഷ ബന്ധപ്പെട്ട ഓഫീസിൽ നൽകണം.

ദിവസം 8

പൂക്കുട

പൂക്കുടയുടെ വക്കു കെട്ടുന്നതിനായി പനനാര് അഥവാ പന വഴുക (3 മില്ലീമീറ്റർ വീതി) ഉണ്ടാക്കി വക്കു കെട്ടുന്നതിനെ കുറിച്ച് എല്ലാവർക്കും ഒരു പോലെ പറഞ്ഞു കൊടുക്കുക. അറിയാത്തവർക്ക് പ്രത്യേകം ചെയ്യ കാണിച്ച് കൊടുക്കണം.

ദിവസം 9

പൂക്കുട

പൂക്കുടയുടെ വക്കു കെട്ടുന്നതിനുള്ള പനനാരിന്റെ പൊളിരുകളുണ്ടാക്കി വക്കു കെട്ടണം. ഓരോരുത്തരേയും പ്രത്യേകം ശ്രദ്ധിച്ച് അറിവില്ലാത്തവർക്ക് ചെയ്യ കാണിച്ചു കൊടുക്കുകയോ പറഞ്ഞു കൊടുക്കുകയോ ചെയ്യണം. വക്കു കെട്ടു പൂർത്തിയാക്കണം.

ദിവസം 10

പൂക്കുട

ഇരു വശവും വക്കു കെട്ട് പൂർത്തിയാക്കാത്തവരെ അതിനു സഹായിക്കണം. അതിനുശേഷം കൈപ്പിടി വെക്കുന്നതിന് $^{1}/_{2}$ ഇഞ്ച് വീതിയിൽ 14 ഇഞ്ച് നീളത്തിൽ ഒരു മില്ലീമീറ്റർ കനത്തിൽ പൊളിരെടുക്കണം. അതിനു ശേഷം പുറം ചുരണ്ടി മിസപ്പെടുത്തണം. ബ്ലോലാമ്പ് കാണിച്ച് നിറം

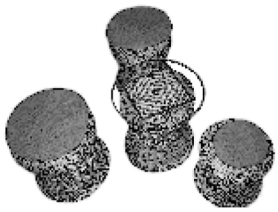
കൊടുക്കണം. ഫെവിക്കോൾ ഉപയോഗിച്ച് രണ്ടറ്റവും കെട്ടി ഉറപ്പിക്കാൻ പറഞ്ഞു കൊടുക്കണം. പൂക്കുട പൂർത്തിയാക്കിയ ശേഷം ബ്ലോലാമ്പ് ചെയ്ത ഫിനിഷ് ചെയ്യുന്നത് പറഞ്ഞു കൊടുക്കുക.

ദിവസം 11

ബാമുഡ (വലുത്)

ബാമുഡ ഉണ്ടാക്കുന്നതിന് 3 മുഴം (56 ഇഞ്ച്) നീളത്തിൽ $^{3}/_{4}$ ഇഞ്ച് വീതിയിൽ 2 മി.മീ. കനത്തിൽ പൊളിരെടുക്കണം (കാലുകൾ). ഇത് കാസ്റ്റിക് സോഡയിൽ മുക്കി വെക്കണം. 4 മില്ലീമീറ്റർ വീതിയിൽ അളികളുണ്ടാക്കി അതും കാസ്റ്റിക് സോഡാ ലായിനിയിൽ മുക്കി വെക്കണം.

ബാമുഡ		അളവുകൾ
പൊക്കം		16 ഇഞ്ച്
വ്യാസം	മുകളിൽ	12 ഇഞ്ച്
	നടുക്ക്	8 ഇഞ്ച്
	താഴെ	16 ഇഞ്ച്
പൊളിരുകൾ		
കാലുകൾ	നീളം	3 മുഴം (56 ഇഞ്ച്)
	വീതി	$^{3}/_{4}$ ഇഞ്ച്
	കനം	2 മില്ലീമീറ്റർ
അളികൾ	വീതി	4 മില്ലീമീറ്റർ



ദിവസം 12

ബാമുഡ (വലുത്)

ബാമുഡയുണ്ടാക്കാൻ ആദ്യമായി 12 കാലുകൾ വച്ച് 1 അടി വ്യാസത്തിൽ നെയ്യണം. അതിനുശേഷം കാലുകൾ നല്ല പോലെ ഉള്ളിലേക്ക് വളച്ചു നെയ്യണം. ഉരലിന്റെ ആകൃതി വരുന്ന തരത്തിൽ 16 ഇഞ്ച് ഉയരവും നടുക്ക് 8 ഇഞ്ച് വ്യാസവും അടിയിൽ 16 ഇഞ്ച് വ്യാസവും വരത്തക്കവിധം

ചെയ്യണം.

