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SOCIO-ECONOMIC AND ECOLOGICAL ASPECTS OF DEVELOPING BAMBOO RESOURCES IN HOMESTEADS OF KERALA

PART – 1 : ECOLOGICAL AND SOCIAL ASPECTS

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ABSTRACT

Bamboo is an important component of the rural landscapes in Kerala. In spite of the great demand for bamboo and significant benefits to farmers and different social groups, the bamboo wealth of rural Kerala is declining drastically. In order to understand the reasons for negative attitude towards bamboo by farmers, and also assess the possibilities of promotion of bamboo cultivation, participatory rural appraisal (PRA) techniques were employed. Through PRA exercises a wealth of traditional knowledge about bamboo cultivation and management was brought to light. At the same time, PRA provided an opportunity for some of the farmers to involve in small-scale bamboo cultivation in their homesteads which in turn helped scientists to understand socio-economic and ecological factors influencing in bamboo cultivation and management.

On-farm experiments indicated that the traditional practice of growing some rhizomatous crops as undercrop of bamboo is an acceptable one. Number of farmers who realised that something can be grown under bamboo is increased from 8% to 100%. Farmers prefer short duration plants as undercrops. This is because the crops can be harvested well before cutting bamboo branches for fencing and the loss of undercrops could be avoided. Selection of crops is determined by the socio-economic status of the farmers. Participant farmers also realised that more than the influence of bamboos, factors such as the level of management, quality of soil and planting material used and shade of other trees determine the crop yields.

A study on the thickness of fibre wall of bamboo branches, an indicator of branch maturity, revealed that, the fibre wall thickness increased with age till branches are of 8-9 (February-March) months old and no change was observed later. Therefore, a common notion prevailing among the farmers in the Low rainfall Dry agroclimatic zone and medium rainfall Humid agroclimatic zone of Kerala that branches are mature at 5-6 months old is incorrect. The study also disapprove the notion that farmers of the Humid and Dry zone are free only during December-January and those of the Kole zone during May-June. Majority of the farmers have free time in the month of March-April. Therefore, ideal time for fencing activity here is February-April.. Advance the fencing activity to March-April in the Kole zone (Coastal zone) also avoid the situation where the delay in thorn cutting damages new culms.

An on-farm experiment conducted indicated that the traditional practice of detopping bamboo culms is acceptable and is of practical importance. No damage to the remaining part of the culm was recorded. Instead the length of the branches increased due to detopping and this may be due to the cessation of apical dominance.

Bamboo branches, though widely used for fencing homegardens and other lands, are increasingly expensive due to the high labour costs involved in cutting bamboo branches and making the fences. Therefore, a need for increasing the life of fence was felt by the farmers. Considering this need, an experiment was designed to study the effectiveness of chemical preservation technique using boric acid and copper sulphate solution. The activity did not provide conclusive results.

An attempt has been made to promote bamboo cultivation in a village in the low rainfall Dry agroclimatic zone of Kerala in order to determine various factors responsible for the success or failure of such attempt. The case studies demonstrated that the farmers of the village wanted bamboo mainly for thorny branches for fencing. During the first year after planting, 15% of the farmers managed the plants at a very good level and another 30% of the farmers at a moderate level, while in the second year, the number has increased to 30% and 43% respectively. Considering the usefulness and success of the programme farmers show readiness to involve themselves in the cultivation of bamboo at the community level. Farmers recognised PRA techniques adopted during the study as useful tools to prepare local landuse plans.

Case studies conducted to understand the relevance of traditional knowledge and practices about bamboo clump management indicated that most of them have scientific base. On the other hand, some of the traditional practices are not practical and do not possess scientific base but only were relevant for the past socio-economic conditions of the village ecosystems. The study recommends certain strategies for the promotion of cultivation and sustainable utilisation of bamboo in farming systems.

INTRODUCTION

Bamboos form an important group of tropical woody monocotyledons that have been traditionally used by people in Asia for a wide variety of purposes. It is estimated that about 2.5 million people depend on or use bamboo materials worth 7 billion US dollars per annum (Liese, 1992). In addition to this, bamboo is regarded as the major resource that meets the need of common people and also a poverty alleviator due to its multipurpose uses (Biswas,l995). Therefore, Chatuwedi (1986) rightly said that "bamboos are all things to some men and something to all men". Like many other tropical countries, India also has large reserves of bamboo covering an area of 10.03 million hectares. This covers about 12.8% of the total area of forest cover in the Country (Biswas, 1995). According to Pathak (1989), in bamboo production, India ranks next to China with 323,000 tonnes per year. The association of men with bamboo in India also is as old as human civilisation (Chandrashekara,l997). Further studies indicated that bamboo is one of the plant components in the rural landscape in many regions of Asia. Homegardens in villages of India, Bangladesh, Malaysia and Indonesia are oflen possess bamboo clumps (Randhawa, 1980.1982,1983: Widjaja, 1991; Aminuddin, 1995). Homestead bamboo contribute much to the economy of the region. For example, according to Krishnankutty (1990), the total area occupied by bamboo in the homesteads of Kerala is estimated 581 ha with a standing crop of about 39 million culms. The quantity of bamboo used from the rural sector in Kerala during 1987-1988 was around 3.2 million culms. Because of great importance of bamboo in the rural socio-economy of several tropical countries there has been a focus on bamboo research (Das, 1990; de Zoysa, et.al.1990; Hammermaster, 1980), aiming at developing scientific ways and means to increase income of farmers from bamboo. Initial studies were mainly on seed handling, propagation techniques, clump management, harvesting of techniques, utilisation and marketing aspects (Williams, 1991). However, cultivation and proper management and use of rural bamboo are being neglected (Krishnankutty, 1990; Widjaja, 1991). A rapid rural appraisal conducted in some of the villages in Thrissur and Palakkad District of Kerala also prompted to the urgent need for promoting cultivation and sustainable utilisation of rural bamboo in the State. It may be pointed out here that methods and technologies for use and sustainable management of any natural resource without considering the socio-economic conditions and needs are unacceptable by the target groups (Santhakumar, 1995). Furthermore, preliminary observations and discussion with the farmers in some of the villages in Kerala have shown that local farmers already have a wealth of traditional knowledge and practices of homestead bamboo cultivation and management (Chandrashekara, 1996; Table 1). Such traditional systems of resource use and management are often being recognised as sophisticated and appropriate as they are socially well based. Therefore, systematic collection and incorporation of farmer's knowledge should be given priority while developing any programme for the promotion of cultivation, use and sustainable management of the resources (Cernea, 1991), including rural bamboo. But, it is a common notion among the proponents of traditional knowledge and practices that all such knowledge have a scientific basis. However, this may not be necessarily the case. Therefore, before incorporation of traditional knowledge and practices for the development of programmes for the promotion of any crop systematic assessment of such knowledge for their validity and relevance in the present day socio-economic context is also required.

Table 1. Traditional practices of homestead bamboo cultivation and their benefits to farmers*

	Practice	Benefits
a.	Trenching around bamboo clump	Restriction of horizontal spread of bamboo roots thereby reducing competition with other crops.
b.	Mounding of soil around clump	Stimulation of production of new culms and soil fertility management
c.	Detopping of culms	Reduction of shading of other crops; formation of longer axillary branches useful for fencing
d.	Intercropping with shade tolerant, short duration crops	Less impact of bamboo on yield of intercrops; crops can be harvested prior to bamboo branch cutting season so avoiding the risks of damage caused in this process. These crops are also suitable for cultivation on raised beds, so reducing root competition with bamboo
e.	Cultivation of bamboo in corner of homegarden	Freedom of movement for gardeners within garden; more space available to grow other crops

*Table 1 in Chandrashekara (1996).

Technology transfer is one method to promote the cultivation and sustainable use of a natural resources. Many times, techniques developed for the purpose appear to be useful and easily adoptable. Farmers being dynamic and receptive to new knowledge and techniques, are often tempted to adopt any such knowledge and techniques if disseminated to them. However, the techniques transferred may fail to give the expected results (Duivenbooden, 1995). Therefore, even if the technique appears to be useful, adoptable and acceptable by the farmers it should be tested for all these qualities either in farmer-managed or researcher- managed trails before dissemination of the technology (Shepherd *et. al.,* 1994) for the large scale implementation. This kind of approach will allow both scientists and farmers to understand the ecological, social and economic dimensions of problems and prospects in adopting a new technique or landuse system.

The rapid rural appraisal conducted in Kerala also clearly recognised the fact that the chain existing between the process of production and consumption of rural bamboo is poorly understood by each stakeholder group. In order to avoid a situation where, for instance, cultivation is encouraged without attention paid to the market, or utilisation is promoted without knowing whether there is sufficient raw material, it is important to take a holistic approach while developing programme for promoting bamboo (Blowfield *et. al.,* 1995). A programme, therefore, to promote cultivation, management and sustainable use rural bamboo evidently should focus on following aspects:

1) Analysis of traditional practices of homestead bamboo cultivation and management for their strengths, weaknesses and relevance in management of rural bamboo.
2) Development of activities relevant to promotion of bamboo cultivation and management and analyses of such activities for their suitability, replicablity and usefulness before implementing in larger scale.

3) Estimation of the present supply and demand for bamboo in Kerala, assessment of the potential of rural bamboo compared to other crops in the homestead cultivation systems and identification of the problems and prospects in bamboo use by the weaving community in the State.

With this background, in the present research programme, it was decided to design and implement certain activities to cover all the three aspects related to the enhancement and promotion of knowledge and cultivation and sustainable use of bamboo. Based on the information gathered by rapid rural appraisal exercises and discussions held in the planning meetings in the preliminary stages of the project, activities (Table 2) were identified to address systematically.

The report is presented in 2 parts. In this report (Part l), details of the first four activities are given. These activities are essentially researchers and /or farmers managed trials to understand various scientific and socio-economic issues influencing each activities. The last three activities designed to enhance the knowledge about the use of bamboo by non-farming weaving community and about the economics and trade of rural bamboo are discussed in greater detail in the Part 2 of the report.

Table 2. Activities conducted as part of the project

	Part 1
Activity	1: Studies on undercropping of bamboo with annual rhizomatous crops in homesteads of Kerala
Activity	2: Impact and benefit of different cutting regimes for bamboo branches and culms as fencing materials in three agroclimatic zones in Kerala
Activity	3: Application of chemical preservation technique to prolong the life of bamboo branches used for fencing
Activity	4: Promotion of bamboo cultivation in a village in low rainfall Dry agroclimatic zone of Kerala: the case studies - 1 and 2
	Part 2
Activity	5 : Development of bamboo resources in homestead: production, marketing and employment generation in Kerala, India
Activity	6 : Socio-economic aspects of bamboo weaving communities in Kerala
Activity	7: Cost-benefit analysis of bamboo in relation to homegarden tree crops in Kerala

STUDY AREA AND CLIMATE

This project covered three agroclimatic zones of Kerala namely the Low rainfall Dry zone, the Humid zone and the Kole zones. The details of agroclimatic conditions of these zones are given in Kerala State Land Use Board (1978) and Nair and Sreedharan (1989).

I. Dry zone is located in Chittoor Block of Palakkad district in the north eastern part of the State. The zone is characterized by low rainfall of about 969 mm and remains dry for most of the months. The mean maximu-mtemperature was 44^{o}C and mean minimum was 21.1^{o} C. The soil are inceptisols. The agriculture. in this area mainly depends on irrigation.

II. Humid zone consists of central districts of Palakkad, Thrissur and Ernakulam excluding the high ranges and coastal saline areas. Being the windward side of the Western Ghats, it receives heavy rainfall of about 2400 mm to 3560 mm, though with erratic distribution; the mean maximum temperature was 32.2^{o}C and the mean minimum was 21.1^{o}C. The main soil types are laterite alluvium and saline.

III. Kole zone lies in Thrissur and Malappuram Districts in central part of the State and is low- lying along the coastal strip and inundated for more than 5 months in an year. Soils are clay loam type. The mean annual rainfall is about 2500 mm. Mean maximum temperature in the zone was about 30.5^{o}C and mean minimum was

CHAPTER 1

Studies on undercropping of bamboo with annual rhizomatous crops in homesteads of Kerala

1.1. Background and objectives of the activity

Traditional farmers in Kerala are aware that in the multi-species homegarden systems bamboo can also be grown and managed as an essential crop. Also area around bamboo need not be left fallow but many annual crops could be grown despite the problem of shade and shallow root distribution of bamboo (see Table 1 in the Introduction). Therefore, the potential of growing annual crops under the bamboo with a sample of homegarden farmers was examined. Also an on-farm agronomic and socio-economic case study was conducted to investigate the conflicting knowledge that farmers held about possible plant associations with bamboo. The specific objectives of the proposed activity on on-farming experiment on intercropping of bamboo with shade tolerant, short duration crops was to investigate:

⇒ potential for bamboo and crop association in mixed homegarden systems.

⇒ Degree of influence of bamboo clump and other factors on the crop yield.

⇒ influence of socio-economic factors upon participation of farmers in the on-farm research, choice of crops to be grown under bamboo shade and management of crops.

1.2. The location

The case study was undertaken in two phases during 1994-1996. In the first phase (May 1994 to February, 1995), the study was undertaken in two revenue villages namely Elavancherry and Vithanassery situated in the Humid agroclimatic zone , Palakkad District. In the second phase (May 1995 to February, 1996), the study was continued in the above mentioned villages and also extended to villages in the low rainfall Dry zone in Palakkad District namely Thadanara, Pathanara, Anamari, Karipode, Mudappallikolambu and Palayam.

The people of the villages have a wide range of socio-economic backgrounds. In Vithanassery and Elavancherry villages there are representatives of the Harijan Ezhuthachan, Ezhava and Nair castes. The major religion is Hinduism. However, in villages of Dry zone apart from Harijans and Ezhavas, Mudaliars and Muslims are also found in the community. The predominant occupation is agriculture though many individuals are employed in private and government establishments. Members of the poorer community are commonly employed as casual labourers by land owners and kiln-operators. At the time of major agricultural activities farmers generally arrange hired labourers though some farmers complete their work by mutual help.

