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REHABILITATION OF DEGRADED FORESTS THROUGH LANDSCAPE BASED PARTICIPATORY APPROACH

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PROJECT PROPOSAL

1. Project number : 318/1999

2. Title of the Project : Rehabilitation of degraded forests through landscape-based participatory approach.

3. Objectives :

1) To build capacity within KFRI and KFD for landscape ecology based participatory forest management.
2) To adopt participatory management approach to plan, design and implement strategies for rehabilitation of degraded forests for protecting and perpetuating the structures and processes of landscape ecosystems.
3) To establish demonstration forest plots to represent a set of landscape-based participatory approach for the rehabilitation of forests.

4. Date of commencement : September 1999

5. Scheduled date of completion : August 2001

6. Funding agency : Australian Assistance for International Development (AusAID)
Department of Planning and Economic Affairs, Government of Kerala

7. Project team

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Ms. Prakriti Srivastava (KFD)
Mr. M.L. Thomas (KFD)

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This project was delegated by AusAID to GRM International Pty. Ltd. for implementation, who subcontracted it to Hawthorn International as a consultant. We are grateful to the officers of GRM International, especially Mr. John Lyndon and Ms. Gabrielle Evans for their interest and cooperation shown during the project implementation. The officials of Hawthorn International organized visits by several of our officials and scientists for training. We specially thank Ms. Karen Medica and Ms. Sally Low who took a lot of pains to organize the training and arrange for trips we made in Australia. The leader of the Hawthorn team, Professor Ian Ferguson deserve special credit for organizing the technical programme of this project in the most efficient and impeccable manner. We thank the scientists who visited India as consultants in this project, namely, Dr Sadanandan Nambiar, Dr. David Flinn, Dr. Peter Stephen, Dr. Steve Reid, Dr Richard Loyn, Dr Tim O'Meara and Dr Rowan Reid. We also thank the number of individuals and institutions who were involved in our Senior Management Study Tour and Capacity Building Programme. Special mention should be made to Melbourne University School of Forestry (Creswick and Melbourne), CSIRO Division of Forestry and Forest Products (Canberra), Centre for Forest Tree Technology (Victoria), Department of Natural Resources and Environment (Victoria).

The project team is extremely grateful to the authorities of the Kerala Forest Department who permitted this project to be undertaken in locations under their jurisdiction. We are thankful to Mr. K. B. Thampi, IFS (CCF, World Bank Cell) for his special interest in implementing PFM in the selected forest area. The Conservator of Forests, Mr. N. Gopinathan, IFS deserves special thanks for extending support to undertake this work in the Nilambur North Division. We thank Dr. K.S.S. Nair, former Director of Kerala under whose leadership this project was initiated. We also thank Dr J.K. Sharma, present Director for his interest and encouragement given for this project. Finally we are indebted to the officials of the Department of Planning and Economic Affairs (Western Ghats Cell), Government of Kerala for their keen interest and financial support extended for

Component 4 of this project. The people of Vellimuttom and Vaniampuzha deserve special mention for their keen interest and hospitality shown to the whole project team.

Several scientists, research fellows and technical personnel in KFRI have helped the project team in this project. We thank Smt. P.Rugmini (Statistician) for help in analysis of the entomological data, and Shri. C.M. Brijesh, C. Binod, Dilip Kumar, Mrs. Seena, Ms. Mala, Ms. Yamuna, AS Binil Kumar (Research Fellows), for assistance in fieldwork.

Executive Summary

This project, started as a capacity building project, was aimed at evolving a model for rehabilitation of degraded forests through participatory action programme. The landscape ecology concept, a relatively new concept, has been adopted to achieve this goal. Training and capacity building for this project implementation were given to seven scientists and three forest officers in Australia using an AUSAID programme. Besides, several training sessions were held in India employing the expertise of several reputed scientists from overseas.

Deforestation and degradation of forest ecosystems in the tropics pose great threat to the conservation of a large number of endemic and endangered tree species and ecosystem as a whole. Kerala, located in the south-western part of India, with its rich tropical forests, has 740 indigenous tree species, of which a good number are endemic. Most of the species have environmental or medicinal value. Hence the gene pool of all these species needs to be conserved in the natural forests. With a high density of population in Kerala, a large number of people live in the periphery of the forest, depending on its natural resources for sustenance, which makes conservation a challenging task. An attempt was made to evolve a suitable model for conserving forest ecosystem using Participatory Forest Management (PFM) based on landscape ecology concepts. The model suggested is based on two diverse forest habitats – a forest area inhabited by tribal communities and another forest area surrounded by the non-tribal communities.

Landscape level participatory approach to rehabilitate the degraded forest is very unique as it takes into account the physiographic, ecological and sociological characteristics of the land. Landscape varies according to these characteristics and the historical impact of man on it. Therefore, in this approach, the physical landscape and social considerations are integrated, resulting in a fusion of ecology and sociology.

The forest and the non-forest areas forming the entire degraded landscape were identified at two locations. The topographical features, vegetation and fauna within the landscape were analysed to establish the linkages between different landscape units. Physical, biological and anthropogenic causes of degradation were also identified.

Altogether, 135 species of insects were recorded from the forest ecosystem at Vellimuttom and 165 species from Vaniyampuzha. The homestead contained 104 species at the former location and 144 species at the latter. The insect species diversity (Shannon-Weiner index) of the forest patch at Vellimuttom was 3.298 and 4.863 in Vaniyampuzha. In homesteads, the former registered a value of 2.867 and 3.796 in the latter. The faunal elements in both locations included several rare and endemic species.

A stakeholder analysis was conducted to determine the number of people depending on the forests and their resource availability within the landscape. Based on these landscape-ecological details, the restoration of degraded forests was attempted. In the non-tribal site, different tree species were planted as per the requirement of the stakeholders. Awareness campaign was quite effective in the tribal site. While restoring the forest sites, the stakeholder empowerment and aspirations were given high priority. Stakeholders were educated on the environmental benefits of the forests and trained to use the forests in a sustainable way. They were also trained for other means of employment. The problems and basic requirement of people in tribal and non-tribal areas were quite different.

The landscape-based approach was found useful in understanding the ecological, physiological, silvicultural and sociological requirements for restoration of degraded forests. The PFM approach is expected to conserve the forests in a sustainable manner as it empowers the people and gives them the feeling that the forests belong to them. Only when the conservation needs coincide with the interests of the local communities, can forests be effectively protected, especially when the forestlands are highly fragmented as in many tropical countries. The success of conservation will depend on circumventing the many social and ecological problems faced during this process.

1. INTRODUCTION

Deforestation and degradation of forest ecosystems in the tropics have received much attention at local and global level due to their consequences as felt in the form of human poverty, loss of plant and animal genetic wealth, erosion of landscapes, silting of water courses, drought and flooding. India is one of the mega-diversity centers of the world on account of its wide range of ecosystems ranging from the coastal areas, deserts and arid regions to the tropical and boreal forests. Due to heavy population pressure, many ecosystems are facing different levels of disturbance leading to tremendous loss of biodiversity. Of the various ecosystems, the tropical forests are by far, the richest in terms of their biota. The importance of biodiversity for maintaining life support systems of the biosphere is well recoganised. In fact, biodiversity conservation is the focal point of the National Conservation Strategy formulated in 1992. As per forest policy also, greater stress has been given for the conservation and sustainable use of forest resources.

A recent study in Kerala, conducted by the Kerala Forest Research Institute for the World Bank aided Kerala Forestry Project has indicated considerable depletion of forest area both in qualitative and quantitative terms (Nair et al. 1997). A number of factors – mainly human and physical factors such as over-exploitation, fire, soil erosion, grazing and unscientific resource management have been identified as contributors to the degradation process. It may be pointed out here that due to adverse anthropogenic disturbances, a mosaic landscape comprising of various landscape elements has undergone drastic changes leading to the degradation. Since the impact of these degradation processes are devastating both in socioeconomic terms and in terms of biodiversity and imbalance in the forest ecosystem, management and rehabilitation of degraded forests should be based to sustain the basic structure and functions of ecological systems and at the same time cater to the basic needs of the people. In this context, strategies to be adopted for forest management and rehabilitation should be ecologically and socioeconomically sound. In addition, in a mosaic landscape with several landscape elements such as, non-degraded forests, degraded forests, plantations, village ecosystems, etc., there will be interlinkages and interactions between these elements and also with

those across the landscape. The changes occurring in the landscape can be understood and managed only when the human interactions are studied. Therefore, the landscape ecological and Participatory Forest Management (PFM) approaches are important, as opposed to the conventional timber based approach to facilitate rehabilitation and sustainable management of degraded forests. However, current efforts and management practices are inadequate to deal with ecological systems involving multiple resources and multiple ecosystems at the landscape level. This study is proposed to fill this gap by understanding linkages and interactions between the different landscape elements so as to understand the options available in the participatory mode of management.

Every single ecosystem is itself a network of relation between organisms themselves and their biotic environment. Such eco-regions have different constituents such as primary producers, consumers and destruents. Landscapes are often defined on a spatial scale above the scale of a single patch of forest or meadow and below the scales of biomes or regions. Landscapes are thus areas of heterogeneous environment and biota where the pattern of heterogeneity is characteristic and identifiable as unique or typical of that landscape type. Landscape is defined as a geographical area within which multiple natural resources interact with one another such as a large watershed or eco-region. These ecosystems, which are in a dynamic biological balance, are open, have an input and output, can reproduce themselves and are more or less stable. When stressed, they begin to change and they can collapse. Biotic stresses such as disease incidence, predation or competition alter the biological system together with abiotic stresses such as temperature (fire), water (drought or floods), wind, noise, magnetism, electric flux or chemical input such as pesticides, herbicides, inorganic fertilizers etc. Biodiversity conservation is a holistic concept encompassing a wide spectrum of biota and of activities ranging from inventorying the biota *in situ* and *ex situ* conservation. For understanding such activities, detailed knowledge of the existing ecosystem is required. This requires extensive surveys of the flora and fauna of various locations, gathering information on the traditional use of biodiversity as well as developing method of conservation.

Insects form important constituents of terrestrial biota because of their greater diversity and functional roles in the ecosystem. The distribution of insects is influenced by a number of parameters such as the altitude, vegetation type and climate. Majority of insects are herbivorous and hence their composition and abundance are dependent on the availability of specific groups of plants. Being highly fragile in nature, even slight perturbations in the ecosystem are likely to affect their survival so much so they have been considered as useful objects for monitoring ecosystem health. Similarly, birds, mammals and some of the invertebrates play an important role in a sustainable landscape.