ദിവസം 13

ബാമുഡ (വലുത്)

ബാൻഡ നെയ്ത ശേഷം $1\frac{1}{2}$ അടി നീളത്തിൽ 1 ഇഞ്ച് വീതിയിൽ 24 കാലുകൾ ഉണ്ടാക്കണം. കാലുകൾ ബാൻഡയുടെ അടിവശത്ത് ഉറപ്പിച്ച ശേഷം നടുഭാഗത്ത് കയറു കൊണ്ട് ബലമായി കെട്ടി കല്ല വയ്ക്കണം (3ചിറ്റ് കല്ല)(2 മി.മീ. കനം)

അതിനുശേഷം കാലുകൾ മുകൾ വശത്ത് കുത്തിക്കൊടുക്കണം. ശേഷം സീറ്റ് വയ്ക്കുന്നതിന് കല്ല വച്ച് 1 ഇഞ്ച് കുഴി ആകുന്ന വിധത്തിൽ പൂർത്തിയാക്കണം.

ദിവസം 14

ബാമുഡ (വലുത്)

ബാമുഡയുടെ രണ്ടു വശവും പനനാരുപയോഗിച്ച് (4 മില്ലീമീറ്റർ വീതി) കെട്ടുവാൻ പരിശീലിക്കണം.

പൂർത്തിയായ ബാൻഡ ബ്ലോലാമ്പ് കാണിച്ച് ഫിനിഷ് ചെയ്ത ശേഷം പോളീഷ് (ടച് വുഡ്) ചെയ്യുന്നത് കാണിച്ചു കൊടുക്കണം.

ദിവസം 15

തേൻകുപ്പി

1 സെ.മീ. വീതിയുള്ള കാലുകളാണ് ഉപയോഗിക്കേണ്ടത്. 8 കാൽ വച്ച് അടിയിടണം. അതിനുശേഷം ബിയർ കുപ്പിവെച്ച് മുകളിലൂടെ നെയ്യണം. നെയ്തത് കുപ്പിയോട് ചേർന്നിരിക്കാൻ ശ്രദ്ധിക്കണം. അറിയാത്തവർക്ക് പ്രത്യേകം കാണിച്ചു കൊടുക്കണം.

തേൻകുപ്പി	അളവുകൾ

ബിയർ ക്യപ്പി	1 എണ്ണം
അളികൾ	
കാൽ വീതി	1 സെ.മീ
അളി വീതി	5 മില്ലീമീറ്റർ

ദിവസം 16

ബാംബൂ ട്രേ

ട്രേ	അളവുകൾ
നീളം	14 ഇഞ്ച്
വീതി	8 1/2 ഇഞ്ച്
ഉള്ള് പൊക്കം	1 1/2 ഇഞ്ച്
പൊളിയുകൾ	
അടിത്തട്ട് അലക് നീളം	8 ഇഞ്ച്
അടിത്തട്ട് അലക് വീതി	1/2 ഇഞ്ച്

മേൽപ്പറഞ്ഞ അളവിൽ പൊളിയുകളുണ്ടാക്കി യോജിപ്പിച്ച് ഫെവിക്കോൾ വച്ച് ഒട്ടിക്കുന്നതിനെക്കുറിച്ച് വിശദമായി പറഞ്ഞു കൊടുക്കണം

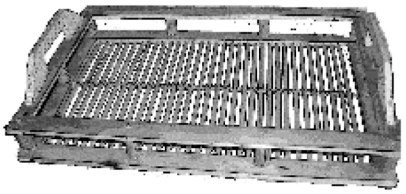
ദിവസം 17

ബാംബൂ ട്രേ

ബാംബൂ ട്രേയുടെ അടിയിൽ പനമ്പ് വയ്ക്കുന്നതിന് നിറം കൊടുത്ത് പൊളിയുകൾ ഉപയോഗിച്ച് പനമ്പ് നെയ്ത്ത് പരിശീലിപ്പിക്കണം

പനമ്പിന്റെ അളവ്

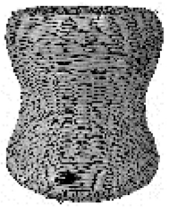
നീളം	13 ഇഞ്ച്



വീതി	8 ഇഞ്ച്

ദിവസം 18

ചെറിയ ബാമൂഡ



40 ഇഞ്ച് നീളത്തിൽ $^{3}/_{4}$ ഇഞ്ച് വീതിയിൽ മുളയുടെ പുറം പൊളി ഉപയോഗിച്ച് കാലുകൾ ഉണ്ടാക്കണം (പുറം ചുരണ്ടണം). പൊളിരുകൾ ഉണക്കി കാസ്റ്റിക് സോഡ ലായിനിയിൽ മുക്കണം.

4 മില്ലീമീറ്റർ വീതി യിൽ അളികൾ ഉണ്ടാക്കണം. അടിവട്ടം 10 ഇഞ്ച് നെയ്യ കഴിഞ്ഞാൽ 13 ചിറ്റ് കല്ല വച്ച് ഉൾവശം വളക്കണം. നടുഭാഗത്തിന് $9^{3}/_{4}$ വ്യാസം വേണം. ഉയരം $12^{1}/_{2}$ ഇഞ്ചും അടിഭാഗം വ്യാസം $14^{1}/_{2}$ ഇഞ്ചും ആക്കി നിർത്തി അടിവശം പനനാരുപയോഗിച്ച് കെട്ടുക.