1.3. Methodology

1.3.1. Study during the first phase

1.3.1.1. Selection of collaborating farmers

Following identification of homesteads with bamboo clumps, a process of selection was undertaken amongst farmers who were interested in collaboration with the project and who were willing to undercrop their bamboo clumps. Socio-economic status of homestead-bamboo owners was determined by a relative wealth ranking exercise (Grandin, 1988). Relative wealth ranking was based on ownership of land, occupation and income sources of the household, together with indicators such as ownership of livestock, ownership of consumer items such as televisions, and nature and condition of the dwelling in terms of number of rooms and construction materials used. This led to a three tier stratification of the households as low, middle or high-income.

From the community of homestead bamboo-owners, 33 individuals were requested to take part in on- farm research. Selection was made primarily by project staff although in one case staff were recommended by one farmer to contact a certain other farmers, and another farmer approached the staff after hearing about the activity from his relative. Eight out of thirty three individuals later declined to take part in the study. The sample of remaining 25 households, in terms of relative wealth, was composed of 7 high-income and 9 each in middle-income and low-income families.

1.3.1.2. Crops selection and planting strategy

During the Rapid Rural Appraisal, ginger *(Zingiber officinale)* and turmeric (Curcuma longa) were suggested by farmers as potential understorey crops for bamboo. For the trial, project staff asked farmers to plant rhizomes in three crop beds per crop stretching from 1-5 m from the bamboo clump.. This trail was principally to investigate potential shading and root effects of bamboo upon understorey crops. It was intended that differences between sub-plots for yield of each species could be examined through a statistical analysis of variance (ANOVA).

Farmers were asked to follow their usual practices of soil preparation, However, recommendations were given as to height of raised bed (30 cm), width (1 m), and crop spacing (25x25 cm or 12 rhizomes/sq.m). Project staff expected farmers to use readily available planting material. However, for three farmers KFRI has given planting material because these farmers though interested in participating could not be able to obtain materials from the market due to time and money constraints. Size of planting material and depth of planting was left to the farmers. The amounts of planting material varied from 2009 to 4000g.

The study commenced in the planting season, June 1994 and was completed following the harvesting season, February 1995.

1.3.1.3.Monitoring and analysis

A detailed study of both socio-economic and crop management aspects was made by project staff through house visits once a month. Information was gathered during informal interviews. Supplementary information such as performance of crop, incidence of pest or diseases was gathered by field observations. The level of involvement of participant farmers in the crop management was assessed at three stages namely initial, intermediate and final stage of crop cultivation. Initial stage includes the preparation of bed, planting and protection, intermediate stage includes weeding, fertilizer application and mounding while the final

stage includes second round fertilizer application, mounding and harvesting. Participation was marked as good (G), moderate (M) and poor (P).

Analysis was based on the information collected from individual houses. Reasons for getting either good, moderate or poor rhizome yield were discussed with farmers on an individual basis and at collective level during a post-harvest evaluation workshop.

1.3.2. Study during the second phase

The study was continued in the second growing season i.e. May 1995 to February 1996.

1.3.2.1. Selection of collaborating farmers

Humid zone

Vithanassery and Elavancherry revenue villages were revisited and all twenty five 'research farmers' were contacted to know about the possibility of continuing undercropping experiment. Out of 25 farmers 21 have agreed to involve in the activity. Our visit to other areas of the village has made us to identify a five more potential participant farmers. Son of one participant studying in a College at Thrissur has shown a keen interest in the activity. So we decided to use him as the key person of the village and asked to identify another 25-30 potential farmers who can participate in the activity. We also told him to choose participants from different socio-economic matrices of the village. His effort enabled us to include another 20 farmers in the activity. Thus, totally 46 farmers agreed to join in the activity. However, when the activity began, 7 farmers could not continue with the activity. Among them 3 were 'research farmers' and the rest were 'new farmers'. The sample of remaining 39 households, in terms of relative wealth, was comprised of 14 high-income and 11 each in middle-income and 14 low-income families.

Low rainfall Dry zone

First we contacted 25 research farmers of Thadanara revenue village who were involved in the branch cutting activity and discussed with them about our undercropping experiment. Out 25 farmers 14 have readily agreed to involve in this activity also. Fifteen other farmers from revenue villages namely Thadanara, Pathanara, Anamari, Karipode, Mudappallikolambu and Palayam have agreed to participate in the activity. Therefore, total number of farmers who have agreed to join the activity raised to 29. Subsequently, ***8*** farmers did not continue with the activity. Therefore, finally, in this zone, we left with 21 farmers. The sample of remaining 21 households, in terms of relative wealth, was composed of 6 each of high-income and middle-income and 9 low-income families.

1.3.2.2. Planting activity

In both zones, the study commenced in the planting season (May 1995) and completed following the harvesting season (February 1996). Crop plant strategy was similar to that followed in the first growing season described in 1.3.1.2. However, for about 80% of the farmers, planting materials (turmeric) was supplied.

Methods of monitoring of the activity and analysis of socio-economic and crop management aspects were same in described in 1.3.1.3.

1.4. Results and discussion

1.4.1. Farmer's collaboration

Out of thirty three farmers contacted during the first phase, twenty five farmers showed interest in participation. Similarly, in the second phase, 60 out of 90 farmers contacted continued to show interest in involving in the activity. High level of involvement of farmers (67% to 80% of the farmers contacted) in the rhizomatous crop study was an indication of the farmers positive attitude towards participatory research programmes of this kind.

Relative wealth ranking of all farmers contacted indicated that those who did not participated in the activity belonged to high-income (in the Humid zone , 4 out of 11 and 5 out of 14 in the first and second phases respectively; in the dry zone, 8 out of 14 in the second phase) and to low-income (in the Humid zone , 4 out of 13 and 5 out of 18 in the first and second phases respectively; in the dry zone, 7 out of 13 in the second phase) groups. High-income farmers stated that under-cropping of bamboo with rhizomatous crops was a waste of time because, a) they do not themselves do work in their farms but employ labourers for the purpose and do not feel that the resultant income would justify additional labour costs and, b) they are already growing rhizomatous crops on other landholdings. Lack of interest in participation by a few farmers of lower economic stratum was stated to be due to lack of time as they have to spend more time as labourers to earn their living.

1.4.2. Farmers' attitude towards experimental design

As mentioned in the section 1.3.1.2, farmers were asked to grow ginger and turmeric within a 5m distance from the base of their bamboo clump, in alternate rows, to have three replicates for each crop. Most of the farmers did not follow the experimental design while preparing beds and planting, and there were many variations in level of post- planting management also. As the study progressed, staff realised that crops yield was for less important than measuring changes in farmer's attitude towards bamboo. Some farmers planted too deeply resulting in poor establishment of the crop. Amount and quality of planting material also varied widely. This rendered scientific yield comparisons inappropriate. Reasons for not following the planting design were blamed on, 1) lack of planting material to cover the assigned area and, 2) labourers did not follow the instructions of the individual who had to agreed to collaborate with the experiment.

1.4.3. Farmers participation in crop management

During monthly monitoring visits future crop management requirements were discussed with the farmers. There was a two way flow of knowledge. Sometimes suggestions given by experienced participant farmers were transferred by project staff to other participants for better management of crops, for example, weeding and remounding of raised beds after heavy rain. While discussing with farmers participated in other activities of the project or with farmers who visited on-farm experimental sites project staff gathered information useful to manage rhizomatous crops. Such information have also been transferred to participants farmers. At the same time, level of farmer involvement in the cropping activity was assessed by project staff.

1.4.4. Gender participation

It is generally stated that rural women play an important role in planting, nurturing and harvesting homegarden crops because the homestead is their domain (Sharma, 1980; FAO, 1982; Chandrashekara and Sankar, 1994). It was evident from the study that, although females assist with some agricultural activities, cropping decisions are predominantly made by male members of the family. In one case a female member was interested in participating in

the research activity but she was over-ruled by a male member of her family. Otherwise there was no evidence that men stopped women from working. From Table 1.1 it can be seen that 65% to 82% of males in the sample were active in the work. The remainder employed labourers or got other family members to do the work. For females, only 19% to 45% were actively involved. Reasons given for lack of female involvement were, a) lack of time after domestic chores done, and b) they are not used to doing such work as it was deemed men's work.

In households where male family members were away from home or did not have time to manage the cropping trial, the least level of management was observed. This was especially so in the poorest economic stratum as the women were fully engaged in household chores and could not afford to hire labour.

Table 1.1. Gender involvement in undercrop management in the Humid and Dry agroclimatic zones of Palakkad District. Values given in parentheses represent percentage of total informants.

	Humid zone			Dry zone*		
	1st phase		2nd phase		2nd phase	
Categories	Male	Female	Male	Female	Male	Female
No involvement no appreciation of the activity	1 (5)	4(16)	1(3)	5(13)	1(5)	4(17)
appreciation of the activity	2(9)	7(28)	2(5)	10(26)	3(15)	6(28)
Observed sites but not physically involved in the activity	2(9)	4(16)	5(13)	12(30)	3(15)	7(33)
Participated in the activity	11 (50)	8(31)	15(39)	9(23)	9(45)	3(14)
Participated in the activity, and giving suggestions and comments for better crop management	6(27)	2(9)	15(39)	3(8)	4(20)	1(5)
Total	22(100)	25(100)	38(100)	39(100)	20(100)	21(100)

* Study was conducted only in the growing season May 1995 to February 1996 (2nd phase of the Activity).

1.4.5. Economic influence upon participation

Level of involvement of farmers in the cropping activity was influenced by their economic status. Table 1.2 shows that middle and low income farmers showed greater participation than the high income group. This was because, high-income households were having a low priority for raising minor crops under homegarden bamboo as compared to cash-cropping in other land-holdings. However, during second year, in the Humid zone , high income farmers who continued crop cultivation showed keen interest to give suggestions and positive comments for better crop management.

Table 1.2. Participation by farmers of different economic status in undercrop management in the Humid and Dry agroclimatic zones of Palakkad district.

	Number of participants of different economic groups								
	Humid zone						Dry zone*		
	Istphase			2ndphase			2nd phase		
Categories	High	Middle	Low	High	Middle	Low	High	Middle	Low
No involvement in the activity									
no appreciation of the activity	0(0)	0(0)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
appreciation of the activity	1(14)	0(0)	0(0)	0(0)	0(0)	0(0)	1(17)	0(0)	0(0)
Observed sites but not physically involved in the activity	3(43)	0(0)	1(11)	444)	2(12)	0(0)	4(66)	2(22)	1(17)
Participated in the activity	2(29)	5(56)	5(56)	1(11)	9(53)	7(54)	0(0)	6(67)	5(83)
Participated in the work and giving suggestion and comments for better crop management	1(14)	4(44)	2(22)	4(44)	6(35)	6(46)	1(17)	1(11)	0(0)
Total	**7(100)**	**9(100)**	**9(100)**	**9(100)**	**17(100)**	**13(100)**	**6(100)**	**9(100)**	**6(100)**

* Study was done only in the growing season in May 1995 to February 1996 (2nd phase of the Activity)

1.4.6. Crop preference

Not all the participants preferred to grow the same crop. However, most of the farmers opted for turmeric cultivation in preference to other crops such as ginger, mango ginger *(Curcuma amada)* and Chinese potato *(Coleous paviflorus)* for three reasons:

a) turmeric is used more frequently than other crops for culinary purposes,

b) planting material of turmeric was more easily obtained by farmers, and

c) turmeric is said to be more disease-resistant than other crops, particularly ginger

Those farmers unable or unwilling to acquire turmeric or ginger for the trail planted mango ginger, arrowroot *(Maranta arundinacea*) or Chinese potato depending on the availability of planting materials. When asked the most participants preferred turmeric over ginger apart from the reasons mentioned above they mentioned that as the ginger has a lower domestic demand but a higher market value, it is often grown as a cash crop in fields outside the homegarden. It may also be pointed here that the farmers preferred crops with a short growing season so that they can harvest before branch-cutting from bamboo clumps for fencing in January-February. This is a strategy adopted by farmers to minimise understorey crop losses during the branch cutting operation.

1.4.7. Crop management

One practice that was recommended to follow during the cropping period was remounding of beds by soil during the rainy season. Remounding of beds was to improve the development of crops rhizomes. Half of the participants followed this practice while the rest did not, because of reasons like heavy rain, lack of time due to other works and ill-health.

During the planting time some farmers used bamboo branches or banana leaves to cover the planted beds to discourage hens and thus protect and crops from hens. Ash was applied as a nutrient by almost all participants. Out of eighty five farmers thirty eight have applied organic manure which is available in their homegarden. Only four have applied a small quantity of inorganic fertiliser from the bulk purchased to apply for other crops both in homegarden and other crop fields. However, having access to manure did not mean that it was used for these crops as well. Five farmers sold manure as a commodity but did not apply it to rhizomes of the experimental plot. Manure is generally prioritised for use on paddy fields. Following discussions with farmers about probable harvest dates, farmers agreed to let project staff measure yield during harvesting so that yields from each plot could be compared. Crop yield in relation to distance from bamboo clump was measured. There was no significant correlation between crop yield and planting distance from bamboo clump because of several variations in planting practice.

Ratio of harvested weight to planting weight of each crop is calculated as an indication of what farmers gained from participating in the cropping activity. This was further extended to relate yields to the levels of crop management at three stages of crop cultivation in order to evaluate how management affected crop yield (Table 1.3). Higher yields were achieved by farmers who tended their plots better, particularly at the later mounding stages. Although this was not a surprising result, it was important that the project staff were able to discuss with farmers the precise reasons for the results they obtained, particularly in cases where yield were low.