The forests along the Western Ghats support a unique fauna on account of its ecological, climatic and topographical features. So far, no in-depth faunistic study has been carried out in this region for lack of sufficient expertise. At present, many areas in this region are highly degraded due to biotic and environmental stresses. A programme on the rehabilitation of degraded forests using participatory forest management was carried out at Vellimuttam and Vaniyampuzha in the Nilambur Forest Division. It is well known that the complexity of living matter and its interrelationships to environmental factors increase as the level of organization rises. Insects, birds, mammals and many invertebrates which form a major component of natural ecosystems play important roles in their sustenance and also serve as bio-indicators for monitoring ecological changes on spatial and temporal scales. It was in this connection that a survey was made on some of these faunal elements of the area to serve as baseline data for evaluating changes occurring in the landscape as part of the rehabilitation programme and the findings of this study are presented herein. The interrelationship between the faunal elements and their interaction with the flora are given some importance in this study.

The pressure of a growing population and ever expanding human activities has increased the demand on the scarce land resources. The decrease in land–man ratio has put pressure on forest land for agriculture, industrial and settlement needs. Human-environmental relations are confronted with major problems due to degradation of forests. Millions of people live inside or in the periphery of forestland depending on its resources for their subsistence. Local communities, mainly the tribal are usually the most immediate and

adversely affected by such degradation. Considering the dependency of a sizeable per cent of the people on the forests, deforestation will have many social, economic, and ecological effects. Major causatives include, such issues as poverty, unequal land ownership, women's status, education and population. As stated earlier, in a landscape there are several landscape elements (forests, degraded forests, plantations, village ecosystems, human activity etc..). The changes that happen now and the potential changes can be understood and managed only when the human interactions are studied. In this project we have tried to address the degradation of forests in two locations, a non-tribal landscape and a tribal landscape. It is pointed out that the landscape approach to understanding the degradation of forests is more effective compared to an ecosystem approach. Besides, the participatory action by the stakeholders is given high importance in sustainable management of the forests.

2. CAPACITY BUILDING

2.1. Component 1: Senior management study tour to Australia

Objectives:

Provide a greater understanding of Landscape Ecology and Joint Forest Management (JFM) concepts, policies and practices as well as forest research, management and programme implementation in Australia.

Study Tour Team:

The Study Tour Team nominated by the GOI consisted of the following officers:

1. Dr. Jose Kallarackal (Team Leader), Scientist and Head, Plant Physiology Division, Kerala Forest Research Institute, Peechi 680 653, Kerala, India.

2. Dr. M. Jayakumar, Director, State Committee on Science, Technology and Environment, Thiruvananthapuram, Kerala, India.

3. Mr. Mahesh Jiwarajka IFS, DIG of Forests, Ministry of Environment and Forests, New Delhi, India.

4. Dr. Mehar Singh IFS, Conservator of Forests (Wildlife Wing), Palakkad, Kerala, India.

Period of Tour:

31 January 1999 to 14 February 1999 (2 weeks)

Major activities undertaken:

I. <u>In Queensland (2 February to 5 February 1999)</u>

Visits to the following places were made and discussions were held with the appropriate authorities to understand the forestry system, practices and policies in Australia.

Douglas Shire Council, Mossman

Mr. Mike, the Shire Council Chairman explained the afforestation work undertaken in the Shire using unemployed youth. They are also engaged in waste recycling. They have 70 Km^2 of natural tropical forests included in the World Heritage List. They are following plantation forestry in the degraded forests. They have 200 timber species and they find that rainforest species grow better in mixed plantations. Many discussions were held about licensing of saw-mills and the monopoly in timber market. They were in the process of organising a local co-operative.

Department of Primary Industries, Atherton

Mr. Allan Davies explained the activities of the DPI to us. He gave the team the classification of the different types of forests in Australia. Since 1988, there is no logging in the rainforests.

Atherton Tablelands

The Officials of the Dept. of Natural Resources took the team for a visit to the forest areas of the tablelands. The natural forest has species of *Eucalyptus tereticornis, E. grandis and E. camaldulensis.* Plantations of *Araucaria cunninghamii* (hoop pine) were also shown. Much research is going on in the breeding of hoop pine with the help of QFRI, Gympie. We were also introduced to Red Cedar (*Toona ciliata*) plantations and also their disease problems.

Since the tablelands have high wind velocity, *E. microcorys* was used as a windbreak because of the high branching habit of this species.

Farm Forestry of Mr. Rod Marti

The team was introduced to a farm forestry practice of Mr. Rod Marti in Atherton Tablelands. This is a 3.7 ha plot with 3500 trees planted, belonging to 13 species. 3-4 species were exotic. *Desmodium sp.* and *Tinaroo glycine* were used as cover legumes. Pinto Peanut, a shade tolerant legume was also used.

Eachem National Park

The team visited a community forestry activity associated with Eachem National Park. Volunteers raised a nursery and took plants for their lands.

Lake Bareen National Park

This NP happened to get divided into two blocks because of the presence of a grazier. This blocked the movement of animal and bird species between the two blocks of forest. With the help of a community movement, a wildlife corridor was made along a creek connecting the two bits of the park. This required the co-operation of the grazier. Research shows that this corridor is now used by wildlife for more mixing of the species. This corridor, the Donagee corridor is 60-100 m wide and 2 km long.

Lake Corridor (Mr. Ray Burns)

The team visited another wildlife corridor connecting Eachem NP with Bareen NP. The purpose of this corridor was to enhance fauna management for better genetic vigour. A number of farmers had to be involved here. The trees planted in this corridor were mostly timber species, probably giving the farmer a feeling that it would be useful for him later.

Farm Forestry of Mr. Errol Wiles, 25 School St., Babinda, near Innisfail

This is a family tree farm set up with the intention of self-processing the timber. *E. pellita* (4X3 m) was growing well in this farm.

II. In Australian Capital Territory - Canberra (6 February to 9 February 1999)

Mr. Kevin Cooper's Farm at Bungonia (NSW)

The team was taken to a farm forestry site at Bungonia by a Landcare co-ordinator Ms. Sophie Clayton. This was a site with 650 mm rainfall and infertile and eroded soil. Dry land salinity problem is also there. Radiata pines and eucalypts were used for planting this area. The rainfall created substantial erosion, forming deep and wide gullies. These gullies were also planted with trees. The old idea of pastures without trees was giving way to more tree covered pastures in this farm. Landcare, an NGO was helping this and several other farms in tree planting activity.

An interesting trial found in this farm was the Nelder Whale design. This involves planting trees in rows radiating from a point like the spokes of a wheel. Different clones were planted with varying spacing. This was to select the best clone and the correct spacing for radiata pines.

Visit to an NGO - Greening Australia

Ms. Vanessa Elwell - Gavins, Programme Development and Policy Manager of this organisation explained the activities. They have 54 regional officers and 250 staff members. They are non-political. Their main objective is to get environmental health by improving vegetation management. Besides they aim at:

1) Commercial wood production
2) Using more native species
3) Sustainable management of native forests
4) Agriculture

Visit to an NGO - Australian Forest Grower

The activities of this NGO was explained to the team by Mr. Allen. The main objective was to encourage people for farm forestry. Their main priority was small growers. They do lobbying in the government for reforms favouring farmers.

CSIRO's Australian Tree Seed Centre, Yarralumla

Dr Chris Harwood explained the activities of the centre. The team was shown around the experimental areas. The grafts of eucalypts were interesting.

CSIRO's Yarralumla

Here, Dr. Glen Kyle, the Chief and Dr. Ken Old, the Asst. Chief welcomed us. Both of them showed their appreciation for the forestry research pursued in KFRI.

Dr. Phil Ryan explained the GIS capabilities in this centre. He talked in detail about Digital Elevation Models, Terrain Analysis, GPS, Gamma Radiometric Remote Sensing etc. We found that this was a very good and ideal place for training in GIS use.

Dr. Bryan Myers talked about the use of effluents in irrigating the plantation. Dr. N.E. Marcar explained the physiological studies being done.

Dr. Theiveyanathan explained the ground water studies in Wellington.

Finally Dr. E.K.S. Nambiar summed up all the activities. He also talked to the team widely on landscape ecology concepts.

In Victoria (10 -14 February 1999)

CSIRO Forestry and Forestry Products, Clayton

Dr. Gary Waugh, the Head of this centre explained the research activities. This is a centre mainly meant for research in wood utilisation. All aspects of wood utilisation including seasoning, preservative treatments, saw-milling, resin impregnation, polishing, anatomy, pest and sap stain fungal problems, reconstituted wood products etc. are dealt with in this centre. We found this to be a very potential place for training of Indian scientists. They were also interested to collaborate with KFRI in future.

Centre for Forest Tree Technology (CFTT)

This is a centre under the Department of Natural resources. Prof. David Flinn was the leader of the group here. The research in this centre was on fire management, commercial forestry and natural forest management. Dr. John Kellas, Dr.Simon Murphy, Dr. Paul Dignan, Dr. Barry Roberts and Dr. Michael explained the activities in the above fields. We were also shown the GIS developed for an extensive area, which updated the fire occurrences every hour on the computer. Dr. David Flinn discussed at great length about landscape ecology concepts as applied in management of forests in Victoria State. It was found a very suitable place of future training.

School of Forestry, Melbourne University

Professor Ian Ferguson arranged for explaining the activities. Dr. Rowan Reid exposed us to the work going on in farm forestry, especially the activities of Master Tree Grower Programme. Dr. J.M. Sasee explained the work going on in ecophysiology. Dr. Peter gave us details of the work going on in biodiversity monitoring. Professor Ian Ferguson then discussed about landscape ecology. He explained the relation between structure and function of ecosystem and also the social and cultural aspects involved in its sustainability. He then discussed the activities going to be done in component 2 of the AUSAID project in Kerala.

Landcare, Creswick

This is an NGO, which has its origin in Victoria State. Their main objective is to encourage farmers to farm forestry. They use positive approaches to do this than speaking about environment benefits. For example, they call a field day for timber-tree growing and speak about the environmental benefits only as a side-benefit.

Sawmill Training Centre, Creswick

This centre, with the Forestry School of Melbourne University, trains for saw-milling technology. The facility is of an advanced nature. Special technologies to be used with eucalypts and pines are dealt with here.