ബാമൂഡ		അളവുകൾ
ഉയരം		$12^{1}/_{2}$ ഇഞ്ച്
വ്യാസം	മുകളിൽ	$12^{1}/_{2}$ ഇഞ്ച്
	നടുക്ക്	$9^{3}/_{4}$ ഇഞ്ച്
	അടിയിൽ	$14^{1}/_{2}$ ഇഞ്ച്
പൊളിരുകൾ		
കാലുകൾ	നീളം	40 ഇഞ്ച്
	വീതി	$^{3}/_{4}$ ഇഞ്ച്
	കനം	2 മില്ലീമീറ്റർ
അളികൾ	വീതി	4 മില്ലീമീറ്റർ

ദിവസം 19

ചെറിയ ബാമൂഡ

ചെറിയ ബാമൂഡ ഉണ്ടാക്കുന്നതിനുമുമ്പ് പൊളിരുകൾ ഉണക്കി കാസ്റ്റിക് സോഡ ലായിനിയിൽ മുക്കണം. ബാമൂഡ ഉണ്ടാക്കുന്നത് പൂർത്തിയാക്കണം.

ദിവസം 20

ഫ്ലവർ വേസ്

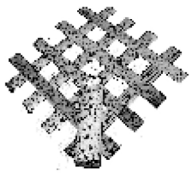
പൊളികൾ എടുത്ത് 8 കാൽ ഉപയോഗിച്ച് അടിവട്ടം $2\frac{1}{2}$ ഇഞ്ച് നെയ്തശേഷം ഉൾവശം കൂടുക്കി നെയ്ത് 4 ഇഞ്ച് ഉയരം വരണം.

അതിനുശേഷം മേൽ വശത്തേക്ക് വളച്ച് 1 ഇഞ്ച് പൊക്കത്തിൽ $2\frac{1}{2}$ ഇഞ്ച് മുകൾ വട്ടത്തിൽ പൂർത്തിയാക്കണം. ഇരുത്ത് 1 ഇഞ്ച് നെയ്യണം. ആകെ ഉയരം 6 ഇഞ്ച്.

ഫ്ലവർ വേസ്		അളവുകൾ
പൊക്കം		6 ഇഞ്ച്
മുകളിൽ	വ്യാസം	$2\frac{1}{2}$ ഇഞ്ച്
പൊളിരുകൾ		
കാൽ	നീളം	14 ഇഞ്ച്
	വീതി	$\frac{1}{4}$ ഇഞ്ച്
അളികൾ	വീതി	2 മില്ലീമീറ്റർ

ദിവസം 21 വിലയിരുത്തൽ

ഇതുവരെ ഉണ്ടാക്കിയ ഉല്പന്നങ്ങളെക്കുറിച്ചുള്ള വിലയിരുത്തൽ. പോരായ്മകൾ പരിശോധിക്കുകയും അവയ്ക്കുവേണ്ട നിർദ്ദേശങ്ങൾ നൽകുകയും ചെയ്യുക. പഠിതാക്കളുടെ കഴിവുകളെയും കലാവാസനകളെയും വിലയിരുത്തി പ്രോത്സാഹിപ്പിക്കുക. പഠിതാക്കളുടെ സംശയങ്ങളും നിർദ്ദേശങ്ങളും കേട്ട് വേണ്ടത് ചെയ്യുക.



ദിവസം 22 ക്രാഫ്റ്റ്

സ്കെയിൽ ഫ്ലവർ

ക്രാഫ്റ്റ് വർക്കിനെ കുറിച്ച് എല്ലാ കാര്യങ്ങളും പറഞ്ഞു

കൊടുക്കണം. 4 തരം സ്കെയിൽ ഫ്ലവർ, പെൻ സ്റ്റാന്റ്, പെൻ കപ്പ് എന്നിവ ഉണ്ടാക്കുന്നതിനെ കുറിച്ച് നിർദ്ദേശങ്ങൾ നൽകുക.

ദിവസം 23

സ്കെയിൽ ഫ്ലവർ

2 തരം സ്കെയിൽ ഫ്ലവറുകൾ ഉണ്ടാക്കാം.

സ്കെയിൽ ഫ്ലവർ		അളവുകൾ
8അലക്	വീതി	$^{3}/_{4}$ ഇഞ്ച്
	നീളം	8 ഇഞ്ച്
10 അലക്	വീതി	$^{3}/_{4}$ ഇഞ്ച്
	നീളം	$9^{1}/_{2}$ ഇഞ്ച്
ഫ്ലവർവെക്കുന്ന കുഴൽ		$4^{1}/_{2}$ ഇഞ്ച്

ഫ്ലവർ വെക്കുന്ന കുഴൽ $4^{1}/_{2}$ ഇഞ്ച് നീളത്തിൽ $^{1}/_{2}$ ഇഞ്ച് ചെരിച്ച് മുറിക്കണം. അലകുകൾ $^{3}/_{4}$ ഇഞ്ച് അകലത്തിൽ ചെരിച്ച് ഫെവിക്കോൾ ഉപയോഗിച്ച് ഒട്ടിക്കുന്നതിനെ കുറിച്ച് പറഞ്ഞ് മനസ്സിലാക്കണം.