Discussion with participant farmers on the crop yield led to recognise 12 reasons for poor yield (Table 1.4). Most of the participants have given more than one reason for the poor yield. During the first year, the poor performance of crop was attributed mainly to the late start (last part of June) of the cropping trial and the poor quality of planting material that farmers had purchased from traders. Whereas, during the second year, the lack of rain and hard and dry soil were attributed as the major reason given for poor yield.

In addition to the varied cropping patterns adopted by farmers, variations in growing conditions were observed among homegardens in terms of micro-site soil type, aspect, light

incidence and other tree crop associations. The latter was most important as cumulative competitive effects upon crop yield were be due not only to bamboo, but also to adjacent trees, such as tamarind *(Tamarindus indica),* coconut *(Cococs nucifera),* rain-tree *(Samania saman),* mango *(Mangifera indica)* and neern *(Azadirachta indica).*

Table 1.3. Levels of participation of farmers in different stages of crop management and yield ratios of undercrops in the Humid and dry zones of Palakkad District.

	Levels of participation in different stages crop management[a]								
	G[b]G[c]G[d]	GGM	GMG	GMM	GMP	GPM	MMM	MMP	MPP
HUMID ZONE 1ST PHASE Number of participants	1	1	1	8	1	1	3	3	6
Ratio of harvested weight and planting weight of crop ..... >6 times	1	0	0	1	0	0	0	0	0
4-6 times	0	1	1	4	0	0	1	1	1
2-4 times	0	0	0	3	1	1	2	1	1
<2 times	0	0	0	0	0	0	0	1	4
2nd phase Number of participants	4	4	2	12	6	0	2	2	5
Ratio of harvested weight and planting weight of crops ..... >6 times	1	2	0	1	0	0	0	0	0
4 -6 times	2	2	1	1	2	0	0	0	0
2 - 4 times	1	0	1	6	3	0	2	0	1
<2 times	0	0	0	4	3	0	0	2	4
DRY ZONE 2nd phase Number of participants	1	1	0	6	5	1	0	4	3
Ratio of harvested weight and planting weight of crops ..... >6 times	0	0	0	1	0	0	0	0	0
		1	0	1	0	0	0	0	0
2-4 times	0	0	0	3	4	0	0	4	0
< 2 times	0	0	0	1	1	1	0	0	3

a, The level of involvement of participant farmers in the crop management was assessed at three stages namely initial, intermediate and final stage of crop cultivation.
b, Initial stage includes the preparation of bed, planting and protection,
c, Intermediate stage includes weeding, fertilizer application and mounding
d. Final stage (second round fertilizer application, mounding and harvesting. Participation was marked as good (G), moderate (M) and poor (P).

Table 1.4. Factors responsible for the poor yield of annual rhizomatous crops cultivated under bamboo the Humid and Dry agroclimatic zones of Palakkad district.

Reasons for poor crop yield		Number of respondents[a]	
		Humid Zone[b]	Dry Zone
1.	Lack of rain	0 (30)	22
2.	Hard and dry soil	1(6)	10
3.	Nutrient poor soils	4(3)	5
4.	Lack of knowledgeof crop cultivation	5 (3)	5
5.	Poor quality planting materials	18 (4)	4
6.	Late planting	16 (3)	6
7.	Disturbance by hens	5 (5)	1
8.	Shade and roots of bamboo	5 (4)	6
9.	shade of other trees	10 (4)	1
10.	Insect damage to crop	7 (3)	2
11.	Poor management	12 (2)	2
12.	Project staff did not give guidelines	0 (1)	2

a, No. of participants: Humid zone ; 25 and 39 in 1st and 2nd phases respectively, Dry zone ; 21 in the 2nd phase.

b, Values out side the parentheses are for respondents of the 1st phase of the activity and those in the parentheses are for respondents of the 2nd phase of the activity.

1.4.8. Response of farmers to on-farm experiment

There was evidence from the study that farmers have been encouraged to consider developing cropping strategies in collaboration with the project. This is clearly indicated by the second time involvement of farmers in the experiment. In addition to this, some farmers were ready to repeat the trial but with different modes of organic and inorganic fertiliser application on each bed. Another farmer expressed the opinion that ginger should not be grown in the same place year after year and that a crop rotation was necessary, so in the following season he planned to grow chilli *(Capsicum annuurn).* Other crops that were suggested by farmers were Colocosia (Colocosia esculanta), elephant yam *(Amorphophallus campanulatus),* okkra *(Hibiscus esculentus),* white chilli *(Capsicum* sp.) and kacholam *(Kaempferia galanga;* a medicinal tuber) and these can be sold or used for domestic purpose.

1.4.8. Change in the attitude of farmers towards bamboo

A positive change in the participants attitude towards bamboo during the course of the study was observed (Table 1.5). Even when poor yield ratios were obtained, however, many farmers were still pleased to note that yield can be obtained if crop is managed well. Thus, the fact that undercropping was possible with bamboo clumps itself a pleasant surprise for many farmers. These results show that, amongst the sample of participating farmers, the myth that nothing can be grown under bamboo has been challenged. This on- farm rhizomatous cropping trial has encouraged the sample farmers to think more positively about bamboo- crop association. It may also be pointed here that as early as in the 6th century A.D., Khana in her book 'Khana Bachan' mentioned that crops like potato can be grown under bamboo clump (Chandrashekara,

1997). This on-farm experiment offered an opportunity to clearly demonstrate that this traditional knowledge is acceptable one. However, it cannot be assumed that beliefs about the harmful effects of bamboo upon other crops have fully vanished both in scientific and farming communities. Allelopathic effects have been reported of bamboo root (Jayakumar *et al.,* 1987) and leaf extract (Eyini *et al.,* 1989) upon growth of crops such as groundnut *(Arachis hypogaea* Willd.) and corn *(Zea mays* L.). Traditional farmers classified bamboo leaves as 'hot'. This 'hotness' of bamboo leaves may indicate that they are allelopathic or reduce soil moisture availability required by crops. At the same time farmer's knowledge of the ecology of plant association indicate that the negative effects of bamboo leaves on crop can be minimised by sweeping away of bamboo leaf litter from crop mounds towards the bamboo clump. Root competition for nutrient and moisture by bamboo with undercrops can be reduced by digging trenches between the clump and mounding the clump with soil. Better management of crop mounds would also help in diminish root competition.

Table 1.5. Attitude of participants to undercropping bamboo with rhizomatous crops before and after the study conducted in the villages of Humid and Dry agroclimatic zones in Palakkad district.

		Number of respondents		
		Humidzone		Dry zone
		1st phase	2nd phase[a]	2nd phase
Before the study				
1.	Did not aware that crops could be grown under bamboo	15	11	23
2.	Aware of but not tried	8	5	6
3.	Had tried before	2	1	0
After the study				
1.	Recognised that crops could be successfully grown under bamboo	25	18	25
a.	Willing and likely to practice in future	19	14	18
b.	Unlikely to practice	6	4	7

[a] Farmers who participated in the 2nd phase only.

1.5. Conclusion

The multi-disciplinary on farm research involving farmer participants to understand the performance of rhizomatous crops under bamboo clumps has enabled to recognise various socio-economic and agronomic factors influencing farming activities and their contributions in determining the yield of crop under bamboo clump. This kind of multi-disciplinary on-farm research generally cannot expect any scientific cropping pattern and any statistical method for analysis of results cannot be adopted. As documented earlier, most of the farmers did not follow the experimental design while preparing beds and planting, and there were many variations in level of post- planting management also. As the study progressed, staff realised that enumeration of crop results was for less important than measuring changes in farmer's attitude towards bamboo.

Although, farmer's were willing to experiment with other crop patterns and management techniques for their agroforestry systems. This initiative needs appropriate intervention by research institutions, government and non-government agencies to encourage farmers of different socio-economic matrix *so* as to cover their requirement. For example, this study has indicated that poor farmers prefer to grow crops for their subsistence while rich farmers opt primarily for cash crops. At the same time, ways and means of transfer of a set of technology which could be chosen and adopted by farmers of a wide range farmers of different socio-economic groups are also to be decided in order to promote intercropping of crops with bamboo, thereby attempting to overcome a constraint on bamboo promotion and conservation.

CHAPTER 2

Impact and benefits of different cutting regimes for bamboo branches and culms as fencing materials in three agrociimatic zones in Kerala

2.1. Background and objectives of the activity

The branches of bamboo are an essential fencing material in some parts of Kerala. Therefore, management of bamboo is an essential activity amongst certain sectors of the rural community. A rapid rural appraisal conducted in Thrissur and Palakkad Districts in MarchrApril 1994 has shown that in both the Districts, majority of the farmers prefer thorny bamboo *(Bambusa bambos)* over thornless one. It was also noticed that in the low-rainfall dry zone and the Humid zones of Kerala, the bamboo branches were cut during the months of December-February when they were about 4-5 months old. On the other hand, in the coastal zone of Thrissur district, farmers cut branches during the months of May-June when they were 9-10 months old. According some farmers this difference in fencing season is due to the fact that the fencing activity in a given zone coincides with the maturity of branches and labour availability. Thus a question whether bamboo branches mature in different seasons in different zones was raised among the project staff and farmers. It was also scientifically not known what qualitative and anatomical characters could be assigned to mature and immature branches. In this context, a study was designed in three agroclimatic zones namely the Humid zone , low rainfall Dry zone and low lying coastal zone (Kole) of the State to:

⇒ analyse the qualitative and anatomical features of bamboo branches of different ages, and

⇒ identify socio-economic factors influencing the seasonal variation in branch cutting and fencing.

As also indicated in the Introduction, many traditional farmers suggested the cutting of top one fourth of culms is a technique to minimise aboveground competition by bamboo with other crops. They also added that cutting of tip portion would not adversely affect the remaining portion of the culm. On the other hand some other farmers did not agree with this fact and they believe that remaining portion of the culm get damaged and become useless. In this context, it was decided to study the impact of culm tip removal on the clump health.

2.2. Methods

2.2.1. Selection of collaborating farmers

Twenty five farmers from each zone were selected for the study. Economic status of homestead bamboo owners was determined by a relative wealth ranking exercise by adopting the method described in the Chapter 1. This led to a three-tier stratification of the households as low, middle or high-income classification of participant farmers based on relative wealth rank.

Even though much care was taken to include farmers almost equally from different economic groups, in the Kole zone it was not possible. Here only five farmers out of 25 belonged to lower group. This may be attributed to the fact that poor farmers in this zone either have very small homegardens or do not have proper fencing around their homegarden.

2.2.2. Experiments on the maturity of branches

In each zone, all twenty five participants were asked to retain one new culm undisturbed in their bamboo clump for the study. Selection of the culms was done with farmers help and consent and later marked with aluminium tags. One to three branches per node (depending on the number of branches present in a given node) were cut for anatomical study. Every month branch/branches were cut from single node, and it was started from 4th or still higher order node from the culm base. In the case of absence of branch in any given node in a given month, collection was done from the subsequent node bearing branches. After recording the qualitative features, branches were cut and pieces from the bottom and tip portion of such branches were carried to the laboratory in polythene bags. The remaining branch portions were labelled with aluminium tag and tied to the existing fence in farmers house. These branch portions were monitored at monthly interval for their the qualitative changes.

Each branch piece brought to the laboratory was air dried and later cut into two small pieces. One piece was used to estimate moisture content after oven drying at 105^{o} C for a constant weight. The other piece was used to study the cell wall thickness of fibres. The sample was macerated with acetic acid and hydrogen peroxide (1:1) solution and later kept in oven at 105^{o} C till the sample became white. After maceration sample was washed thoroughly with water and shaken gently. Separated fibers were stained with safranin and mounted on a slide using glycerine. From each sample 50 fibers were measured for the cell wall thickness using micrometer.

Although, participant farmers have agreed to retain marked culms intact for the study purpose, during the monthly collection of November 1994, it was recorded that marked culms were damaged in few houses of the Dry and Humid zones. In anticipation of the further decline in the number of participant farmers in subsequent months, it was decided to carry out the experiment on branch maturity in the controlled condition also. In each zone, three more farmers having more bamboo clumps either in their homegardens or other land and willing to participate in the activity were identified. At least 10-15 new culms (5-6 months old) were marked per clump from each farmer's land. Branches were cut from 10th node, from November 1994 to June 1995 at monthly intervals. Thus every month three replicate sample from 10th node were collected for the study. Moisture content and cell wall thickness were studied following methods explained above.

2.2.3. Culm cutting experiment

Total number of participant farmers who agreed to retain one culm for the experiment was 21, 19 and 18 in the Humid, Dry and Kole zones respectively. The study was aimed to know the effect of damage occurred to the top portion of the culm on the growth and quality of the remaining basal portion. Thus four types of damage were made and they were:

a) cutting the top portion at the middle of an internode.
b) cutting the top portion at a node.
c) slicing the top portion vertically passing through an internode and a node.
d) slicing the top portion vertically only at the internode.

At least three replicate samples were selected for each of the above treatment. Qualitative changes occurred in such damaged culms were compared with those in undamaged culms. Parameters studied were:

a) branch formation at or from nearby nodes.
b) growth and health of the culm.
c) incidences of disease and insect damage in damaged parts.

2.2.4. Monitoring

A detailed study of socio-economic factors and work calendar of both farmers. and labour communities in the regions were made by project staff through house visits and informal discussion with both participants and non- participant farmers at monthly intervals. Information was gathered from participant farmers during informal interviews.

Analysis was based on the information collected from individual houses. Socio-economic and ecological reasons for practicing a given type of fencing activity were collected. Possibilities for adopting scientific results obtained by the study in using bamboo branches for fencing and management of culms were also discussed with farmers on an individual basis and at collective level during post- experiment meetings.

The study commenced in September 1994 in the Humid zone and in October 1994 in the dry and Kole zones and was completed in November 1995.