School of Forestry, Creswick

This is a separate establishment of the Melbourne University. The Head of the School is Dr. Peter Vinden. Here research is being done on wood utilisation, tree physiology, GIS, forest operations, environmental impacts, nutritional aspects etc. A number of training courses are conducted in forestry subjects. Hence this is potential place for training.

Community Fire Fighting Brigade, Creswick

This is fire fighting brigade set up with the community support. Locals participate in forest fire fighting as volunteers. They are well equipped for this work.

Hobby Farm of Rudy & Alison Novotony, Hill View

The team visited the small farm and was interested to observe the methodical way in which GIS data was kept on a location map. The overlays included contour, fencing, agroforestry and several other parameters. This is an ecotourism attractant also.

Achievements

The Senior Management Study Tour team was exposed to several sites in Australia where forest management is carried out using landscape ecology concepts. They were also introduced to strong and weak points in the management of Australian forestry. In general, a strong research base supports the management. The facilities available at several forestry related organisations in Australia were exposed to the team. On the basis several of them have been identified as potential training locations. The importance of joint forest management was also understood from several locations.

2.2. Component 2: In-India Project Preparation and Needs Analysis

The Australian Team comprised of the following consultants:

Professor Ian Ferguson (Team Leader)(Melbourne University)
Dr. Sadanandan Nambiar (CSIRO)
Dr David Flinn (Centre for Tree Technology, Heidelberg)
Mr Peter Stephen (Melbourne University)

Following an initial briefing on March 8-9, the Australian Team spent three days visiting possible field sites at Peechi (March 10) and Nilambur (March 11-12). The choice of site was critical to the project design and the team also used the opportunity to develop an initial rapport with scientists and KFD staff involved. For each of the four

communities/villages visited, discussions were held with men and women. Thanks to Dr Nambiar's skills in Malayalam, this provided very useful information for later project design, both for the Australian and the Project Team.

In the ensuing period prior to the Project Management Workshop, the Australian Team facilitated an intensive SWOT Analysis in relation to the choice of sites. This formed an important component in capacity building as very few KFRI or KFD staff had had prior experience in this form of analysis or in interdisciplinary project design. The SWOT analysis was carried through to a summary of the choice of site and Project Plan in time to enable presentation at the Project Management Workshop. The Australian Team and several members of the Project Team revisited Nilambur on March 17 to confirm some of the design elements but did not conduct discussions with villagers. This proved doubly valuable, as some members of the Project Team had not previously visited the sites.

The SWOT Analysis and choice process facilitated wide discussion and awareness of the processes involved at the Project Management Workshop on March 19 and enabled the Project Steering Committee, who were present, to confirm the choice of site. The Australian Team was also able to have discussions with the Director, KFRI and Mr Thampi, KFD Co-ordinator of the World Bank project about additional funding for the project, as it was apparent that additional resources would be required to mount properly the research and demonstration components. Karen Medica of Melbourne Enterprises International had joined the team from March 18-20, presented a talk on gender issues at the Project Management Workshop, and subsequently discussed resource and other issues with GRM and AusAID in Delhi, and with KFD in Thiruvananthapuram.

Following the Project Management Workshop, discussions were held with staff concerned regarding training in Australia. It became apparent that the list of potential trainees was largely dictated by the disciplinary requirements of the subsequent project and the skills of current staff, which left little scope for choice. Every effort was made to consider more women.

Staff recommended for training in Australia	
Dr. U.M. Chandrashekara	KFRI
Dr. V. Anitha	KFRI (female)
Dr. P. Vijayakumaran Nair	KFRI
Dr. Mammen Chundamannil	KFRI
Dr. George Mathew	KFRI
Dr. K.K. Ramachandran	KRRI
Dr. N.C. Induchoodan	KFRI
Dr. N.V. Trivedi Babu	KFD
Ms. Prakriti Srivastava	KFD (female)
Mr. M. L. Thomas	KFD
Reserves	
Dr. P.S. Easa	KFRI
Dr. J. Kallarackal	KFRI

During discussion with staff involved in the project, it became apparent that the design of the training programme needed to be changed. Many of those likely to be involved were senior and experienced scientists who needed more extensive training/work attachments in certain areas to update or develop particular skills for the project. This led to a revision of the programme and a request to GRM for additional resources.
Further discussion also led to the selection of a project team.

Project Team

Name	Organisation
Dr. Jose Kallarackal	KFRI (Project Co-ordinator)
Dr. U.M. Chandrashekara	KFRI (Principal Investigator)
Dr. V. Anitha	KFRI
Dr. P. Vijayakumaran Nair	KFRI
Dr. Mammen Chundamannil	KFRI
Dr. George Mathew	KFRI
Dr. P.S. Easa	KFRI
Dr. K.K. Ramachandran	KFRI
Dr. N.C. Induchoodan	KFRI
Mr. N.V. Trivedi Babu	KFD
Ms. Prakriti Srivastava	KFD
Mr. M.L.Thomas	KFD

The remaining work involved facilitating the refinement of the Project Planning Matrix, Budget and Time schedule, details of the Sub-Projects, and the presentation of the Landscape Planning Workshop. This Workshop was spread across three days (March 20, 22 and 23), each of the respective components (Landscape Ecology, Dr Nambiar; Biodiversity, Dr Flinn; Participation, Peter Stephen; Socio-Economic, Prof Ferguson) being used as a base from which to workshop further details for the research and demonstration Sub-Projects. Evaluations were carried out of these presentations and the results (see attachment) were again very positive. The three Sub-Projects were Landscape Ecology, Participatory Forest Management, and Demonstration Forests. The Project Team was able to develop initial research and demonstration plans for each Sub-Project, appropriately integrated across the Project, which will be refined in the course of their training in Australia.

2.3. Component 3: Five Week Intensive Training Program in Australia

Component Three involved a five-week training program in Australia for ten representatives of the Kerala Forest Research Institute (KFRI) and the Kerala Forest Department (KFD). Component Three commenced on April 26 1999. The major objectives pertaining to Component Three were to develop the capacity of the KFD and the KFRI relating to ecologically sustainable forest management (ESFM), including landscape ecology, forest economics and joint forest management (JFM). A further objective was to enable participants from KFRI and KFD to pursue effective work based skill knowledge upgradation through continued implementation of tasks relating to the demonstration project in Kerala. AusAID approved a request for additional training funds to accommodate the specialization needs of KFRI and KFD scientists, in addition to proposed core modules on Sustainable land use, JFM, ESFM and Environmental Impact Assessment (EIA).

Revised specific deliverables included training in the following areas:
Pre-Visit Workshop (Kerala)
Sustainable Land Use
Ecosystem Modeling
Geographic Information Systems/Remote Sensing
Biodiversity Management
Landscape Ecology
Sociology and Participatory Approaches to Forest Management
Sustainable Resource Utilisation
Landscape Planning and Management
Environmental Monitoring, EIA, Participatory Management
Fire Ecology and Restoration
JFM/ESFM
Review and Evaluation
Post Visit Workshop (Kerala)

Training was delivered using case studies, workshops, field excursions and workplace assignments, with participants expressing a high degree of satisfaction overall and appreciation for having their individual needs catered to through the provision of specialised training.

The Project Reference Group (PRG) coordinated through the KFRI Project Coordinator, monitored follow on activities in Kerala.

Preparation

During Component Two discussions with the KFRI Director, Counterpart Project Coordinator and PRG, it became apparent that the training proposed by

Hawthorn/University of Melbourne in the original submission would not meet the needs of KFRl for the demonstration project. The candidates for in-Australia training were senior and experienced scientists who sought very specialised training, which could not be offered in the **two** general streams proposed in Hawthorn's response to the original project design document (PDD). Hawthorn had indicated in its proposal that training undertaken in Component Three would be subject to consultation with members of the Project Review Committee (now the PRG) and Counterpart Project Coordinator, Dr Jose Kallarackal. This led to a major revision of the program to provide separate training and placements for an additional 24 days of training. Additional teaching staff were required to conduct the training modules on a one-on-one or one-on-two basis. Some revision was also made to the content of the remaining modules. The proposed redesigned program was subsequently approved by the KFRl Director, Counterpart Project Coordinator and supported by the Project Team.

Component Activities

The activities of Component Three were as follows:

1. A one-day workshop was conducted prior to departure of staff for Australia to present to KFRI/KFD/STED management the learning gains to date, progress on demonstration project activities and expected scope of work (including individual projects) and learning gains from the Australia visit.

2. A brief orientation program to settle in trainees which was assisted by the issue of pre-departure materials which included details of entitlements, in-Australia training, health and welfare arrangements.

3. Ten nominated staff from KFRI and KFD visited Australia for a five-week training/work attachment program. The identified training modules included a small set that was common to all participants and then some that were specific to individuals or groups. The program was complex as the summary shows.

The individual modules and the participants were as follows:

Group 1 : Dr P. Vijayakumaran Nair
Group 2: Drs K.K. Ramachandran and George Mathew
Group 3:Drs U.M. Chandrashekara and N.C. lnduchoodan
Group 4: Drs Mammen Chundamannil and V. Anitha, Messrs Trivedi Babu and M.L. Thomas, Mrs Prakitri Srivastava

Sustainable Land Use: All Groups - An introductory module on the program, arrangements, library and computing facilities, and sustainable land use was given at the Creswick campus of the University of Melbourne (UM) on the first **two** working days after arrival by Professor Ferguson, Mr. Shepherd, Ms Medica and Dr Hooda on 26-27 April.

Ecosystem Modelling: Groups I ,2 and 3 - This module involved an initial session on water use and hydrological models led by Dr Benyon (CSIRO), Dr Hooda and Professor Ferguson (28 April); a session on ecosystem spatial modelling by Mr Walshe (Botany, UM) and Dr Hooda (29 April); and one on soil
and ecosystem modelling by Dr Ryan (CSIRO) Dr Weston and Dr Hooda (30 April). In each case some hands-on work was involved to reinforce understanding.

Geographic Information Systems, Remote Sensing: Group 1 - This module involved very intensive one-on-one training in a work attachment mode on GIS and Remote Sensing principally with Mr Farrell (Natural Resource Systems) and his colleagues, with assistance from Mr Wild, and Professor Bishop (Geomatics, UM), It extended for a total of 12 days from 3 -12 May and 15-20 May inclusive.