ദിവസം 24

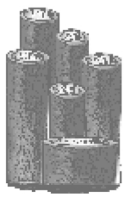
സ്കെയിൽ ഫ്ലവർ

സ്കെയിൽ ഫ്ലവർ ഉണ്ടാക്കാൻ എല്ലാ അലകുകളും കൃത്യമായി അളന്ന് മുറിച്ച് എമരി പേപ്പർ ഉപയോഗിച്ച് മിനുസപ്പെടുത്തണം.

അതിനുശേഷം $4^{1}/_{2}$ ഇഞ്ച് നീളത്തിൽ ഫ്ലവർ വെക്കാനുള്ള കുഴൽ വൃത്തിയായി മുറിച്ച് മിനുസപ്പെടുത്തി എടുക്കണം. $^{3}/_{4}$ ഇഞ്ച് അകലത്തിൽ ഇടവിട്ട് ഒട്ടിച്ച് ശേഷം മുകളിൽ കുഴൽ പിടിപ്പിക്കണം.

ദിവസം 25

പെൻകപ്പ്



കുഴലുകൾ അളവുകളിൽ മുറിച്ച് മിനുസപ്പെടുത്തണം. അതിനുശേഷം 4 ഇഞ്ച് ചുരുത്തിൽ $^{1}/_{2}$ ഇഞ്ച് കനത്തിൽ അടിത്തട്ട് ഉണ്ടാക്കുവാൻ നിർദ്ദേശിക്കണം.

പെൻകപ്പ്	അളവുകൾ	എണ്ണം
കുഴലുകൾ	5 ഇഞ്ച്	1എണ്ണം
	4 1/2 ഇഞ്ച്	1എണ്ണം
	4 ഇഞ്ച്	1എണ്ണം
	3	1എണ്ണം
	2 ഇഞ്ച്	1എണ്ണം
	1 ഇഞ്ച്	1എണ്ണം
അടിത്തട്ട്		
വീതി	4 ഇഞ്ച്	
നീളം	4 ഇഞ്ച്	
കനം	1/2 ഇഞ്ച്	

ദിവസം 26

പെൻകപ്പ്

പെൻകപ്പിന്റെ കുഴലുകൾ ഫെവിക്കോളും സൂപ്പർ ഗ്ലൂവും ഉപയോഗിച്ച് യോജിപ്പിക്കണം. അതിനുശേഷം അടിഭാഗം മിനുസപ്പെടുത്തി അടിത്തട്ട് ഒട്ടിച്ച് ഉണക്കണം.

ദിവസം 27

പെൻകപ്പ്

ഉണങ്ങിയ പെൻകപ്പിന്റെ അടിത്തട്ട് മുറിച്ചെടുത്ത് അരം ഉപയോഗിച്ച് മിനുസപ്പെടുത്തണം. അതിനുശേഷം എമരി പേപ്പർ ഉപയോഗിച്ച് വീണ്ടും മിനുസപ്പെടുത്തണം.

100 മില്ലി ടച്ച് വുഡിൽ 150 മി.ലീ തിന്നർ ചേർത്ത് യോജിപ്പിച്ച് പോളിഷ് ബ്രഷ് ഉപയോഗിച്ച് പെൻകപ്പിൽ തേച്ച് പിടിപ്പിക്കണം.

ദിവസം 28

പെൻസ്റ്റാന്റ്

പെൻസ്റ്റാന്റ് ഉണ്ടാക്കാൻ ആദ്യം $7\frac{1}{2}$ ഇഞ്ച് നീളത്തിലും $2\frac{1}{2}$ ഇഞ്ച് വീതിയിലും ബെഡ് ഉണ്ടാക്കണം.

ശേഷം തല മുളടെ 6 ഇഞ്ച് വണ്ണത്തിലുള്ള $4\frac{1}{2}$ ഇഞ്ച് നീളത്തിൽ കമ്പില്ലാതെ മുറിക്കണം. 3 ഇഞ്ച് വണ്ണമുള്ള 4 ഇഞ്ച് നീളമുള്ള 2 കഷ്ണം മുറിക്കണം. രണ്ടിനും $\frac{1}{2}$ ഇഞ്ച് ചരിവ് കൊടുത്ത് മുറിക്കണം.