2.3. Results and discussion

2.3.1. Farmers' collaboration in the experiments

In the Dry zone of Palakkad district, unlike in the Humid zone , vast areas had to be covered in order to select samples from economic matrix. In the Kole zone of Thrissur district, the selection of the houses was quite difficult as it was hard to find houses with bamboo. However, once the potential households were recognised no problem was experienced in getting farmers to participate. In spite of the fact that there will not be any immediate direct benefit for the farmers by collaborating with the experiment, most of them (all 25 farmers contacted in the Humid zone and 25 out of 27 contacted both in the Dry zone and the Kole zone) have decided to cooperate with the experiment. Reasons for the reluctance of a few farmers in joining the experiment were analysed. This has indicated that in one case, the problem was that it was a joint family and so the permission from all has to be taken. Whereas in another case, farmer owns a small bamboo clump he feared that if branches/culms were cut it would harm the bamboo clump also. As mentioned earlier, in the Kole zone, two farmers did not agree to participate. While in one house, the male adult said that usually branches are cut only once in a year and by taking branches every month there might be chances then in the process the clump as a whole or culms nearby will get destroyed. His question was as to what will be done if such a thing happens. It was said that payment for the deceased will be met, yet he refused. This could mean he was either ignorant about bamboo, its growth etc., or this was a mere excuse to avoid participating in the activity. Another man, refused to participate and he said that if he gives word, he has to keep it. His problem was that the bamboo clump was in the border of his land. The culm has been falling on the neighbours land. The neighbour who was a drunkard, abuses him every day, thus they were planning to sell off the clump.

Three major reasons and different combinations of these major reasons have been given by participants for collaborating in the activity (Table 2.1). According to about 50% of the participants their cooperation in the experiment is because 'officials asked and they also felt that they are not going to loose much instead cooperating with the researchers'. Of the total participants with above mentioned view about 46% of them come under low economic group. Twenty six farmers felt that after all by cooperating with the project they are not going to loose much, but a few branches. Of this 13 were from the higher economic group and only 2 from the lower group. Fifteen farmers thought of helping researchers and wanted to be a part of the experiment by collaborating with the activity.

Table 2.1. Reasons given to participate in the branch cutting and culm cutting experiments by farmers of different economic status in three agroclimatic zones of Kerala State.

Reason for participation	Dry zone			Humid zone			Kole zone			Total		
	Economic group											
	H	M	L	H	M	L	H	M	L	H	M	L
Officials asked	0	1	4	0	1	4	1	1	1	1	3	9
Official asked and nothing much to loose	1	0	1	1	2	1	2	2	2	4	4	4
Officials asked, nothing much to loose and interested in helping researchers and to become a part of the research	2	1	1	0	2	1	0	1	1	3	4	3
Nothing much to loose	1	1	0	1	2	0	4	4	0	6	7	0
Nothing much to loose and interested in helping researchers and to become a part of the research	2	2	1	2	1	1	2	2	0	6	5	2
Interested in helping researchers and to become a part of the research	3	3	1	2	2	2	1	0	0	6	5	3
Total	**9**	**8**	**8**	**6**	**10**	**9**	**11**	**10**	**4**	**26**	**28**	**21**

*, Income groups: H: High, M: Middle, L: Low. Based on wealth ranking.

The general attitude of poor farmers towards the government officials was evident while analysing the reasons for their cooperation in the experiment. They always have a submissive attitude towards the officials. Most of them have cooperated with the experiment since the officials requested for it. Difference in main reasons for cooperation among farmers were seen among three different zones. Most of the people in Kole zone (68% of the total) cooperated mainly due to officials request and due to the feeling that they are not going to loose much by doing so. Only one farmer in Kole zone showed genuine interest in the experiment and wanted to be a part of the experiment. This may indicate that more participants from the dry and central zones wanted to participate in this on- farm experiment as the results of the study may be useful for proper utilisation of bamboo branches and management of culms. Whereas less farmers in the Kole zone are interested in the study and its results.

All participant farmers did not agree to cooperate in both branch cutting and culm cutting experiments. In the Humid zone , out of 25 farmers, one did not let us experiments with the bamboo branches. Here the rich old farmer said that he needs branches to fence. He also told that branches are costly and what he gets from his clump is insufficient. However, he showed interest to participate in the culm cutting experiment. In the dry and Kole zone all participant farmers agreed to set apart marked culm for branch cutting experiment. This is mainly because

they felt after all by cooperating with the project they are not going to lose much but a few branches. However, 16 out of 79 farmers contacted did not agree to participate in the culm cutting experiment. Reasons for not involving in culm activity were, a) clumps are small, b) culms are in less number, and c) if culm is cut prior to maturity the cut portion will go useless. One rich farmer though gave culms for the activities, but for cutting culms a small one was selected by him. He says that the cut portion is of no use, as it is immature. He also did mention that culm will cost Rs. 40/- to Rs. 50/-. This shows that he was not willing to loose much money by participation in the activity. On the other hand, when a small culm was pointed out for the activity, another rich farmer said that if a culm is taken for the study, the best should be taken and the farmer pointed out a bigger culm. These results indicate that the degree of collaboration of farmers in on-farm experiments vary with respect to the type of activity and how much importance a farmer gives for the on-farm experiments.

2.3.2. Level of participation in the experiments

In the Humid and Dry zones, in each house, at least one family member usually male member came to the spot during monthly sample collection throughout the experimental period. In the absence of the male member, the female was always around, but she hardly came to the spot where the activity was done. During the first two collections, most of the farmers were very observant and asked about the activity. But subsequently they did not bother to keenly watch the activity or to ask questions as they now know what exactly was being done, In one house, it was understood that the lady there, did not even know as to what was going on. During our second visit the lady of the house had to ask why we were there. In the previous visit it was her husband who was at home and agreed to participate in the activity. He obviously has not told his wife about it. It was one participant's neighbour who told her what was being done. In another house, the females have seen what was being done, from a far, but they did not show any interest to ask their male member what was going on nor did the male member told tell them. During the second visit on putting this topic, they did ask what exactly is going on.

Unlike in the Humid and Dry zone in the Kole zone only 30-40% of the farmers were at the site during experiment and in the remaining cases either no member of the house was available as they go for work or just directed us to go and carry out our work.

Even though all the farmers initially cooperated 33 farmers discontinued from the experiment. It was also seen that most of the farmers who discontinued from the activity mainly belong to the dry and Humid zone s (n=30), and only three farmers from the Kole zone (Table 2.2). In 26 houses, the branches of the selected culm were also cut by workers while cutting branches from other culms because it was difficult to maintain branches of the selected culm which was intertwined with those that had to cut. The farmers have to depend a lot on the convenience of the workers who are cutting the branches. In some houses (n= 7) farmers said that while the labourers cut the culms nobody was there in their home and the labourers did not know that which one to be retained. In the Humid zone , one farmer who helped us to identify few suitable farmers to include in the activity and himself activity participated in the experiment could not be able to maintain the marked culm after the 3rd collection. This is again because when he was not there during branch cutting for fencing labourers cut branches from marked culms also.

Table 2.2. Number of houses remained to collect bamboo branch samples in different months in three agroclimatic zones of Kerala.

Months	Number of households		
	Agroclimatic Zones		
	Dry*	Humid	Kole*
1994			
September		24	
October	25	24	25
November	24	24	25
December	20	23	25
1995			
January	18	21	25
February	15	19	25
March	13	18	25
April	10	17	25
May	8	14	24
June	7	13	22
July	7	13	22

*, Collections started from October 1994.

All the culms marked for culm cutting experiments were maintained till the end of experiments except for cutting branches for fencing in three houses. In the central and dry zones, at one or the other visit participant farmers discussed with us the qualitative changes visible in cut and uncut culms.

2.3.3. Branch maturity

As mentioned in the Methodology, in each zone, first sample collection of branches was from 4, 5, or 6th node which subsequently led to monthly collections from different nodes. In order to compare the moisture content and cell wall thickness among branches of different nodes in a given month statistical methods like ANOVA and LSD tests for unequal samples were employed. However, in the first two months collections, no significant difference among branches of different nodes collected in a given month was observed. This indicated that the average values of a parameter obtained for the branch collected in a given month from a house could be considered as the sample and monthly mean and standard error values could be calculated based on number of houses sampled. and LSD tests for ANOVA unequal samples were also performed considering the average values obtained for a given parameter in the monthly collection from individual houses. This kind of change in statistical analysis also became necessary as the number of houses sampled declined during the experimental period.

Comparison of cell wall thickness of branches showed a significant difference among samples collected in different months ($P<0.05$), except in first two months ($P>0.05$). From September or October 1994 to February 1995, increase in cell wall thickness was gradual but a steep increase in cell wall thickness between February and March 1995 was recorded (Table 2.3). Subsequently no clear trend in the change of cell wall thickness was recorded up to July 1995. The steep increase in cell wall thickness in samples collected in March as compared to those samples collected in previous months may be an indication of branch maturity in bamboos. Generally, in a given month, no significant differences among samples collected from three agroclimatic zones was noticed.

Table 2.3. Fiber wall thickness (m μ ± S.E.) in bottom and tip portions of branches of *Bambusa bambos* culms collected in different months from three agroclimatic ones of Kerala. Values in parentheses are S.E.

Agroclimatic Zones	Period of collection									
	1994	1995								
	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	June
Dry Zone*										
Branch tip	—	4.92 (0.32)	5.68 (0.40)	5.99 (0.26)	6.02 (0.32)	8.58 (0.48)	12.16 (0.24)	13.62 (0.48)	13.86 (0.36)	13.72 (0.41)
	---	5.30 (0.41)	6.26 (0.52)	7.49 (0.40)	7.52 (0.28)	8.16 (0.24)	12.17 (0.24)	14.72 (0.32)	14.98 (0.42)	14.86 (0.28)
Humid zone										
Branch tip	3.32 (0.44)	3.82 (0.32)	4.61 (0.38)	4.83 (0.24)	5.28 (0.30)	8.30 (0.24)	12.64 (0.41)	13.12 (0.18)	13.46 (0.24)	13.25 (0.16)
Branch bottom	5.58 (0.53)	5.86 (0.72)	6.02 (0.38)	6.82 (0.36)	6.92 (0.28)	7.46 (0.26)	12.92 (0.32)	13.42 (0.18)	13.28 (0.28)	13.16 (0.16)
Kole Zone*										
Branch tip	--	3.16 (0.24)	3.46 (0.30)	4.25 (0.22)	4.96 (0.32)	6.26 (0.30)	11.08 (0.46)	12.12 (0.34)	12.74 (0.22)	13.12 (0.26)
Branch bottom	-	4.92 (0.32)	5.76 (0.36)	6.78 (0.42)	7.16 (0.24)	8.14 (0.28)	11.76 (0.40)	13.48 (0.28)	13.26 (0.32)	13.68 (0.24)

*, Collections started from October 1994.

Moisture content in the branches of bamboo was about 63.8 to 69.8 % in September and October 1994 but declined afterwards (Table 2.4). Between March and April 1995, a significant increase in moisture contents was noticed. This may be attributed to development of fresh foliage followed by increased translocation of water.

As already mentioned in the Methods section, despite the participants have agreed to retain marked culms without cutting branches, several farmers could not do so. We thought our laboratory experiments on branch maturity may hampered due to lack of sufficient samples. Thus a controlled experiment on cell wall thickness and moisture content in branch were conducted. Since the results of controlled and 'uncontrolled' experiments were of same kind, data obtained by controlled experiment have not been given in order to avoid repetition.

Table 2.4. Moisture content (%) (mean ± S.E.) in branches of *Bambusa bambos* in different months collected from three agroclimatic zones of Kerala. Values in parentheses are S.E.

Agroclimatic Zones	Period of collection								
	1994			1995					
	Sept	Oct	Nov	Dec.	Feb	March	April	May	June
Dry Zone*	---	67.6 (2.9)	46.3 (3.2)	(2.6) (1.8)	37.2 (2.7)	36.6 (1.6)	42.6 (2.0)	44.9 (1.8)	46.8 (2.0)
Humid zone	69.8 (2.6)	62.6 (1.8)	41.3 (2.4)	(3.0) (2.4)	32.8 (1.6)	36.1 (2.1)	46.8 (2.6)	47.8 (1.0)	52.6 (3.2)
Kole Zone*	---	63.8 (2.5)	39.6 (3.1)	36.8 (1.6) (2.2)	35.2 (1.6)	35.9 (1.4)	35.6 (2.1)	41.5 (1.6)	43.9 (2.1)

*, Collections started from October **1994.**

Influence of socio-economic conditions and the level of participation by the participant farmers on the results of on-farm experiment vary depending on the type of experiment. For example, in the undercropping experiment (Chapter 1), crop yield could be able to relate to parameters such as the distance from bamboo and the level of crop management etc. This is because farmers did not follow the experimental design and adopt their own crop management strategies which greatly influenced the crop yield. Thus, the study could not be able to analyse results scientifically but helped to understand the socio-economic factors responsible for the poor yield. On the other hand, maturity of bamboo branches is independent of any influence of socio-economic conditions of the farmers and general management practices if at all practised. Therefore, whatever little sample households left in the course of study was enough to analyse data scientifically. At the same time the study also able to analyse the various factors which influence the involvement of farmers in the on-farm activity.

2.3.4. Qualitative analysis of branches and branch cuttings

Though new culms were formed in July-August 1994, branch production was recorded in September, 1994 (Table 2.5). While the leaf production was first recorded in November 1994, leaf fall was in February-March 1995. However, new flush of leaves were produced in March-April. Incidence of branch tip damage by insects were noticed in January 1995.

Bamboo branches cut and placed on fence at monthly intervals showed different qualitative changes during the course of time (Table 2.6). While the samples collected during September-December 1994 damaged completely within 4-6 months, those collected during January-February 1995 became brittle with dried tips within 5-6 months. Except for drying and falling of leaves no major changes in the samples collected after March 1995 was recorded during the study period up to September 1995.

Table 2 . 5 General features of branches of *Bambusa bambos* in different months.