Biodiversitv Management: Group 2 - This module was initiated by Dr Read starting with an overview of risk management and with baseline monitoring in a landscape context (3 May) by Mr Loyn (ARI). The second day (4 May) was devoted to covering the range of issues concerning conservation of biodiversity, aquatic ecosystems, threatened species and communities and field techniques for monitoring, led by Mr Loyn (ARI), Ms Arundell (ARI) and some 8 colleagues. This provided a preparation for attendance at a two-day (5-6 May) National Forum organised by Greening Australia, a community group, on revegetation, regeneration and landscape ecology. In addition two guest lectures given at the forum by some distinguished scientists, the group participated in workshop sessions and discussions on the outcomes. The next day (7 May) was devoted to a field trip with Mr Loyn (ARI) and Ms Arundell (ARI) to Toolangi Forest and Healesville Sanctuary to see and study wildlife habitat issues. The final days (10-12 May) were spent with Museum of Victoria on invertebrate ecology and fauna research in the box-ironbark forests and ARI staff, enabling the two members of the group to pursue some detailed work attachments with researchers in their respective specialist fields.

Landscape Ecology: Group 3 - This module was initiated by Dr Booth (CSIRO) at the ARI Heidelberg, starting with an overview of site-species matching, using computer-based models, followed by baseline monitoring in a landscape context (3 May) by Mr Loyn (ARI), in common with the module above. The second day (4 May) was similarly in common with the module above and devoted to covering the range of issues concerning conservation of biodiversity, aquatic ecosystems, threatened species and communities and field techniques for monitoring, led by Mr Loyn (ARI), Ms Arundell (ARI) and some 8 colleagues. This enabled the individual specialists in each group to pursue their own specialties. The third day (5 May) was devoted to a field trip with Messrs Murphy (CFTT) and Dignan (CFTT) to the Central Highlands regarding research in tall wet forests and to participate in a field workshop on soil erosion in wet mountain catchments. The next day (6 May) was devoted to attendance at the National Forum organised by Greening Australia; a day dealing specifically with landscape ecology. In addition to guest lectures given at the forum by some distinguished scientists, the group participated in workshop sessions and discussions on the outcomes. The last day of the week (7 May) involved a visit to Toolangi with Mr Loyn (ARI) and Mr Yen (MuseumVic) to inspect fiefd-sampling techniques. This was followed by a day (10 May)

workplace attachment devoted to box-ironbark sampling and wildlife habitat research with Mr Loyn (ARI). Dr Todd provided a day (11 May) of instruction on predator-prey and risk management modeling, with some hands-on computer-based instruction. Professor Burgman followed (12 May) with a further day of computer-based modelling and statistics for risk management. Both these were given at the University's Parkville campus.

Sociology and Participatory Approaches to Management: Group 4 - This module was led by Mr Reid, Mr Stephen, Ms Wright (Anthropology, UM) and developed some of the theory and approaches to participatory management, including gender issues. The first day (28 April) spanned an array of experts including Ms Dart (participatory approaches), Ms Wright (applied anthropology research methods), Ms Williams (interview and survey techniques) and Mr Woods (participatory approaches). Following initial sessions by Mr Brown (Landcare and sociological research methods) and Ms Adams (farmer-initiated research) on 29 April, the group undertook a field tour in the Violet Town area, including a workshop with farmers to identify their needs. The Group then travelled to the Otways (20 April) where a field visit involved presentations by Messrs Armstrong and Holden (Apollo Bay Landcare), Mr Hadley (Otway Ranges Environmental Network), Mr Rawk (DNRE) and Mr Codd (Corangamite CMA). The Group returned to Melbourne for sessions (May 3) by Mr McClean (community participation in RFAs), Ms Kwitko (gender in participation planning process), and Ms Beilin (gender in natural resource management). May 4 was devoted to sessions on the East Otways Master Tree Grower Program, led by Mr Stewart (Otways Agroforestry Network)

Sustainable Resource Utilisation: Group 4 - This module (5 May) involved a presentation of a sequence of case studies based on Central India and traditional non-timber forest products, the Indian beedi industry, Indian tribals and development of rural non-timber forest product (NTFP) industries, planting of eucalypts, and related chemical synthesis and intellectual property issues. These sessions were led by Professor Vinden and Mr Blackwell and included a visit (6 May) to a Eucalyptus oil farm to discuss Eucalyptus oil utilisation in Victoria.

Landscape Planning and Management: Groups 3 and 4 - This module involved an initial one-day session (6 May) on planning systems by Mr Wild and rofessor Ferguson. This was followed by a three day visit (10-12 May) to the Grampians National Park to examine landscape planning (10 May), fire and biodiversity management (1 1 May), and ecotourism and Koorie participation (1 2 May). The visit was led by Messrs Harris and Parks, and Ms Reid (all of Parks Vic) and others of their staff, members of the Koorie community, Professor Ferguson, Mr Stephen, and Mr Blackwell.

Environmental Monitoring, EIA, Participatory Management: All Groups - Special arrangements were made for the entire group to travel by bus with Mr Blackwell to Barmah and Canberra. This arrangement was made possible by the willingness of the Group to trade their weekend for the travel involved, as the cost of air transport was out of the question. However, it was also an opportunity to reunite the entire party and to provide a bonus visit that had both professional and social values in recognition of some

excellent work. This was important, as it was becoming apparent that the workload and isolation was telling on some members. The additional costs of transport (Barmah-Canberra and return) and staff were borne by the School of Forestry. The Group travelled to Barmah Forest near Echuca (May 13) to link with another visiting group under Dr Bren, and to see some of the Koorie community involvement and Red Gum forest management. The remainder of the day was taken in travel to Canberra with late arrival there. On 14 May, the group visited CSIRO Forestry, Canberra, and had presentations on environmental monitoring and EIA by several staff hembers from Dr Nambiar's (CSIRO) group. On 15 May, Dr Dargavel (RSSS, ANU) and Ms Buchy (Forestry, ANU) conducted a session on participatory forest management and Dr Nambiar (CSIRO) hosted a social for the group. The group travelled back to Creswick on Sun, 16 May. In effect the party encompassed more than two days of work in the four days, despite considerable travel times, and special thanks are due to the team and their colleagues who served well beyond the call of duty in providing inputs on this trip.

Fire Ecology and Restoration: Groups 2,3 and 4 - The module involved a four-day session led by Dr Tolhurst. The first day (17 May) involved sessions dealing with fire history and climate and environmental factors relating to wildfire and prescribed burning, supplemented by a field visit to local wildfire and prescribed burning sites. The second day (18 May) dealt with the use of the vital
attributes model in landscape planning of prescribed burning and fire management, using the Grampians as a case study. An afternoon field visit to Wombat Forest was conducted to look at fire ecology research. The third day (19 May) dealt with sessions on fire ecology principles, followed by a visit to the Department of Natural Resources and Environment (NRE) Fire Management Branch in Melbourne where Mr Crowe (NRE) dealt with investigatory, legal and statistical issues on fire occurrence. The final day dealt with fire behaviour and fire management and prescribed burning, followed by a visit to the Bacchus Marsh and Altona depots of NRE to examine equipment, communications and
retardants.

JFM/ESFM: All Groups - May 21 was used to review progress, especially for Groups 2 and 3 with Dr Read, and the remainder in preparing for the review presentations. Concluding sessions on JFMIESFM were conducted by Professor Ferguson (24 May) and introducing the Viridans biological database by Drs Gullan and Dr Opie (both of Viridans) (24 May), and by Mr Stephen summarising eartier material on JFM and participatory management on 25 May.

Review and Evaluation: All Groups - This final session was conducted on 26-28 May. This involved presentations by Kerala staff on the design of the sub-projects to be pursued at Nilambur. The session was conducted by Dr Nambiar (CSIRO), Dr Flinn (CFTT), Dr Read, Mr Reid and Mr Stephen (MU); the broader involvement being to ensure that staff involved in later visits were well briefed. Questionnaires for evaluation for the course were issued and collected. Certificates of Completion were issued to each Trainee on course completion.

Social Activities

The formal social activities included a welcome barbecue with Creswick staff at the home of Professor Vinden, a visit to Sovereign Hill and other sites around Creswick, a weekend at Philip Island home of Mr Stephen's parents and including a visit to the penguin parade, a visit to Healesville Sanctuary (Group), a visit to Tidbinbilla Nature Reserve and to Canberra sights, a social at the home of Dr Nambiar in Canberra, a visit to the Great Ocean Road, a shopping and sightseeing visit to Melbourne, and a Creswick which included staff from the School of Forestry, CFTT, Hawthorn.

Post-Visit Workshop

A Post-visit Workshop was initiated by KFRI participants on 7 June 1999. The workshop primarily dealt with the following items:

a) Finalisation of a project planning matrix.
b) Assigning individuals with responsibilities in Component 4.
c) Funding sources for pursuing the Component 4

Members from KFD were unable to attend the above workshop as they were busy taking up their new assignments within the KFD. Following the Post-Visit Workshop a final document on Project Planning was produced in July 1999.

Significance of Component Three

The overall objectives of Component Three were to:

a) Enhance understanding within KFRI and KFD in relevant specific disciplines relating to landscape ecology, forest economics and JFM and their contribution to effective ecosystem management.
b) Enable participating Indian Staff to pursue effective work based skill and knowledge upgrading through implementation of tasks relating to demonstration project.

Lessons Learned

One of the most important lessons learnt was the importance of recognizing and conveying the experience of staff to be trained in the original brief. Had AusAlD not been willing to recognize the shortcomings that stemmed from the original plan in this respect, project outcomes could have been seriously compromised.

The notion of individual workplace assignments was generally not always appropriate based on the experience of the trainees. The notion of senior staff gaining from working alongside staff undertaking routine research was generally not tenable for most trainees. With respect to GIS-Remote Sensing, workplace assignment was relevant to the needs of the trainee and a specialised GIS/Remote Sensing placement for Dr Nair was arranged to facilitate his meeting the specific and specialised needs of KFRI and KFD by reference to similar experiences in Australia.

Overall, the participants were not juniors totally lacking in research experience. In general, the project has aimed to provide a mixture of knowledge and exposure to field and laboratory techniques, with an emphasis on how the participants might develop their own research in the light of that experience. The exposure to a broader range of techniques and the issues of integration of research were important lessons for most participants, which will assist the sustainability of this project and other future projects also.