ദിവസം 29

പെൻസ്റ്റാന്റ്

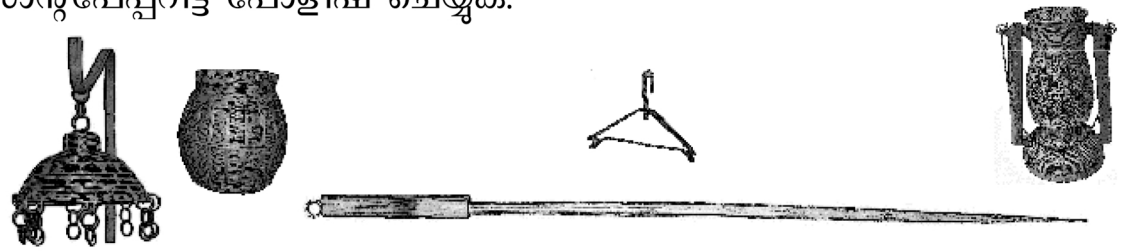
പെൻസ്റ്റാന്റിന്റെ മിനുസപ്പെടുത്തിയ കഷ്ണങ്ങൾ ഫെവിക്കോൾ ഉപയോഗിച്ച് ഒട്ടിക്കണം. അതിനുശേഷം നല്ലപോലെ ഉണക്കി തിന്നർ ഉപയോഗിച്ച് നേർപ്പിച്ച ടച്ച് വുഡ് ഉപയോഗിച്ച് പോളീഷ് ചെയ്യണം. പോളീഷ് ചെയ്യുമ്പോഴും അത് ഉണങ്ങുന്നതിനു മുമ്പും പൊടി വീഴാതെ സൂക്ഷിക്കണം.

ദിവസം 30

ഹാങ്ങർ

37 ഇഞ്ച് നീളത്തിൽ 1 ഇഞ്ച് വീതിയിൽ, 2 മി.മീ കനത്തിൽ അലക് മുറിച്ചെടുക്കണം. അലക് എമരി പേപ്പർ ഉപയോഗിച്ച് മിനുസപ്പെടുത്തണം.

അതിനുശേഷം ബ്ലോലാമ്പ് കാണിച്ച് 16 ഇഞ്ച് നീളത്തിൽ വെച്ച് വളക്കുക. മുകൾ വശവും വളച്ചശേഷം സൂപ്പർ ഗ്ലൂ ഉപയോഗിച്ച് 2 അഗ്രവും ഒട്ടിക്കുക. നടുവിൽ തൂക്കുന്നതിനുള്ള കുറ്റി വളച്ച് ഒട്ടിക്കുക. അവസാനം സാന്റ്പേപ്പറിട്ട് പോളീഷ് ചെയ്യുക.



Appendix -2

Species suitable for cultivation in Kerala

1. *Bambusa balcooa* Roxb (*Dendrocalamus balcooa* (Roxb.) Voight).

Common names: Assamese – *Baluka;* Bengali- *Balku bans;* Duars – *Borobans;* Garo- *Wamnah, Beru;* Tripura - *Barak*

It is indigenous to the Northeastern India and distributed in Nagaland, Meghalaya, Tripura, Assam, West Bengal and Bihar up to an altitude of 600 m. *B. balcooa* prefers heavy textured soil with good drainage. It is a clump forming species with culms 12 to 20 m tall, internodes 20 to 40 cm long and 8 to 15 cm in diameter and nodes thick with a whitish ring above (Fig. 20). Young shoots are blackish green with acute tip. Culms are coarse, stout, dull greyish-green with pointed re-curved branches towards the base. Flowering cycle is about 35-45 years and the flowered clumps dry without any seed set. Gregarious flowering was reported from India during 1986-1988. It is cultivated in villages of Northeastern region. The species is planted at an average of 400 clumps/ha at a spacing of 5 m x 5 m and mature culms can be harvested within a period of 5-6 years.

Annual production of 1200 to 1600 culms/ha has been reported. Observations from KFRI bambusetum indicated that one mature (about 4-5 years old) bamboo culm weighed 150 kg. It is used for scaffolding, agarbathi sticks, wood chip industry, banana props, agricultural implements, handicrafts and for the paper pulp.

2. *Bambusa bambos* Voss (*Arundo bambos* L. ; *Bambusa arundinacea* (Retz.)Willd)

Common names: English - *Thorny bamboo*; Assamese – *Kotoha Kata, Koto*; Bengali - *Baroowa, Behor;* Manipuri - *Saneibo*; Oriya – *Daba;* Tamil – *Mungil;* Malayalam – *Mula, Illi, Pattil*

This species is widely distributed in moist deciduous forests, occupies 15 per cent of bamboo area of India and one of the most common species in homesteads in southern India. It prefers rich, moist, alluvial soil and grows along perennial rivers and valleys up to an altitude of 1000 m receiving a rainfall of 2000 to 2500 mm. *B. bambos* is highly productive with strong rhizome. It produces dense tufted clumps; culms are strong, cylindrical, erect, hollow dark-green coloured, up to 30 m tall with 15 to 18 cm in diameter. Walls are 3 cm thick at the base. Branching is observed at all the nodes, central dominant branch is produced first, with one or two laterals. Branches bear spines. Because of the strong thorny lateral branches the base of the clumps gets congested making it difficult to extract if it is not properly managed.