Period of collection	Features
September	Branches newly formed, tender, green with ashy materials. Secondary branch and lead sheaths present. Buds of leaf and secondary branches are seen.
October	As in September samples..
November	Branches green, less ashy. Leaves and branches present. Thorns green fleshy and easily bend.
December	As in November samples.
January	Thorns green, slightly strong. Incidence of branch tip damage by insects was more.
February	Branches yellowish green without ashy material. Sheaths falling off. More leaves per branch. Thorns strong. Branches bend easily but not breaking. Branch tip still fleshy but the remaining portion is bard.
March	Branches yellowish green. Leaves either absent or new leaf buds and foliage emerging out. Thorns strong.
April	Branches yellowish green or pale green. Leaves present. Thorns do not break easily even at the tip portion.
Mav	As in the April sample.
June	As in the April sample.

Table 2.6. Qualitative, changes in branches of *Bambusa bambos* cut and used in fencing in different months in three agroclimatic zones. Study was started in September 1994 and completed in September 1995.

Qualitative changes		Months of branch cutting and used in fencing									
		Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June
		Months of observation of qualitative changes									
1.	Branch tip and secondary branches dried out	Oct	N o ~	Jan	April	June	Sept	----	----	——	---_
2.	Samples crumpled. lost original colour .	N o ~	N o ~	Dec	Feb	----	----	---	——	——	-
3.	Sample brittle	----	---	---	--	June	Sept	----	----	----	---
4.	Samples damaged completely	Dee	Jan	Mar	June	----	---	----	----	----	
5.	Broken into pieces beyond identification	Dec	Jan	Mar	----	----	----	----	- —	---	—
6.	Samples completely dried	---	Dee	Feb	Jun	----	-----	---	--	----	--
7.	Samples broken at points where tied	----	——	----	Aug	Sept	----	----	----	----	----
8.	Thorns shrunken and bend or break easily	----	----	---	Mar	June	Sept	----	----	----	----
9.	Leaves dried but present on branches	--	--	--	Jan	--	Mar	June	June	Sept	Sept
10.	Leaves dried and fall off easily	---	Dee	Dec	Feb	Mar	June	July	Sept	---	---

2.3.5. Culm cutting experiment

There was no damage to the remaining portion of the culms whose tips were cut in different ways. Except one or two internodes below the cut portion, remaining parts of the culms were intact and undamaged. A comparative study on eight month old tip cut and uncut culms was made in February 1995. The length of the central and lateral branches from 4th to 10th nodes of these culms were measured. A significantly lengthy branch production from the nodes of cut culms than in uncut culms ($P < 0.05$) was recorded (Table 2.7). This can be attributed to the cessation of apical dominance due to damage occurred to the tip.

Some farmers initially were of the opinion that the damage caused to the tip portion of the culms leads to the loss of whole culm. But the present study had shown to all participant farmers that such a belief is baseless. At the same time the study has clearly demonstrated that the traditional knowledge and practice of culm tip removal has scientific basis. When the advantages of this traditional practice are understood it is also possible to learn how some traditional systems and practices are innovative and dynamic. For example, the culm tip removal lead to the production of lengthy branches. Therefore, by cutting culm tip farmers gets more branches for fence and the loss from cutting tip portion is compensated. Similarly, the shade of bamboo on crops growing nearby in mixed farming systems can be minimised by culm tip removal.

Table 2.7. Length of the branches (cm ± S.E.) of damaged* and undamaged bamboo culms in February 1995 in three agroclimatic zones.

Agroclimatic zones		
	Undamaged culm***	Damaged culm***
Central branch	210.8 ± 34.6	432.6 ± 31.2
Lateral branch	137.6 ± 26.4	216.8 ± 14.6
Central branch	342.6 ± 56.8	548.4 ± 26.4
Lateral branch	126.9 ± 24.8	218.9 ± 32.6
Central branch	286.2 ± 38.2	438.6 ± 20.6
Lateral branch	142.4 ± 20.6	216.8 ± 30.2

*, Culms were damaged in September 1994 in the Humid zone and in October 1994 in Dry and Kole zones.

**, Based on measurement made branches collected from 4th to 10th nodes.

***, Culms of 3-4 months were selected for the study.

2.3.6. Work calendar

Based on the information collected by the participants of three agroclimatic zones work calendars of farmers and labourers were prepared (Tables 2.8 and 2.9). In the dry and Humid zone s, rich farmers find a short duration of free time even during March-April and this interval could be used for fencing work. For the middle class and poor farmers more free time is available from February to May. Work calendars of the labour community in these zones showed that they can be engaged for fencing work from February to May also provided they are not involved in other works such as road construction and brick manufacture which fetch them more wages than from agriculture related activities. In the Kole zone, both farmers and labourers will have less or no paddy field works from May 15- July 15. However, they will have homestead works. By prioritising fencing works it can be completed before June 15.

2.4. Implication of the results and conclusion

It is a common notion among the proponents of traditional knowledge and practices that all such knowledge and practices have a scientific basis. However, this is not necessarily the case. The present study on monthly variation in cell wall thickness of fibres of bamboo branches and qualitative observation made on such branches indicated that both in the Kole zone and in Dry and Humid zone s of Kerala branches are strong and mature by March-April (at 6-7 months old) and there is little variations in the later stages. These results are against to the belief prevailing among traditional farmers on branch maturity. However, it should be remembered that any traditional practice is a part of the socio-cultural set-up of the community. That is one of the reasons why during the rapid rural appraisal, farmers mentioned that in the dry and Humid zone , fencing activity is more prevalent during December 15 to January 15 (Dhanu Masam) due to the off- season of paddy cultivation for both farmers and labourers. In addition to this some farmers also linked new fencing in this month with the occasions such as festivals and marriages which are more common in this month and the coming one.

However, information collected on monthly activities of farmers and labourers during the present study indicated that in the present day set-up there was a free time either to both farmers and labourers or one of them even in the months of March-April. At the same time, monthly visits to these two zones for various activities of the project also helped to know that there is a lot of variability among labour availability, branch cutting and fencing activities. Some of the observation made were:

1) in some places, skilled labourers are available round the year

2) branches after cutting, are used after 2-3 months,

3) most farmers now-a-days do not relate fencing activities with festivals.

It was also observed that some farmers fence their homegarden during the month of April- May. Discussion were made with such farmers about practical problems they are going to face by postponing fencing activity to April-May instead of completing it in December- January as practised by traditional farmers. According to them there is no problem by delaying the work except the fact that if labourers are not available in time, fencing may not be possible because after getting the first rain they have to concentrate on paddy field works.

Table 2.8. Work Calendar of farmers and labourers in the Humid and Dry agroclimatic zones of Kerala

Period Malayalam month[a]	Major Activities	Involvement of farmers and labourers	
		Farmers	Labourers
	Agricultural Activities		
	First crop		
Medam (16 April - 15 May)	Manuring fields, raising seedlings	*	*
Medam (16 April - 15 May) and Edavam (16 May- 15 June)	Ploughing paddy fields	*	*
Edavam (16 May - 15 June) and Mithunam (16 June - 15 July)	Planting paddy	*	•
Mithunam (16 June - 15 July) and Karkkidakam (16 July - 15 August)	Weeding and second time manuring	*	*
Chingam (16 August - 15 September) and Kanni (16 September - 15 October)	Paddy harvesting and post-harvest works	*	*
	Second crop		
Chingam (16 August -15 September)	Raising seedlings, ploughing Daddv fields	•	*
Thulam (16 October - 15 November)	Planting seedlings	*	•
Vrischikam (16 November- 15 December) and Dhanu (16 December - 15 January)	Weeding and second time manuring	•	•
Makaram (16 January - 15 February) and Kumbam (16 February - 15 March)	Paddy harvesting and post-harvest works	•	•
	Other activities		
Vrischikam (16 November - 15 December), Dhanu (16 December - 15 January) and Makaram (16 January - 15 February)	Fencing	*[b]	*
Meenam (16 March - 15 April) and Medam (16 April - 15 May)	Road construction, brick works, cattle grazing etc.,	---	•
Kumbam (16 February- 15 March), Meenam (16 March - 15 April) and Medam (16 April- 15 May)	Free time	*[b]	*

a, Corresponding Julian month is given in parentheses.
b, specific to Middle income and lower income farmers,

Table 2.9. Work Calendar of farmers and labourers in the Kole zone of Kerala

Period Malayalam month[a]	Major Activities	Involvement of farmers and labourers	
		Farmers	Labourers
	Agricultural Activities		
	First crop		
Karkkidakam(l6 July - 15 August)	Ploughing paddy field, raising seedlings	*	*
Chingam (16 August - 15 September)	Planting seedlings	*	*
Kanni(16 September - 15 October), Thulam (16 October - 15 November) and Vrischikam (16 November - 15 December)	Weeding and manuring	*	*
Dhanu (16 December - 15 January)	Paddy harvesting and post-harvest works	*	*
	Second crop		
Dhanu (16 December - 15 January	Raising seedlings, ploughing paddy fields	*	*
Makaram(16 January - 15 February)	Planting seedlings	*	*
Kumbam (16 February - 15 March) and Meenam (16 March - 15 April)	Weeding and second time manuring	•	*
Meenam (16 March - 15 April) and Medam (16 April- 15 May)	Paddy harvesting and post-harvest works	*	•
	Other activities		
Medam (16 April — 15 May), Mithunam (16 June - 15 July), Karkkidakam (16 July- 15 August) and Chingam (16 August- 15 September)	Fencing	*	*
Makaram (16 January- 15 February), Kumbam (16 February-- 15 March)	Road construction, digging wells, etc.,	---	* •
Edavam (16 May- 15 June), Mithunam (16 June - 15 July) and Thulam (16 October- 15 November)	Homestead works	*	•
Medam (16 April- 15 May), Edavam (16 May - 15 June), Mithunam (16 June- 15 July) and Thulam (16 October - 15 November)	Free time	*	*

a, Corresponding Julian month is given in parentheses.

In the context of these information and results obtained by branch cutting experiments we have discussed with all 50 farmers at individual and in groups to assess the possibility of suggesting to postpone both branch cutting and fencing work for **2-3** months from December-January. This kind of exercise has helped as to identify three group of farmers:

Group 1: Farmers who cannot change the existing practice of branch cutting and fencing. The farmers belong to this group are:

a) rich farmers with vast area of paddy cultivation and problem of labour availability.

b) farmers of the locality where labourers go for outside farming activities such as road construction, brick manufacturing, building construction which are more during post- paddy harvest period, i.e. March-May.

c) farmers who are dependent on branches from outside sources which generally not available after March to buy.

d) those who feel *to* finish fencing work at the earliest.

e) those farmers and labourers feel that cutting branches and working during April-June (summer months) are difficult than during winter months.

Group 2: Farmers ready to carry out fencing work in April-May are :

a) those who get laborers whenever required.

b) those who are access to labourers who are skilled primarily in bamboo branch cutting and fencing or bamboo works.

c) those who do fencing themselves with a little or no assistance from labourers.

Group 3: Farmers who are in favour of changing the period of fencing gradually because fences of January of the previous year cannot stand up to April of this year. These farmers wanted to delay the fencing activity by one month so that in the subsequent years it can carried out in April-May.

The question still remained with some farmers was whether fences made in April- May lost long for more than one year. Some farmers are of the opinion that although they have observed a distinct difference quality of branches collected before February and those collected after March, they still not convinced that fence can remain for more than one year. Those who are convinced about the longevity of branches cut in April-May also mentioned that such a fence can remain as protective devise for two years only by adopting following steps:

1. adequate to amount of branches should be used.

2. fence should be fastened properly using strong supporting structures and tying materials.

3. tying materials have to be replaced immediately as and when damaged.

In the Kole zone, none of the participants have cut branch and fence till the end of June. It was also observed that several participant and non-participants have cut branches in July at the time of emergence and growth of new culms in the clump. This has led to the damage of new culms while cutting branches. In this context, we have asked farmers that why not they cut branches and fence before 15th of May as there is no significant difference in branch quality in May and June-July. Following reasons have been given for delay in branch cutting and fencing:

1. labour availability and free time to farmers are more in June-July.

2. soil will be soft in June-July than in May and thus easy to fix stakes into the soil.

3. some people believe that branches will mature only in the Karkkidakam Month July).

In order to avoid the damage to new culms, some farmers adopt a strategy to cut branches in May-June and use them to fence leisurely in August-September. However, according to experienced labourers and farmers, such branches are not as strong as just air dried ones. Longer the branches kept after cutting more brittle and less strong they are.

In view of the scientific study made on the maturity of bamboo branches and possible damage to new culms by delaying branch cutting, we have asked all 25 participants of the Kole zone their opinion about advancing fencing activity. However, none of the participant farmers agreed to do *so* because all of them found it difficult to get labourers in April-May even for other works. Labourers also do not wish to work with bamboo during summer season because both branch cutting and fencing will be difficult task at that season. However, according a professional worker of bamboo, though such difficulties are there, branch cutting and fencing can be finished before the emergence of new culms and thus clumps can be managed well. However, it is also a fact that professional bamboo workers are declining day by day.

CHAPTER 3

Application of chemical preservation technique to prolong the life of bamboo branches used for fencing

3.1. Background and objectives of the activity

During visits to farmlands for on-farm experiments it was understood from the farmers that fencing of lands using bamboo branches was expensive due to the high labour costs both for cutting bamboo branches and making the fence. The farmers felt that they could save money if the life of the fence was prolonged from one year to three years. Therefore, standardisation of chemical preservation technique to prolong the life of bamboo branches and analyse the factors influencing in the adoption of the technique was done. Although, a standard chemical preservation technique was available for bamboo culms (Kumar and Dobriyal, 1988), a modification to suite the specific need was essential to test the feasibility, usefulness and adoptability. Thus, the objectives of this activity were to conduct a field experiment to standardise a preservation technique and to analyse the applicability of the technique in the farmers fields through informal discussions with the farmers about the technique.