The other lesson is a familiar one - the difficulty of mixing scientists and managers and of satisfying both in one group. AusAID trainers deliberately attempted to adapt the program to the indications of each group but compromises were necessary and each would have desired more emphasis on science or management. It was also especially unfortunate that the three KFD managers missed the first week of the program, as they would have benefited greatly from it, even though arrangements were put in place to assist their transition into the training program.

Evaluation Results

Overall the results indicated a high level of satisfaction with average scores ranging between 1.3 and 2 on a scale of 1 - 5 with 1 being the most favourable score. Comments revealed that participants held differing expectations of the training. Some were primarily interested in their area of expertise while others appreciated the project's interdisciplinarity and the way in which the training exposed them to issues beyond their normal focus. Several participants commented favourably on the institutions and workplaces visited, especially the CSIRO. Two participants commented that they would have appreciated exposure to sites outside of Victoria or to sites of greater relevance to Kerala.

Conclusion

The major achievements of Component Three included the provision of training across a diverse array of topics at an advanced level, tailored to the backgrounds and roles of the scientists and managers concerned. The mode of training varied widely according to the topic, Group and time available but stressed the interactive process through case studies, workshops, field/workshops and workplace assignments. The evaluations showed an increased awareness among KFD/KFRI staff of integrative and inter-disciplinary character of Landscape Ecology research. Training further enhanced participatory management skills, increased understanding of JFM and Landscape Ecology Approach among all participants, and resulted in refinement of the Project Planning Matrix. Participant evaluation of the program was overwhelmingly positive.

2.4. Component 5: Follow up Support for Demonstration Project

Component 5.1: Socioeconomics and Participatory Forest Management

The objectives of Component 5 are to:

- Revise and evaluate progress of trainees in demonstration project implementation.
- Assist project staff in resolving issues relating to project implementation.
- Evaluate overall benefits to date a) to stakeholders through implementation of landscape ecology approach and b) to institutions through the training and capacity building approach.

The two participating Australians were Dr. Tim O'Meara and Mr. Rowan Reid. Dr. O'Meara carried out project activities in Kerala from January 29 through February 15, 2000, and Mr. Reid carried out project activities in Kerala from January 31 through February 14, 2000. Organisations involved included the Kerala Forest Research Institute, the Department of Forestry of the University of Melbourne and, as project managers, Hawthorn Consulting Group.

Activities undertaken by the consultants included:

- Preparation and then delivery over three days of seven training modules on socioeconomic topics.
- Two days of practical training sessions on socioeconomic survey methods with the socioeconomic group of the project team.
- Visits over three days in Nilambur North Division to the two demonstration project sites at Vellimuttom and Vaniampuzha and a PFM site at Edakord Station.
- Wrap Up Meeting with KFRI Director, Project Coordinator, and KFRI and KFD project staff to present a draft summary of major findings and recommendations.

Observations and discussions carried out during the assignment lead to the following conclusions:

1. A major benefit of the project is the training received by KFRI project staff in the concepts, methods and practice of Landscape Ecology.
2. A major benefit of the project is that it has provided a research framework and practical field demonstrations for multidisciplinary research and training on issues related to the preservation and regeneration of natural forests near human settlements.
3. Dr. P. V. Nair gained especially valuable specialist training in advanced GIS techniques while in Australia.
4. Opportunities remain to enhance the coordination of individual research being carried out at the two demonstration sites so that individual research projects contribute fully to answering some common research question or questions.
5. KFRI project staff reported that some demonstration project activities are held up by lack of equipment and other resources.
6. In the course of carrying out the demonstration project, incipient problems have become apparent as a result of direct KFRI staff involvement in the implementation

of those PFM activities required under Items 2 through 5 of Sub Project 5. These activities take KFRI out of its institutional mandate and expertise and into the institutional mandate and expertise of KFD.

7. KFRI has an important role to play within its mandate by carrying out research and development activities and providing technical advice on PFM, both in applying PFM at particular sites and adapting the PFM model for Kerala conditions.
8. With specialised training and capacity building, KFRI could play a leadership role in environmental impact assessment in Kerala, with important benefits for the institution and for both the forests of Kerala and the communities that depend on them.

Recommendations:

1. KFRI staff should be involved directly in carrying out research and development and providing technical advice on PFM policies and activities, both at particular PFM sites implemented by KFD and more generally in helping to adapt the PFM model to Kerala conditions.
2. KFRI staff should not be involved directly in implementing the PFM activities listed under Items 2 through 5 of Sub Project 5 in the demonstration project planning matrix.
3. Project-sponsored field research on PFM should be carried out only at PFM sites implemented by KFD.
4. Field demonstration or pilot sites implemented by KFRI should be used only for research on landscape ecology.
5. Project should provide certificate training in country for selected KFRI staff on environmental impact assessment as a follow up to the basic training already provided.
6. Project should provide follow-up training and capacity building to selected KFRI staff for the purpose of supporting its research and development activities on PFM, rather than implementation activities, and support a national research conference on PFM hosted by KFRI.

Component 5.2: Landscape Ecology and Biodiversity

Component 5.2 focussed on activities of Sub-Project 1: Landscape Ecology and Sub-Project 2: Biodiversity Assessment and Monitoring, but also considered related activities in Sub-Project 4: GIS Mapping. The two participating Australian consultants for Component 5.2 were Mr. Richard Loyn, from the Department of Natural Resources and Environment, Victoria, and Dr. Steve Read, from the School of Forestry, University of Melbourne, Victoria. Both carried out project activities in Kerala from Sat 5 August to Sat 19 August 2000, in association with the Kerala Forest Research Institute (KFRI) and the Kerala Forest Department (KFD), as organised by the project managers, Hawthorn Consulting Group.

Activities undertaken by the consultants included:

- A Project Review Workshop with the Project Coordinator and KFRI project staff at the start of the consultancy.

- Visits with project staff over two days to the two demonstration project sites at Vellimuttom and Vaniampuzha. Access to parts of the Vaniampuzha site was curtailed by monsoonal flooding of some streams.
- Visits with project staff over two days to Silent Valley National Park and Parambikulam Wildlife Sanctuary, to demonstrate and discuss monitoring methods for flora and vertebrates in more accessible terrain.
- Discussions with project staff of methodologies used and data collected, followed by practical demonstrations of techniques of data analysis, linkage and presentation. These activities allowed clarification of joint research questions at each project site, and started the process of integrating the design and analysis of individual research projects into overall research goals.
- Preparation and then delivery of six training modules on landscape ecology, biological research design and analysis, biodiversity, and environmental impact monitoring, these topics being chosen after discussion with KFRI project staff.
- Preparation and then delivery, including especially to KFRI and KFD staff not trained in Australia, of a field day on monitoring techniques
- Wrap-Up Workshop with KFRI Director, Project Coordinator, and KFRI and KFD project staff at the end of the consultancy, and presentation of a draft summary of major findings and recommendations.

Observations and discussions during Component 5.2 led to the following conclusions:

1. Considerable effort has been put into biological monitoring at Vellimuttom and detailed work has been done on vegetation analysis, and considerable data have been collected on insects and a little on earthworms, but there has been no systematic work on soils, birds or mammals. The monitoring effort and resultant progress is therefore not uniform across the various disciplines of flora and fauna.
2. In part, this situation has arisen because the attention of the KFRI researchers has been caught up in the discussions concerning implementation of PFM at Vellimuttom, and the proposed establishment of a VSS (Forest Protection Committee). The role of KFRI in carrying out research and development activities and providing technical advice on PFM is clearly distinct from any direct involvement in the implementation of PFM at any site. Moreover, State Planning Board funding has allowed the biodiversity and landscape monitoring components of the project to proceed independent of PFM implementation. Slow progress on the change of site management status need not confound progress on the biological monitoring, and need not obscure the biological achievements made.
3. Substantial replanting has taken place at Vellimuttom, and a fence constructed and maintained, using funds from various sources (KFRI, KFD and Kerala State Planning Board). This demonstrates community support for rehabilitation in advance of the establishment of a formal VSS covering this site
4. A digitised map of the Vellimuttom site showing the vegetation sampling quadrats is still to be completed, due to delays in combining the computing and mapping aspects of this GIS work. This map will be an important catalyst in

moving the whole project team towards an integrated analysis of the flora, fauna and sociological data collected to date, and in integrated planning of the collection of future flora and fauna data.

5. In part, the variation in amount of data collected from the Vellimuttom site across the various biological disciplines is also due to a lack of awareness in some of the project team of the importance and value of base-line data. Even at sites where base-line biological values are low (and Vellimuttom is clearly not in this category, with 68 species of trees and larger plants detected in the vegetation survey, over 500 species or species-groups of insects collected, and at least 25 species of birds observed by the consultants in just one afternoon), collection of base-line data is an essential part of demonstrating successful rehabilitation. In addition, analysis of patterns and linkages in the base-line data can reveal significant aspects of the biological complexity of a site, and lead to development of more rapid monitoring tools. The Component 5.2 consultants thus spent considerable time demonstrating such integrated analytical methods to the project team.
6. Rehabilitation activities to be undertaken at Vaniampuzha need to be decided in consultation with the tribal communities. The forest at this site is less disturbed, and the research questions to be posed will be more subtle than those at Vellimuttom, and will need to be developed by the project team working as a whole. Twenty-one vegetation quadrats have been established at Vaniampuzha and should form an initial basis for monitoring the fauna and soils, with further work to be planned and initiated when site management objectives have been agreed. Progress towards GIS analysis of Vaniampuzha has been slow, and preparation of a digitised map would also act here as a catalyst towards integrated planning of future monitoring.
7. Overall, and including the training carried out by the Component 5.2 consultants, it is clear that considerable capacity is being built within the KFRI project team for carrying out the biological monitoring required in forest rehabilitation projects, including understanding how to implement monitoring at a landscape level and with an interdisciplinary approach. The implementation of complete monitoring schemes at Vellimuttom and Vaniampuzha will need to be reviewed as part of Component 6 of this project, while the increased capacity of KFRI in this area will only be properly demonstrated by its success in future forest rehabilitation projects.

Recommendations put forward by the Component 5.2 consultants included the following in reference to short-term activities, with KFRI having the opportunity to address these before Component 6:

1. Vegetation monitoring should continue at Vellimuttom, with future monitoring restricted to selected quadrats only. The growth and survival of seedlings from the first round of planting should be assessed, and the results presented to KFD, before the second round of planting is implemented. The impact on planted seedlings of different methods of bamboo harvesting should be assessed, using the bamboo harvesting as a form of controlled site disturbance.