Different flowering cycles like 30-34 years and 44-49 years have been reported. In homesteads of Palakkad District of Kerala flowering occurred in 1951-52 and then in 1996-1997 indicating a flowering cycle of 45 years in this area. A single clump produces about 50 to 100 kg of seeds with a total production of 50-100 quintals of seeds/ha. About 70,000 to 85,000 seeds weigh one kg; initial viability is 90 to 100 per cent. Seeds are viable under normal conditions for about 6 to 8 months and viability can be extended up to five years by proper storage methods by controlling humidity and temperature. Vegetative propagation by offsets, rooted culm and branch cuttings and tissue culture is done. A plantation with 250 clumps/ha produced 4250 culms/ha within six years after planting and an annual harvest of about 2000 culms per ha is possible thereafter. Intensive management like soil working, fertilization and irrigation can improve the productivity by 3 to 5 times in *B. bambos*. There are several uses and some of them are pulp and panel products, handicrafts, scaffolding, thatching, roofing, baskets, mats, bows and arrows, furniture, floating timber and rafting, cooking utensils, fencing, fodder, medicine, etc. Young shoots are edible.

3. *Bambusa nutans* Wall. ex. Munro

Common names: Assamese- *Bidhuli, Mukial*, Lepecha - *Mallo, Mahi bans;* Oriya - *Badia bansa*; Tripura - *Kali, Beng, Makla*

A medium sized bamboo with culms reaching a height of 5 to 10 m with a diameter of 5-10 cm and an internode length of 25-45 cm. It is loose clump forming, usually unbranched below and much branched above, culms straight, green smooth, not shining white-ringed below the nodes, node slightly thickened often hairy and lower nodes bear rootlets (Fig 22). It naturally occurs in Sub-Himalayan region from Yamuna eastwards to Arunachal Pradesh and common in Brahmaputra valley.

It is commonly cultivated in Northwest India, especially in and around Dehra Dun, and in Orissa and West Bengal. It grows in moist hill slopes and flat uplands in well-drained sandy loam to clayey loam at an elevation between 600 and 1500 m. Flowering cycle is about 35 years. Rooting culm cuttings and offset planting are used for establishment of planting stock. It is commonly used as poles, construction work and for paper pulp.

4. *Bambusa polymorpha* Munro

Common names: Assamese – *Jama betwa, Betwa;* Bengali- *Betua, Jaibaroowa, Jama*;, Hindi-*Narangi bhas;* Tripura – *Bari*.

It is a large evergreen, densely tufted bamboo growing up to a height of 16 to 25 m with an internodal length of 40 to 60 cm and a diameter of 8-15 cm. Culms are gray to grayish green, white scurfy when young, nodes thick and lower one with rootlets (Fig. 24). It is naturally found in Northeast and Madhya Pradesh, introduced to Tamil Nadu, Kerala and Karnataka and cultivated in Bengal and most of Northeastern states. It prefers low hill slopes along the valleys with deep fertile, well-drained, loam and riverine alluvial soil. *B. polymorpha* can be grown in association with teak.

Flowering cycle is 55-60 years. Number of seeds per kilogram is about 21000 to 40000 and germination percentage is about 40. Seedlings are raised in nursery beds. It can be propagated by pre-rooted and pre-rhizomed branch cuttings with 45-50% rooting. Plantations mature within 8 years. It is used for pulp, construction (in Myanmar considered best for walls, floor and roof of houses), agarbathi sticks, fibreboards, edible shoots (with a distinctly sweet taste) and for landscaping. It is a graceful species of bamboo for landscaping.

5. *Bambusa vulgaris* Schrad.ex. Wendl

Common names: Bengali and Manipuri – *Bakal;* Oriya – *Sunderkania bansa*

A moderate sized bamboo with a height of 8-20 m and diameter 5-10 cm and internodal length of 40-45 cm. It has three varieties with yellow culm and green stripes, with green culm and yellow stripes and the third with green culm and without stripes. It is a common bamboo grown in homesteads and gardens. It in naturally found in Madhya Pradesh. The suitable site for the species is moist soil periphery of the cultivated lands, creeks and at the foothills. It grows up to an altitude of 1200 m and exhibits salt and frost tolerance.

Although flowering is reported no seed set was found. It is easy to propagate vegetatively using culm and branch cuttings and about 90-100% is obtained. An yield of 10 tonnes/ha/year is reported when planted at a spacing of 12 m x 12 m. But it can be planted at a closer spacing of 8 m x 8 m. Propagation by pre-rooted and pre-rhizomed cuttings is also possible. It is used for building construction, pulp, poles, handicrafts, fencing and landscaping. The leaves are medicinal. Three types of this species are seen – Yellow culm with green stripes, green culm with yellow stripes and pure green culms.

6. *Dendrocalamus asper* (Schult) Bacjer ex Heyne.

It is densely tufted bamboo with large foliage leaves. The culms are up to about 20 m tall, with a diameter of 8-12 cm and internodal length of 40-50 cm. It is dark green, non-waxy the lower part is thickly covered with brown velvety hairs with a band of silvery brown hairs above and below each node in upper culm. The lower nodes bear numerous young roots.

It is largely cultivated in Southeast Asia for its shoots. The culms are large and strong. It is suitable for building and structural uses.

7. *Dendrocalamus brandisii* (Munro) Kurz.