3.2. Methods

Bamboo branches required for the experiment were collected two times i.e. March 1996 and April 1996 from a homegarden at Kodanoor (Thrissur District) and transported same day to the KFRI, Peechi. Boric acid and copper sulphate (2% solutions of each chemical) were used separately to treat bamboo branches in tanks. Both fresh branches (immediately after the collection) and air dried (for five days) branches were used for the experiment. Full immersion of the branches in the solution and dipping the bottom portion of the branches formed two sets of treatment. The period of treatments were one to seven days. Thus, every month, for each preservative treatment, eight sub-sets of branches used. Untreated branches (both fresh and air dried) were used as the control. For each sub-set, approximately two kg of branches were used. After the preservative treatment, branches were used to fence a small area. The qualitative and quantitative changes were monitored at six monthly interval for one year. .

For each sub-set five replicate branch samples were collected from the fence. Each sample was powdered separately. The alkali solubility test was employed to estimate the amount of wood decayed over a period of time in a given wood sample (American Society for Testing Materials, 1981). Thus two gm of powdered replicate branch sample was taken in a beaker and 100 ml of 1% Sodium hydroxide was added. After stirring well, the covered beaker was placed in the water bath and heated for one hour with intermittent stirring. At the end of 1 hr, the content was filtered with thorough washing with 100 ml of hot water followed by with 50 ml acetic acid (10%) and again with hot water. The saw dust retained over the filter paper was dried to constant weight at 100^{o} C to 105^{o} C. The difference between the initial and final sample was calculated to obtain the weight of the alkali-soluble material in the wood sample and this was expressed in percentage.

Qualitative changes observed in bamboo branches (both untreated and treated) were also recorded at six months interval.

3.3. Results and discussion

Bamboo branches from six moth old and twelve month old fences contained about 15% to 28.61% of alkali-soluble materials (Table 3.1). The study did not show any difference between branches treated with different chemicals in different ways as well as between treated

and untreated branches for the amount of alkali soluble material in the wood. An earlier study (Chapter 2), showed that 8-9 month old bamboo branches, collected during March-April were strong with the fibre wall thickness ranging from 12.16 m to 14.98 m . Such branches found to be not much changed in their physical strength even after one year in the fence. The absence of any difference between treated and untreated (control material) even twelve months afler their use in fence also demonstrated that fences made using 8-9 month old bamboo branches did not need any treatment using the chemical preservatives.

Table 3.1 Percentage of alkali-soluble materials (mean ± S.E.) in bamboo branches dipped one day in copper sulphate and boric acid solutions. Values in parentheses are for samples dipped seven days.

Treatment			Percentage of alkali-soluble materials at different period after use in fencing	
Chemical	Sample type	Treatment method	6 months	12 months
Copper sulphate	Fresh	bottom dip	19.00±0.56 (24.85±6.81)	22.46±1.36 (22.09±3.81)
--//--	--//--	complete dip	19.55±0.23 (18.33±2.11)	25.83±5.76 (28.61±7.21)
--//--	Air dried	bottom dip	15.00±4.68 (22.50±1.25)	25.75±3.33 (27.63±1.86)
--//--	--//--	complete dip	19.78±6.05 (13.75±1.25	21.75±4.07 (22.76±4.32)
Boric acid	Fresh	bottom dip	22.50±1.44 (20.00±2.89)	25.83±1.01 (28.36±0.82)
--//--	--//--	complete dip	21.25±2.39 (22.50±2.50)	25.08±2.28 (25.68±3.32)
--//--	Air dried	bottom dip	15.00±2.04 (18.00±4.56)	21.74±4.03 (26.06±3.52)
--//--	--//--	complete dip	20.00±0.00 (15.00±2.04)	27.63±3.18 (25.28±1.68)
Nil	Fresh	Control	20.00±0.40	24.30±1.70

LSD = 6.16, df = 136; n = 5 branches.

Bamboo branches treated with chemical preservatives retained the original colour (yellowish green to pale green) of the branches even after twelve months in fence; untreated materials had discolouration and were with black dots. However, the incidence of attack of termites, borers and fungus was noticed in both types (treated and untreated) branches. Similarly, both treated and untreated branches withstood when bent by almost equal pressure.

It can be concluded that the study did not provide conclusive results about the effectiveness of chemical treatments during the project period. Monitoring of the treated and untreated branches for another two years would be useful. With the assumption that the preservation technique would be effective, the opinions about the adoption of the technique were sought from the farmers through discussion. Such discussions with the farmers about the activity provided important insights into various issues to be addressed while transferring this technique. For example, it was clear from the discussion that farmers in the Central and Dry zones of Kerala were interested in preservation techniques because of the high cost of labour for cutting

branches and making fences every season. According to respondent farmers, the technique was affordable to higher income farmers. This was because, to treat branches with chemical preservative a huge tank or container in which solution can be prepared and branches can be dipped is required. Only high income farmers could be access to such facility. Farmers, in general, depended on labourers to cut bamboo branches and fence their lands. Therefore, for some farmers chemical preservation treatment could be an additional burden in terms of managing labourers for the purpose. However, this constraint to adoption of the technology could be tackled if farmers made an attempt, in the initial stage of technology implementation, to invest some time in training labourers and also managing labourers to familiarise them with the technology. The interaction with the low income and middle income farmers helped to note that many of them were willing to adopt the technique if it was effective in increasing the life of fence for atleast three years and some kind of community level facility was available to treat the materials.

CHAPTER 4

Promotion of bamboo cultivation in a village in low rainfall dry agroclimatic zone of Kerala: Case studies

4.1. Background and objectives of the activity

During the rapid rural appraisal carried out as part of the project, in villages such as Pallam, Muthalamada, Padanara and Tadanara of the low rainfall Dry zone of Kerala, farmers expressed their interest to cultivate bamboo in their lands. The interest in bamboo cultivation, as mentioned by them are due to three reasons a) they require bamboo branches for fencing, b) at present they are obtaining them from far of places by spending a huge amount and some times they do not get good materials, and c) the land is suitable to cultivate mainly bamboo rather than any other crop. However, according to the informants, since better planting material and technical know-how are not available they have not made an attempt to cultivate bamboo. These statements would lead one to think that promotion of cultivation of bamboo in large scale should be given priority. However, careful analysis of the whole socio-economic set-up of the given ecosystem with main emphasis on its influence in promoting bamboo cultivation is required. This is possible by adopting a pilot scale bamboo cultivation activity in selected area followed by studying various aspects influencing bamboo cultivation and management. Such an effort is also important because it will ultimately give answers for the following questions:

a) Why a crop is absent or not prominent in the present situation?
b) Why the farmers require the crop or landuse system being promoted ?
c) Is there any difference in accepting the promoting crop or landuse system in relation to the socio-economic status of the farmers? If there is, why and how?
d) What are the socio-economic and managerial factors influencing the success of the growth of promoted crop or of the landuse system?
e) What are the views of the participant and non-participant villagers about the success and failure of the pilot study and about the future activities to be taken in this direction?

The answers obtained for above questions could also be useful to design replicable models for further promotion *of* any given crop. Thus a pilot scale activity for the promotion of bamboo cultivation in a village was launched to find out answers for above mentioned questions. In the present Chapter, two case studies namely promotion of bamboo cultivation in homesteads and in outside lands are given.

4.2. The Setting

4.2.1. Study area, land use pattern and people

Pallam village of the Muthalamada Panchayat in the low rainfall dry agroclimatic zone of Palakkad district is selected for the study. Though most of the residents of the village are farmers, some have small businesses selling timber, fruits, clothes and utensils.

Agriculture is the major source of income of the community as a whole. Majority of the dwellers are agriculturists or agricultural labourers. People usually refer to three types of landuse in the village namely homestead cultivation, forest land cultivation and Paddy cultivation.

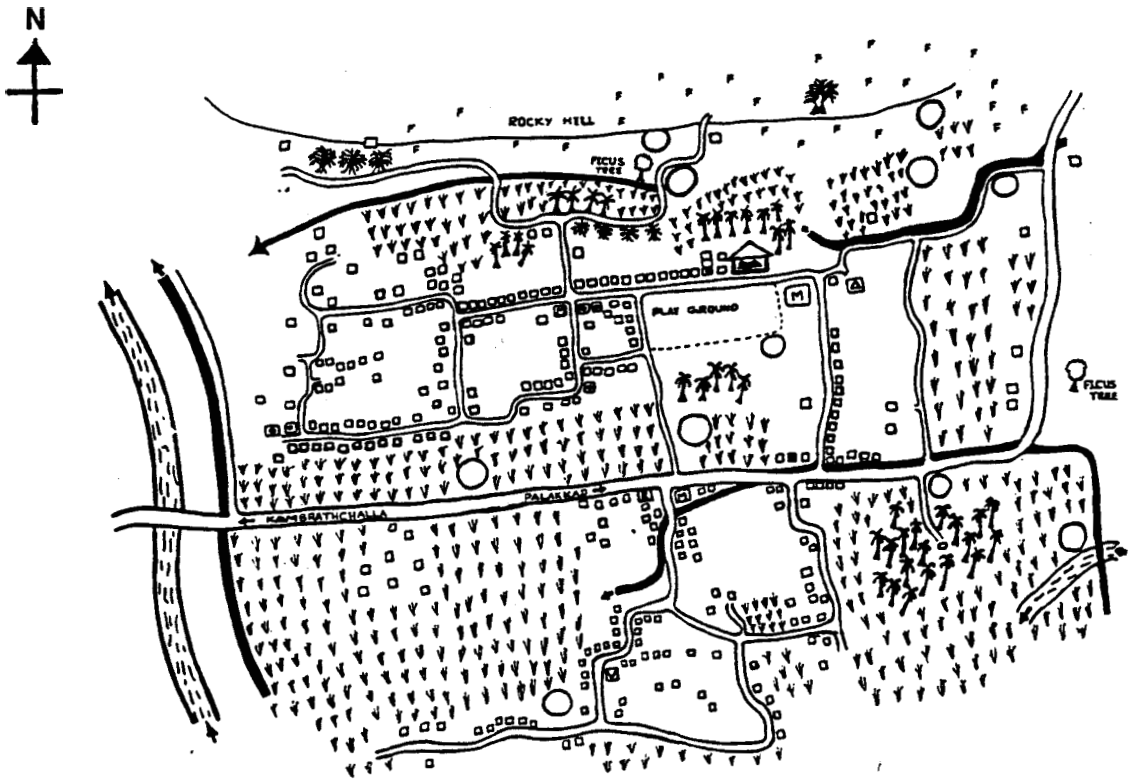
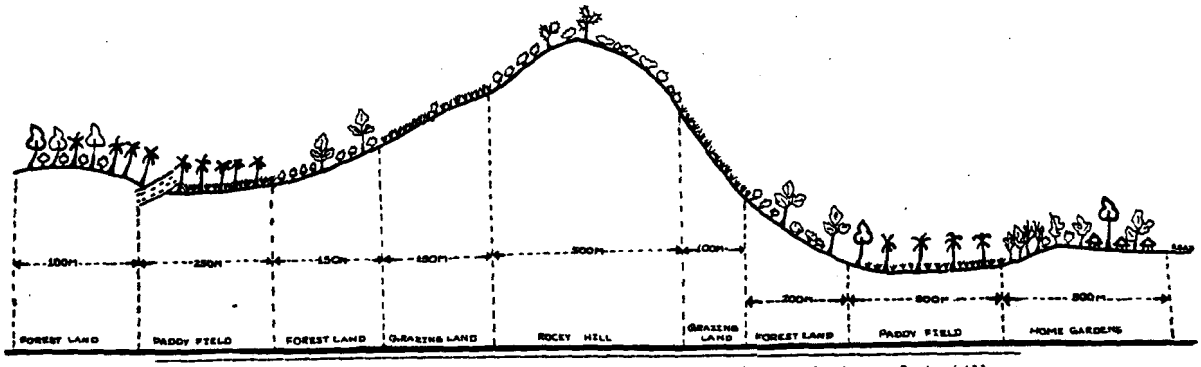


Figure 4.1 Village map showing landuse systems in Pallam. Palakkad District, Kerala. Map is prepared by involving villagers as part of the PRA exercise.

F- Forest land: - lands with coconut cultivation; - land with paddy cultivation: - land with bamboo clumps: - pond: - canal: R - Ration shop; - Health Centre: M - Rice mill; - School; - Mosque; - Houses: - Village road; - River.



Factor	Homegardens	Forest land	Paddy fields	Grazing lands	Rocky hills
Ownership	Individual	Individual	Individual	Individuals as well as Government ownership	Individuals as well as Government ownership
Crops and vegetation	Trees, vegetables	Groundnut, grams, mango and other trees	Paddy, pala, and coconut	Grass	Generally absent
Problems for cultivation	Limited area, shade, hard soil	Water scarcity, erosion, destruction of crops by stray livestock	Water scarcity during summer	Erosion, rocky land, shallow soil	Shallow soil, rocky land, erosion
Opportunities	Timber, bamboo, fuelwood, fruit trees	Good conditions for mango and groundnut and grams as under-crops	Ponds, irrigation canal, planting coconut on field bunds	Bamboo can be planted which will prevent erosion	Bamboo can be planted on patches of soil

Figure 4.2. Village transact diagram of landuse systems in Pallam, Palakkad District, Kerala and their descriptions. Prepared by involving villagers as part of the PRA exercise.

Homegarden cultivation with annual and perennial food crops as such is less prevalent. In the case of rich farmers, they are interested to grow trees in their homegarden, depending on the area, with a long term view of getting a good return after a few decades when their children become grown up. In the case of farmers belonging to middle income group, some of them were found to grow vegetables in their homegarden. But still they also grow as many trees as possible in their homegarden. Low income farmers or agricultural labourers are also found to have little homegarden cultivation. Either they will not be having much homegarden area to cultivate something or they will not get much time to do it after coming back from their farm duties. In some homesteads, particularly the larger ones, bamboo clumps were present *(Bambusa bambos* and *Dendrocalamus strictus).* Though we do not have information on how many homesteads in the settlement own bamboo clumps, it is visible that houses with clumps are scarce.