2. The base-line data on vertebrate fauna at Vellimuttom should be strengthened, initially by instigating a program monitoring bird diversity and abundance. Data on mammal traces should also be collected. Local people should be consulted for anecdotal records, and annotated species lists produced. Sites for vertebrate fauna monitoring should be selected considering those already used for monitoring flora and invertebrate fauna.
3. Simple data on soil texture, colour, pH &c should be recorded from a number of locations across the Vellimuttom site, including the quadrats used for earthworm collection. Monitoring of earthworms and insects should continue after analysis of the data collected to date.
4. Integrated analysis of all the Vellimuttom data (flora and fauna abundance and diversity, leaf area index, soils and sociological data) should be pursued, in consultation with statisticians. The preparation of a digitised map of the quadrats should continue, with topographic data checked, and the map then used for data display. The vegetation data should be analysed by an appropriate ordination method, to segregate the quadrats into a variety of vegetation associations. The hypothesis that insect abundance is correlated with plant diversity should be tested more rigorously. Similar hypotheses about the abundance of other groups should be tested when data are available.
5. Discussions should be opened with KFD concerning development of a strategy for publicising the demonstration forest and experimental site aspects of Vellimuttom.
6. Consideration should be given to performing simple biological analyses on each land block abutting the Vellimuttom site, with measurements covering general characteristics such as vegetation and bird diversity. This recognises that even small forest patches such as Vellimuttom may provide valuable ecosystem services to surrounding land.
7. Base-line data on vertebrates (birds and mammals), invertebrates (insects and earthworms) and soils should be collected at Vaniampuzha, initially from the 21 plots already selected for vegetation analysis.
8. In association with KFD, initial interactions should be made with the Vaniampuzha communities concerning the nature of PFM, as their decisions regarding forest rehabilitation activities will affect the design of future biological surveys at this site.

The consultants also put forward the following longer-term and strategic recommendations, to be addressed during the initiation and management of future projects on forest rehabilitation. Attention to these recommendations will allow KFRI to utilise more fully the capacity that has been built during this project for work in landscape ecology and biodiversity monitoring.

1. Future monitoring projects should be designed so as to include replicate sites and control sites, including adjacent cultivated land and nearby less-disturbed forest where appropriate.
2. Future monitoring projects should use rapid biodiversity monitoring tools at multiple sites, selected on the basis of experience gained to date.

3. Future projects should place sufficient importance on collection of base-line data, especially where base-line diversity values are likely to be low.
4. KFRI should assess the opportunities and demand for retrospective studies on forest rehabilitation.
5. Data from all completed and in-progress projects and their individual components (flora, fauna &c) should be stored in a common framework across KFRI and made accessible to project managers.
6. Interdisciplinary projects require explicit collaboration across disciplines at all stages from initial planning through fieldwork and data analysis to report presentation. Project resources should therefore be managed so as to achieve complementary outcomes for deliverables across disciplines.
7. KFRI should more fully and adequately cost and fund projects to cover its strategic needs in training, equipment maintenance etc. A strategy for staff skill training that covers technical skills, special skills needed by field staff, and project management, team building and leadership skills should be prepared, together with a strategy for maintenance and upgrading of field equipment. This may warrant consideration by KFRI as a whole, especially in the context of a rolling strategic plan for advancing new research projects.
8. KFRI should review the existing committee structure for exchange of strategic information between KFRI and its major client, KFD.

2.5. Component Six – Final Follow Up Visit and Project Completion Workshop

The following part in this chapter is taken from the report submitted by Professor Ian Ferguson and Dr E.K.S. Nambiar after completion of the visit and project completion workshop.

Introduction

The project involved a *Landscape approach to ecologically sustainable forest management* for degraded forests and dependent communities. A primary objective of the project was to enhance the scientific and technical capacity for effective assessment and rehabilitation of degraded forest, recognising the ecosystem processes and socio-economic needs for ecologically sustainable forest management (ESFM). Capacity building activities undertaken under this Sub-Project aimed to assist key stakeholders to plan and manage the forest resource in a manner consistent with principles of *Ecologically Sustainable Development* (ESD).

Terms of Reference (C-6)

The principal objectives for this final mission, Component C6 were to:

- Review and report on implementation progress of degraded forests rehabilitation program through demonstration project.
- Assist project staff on project/program-related issues.

Project Design and History

The project has undergone important changes and experienced some serious difficulties since its inception:

- The scientists involved were mostly senior and experienced, whose skills needs were more in specialist training and work attachments, than introductory skills.
- The KFRI had little experience in interdisciplinary team research, especially that involving integration with field management and other stakeholders through participatory approaches.
- The introduction of systematic team-based research required collaborative planning with KFD staff through the use of SWOT analyses and the preparation of planning matrices.
- The transfer of key KFD staff shortly after the Component - 2 Visit resulted in serious delays in changing the formal status of the chosen sites to that of World Bank Project Participatory Forest Management.
- The delays meant that well-intended efforts by KFRI staff to ensure community planting at Vellimuttom was undertaken in the June 1999 planting season created some strains in relationships with KFD and later, the community and severely constrained the work that could be done by KFRI staff.
- The Vellimuttom community vacillated in their support for the pursuit of a formal PFM for a period after KFD had achieved the change of status for this site and the Vaniampuzha change of status was delayed further by the requirement to obtain the permission of the department responsible for tribal welfare. These delays and events resulted in a loss of confidence in KFRI staff.
- Rebuilding confidence and progress took place commencing with the C5.2 Visit and private visits by Professor Ferguson and Dr Nambiar.
- Since this period, PFM status and the formation of Forest Protection Committees has taken place at both sites and the works programme has completed almost all milestones set for the project.

Field Inspections and Participatory Rural Appraisals

The Final Mission team arranged for meetings of the two VSS to be held during their visit to the respective sites, and were accompanied by the GRM representative. Brief Participatory Rural Appraisals (PRA) were conducted during these visits, drawing on the discussion during meetings, as well as prior and subsequent discussion with groups and individuals from the respective communities.

Recommendations

The issues relating to sustainable forest management essentially concern those of the forest management/community interactions in two very different sites:

- one, involving highly degraded forest and heterogeneous but quite sophisticated and articulate migrant farmers,
- the other, a forest in which the critical degradation is more subtle but highly significant in terms of the non-wood forest products that provide the principal source of income to sustain a very backward, and highly vulnerable tribal community.

The value of the project will only be fully realised by continuing the monitoring, interpretation and participatory research and, in so doing, refining and extending the skills developed in integrating research across disciplines and in providing advice to the varied set of stakeholders.

Recommendation 1: The team should develop an explicit, working description of what constitutes a degraded forest and what is the ideal state to which the ecosystem should proceed at Vellimuttom and Vaniampuzha

Recommendation 2: A soil survey of both sites should be arranged as soon as practical. Soil samples should be collected based on this information to enable recognition of spatial variation in both surface and sub-soils. Chemical analysis should be done on samples to describe depth-wise properties. Samples should be archived for reference and re-analysis over the long term.

Recommendation 3: Hydrological studies should be established at Vellimuttom.

Recommendation 4: Time sequence data should be collected for key biodiversity indicators to establish seasonal and long-term trends. These data should be collected with sufficient overlapping of quadrats to examine the potential relationships between various variables.

Recommendation 5: The boundaries of all plots must be secured with clear and permanent marks (granite posts). Vegetation survey should be undertaken at least once a year. Clear and adequate overlap should be established between the resource map prepared by the community and the monitoring plots.

Recommendation 6: As far as possible, all data should be spatially referenced and a central database of these data maintained.

Recommendation 7: Further internal team building and better communication with the DFO and other KFD staff is needed, especially as different models of PFM will need to be investigated in addition to the formal model now used by KFD.

Recommendation 8: KFRI needs to prepare research plans and milestones to meet issues identified in the PRA's and by the VSS's and to seek further funding for this research in collaboration with KFD.

Recommendation 9: Further funding should be sought to enable continuation of the project. The Mission Team recommends the project to potential donors in the strongest possible terms. The KFD also needs to take particular care in appointment of appropriate persons to the DFO position. The excellent progress of the project to date constitutes a beginning, not an end, to research and capacity building to assist the development of sustainable forest management.

3. MATERIALS AND METHODS

3.1. Site description

Of the two sites selected, site I (Vellimuttom) depicts high degradation of the forests by the local residents and site II, a relatively less disturbed forest (Vaniampuzha) with a tribal community living inside the forests. Both these sites (Map 1) are in the Nilambur range of the Nilambur North Forest Division, which fall under Nilgiri Biosphere Reserve occupying a large part of the Western Ghats. Both the sites are close to each other, i.e., the distance between them is around 15 kms.

Site I: Vellimattom is a small island of forests. In the valley in between and all around migrant farmers have settled down during the last 50 years and they are doing fairly intense agriculture. The population is continuous all around in all directions. Unlike in usual forest settlements where small populations reside within a large forest, here a small pocket of forest has survived. Forestry operations for selection felling of valuable timber and bamboo carried out by the Kerala Forest Department (KFD) have not been followed by any regeneration efforts till the Site Specific Plan (SSP) under the World Bank aided Rehabilitation of Degraded Forests (RDF) II program carried out during the last year. The people residing on the periphery have also contributed to the degradation of the site through their activities such as firewood and green manure collection.