Common names; Bengali – *Bulka;* Manipuri - *Wanan*

Very large evergreen tufted bamboo with a height of 19-33 m and a diameter of 13-20 cm and internodal length of 30 –38 cm. Culms are ashy gray to greenish gray in colour and nodes slightly swollen lower one with rootlets (Fig. 29). It is naturally found in Manipur and the Andamans. It was introduced in to Kerala and Karnataka. The species is found growing in tropical forests chiefly on calcareous rocks and found up to an altitude of 1300 m.

8. *Dendrocalamus giganteus* Munro

Common names: Assamese – *Worra;* Manipuri – *Maroobob;* Sikkimese – *Bhaloo bans;* Malayalam– *Anamula, Paramula*

It is the largest clump forming bamboo species with slender branches. The culms reach a height 24 - 30 m, internodal length of 35-40 cm and a diameter of 20-30 cm. Walls are thick with 2-2.5 cm. Culms are dull green, covered with white waxy crust when young and lower nodes show root scars and rootlets (Fig. 30). It is a native of Myanmar cultivated in Northeast and occasionally in other parts of the country. It is found in moist hill slopes and flat lands with rich loam soil. It is found growing to an altitude of 1200 m. Also, it is found associated with teak.

Flowering cycle is about 40 years. About 20000 seeds weigh one kilogram. Seed set is very poor and sometimes, vegetative growth is observed from flowered clumps. Vegetative propagation using culm cuttings and NAA can be done. Rooting is about 60% and basal one-third part of the culm is not suitable for root induction. It can be planted at a spacing of 10 m x 10 m. Annual yield is about 20-30 tonnes/ha. It is used for building purposes, boat masts, handicrafts, vases, buckets and water pitchers. It is one of the good species for pulp. Young shoots are edible.

9. *Dendrocalamus hamiltonii* *Nees* and Arn.ex.Munro

Common names: Assamese –*Kakua* or *Kako banh;* Tripura – *Pecha;* Manipuri *Unep;* Mizo - *Phulrua*

It is a large clump forming bamboo sometime growing tall and erect often culms at an angle or curved downwards. Culms reach a height of 12 to 25 m with an internodal length of 30-50 cm and a diameter of 10 to 18.5 cm. Branching is found on top parts of the culm, culms are grayish-white when young and dull green when old. Lower nodes are marked with root scars (Fig. 31). It is naturally found in Northwest Himalayas and Northeast India. It is generally cultivated in many parts of the country. It occurs in finer textured soil in semi-evergreen forest in lesser rainfall area. It is known as light demanding, early successional species after shifting cultivation and known to conserve potassium.

Flowering cycle is reported as 30—40 years. Flowering occurred during 1998-99 in Arunachal Pradesh. Vegetative propagation by rooting of culm cuttings is easy and 70% rooting was found. It is found suitable for growing in wastelands in Himachal Pradesh. It is used for walls of huts, construction, basket making, mats, water and milk vessels, fuel, and floats. Young shoots are extensively used as food. The outer slivers are used in cottage industry for binding and caning of chairs.

10. *Dendrocalamus longispathus* Kurz.

Common names: Assamese – *Bulka, Khang;* Mizo – *Rawnal;* Manipuri – *Unal;* Tripura – *Rupai*.

It is a large clump forming elegant bamboo. Culms reach a height of 10-18 m, with an internodal length 25 to 60 cm and diameter of 6 to 10 cm. Walls are 1.2 cm thick. Young culm is glaucous, green and turns to grayish-green when mature (Fig. 32). This species is naturally distributed in Mizoram and Tripura and found in villages of Bihar. It was introduced into Orissa and Kerala.

Flowering cycle is about 30-35 years. About 134880 – 135320 seeds weigh one kilogram with a germination percentage of about 50. Plantig stock can be prepared by rooting culm cuttings with a treatment of NAA 100ppm. Planting is done in 45 cm x 45 cm x 45 cm pits at a spacing of 5 m x 5 m. Offset planting and vegetative propagation by rooting culm cutting is possible with 50-75% rooting. It is used for landscaping, manufacture of paper, basket, food grain containers and tooth-picks.

11. *Dendrocalamus membranaceus* Munro (*Bambusa membranaceus* Stapleton)

Common name: Malayalam- *Enimula*

It is a moderate sized strong bamboo forming dense clumps. Culms reach a height of 20-24 m with a diameter of 6-10 cm and internodal length of 22-38 cm. The young culms are covered with white powdery surf and nodes strongly ringed, basal ones with rootlets, upper branches slender leafy and drooping (Fig. 33). It occurs in moist forests and lowlands and is found below 1000 m altitude. Preferred soils are laterite, black and limestone and also it can tolerate arid and barren conditions.

Although flowering was reported in 1992-94 from Thailand, no information is available on flowering cycle. Vegetative propagation using culm cuttings is

found successful. It is used for construction, chopsticks, shreds and paper. Young shoots are edible and smooth and easy to process.