Towards the hill (Figure 4.1), rainfed cultivation of groundnut, grams etc. are done. People refer to it as 'Forest land cultivation'. Many of the farmers, irrespective of caste or economic status, are showing interest in growing mango in their forest land. From the village map (Figure 4.2), it is seen that paddy still remains as the major crop in the village. In places where the scarcity of water is more, farmers do only single crop of paddy and as second crop groundnut, ginger, turmeric. cassava etc. are also planted.

When moved more towards the hill side the area is rocky and it is mainly used by the community as grazing land for their livestock. This area is mainly revenue land while some area are under individual ownership also.

4.3. Case study 1

4.3.1. Methods

4.3.1 .1. Selection of farmers

This activity in Pallam was commenced in the planting season, May/June 1994. The local Panchayat President was contacted to assist with bamboo promotion in the village. A meeting of local people was called by the Panchayat President to assess interest in, and need for, bamboo propagules. With the help of the participants, names of other villagers who would be interested in growing bamboo in their homesteads was collected. The listed homesteads were visited to assess whether the size and planting arrangement of the homegarden could support the number of propagules requested by the farmer. Ten other people came asking for propagules during this process, which brought 52 families to the list of proposed recipients.

4.3.1.2. Distribution of bamboo propagules

Propagules of *Bambusa bambos* and *Thyrsostachys oliveri* were distributed on 2nd June 1994. Number of recipients of bamboo propagules was raised from 52 to 99. During the distribution detailed methods of planting and steps to be taken by recipients for proper management and care of planted propagules were explained.

4.3.1.3. Monitoring of planting

A week after the distribution of propagules houses and farm lands of all recipients were visited and a list of number of propagules and species received was prepared. These visits also helped to monitor whether planting was done properly and who are all participated in planting and where it has been done etc. Suggestions were also given for further management.

4.3.1.4. Analysis of socio-economic conditions of recipient farmers

During monthly visits, information on economic status, occupation and land resources etc., were collected from all recipient farmers by informal discussions with family members and others. All recipients were classified based on relative wealth ranking (Grandin, 1988). Relative wealth ranking was based on ownership of land, occupation and income sources of the household together with indicators such as ownerships of livestock, ownership of consumer items such as televisions, and the nature and condition of the dwelling in terms of number of rooms and construction material used. This led to a three-tier stratification of the households as low, middle or high-income classification of participant farmers based on relative wealth rank.

40 recipients were selected from the recipient group for the detailed and regular monitoring of the propagules in relation to the economic status and management level. Discussions were also made with these participant farmers to know more clearly the present sources of bamboo, bamboo propagules and reasons for showing interest in involving in the activity.

4.3.1.5. Establishment pattern of propagules and their management

Establishment, growth of bamboo and mode of management were recorded from all houses at half-yearly intervals. Level of management were grouped into four categories namely, a) no management, b) poor management where occasional weeding and watering was done, c) average management where regular weeding and watering was practised, and d) very good management where weeding, watering, manuring and protection of planted materials were done with greater interest.

4.3.1.6. Biomass production two years after planting

Bamboo planted in June 1994 were studied to estimate the aboveground biomass production in two year period. Homesteads where bamboo was planted were visited and the number of clumps established were recorded. If clumps were established and produced culms, the number of culms formed were counted. In each such clumps at least 50% of the total number of culms were selected and measured their height. Diameter of the culms were measured at third internode level of the culm.

The biomass estimation in both the species of bamboo was based on destructive sampling. Some of the culms of newly established bamboo clumps collected from elsewhere were used for the purpose. Simple regression equations were developed between the weights of total aboveground parts and d2H.

The qualitative features of sites where bamboo was planted were categorised sites into three groups and they are:

a) poor quality sites were the one where soil is very dry and shallow with underlying rocks and/or disturbed frequently either by hens and cattle or by storing hey, woods etc.

b) moderate quality sites were the one where soil may or may not dry but without underlying rocks and/or less disturbed.

c) sites were considered as good quality when the soil is deep, not dry and without underlying rocks and least disturbed.

Five clumps growing under a given level of management in a given quality site were randomly selected and aboveground biomass was estimated separately for each clump. Statistical differences between the biomass values of a given bamboo species in relation to the level of management and the site quality were examined through analysis of variance. If ANOVA

values found significant (P< 0.05-0.001), the mean values of biomass were compared using Fisher's least significant difference (LSD) test.

4.3.2. Results and discussions

4.3.2.1. Present source of bamboo branches for fencing

About 37% of the sample farmers, again majority of them are middle and lower income farmers, are getting bamboo branches for fencing from some traders who bring them from distant places (Table 4.1). However, due to the decrease in supply of branches the price of bamboo branches has increased considerably. Two years back an average bundle of branches had cost only Rs. 20 to 25/-. But this year it has become Rs. 50 to 55/-. The next important source is the homegardens in the nearby places. About 17% of the sample farmers depend on this source of bamboo branches. Only 7% farmers who come under middle and low income groups obtain sufficient branches from their own clumps. Whereas 8 farmers had to depend on branches obtained from their clumps as well as obtained either by traders or by nearby homegardens. Two farmers obtained the branches needed without paying, from relatives houses. Thus it is seen that only about 7% of the sample farmers are self-sufficient with branches needed for fencing their lands.

Table 4.1. Distribution of respondents (n=40) in Pallam village of Palakkad district showing present source of bamboo branches in relation to their economic status.

Source of bamboo branches	Economic status of the respondents		
	High income (n=6)	Middle income (n=l6)	Low income (n=18)
Previously from tribals (now not getting)	0	**2**	3
From distant places by traders	3	6	6
From homegardens in nearby places	0	2	5
From own clump	0	2	1
From own clump as well as from traders	2	2	0
From own clump as well as from nearby homesteads	0	1	3
From relative's houses	1	1	0

4.3.2.2. Reasons for showing interest in growing bamboo

The reasons for showing interest for growing bamboo by taking propagules distributed was found to have little bearing on their economic status (Table 4.2). Of the total of 40 farmers, 30 (75 %) intended to grow bamboo for their use. While four farmers showed interest to grow bamboo to get branches and culms for own use and to get some additional income by selling

branches and culms, another five farmers were to apart from these two reasons to utilise their waste and/or unproductive land by growing bamboo. Therefore, it is evident that Pallam is a bamboo poor area but at the same time the villagers required considerable amount of bamboo branches for fencing and a lot of other uses. These facts justified the bamboo promotion activity in Pallam.

Table 4.2. Reasons for growing bamboo by respondents (n=40) in Pallam village of Palakkad district in relation to their economic status.

		Economic status of the respondents		
	Reasons for growing bamboo	High income (n=7)	Middle income (n=l5)	Low income (n= 18)
1.	For branches for fencing and culms for general uses	4	11	15
2.	To get additional income by selling culms and branches	0	0	0
3.	To utilise wastelands / unproductive lands	0	0	0
4.	For reasons 1 and 2	0	2	2
5.	For reasons 2 and 3	2	1	1
6.	For reasons 1,2 and 3	1	1	**0**

4.3.2.3. Source of bamboo planting materials

Villagers were getting not only bamboo branches from tribals but also on request they bring bamboo propagules from the forest and sell it to the farmers at the rate of Rs. **5/-**per seedling. Of the 11 farmers who were already having bamboo in their homegarden 63% got planting material from the tribals and remaining 37% did not remember actually where from they got it. Their ancestors might have planted it. Anyway, people ruled out the possibility of procurement of. propagules from the market or nursery as bamboo propagules were not available. Those who needed it even now could get it from the tribals with little difficulty. A few farmers said that it was possible to raise propagules of branchless variety *(Dendrocalamus strictus)* locally since some clumps in nearby places have flowered recently. But nobody have adopted it since many of them need the branchy variety.

Box 1

Propagation method for bamboo adopted by a farmer

One farmer in the primary sample, who was found very much interested in managing his bamboo clump, found to have successfully adopted 'layering technique' for the propagation of bamboo. He had a thorny bamboo clump on the border of his paddy field. One long culm bent down and touched the soil. So he mounded some soil to the portion which touched the soil keeping one node under the soil. After a few weeks he found a small new shoot coming from the node. After one more month he had cut the culm above and below the node and planted it in his homegarden. The plant is established and growing well. This is one example to indicate that some farmers are innovative.

4.3.2.4. Distribution of bamboo propagules through the project

During the meetings conducted prior to seedling distribution the response of farmers both at individual and collective levels were remarkable. It may be pointed out here that the number of farmers who attended the first meeting was low (9 male farmers:. This is because the meeting was held during the season of paddy planting (May). However, these farmers expressed the general interest prevailing in that village community to receive bamboo propagules from Kerala Forest Research Institute (KFRI) and growing in homesteads. These farmers also undertook to collect the names of other villagers who would be interested in growing bamboo. The response from people resulted in 42 families being listed for receipt of bamboo propagules. Most of the families listed have requested for 5-100 propagules. However, pre-distribution visit to homesteads showed that size of the homegardens in that village in general were too small to grow such a large number of bamboo along with other crops. Thus, during the visit actual requirement from each homestead was assessed This visit helped especially in the case of small land holdings to discuss with farmers, the potential negative aspects of bamboo and to advice the number of bamboo propagules considered appropriate in each case. Apart from this, the visit also helped to discuss and finalise with farmers where to plant the given materials. During these visits 10 other families also registered their names for receiving bamboo propagules.

The majority of households requested thorny bamboo. This correlated with the initial assessment of bamboo being primarily required for thorny branches in Pallam. All homesteads had at least partial thorn-fencing and many stated that collection of branches from forest bamboo was becoming difficult. However, some households asked for thornless bamboo as culms could easily be harvested as and when they were required for domestic use or cash sale. People did not ask for particular bamboo species by local name. As *Bambusa bambos* and *Thyrsostachys oliveri* propagules were available in the Institute (KFRI) nursery it was decided that both types would be released.

As mentioned earlier, the poor attendance at the first Pallam meeting may, in part, have been due to its timing as many people were working. However, news of project interest in homegarden bamboo, and of potentially free propagules, had obviously spread to the wider community by word of mouth, resulting in increase the number of recipients to 99. The enthusiastic response of the people of Pallam to a proposed bamboo seedling distribution also indicates the interest among farmers to cultivate bamboo and involving in on-farm experiment.

4.3.2.5. Planting

Of the 99 families who had received propagules, 58 had planted the propagules in their homegarden. However, the remaining 41 recipients had either planted in their land outside the homegarden (n=21) because majority of them did not have space in their homegarden or had planted propagules both in the homegarden and outside (=20). It may be pointed out here that all these 41 people collected propagules without registering their names in the first two phases of selection of participants. Number of propagules given to individual farmer varied from 1 to 10.

4.3.2.6. Management

As would be expected in a sample of homegardens, growing conditions for bamboo propagules varied in terms of micro-site soil type, aspect, light incidence and other tree crop associations. Although farmers were advised of planting recommendations there were many variations in planting time, depth, spacing, mounding and post-planting management. This was attributed to the fact that many recipients had their first contact with the project at the distribution meeting and did not follow the planting instructions given. In one homestead a woman had planted the seedling with the poly-bag still intact so staff had to advise on re-planting. These suggest that while promoting cultivation of crops like bamboo mere distribution of planting material is not enough but proper technical guidance and extensive field visits to monitor the planting activities are required.

4.3.2.7. Post-planting management of the propagules

Post-planting management was extremely limited as most farmers were confident that propagules would establish without further care. It was felt by majority of the recipient that homestead requirements for branches would be met whether the clump was managed or not.

One rich farmer said that it was foolish to waste fertiliser or manure by applying it to bamboo. However, in some cases, management inputs were observed: these were, fencing the seedling (n = 2), addition of ash and manure (n = 2) and, watering on dry days, remounding and weeding (n = 7).

Pest/disease incidence has been recorded in only one case where a farmer showed staff a leaf-sap sucker that he intended to control by dilute BHC solution. Hens and other livestock have damaged propagules quite considerably in some homegardens. In such cases farmers have been advised to fence propagules or to spread thorny branches of some plants until bamboo established well. Suggestions have been followed by all these farmers. The regular visits of the project staff, as farmers stated, were encouraging them to take care of propagules.

4.3.2.8. Seedling establishment and biomass production

Twenty four months after distribution, 80% of the propagules of *Bambusa* and 66% of propagules of *Thyrsostachys were* found to have survived and established well. Lower survivability rate (0-25%) was recorded for *Bambusa* and *Thyrsostachys* in 11% and 27% of the total number of houses which received the propagules respectively. Complete survivability (100%) of propagules of these two species was recorded in 75% *(Bambusa)* and 60% *(Thyrsostachys)* of the houses that received propagules.

Total aboveground biomass accumulated in *Bambusa bambos* in 2-yr period after planting in different quality sites is given in Table 4.3. While the total aboveground biomass of the well managed clump growing in good quality site was 99.8 kg, that of clumps growing in moderate to poor quality sites under moderate to poor management regimes ranged between 1.4 - 4.7 kg. However, no significant difference was recorded for the aboveground biomass of the

well managed clumps growing in moderate and poor quality sites and moderate to poorly managed clumps growing in good quality sites. These results indicated that the rate of biomass production by bamboo is greatly influenced by both the quality of sites and the level of management. Good quality sites with proper management of clumps leads to significantly more biomass production. Even in poor quality sites when clumps were managed well the amount of biomass production of bamboo would also be significantly higher than in those which were poorly managed.

Table 4.3. Mean aboveground biomass (kg) of 24-months old clumps of Bambusa bambos grown under different levels of management and in different quality sites in homesteads of Pallam village of Palakkad district, Kerala. (n = 5 clumps).