Forestry and subsistence cultivation formed the major form of land use in the past. Social significance of the area highlights a change from industrial forestry to conservation forestry. Economic significance is that dependence on forest is relatively less. The economy is basically agrarian in nature. Departmental selection felling, bamboo extraction, fire, collection of firewood, fodder, lack of forest regeneration, unsustainable harvesting techniques have contributed to the degradation process**.**

Site I consists of the following landscape units: 41.7 ha natural forest, 54 ha teak plantation, and 54 home gardens covering approximately 30 ha. The forest bit is bordered with the teak plantation in the south, with homesteads in the north and east, and with the

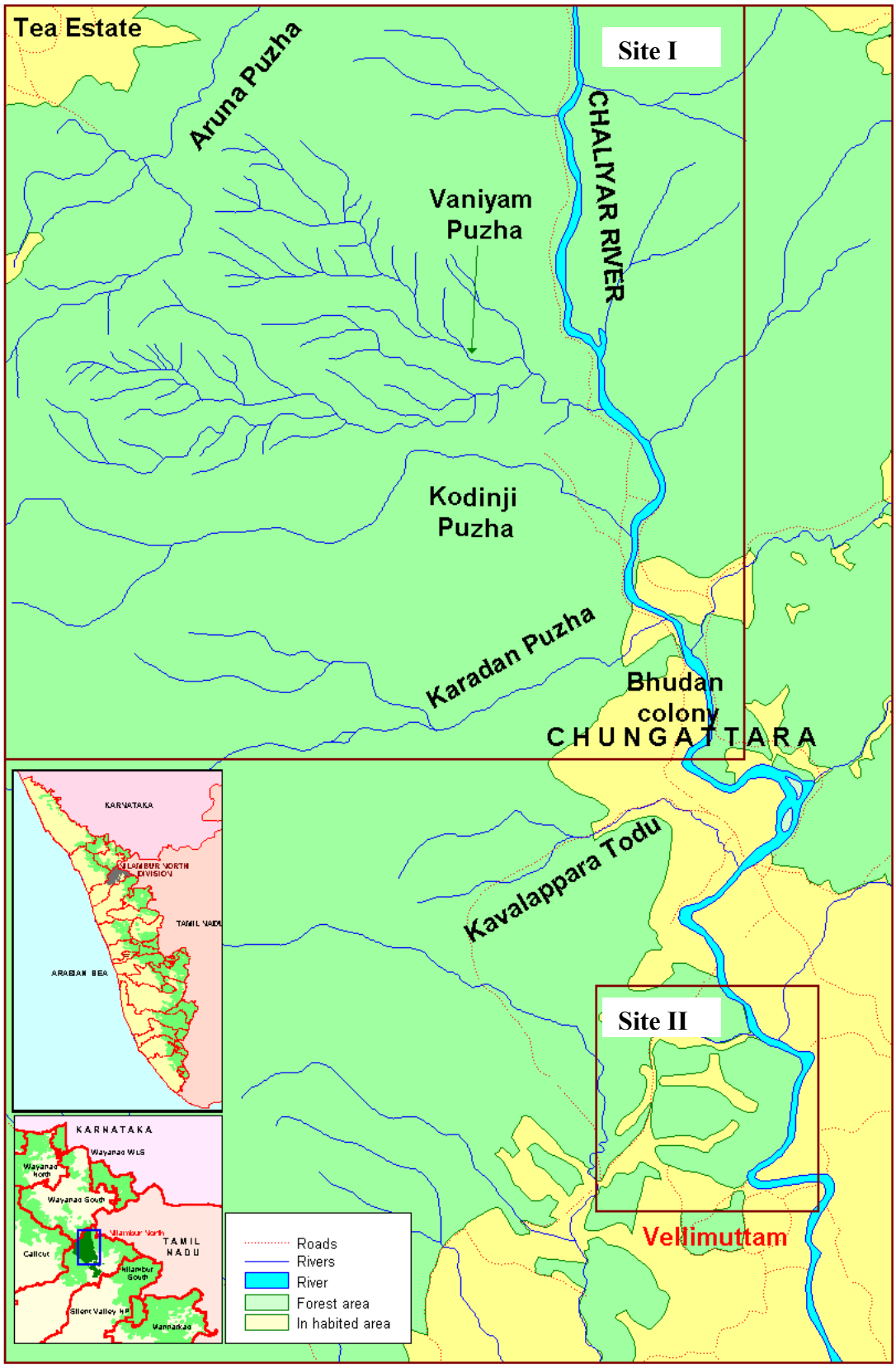
vellimuttom - / Nettikulam road in the west. The forest bit is located at an altitude of 110 m above mean sea level.

Site II: The Vaniampuzha land, once owned by the landlords of Nilambur Kovilalakam had the Paniyans (forest dwelling tribal community) residing in this patch of forest who were settled by the government housing and other schemes from within the forest over 20 years ago in the present spot, i.e., on the periphery of the forest, along the banks of the river Chaliyar, yet they remain partially cut off from the mainstream by the river. In the past, they were in the upper reaches of *Kodinji, Enjamoola* and *Vaniampuzha* rivers, i.e. approximately 3.7 kms from the river Chaliyar. During the colonial rule the production of railway sleepers were done in the Nilambur forests and most of these Paniyans were engaged in that work. Now, the site constitutes three settlements, viz., *Iruttukuthy*, *Vaniampuzha* and *Tharippapatti*. They have been living by the forest by means of collecting the forest produce for sustaining their livelihood. They being a vulnerable section were exploited socially and economically by other sections of the society, even now this continues in one way or the other.

Site II represents a mosaic of habitats – moist deciduous forest, semi-evergreen forest, evergreen forests and two tribal settlements. All the three forest types in the landscape are represented by both disturbed and undisturbed patches (Map 2 & 3). The total area of the landscape is about 31.5 km^2 with Chaliyar River as the eastern boundary, evergreen forests situated about 5 km from the settlement as the western and northern boundaries and Kodinji river as the southern boundary. According to the tribals, they use this area for foraging and gathering.

The climate in both the landscapes is typically monsoonal with an average annual rainfall of over 2500 mm. The major portion (70%) of the annual rainfall occurs from the southwest monsoon, operating in the months of June to August. The northeast monsoon, which sets in October and lasts till the end of November gives but comparatively less quantity of rainfall.

Map 1.Study area



The mean annual maximum temperature is 35^{o}C and the minimum is 15^{o} C. Soils of the forest, both site I and Site II, are sandy loams (Table 1), pH range from 5.1 to 5.8. In site I, when compared to those in site II, soil organic carbon, total nitrogen and extractable calcium were low. However, the amount of extractable potassium was more in Site I.

Table 1. Soil physical and chemical properties of the landscape.

Soil properties	Site I	Site II
Sand (%)	64.0	67.3
Silt (%)	21.3	18.6
Clay (%)	14.7	14.2
PH	5.6	5.2
Organic carbon (%)	2.2	3.4
Total nitrogen (%)	0.234	0.286
C:N ratio	12.95	11.89
Extractable calcium (%)	0.098	0.125
Extractable potassium (%)	0.039	0.024

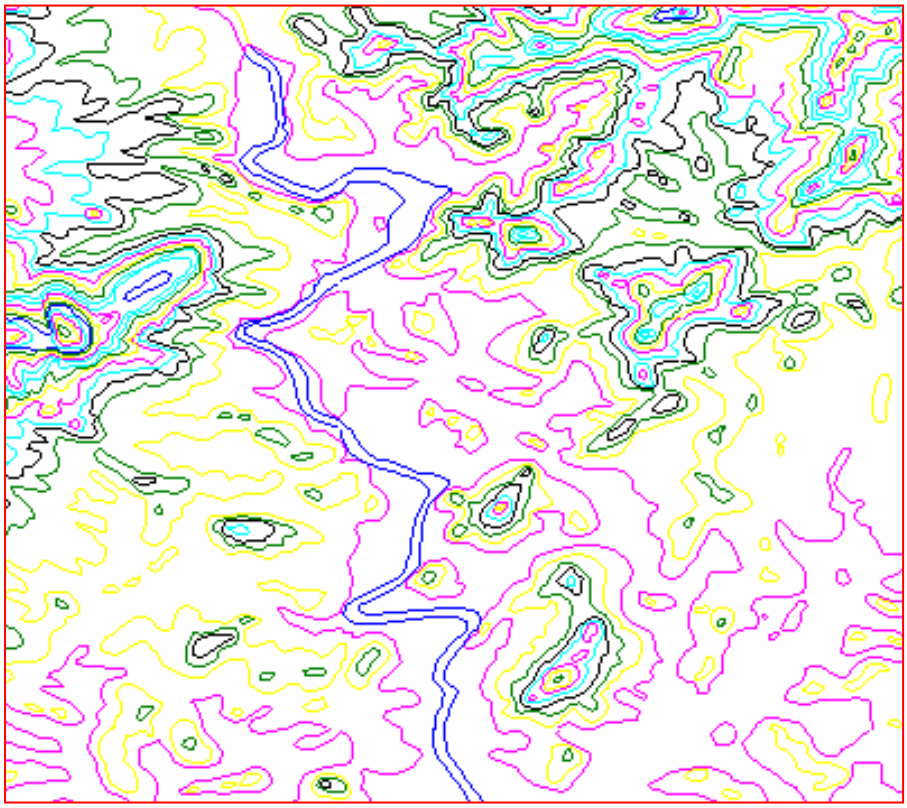
3.2.Vegetation analysis

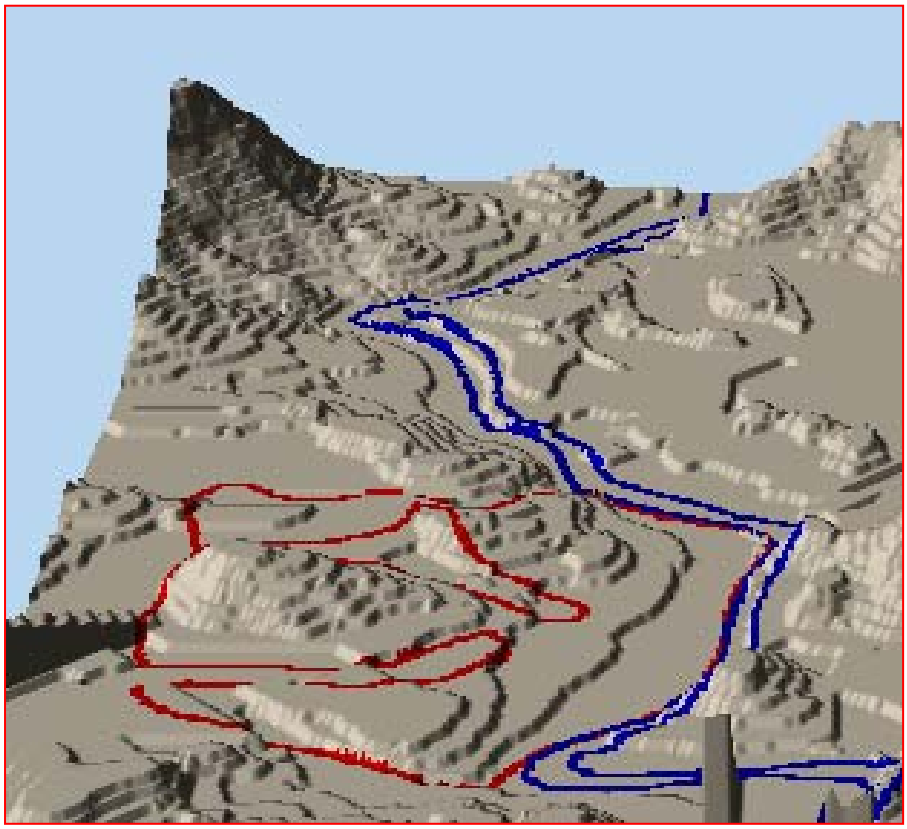
3.2.1. Forested area

The entire forest patch in site I was divided into numbered grids, each of 25 m x 25 m (Appendix 1*)*. Edges and corners with lesser area were estimated separately. Tree components in the forest were categorised into three groups: mature trees (gbh $\geq$ 30.1 cm), saplings (gbh 10.1 to 30.0 cm) and seedlings (girth less than 10.0 cm and height < 1 m). Number of individuals in all these three categories in each quadrate was counted. Number of bamboo clumps and culms in each clump, average girth of each culm and average area occupied by each clump were recorded. Vegetation analysis of shrubs was based on sixteen 5 m x 5 m quadrates.