12. *Dendrocalamus strictus* (Roxb.) Nees

Common names: Bengali – *Karali;* Gujarati- *Nakur bans*, *Kiri bridiru;* Marati– *Narvel;* Oriya – *Salia;* Tamil – *Kalmungil;* Telugu– *Sadanapa veduru;* Tripura – *Lathi bans;* Malayalam– *Kallan mula;* Manipuri- *Unan;* Mizo - *Tursing*

This is a densely tufted bamboo. The culms reach a height of 8 -16 m, with an internodal length of 30 - 45 cm and diameter 2.5 - 8 cm. The culms are hollow in wet and solid in dry zones. The culms are pale blue green when young turning to dull green or yellow on maturity; much curved above half of its height and nodes somewhat swollen. Basal nodes often show rooting and lower nodes are often with branches.

D. strictus is widely distributed in India in semi dry and dry zone along plains and hilly tracts usually up to an altitude of 1000 m and occupies 53% of bamboo area. It is widely adaptable to temperature - 5 to 45^{o}C. It prefers well-drained, poor, coarse-grained and stony soils and can be grown in mixed plantations and along with teak.

Flowering cycle is about 47-55 years. One kilogram seeds contain 25000 to 30000. Germination varies from 25 to 70% based on the sample lots. The seed viability in natural conditions is about 6-8 months and the seeds can be stored for about four years. Different methods of vegetative propagation like offset planting and rooting of cuttings are possible. About 40-70% rooting is observed for culm cuttings treated with NAA. Planting can be done at spacing 5 m x 5 m or 4 m x 4 m based on the management. An annual harvest of 750 to 1000 culms/ha is expected.

It is extensively used for paper and also for construction, agricultural implements, musical instruments and furniture. Young shoots are edible. Decoction of leaves and nodes are used in traditional medicines.

13. *Ochlandra travancorica* Benth.

Common names: Malayalam - *Etta, Kar-eeta, Oda;* Tamil – *Eeral, Eerakalli, Iral, Ita-kalli, Nanal, Odai.*

It is an erect shrubby reed like gregarious bamboo. Culms reach a height 2-6 m with an average internode length of 45 - 60 cm and sometimes up to 150 cm in ideal growing conditions with a diameter of 2.5 - 5 cm (Fig. 36) Culms are grayish green, nodes somewhat swollen with marks of fallen culm sheaths. It is distributed throughout the Western Ghats and occurs widely as an under-growth in the low-level evergreen and semi evergreen forests. It prefers diffused light, requires a rainfall of more than 1500 mm and good drainage. Soil under this bamboo is dark brown, acidic, sandy loam with granular structure, high porosity, good aggregate stability and high water holding capacity.

Recently it has flowered in southern Kerala. About 45-57 seeds weigh one kilogram. Seeds are viable only for short period of 45 days and no storage method is available. It can be propagated through seeds and vegetative methods. Seeds are sown soon after collection in nursery beds filled with sand and soil mixture in partial shaded initially for two months. One-year-old seedlings can be transplanted. Spacing is about 4 m x 4 m. Vegetative propagation using cuttings are possible and 50% rooting is obtained with NAA treatment. It is an ideal raw material for paper manufacture. Culms are used for mat and basket making, umbrella handles, fishing rods and handicrafts. The mats made out of this species are used for making Bamboo Ply. Leaves are used for thatching. Fruits are used as cattle feed.

14. *Pseuoxytenanthera stocksii* (Oxytenanthera stocksii)

Common names: Marati – *Chivari, Mes;* Kannada – *Konda, Oor, Shema*

It is found in Maharashtra, Karnataka, Kerala and Goa. It is a medium sized bamboo culms reaching a height of 9m with a diameter of 2.5-4 cm and an internodal length of 15-30 cm. Culms covered with white or gray deciduous hairs when young and few branches are seen from the nodes. It is mostly confined to banks of streams and requires well drained deep loamy soil.

Although flowering was observed during 2000 onwards in Konkan area, Karnataka no seed set was observed. Vegetative propagation by rooting culm cuttings is very successful and rooting upto 90% can be obtained Cutting need to be taken from culms more than one year old.nIt is cultivated in the homesteads of northern Kerala, Karnataka and Goa. Plantation can be raised with a spacing of 5m x 5 m. The culms are strong and used for household items, constructions and basket making. It can be used for handicrafts and furniture.

15. *Thrsostachys oliveri* Gamble

Common names: Malayalam- *Rangoon mula, Korana.*

It is a large tufted elegant bamboo, culms growing to a height of 15 to 25 m and highly suitable for growing in homesteads. Internodal length is about 40 to 60 cm and diameter about 5 cm. The mature culms are solid at the base. The culms are bright green with whitish silky surface when young and dull green or yellowish on maturity nodes hardly thickened. It is a native of Myanmar and introduced into India. It is cultivated in Arunachal Pradesh, Uttar Pradesh, Kerala and Tamil Nadu. It grows in all types of soils.

Reported flowering cycle is about 48-50 years. Vegetative propagation by rooting of culm cutting is possible. Rooting occurs in basal half of the culm and treatment with NAA enhances rooting response. Offset planting is also found successful.

Spacing is 4x4m the culms are in good demand for construction purpose, pluckers and banana props. Shoots are edible.