Aboveground biomass (kg)			
	Level of management		
Site quality	**Good** (Where weeding, watering, manuring and protection of planted materials were done with greater interest)	**Moderate** (where regular weeding and watering was practised)	**Poor** (where occasional weeding and watering was done)
Good (The soil is deep, not dry and without underlying rocks and least disturbed)	99.8 ± 20.5	38.0 ± 6.7[a]	26.6 ± 4.0[a,c]
Moderate (The soil may or may not dry but without underlying rocks and/or less disturbed).	46.4 ± 12.5a	4.7 ± 1.7[b,c]	2.0 ± 0.7[b]
Poor (The soil is very dry, shallow with underlying rock and / or disturbed frequently either by hens and cattle or by storing hey, wood etc.	29.3± 6.3a	1.4 ± 0.3[b]	1.6 ± 1.3[b]

LSD value : 21.48. Values with same letter in the superscript are not significantly different at 95% confidence limit.

Total aboveground biomass of clumps of *Thyrsostachys* under good, moderate and poor management regimes were 4.6 ± 1.3 kg, 2.3 ± 0.5 kg and 0.65 ± 0.36 kg respectively. No significant difference was recorded for the biomass values of well managed and moderately managed clumps and of moderately and poorly managed clumps. Since number of sample was less the response of this species in terms of biomass production to the combination of level of management and the site quality could not be analysed.

4.3.2.9. Change in the level of management

The level of management of the propagules was assessed by observing the growing clumps and also discussing with the farmers as to how did they manage their propagules (Table 4.4). Very good management, by watering on dry days, mounding, applying manure and fencing the seedling etc., were found with 6 farmers (15%). Among these six farmers one belonged to the higher income group and the rest to the middle income group. Average level of management by pouring water on dry days and frequent weeding were seen with 12 farmers (32 %) (2 belong to higher income group, 3 to middle and 7 to lower income group). Poor management, only by looking at times but not applying water and manure were seen with 11 farmers (32%) (3middle group and 8 lower group). In the case of 8 farmers (20%) who were found not to have managed their propagules, 6 were business people, one a rich farmer who didn't bother to manage his propagules and the other one was a government employee. But the reason they gave for their poor level of management or no management was that bamboo is a plant which need little care and management.

Table 4.4. Level of management of bamboo propagules by farmers in during 1994-95 and during 1995-1996 (in parentheses).

	Number of farmers (%)			
	Economic status of the farmers			
Level of Management	High income	Middle income	Poor income	Total
No management	7.5 (2.5)	10 (5)	2.5 (2.5)	20 (10)
Poor management (where occasional weeding and watering was done)	5.0 (0)	7.5 (0)	20 (7.5)	32.5 (7.5)
Average (where regular weeding and watering was practised)	5.0 (5.0)	10 (15)	17.5 (22.5)	32.5 (42.5)
Very good (where weeding, watering, manuring and protection of planted materials were done with greater interest)	2.5 (2.5)	12.5 (15)	0 (12.5)	15.0 (30.0)

Farmers' involvement in post-planting management of bamboo led in general to better growth and biomass production. This kind of involvement also avoided the growth of bamboo as 'wild'. It may also be indicated that one year after planting the propagules a significant change in farmers' attitude towards the plant was seen. A shift towards average to well management regime from no to poor management was observed. This may be attributed to the better establishment and initial growth of bamboo even with little care in almost all houses.

4.3.2.10. Villagers' opinion about the programme of Bamboo promotion

The bamboo promotion in dry zone, according to villagers, came out of a felt need of the community. This programme, as the local MLA puts it, is timely and in full participation by villagers and a research institute. Inquires showed that, until project intervention, many households had paid for branch-fencing without giving much thought to producing branches themselves. The socio-economic study of the village which tried to elicit the villagers'

perception about bamboo and the programme as a whole also indicated how the programme was socially and economically accepted. It may also be pointed out here that one farmer suggested that making Pallam self-sufficient in bamboo would result in peace of mind for foresters concerned with (the illegal?) harvest of culms and branches from forest tracts.

4.4. Case study-2

Better performance of bamboo propagules distributed in 1994 has prompted among farmers of Pallam to request KFRI to distribute more propagules in the coming season, June-July 1995. During the participatory rural appraisal meetings conducted in the village in 1994-95, however, most of the farmers mentioned that instead of restricting planting of bamboo in homesteads alone farmers should be permitted to do *so* in their outside lands also. Thus, the second phase of promotion of bamboo cultivation in the village was planned to cover both homestead and outside lands of the farmers. The activity was also designed with objectives:

a) to compare and contrast the level of post-planting management of bamboo propagules planted in homesteads and outside lands, and
b) to analysis the establishment and growth of bamboo under different levels of management and site quality.

It was also decided to distribute the young seedlings of *Dendrocalarnus strictus* along with well established propagules of *Barnbusa barnbos.* However, the idea was to ask farmers to plant propagules of *Barnbusa barnbos* immediately and but to retain seedlings of *Dendrocalamus strictus* in polythene bags and manage them for one year before planting them in the next season. This experiment was designed to assess the level of involvement of farmers in the activity where farmers have to manage seedlings of *Dendrocalamus strictus* in polythene bags for about one year period before planting.

4.4.1. Methods

4.4.1.1. Selection of farmers and distribution of propagules

The help of a local key person was taken to prepare a list of farmers who needed the propagules. After receiving the list , all houses and farm lands were visited in the last week of June 1995 to see whether the requirement is genuine in the matter of space available. Number of propagules appropriate to cultivate in each farmer's land was finalised with the farmers. Methods of planting and management were explained. Propagules were distributed on 23rd July 1995 at Pallam. Detailed information on methods of planting and management of propagules of *Barnbusa* was again given during the distribution meeting. Similarly, farmers were informed to retain seedlings of *Dendrocalamus* in polythene bags and manage them for one year before planting. Methods of management of seedlings in polythene bags were also explained.

4.4.1.2. Monitoring of planting

One month after the distribution of seedlings, houses and farm lands of all recipients were visited and a list of number of seedlings and species received was prepared. Relative wealth ranking method as explained earlier in the Section Case Study -1, was employed to classify recipients into lower, middle and higher income groups.

4.4.1.3. Establishment pattern of propagules and their management

Establishment, growth of bamboo and mode of management were recorded from all houses by field visits at quarterly interval. Level of management were grouped into three categories namely, a) no management, b) average management where attempts to protect planting materials were made and occasional weeding was done, and c) very good management where weeding, watering, manuring and protection of planted materials were done with greater interest. Apart from regular monitoring, 18 months after the distribution number of propagules survived and reasons for the mortality of seedlings if any were analysed.

4.4.1.4. Estimation of biomass production in *Bambusa bambos*

Bamboo planted in July were studied to estimate the aboveground biomass production in 18 month period. Here also the method described in the earlier section (Section 4.3.1.6) to estimate the biomass production in bamboo planted in June 1994 was followed.

4.4.2. Results and discussion

A key person in the village has volunteered this time to prepare a list of potential recipients of bamboo propagules. The willingness of the key person can be attributed to a) the success of the first phase of activity, b) enthusiasm of his villagers in growing more bamboo and c) gradual and steady approaches the project staff taken to involve farmers not only in the bamboo promotion activity but also understanding the landuse patterns of the village through PRA techniques.

The demand for thorny species was more than for thornless one. This could be attributed to the fact that farmer's main interest in cultivating bamboo was to obtain bamboo branches for fencing. This time also some of the farmers though having limited land have requested more number of seedlings than could be planted. The fact that something was being given for free in promotion activity must be considered a contributory factor to the good turnout. One might imply that the potential competitive effects of bamboo were outweighed by the value of getting something for nothing and of trying out a project-backed idea. One farmer belonging to lower income category and having only about 0.4 ha land asked for 30 propagules. It must be remembered that smallholders are familiar with government promotion of tree crops, be it coconut, rubber or mulberry, and that bamboo promotion may be perceived in a similar light. This needs careful monitoring. Apart from the reason that farmers knew that plant propagules would be given free of cost, farmers' lack of knowledge about the adverse effect of bamboo when grown in larger scale on the other crops could be assigned to the request by farmers for planting materials more than necessary. Visit of the project staff to plots of all potential recipients before distributing planting material, however, helped to record the number of planting materials appropriate to each plot.

As mentioned earlier, regarding the villagers' opinion about the first phase of the programme, many of the farmers had the feeling that the release of propagules only to homegarden was inappropriate since many of the farmers have only a limited homegarden area, at the same time they have enough outside plot (forest land) where they could grow bamboo without hindering the growth of other crops. Due this fact the second stage of the programme was well-appreciated by them since it released propagules for planting both in homegardens as well as an outside plots. Thus for the second phase of the programme 19 farmers who got propagules in the first phase came again.

More number of low income farmers received propagules to grow in homesteads than in other lands. 85% of the total number of seedlings of Bambusa barnbos given were planted in outside lands and the remaining in homesteads. On the other hand, more number of higher income farmers asked seedlings to plant in outside lands (Table 4.5). However, in the middle income group, number of farmers who requested propagules of Barnbusa to plant in homesteads and

outside lands was 49% and 40% respectively. This indicated that while promotion of bamboo cultivation in homesteads is favourable mainly to recipients of low income groups that in outside lands is beneficial to recipients of high income groups

Table 4.5. Number of farmers who received propagules of *Bambusa* bambos and *Dendrocalamus strictus* number of propagules planted in homesteads and outside lands at Pallam, Kerala.

	Economic status of the farmers			
	Lower	**Middle**	**Higher**	**Total**
Number of farmers who asked propagules	26 (2)	42 (10)	25 (7)	93 (19)
to homesteads only	18 (2)	21 (2)	3 **(0)**	42 (4)
to outside lands only	3 **(0)**	17 (6)	13 (2)	33 (8)
to both lands	5 (0)	4 (2)	9 (5)	18 (7)
Number of seedlings given	**47 (2)**	**114 (43)**	**127 (18)**	**288 (63)**
to homesteads	26 **(2)**	36 (5)	20 (10)	82 (17)
to outside lands	21 (0)	78(38)	107 (8)	206(46)

Values in parentheses are for *Dendrocalamus strictus.*

Although the farmers were asked to retain seedlings of *Dendrocalamus* in polythene bags and manage them for one year period before planting none of them did *so.* Out of 63 seedlings distributed 46 (73%) were planted in outside land and the remaining in homesteads (Table 4.5). Monitoring made one year after seedling distribution showed that only 7 seedlings out of 17 planted in homesteads (41%) and 15 out of 46 planted in outside lands (33%) were survived. The poor survivability may be mainly attributed to the planting of very young seedlings.

Observations made 18 months after seedling distribution showed that about 92% seedlings of *Bambusa* planted in homesteads established well. On the other hand, the survivability rate in outside land was only 61% . Poor management and negligence by the farmers, cattle grazing and disturbance, dryness of the soil and sites with underlying rocks were attributed to the poor survivability of the seedlings planted in outside land. It may also be mentioned here that bamboo seedlings planted in homesteads in the year 1994 showed satisfactory establishment and growth rates. This was mainly due to moderate to better management of seedlings and protection given by farmers. It was also recognised from recipients that bamboo planted outside the homegarden would not receive any after-care. Seedlings planted outside the homegarden may indeed be vulnerable to water stress during dry periods, when homegarden propagules may benefit from shading and its effects upon humidity and soil moisture relations.

It may be pointed out here that the strategy adopted to provide seedlings only to grow in homesteads (Case Study-1) helped to develop confidence among farmers on this bamboo promotion activity. If the seedlings were given to plant in outside lands and the survivability of seedlings were poor as we have recorded here probably the response of farmers in terms of

involvement in the second phase would have been poor or nil though the main reason for the poor establishment of seedlings were due to farmers' negligence.

Although the number of propagules of *Bambusa* survived in outside land was relatively lesser than those in homegardens, biomass production in eighteen months period was not significantly different in two types of sites where management of propagules was moderate to good (Table 4.6). Therefore the protection of planted materials was the major limitation in the survivability and growth of bamboos in the low rainfall dry zone.

Table 4.6. Survivability rate and aboveground biomass production (kg plant $^{-1}$) of Bambusa bambos (18 months after planting) under different levels of management in homesteads and outside lands in Kerala in Pallam village of Palakkad district, Kerala.

	Level of management		
	Good (Where weeding, watering, manuring and protection of planted materials were done with greater interest)	Moderate (where regular weeding and watering was practised)	Poor (where occasional weeding and watering was done)
Number of propagules			
planted in homesteads	52 (l00%)*	18 (100%)	12 (50%)
planted in outside land	66 (89%)	54 (76%)	86 (29%)
Aboveground biomass (kg plant $^{-1}$)*			
growing in homesteads	76.9±10.5a	63.927.8a	24.8±4.7b
growing in outside land	81.8±14.ga	84.6212.0a	20.8±2.9b

*, propagules survived and established (in %) 18 months after planting,
**, LSD value : 36.7, n=5; Values with same letter in the superscript are not significantly different at 95% confidence limit.

4.4.3. Villagers' opinion about the programme of bamboo promotion

Meetings conducted subsequent to this programme has helped to identify future strategies which could be adopted for enhanced cultivation of bamboo in this village. It was clear from the discussion that, if the staff of the project implementing agency invest more time in working with the community, especially during the early stage of the on-farm activities, the level of involvement of the farmers is better. At the same time community management of the activity also need to be supported by the provision of technical know-how, logistical support such as better and suitable planting materials from the project staff as well as monitoring to ensure that poorer household are not excluded from participating as the interest in the activity amongst wealthier households grows. During the meetings, the possibilities of planting bamboo on community land was also discussed with the farmers. They agreed that planting bamboo on community land is quite good in the sense that the waste land near the rocky hill can be utilised, at the same time the village could become self -sufficient in bamboo resource. But they insisted that the programme should not lead to the complete acquisition of the whole

area, since the land is commonly utilised by the community as grazing land for their livestock. Management of seedlings if planted in such community land till the establishment of plants is another issue which also to be addressed. Thus, there is more scope for careful intervention by the agencies to promote bamboo cultivation in community land also.

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