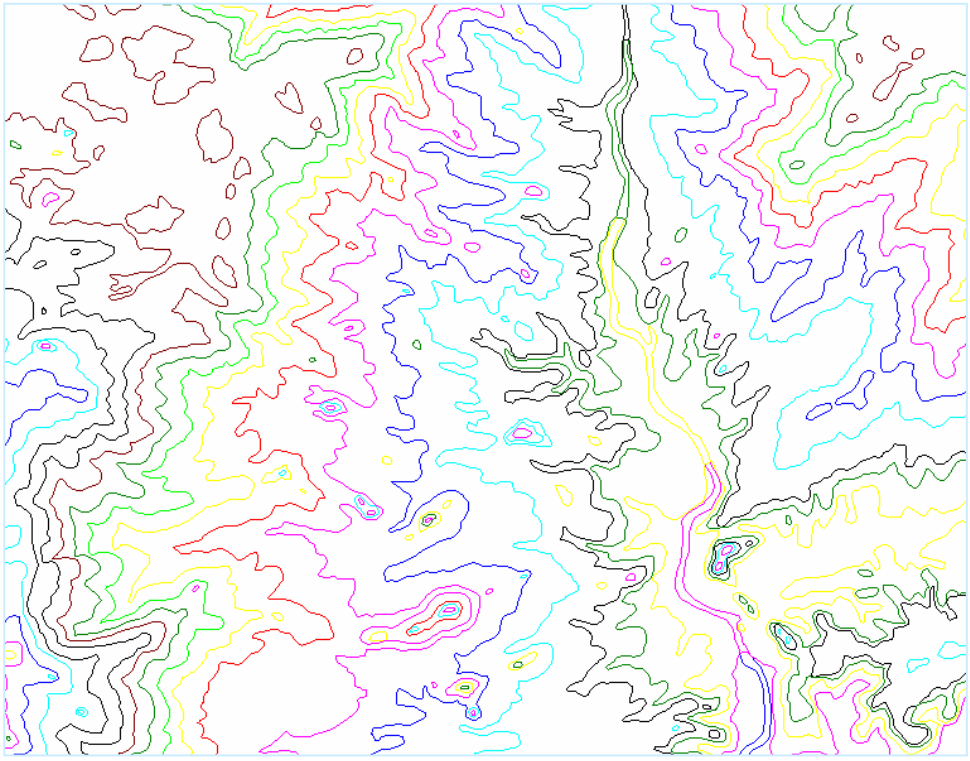
At Site II a reconnaissance survey conducted revealed the following habitats: relatively undisturbed evergreen forests, disturbed evergreen forests, relatively undisturbed semi-evergreen forest, relatively undisturbed moist deciduous forest, moist deciduous forests disturbed due to fire wood and NTFP collections, forest areas affected by fire about 3-5 years back and forests situated within 100-200 m radius from the tribal settlements. Three replicate plots for each habitat were marked for study. Since the variability was very high, 6 replicate plots were selected in evergreen forest (Appendix 2). In each replicate site, a 0.5 ha area was marked, with border trees painted and the area was subdivided into

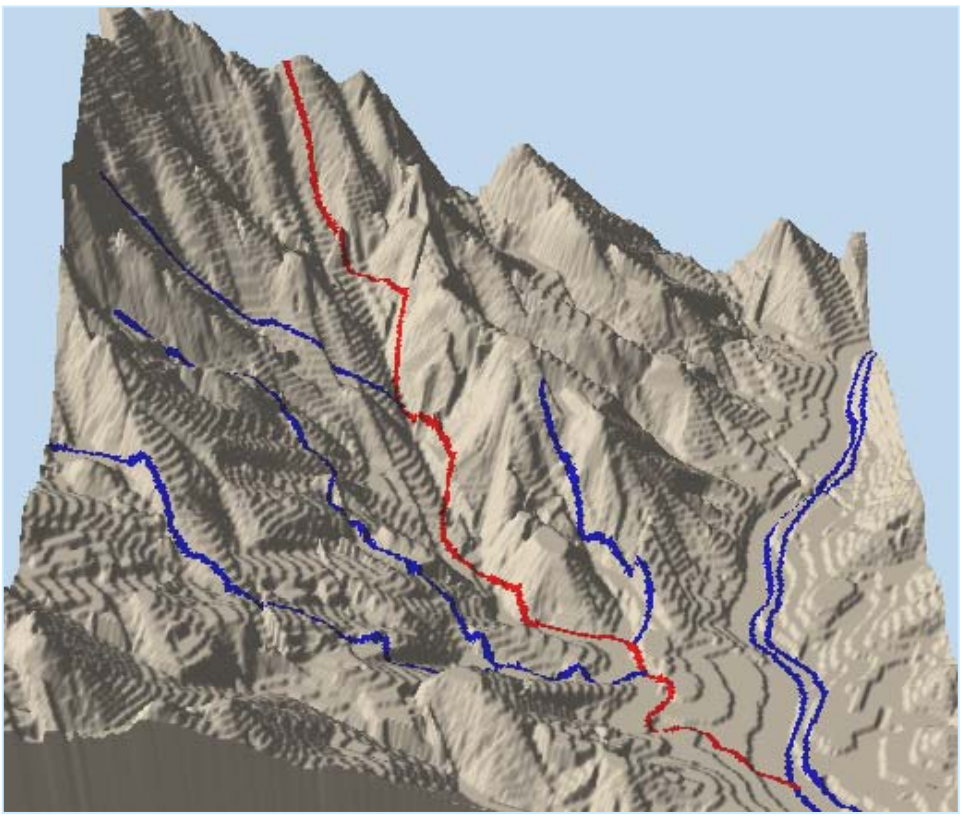
Map 2: Contour maps of Site I & Site II





Map 3: Contour and relief (site II)





25 x 25 m quadrates (Appendix 3). Vegetation analysis of tree components was done separately for tree seedlings, saplings and mature trees categories. Thus, density, basal area and frequency of distribution of each tree species in different categories were estimated. For forests near the tribal settlement, and in moist deciduous forests where signs of fire occurrence was noticed, herbs, shrubs and climber communities were also studied by laying out sub-quadrats in each quadrat

Species diversity (*H*) and species richness (*C*) indices for different plant components (shrubs and trees including bamboo) were calculated using the following formulae:

$$H = -\{(ni/N)\ log_2\ (ni/N)\} \quad \text{(Eq. 1)}$$

$$C = \{(ni/N)^2\} \quad \text{(Eq. 2)}$$

where *H* is the Shannon index of general diversity, *C* is the species richness index, *ni*, the importance value index of each species and *N* is the total importance value index of all species. Agriculture patterns and crop compositions near all three tribal settlements were studied.

3.2.2. Homesteads

All homesteads situated around the forest patch were visited and the information on total area of each homestead were collected from the farmers. A list of tree and understorey crops being grown in each homestead was prepared. In case of tree component, number of individuals of each species in each homestead was recorded when the total area under each annual and biennial crop was estimated.

3.2.3. Teak plantation

Vegetation analysis of shrubs was based on sixteen 5x5 m quadrates, while that of tree seedlings, saplings and trees was based on sixteen 25x25 m quadrates. All these quadrates were established at locations chosen randomly. The tree component in the plantation is broadly grouped into teak and miscellaneous trees. In each group, density, basal area and frequency of distribution of seedlings, saplings and mature trees were estimated separately. Species diversity and species richness indices of shrubs, tree

seedlings, saplings and mature trees of miscellaneous species were calculated using the formulae given already.

3.2.4. Leaf Area Index Measurements

Leaf Area Index (LAI) measurements were made to quantify the canopy cover in the selected plot, which in turn would give us data on the extent of degradation in the forested area. LAI measurements were made using the light interception method. The canopy Analyser (LI-2000, Li-Cor, Nebraska, USA) was used for the measurement of the LAI using a program supplied by the manufacturer. It is usual to calibrate the above instrument with destructive sampling of the leaf area. However, in the present study, this was not possible because the number of species in the natural forest was too large to subject to destructive sampling. However, the basic intention of the present work was to estimate the comparative canopy cover within a forested area. Hence the relative values obtained using the instrument gave us a good indication of the canopy cover and hence degradation of the forest area. The LAI measurements were taken for 51 out of the 625 quadrats laid out for the vegetation analysis. These quadrats were chosen randomly covering the entire area of the site. The measurements were made in December 1999.

3.3. Fire ecology

Since site I was a comparatively small area, fire was not found to be a problem at this site. Hence no study was made in fire ecology at this site. Fire ecology was studied in three plots in site II. Basic techniques for enumeration and measurements are as mentioned for vegetation analysis.

3.4. Faunal diversity

3.4.1. Bird population

Timed area search for birds was conducted in site I for bird monitoring. The hypotheses to be tested on the rehabilitation activities were:

- Rehabilitation may increase bird diversity over time
- Rehabilitation may bring the present vegetation of Vellimattom to more moist and semi-evergreen like similar to that at Vaniampuzha

A ten-day field study of birds and mammals was conducted during the month of April 2000 in Site II. With a view to find the interrelationships between species, sampling of earthworms was done from 12 randomly selected quadrats at site I, once in the monsoon season. The biomass of the earthworms was measured for each plot of size 25x25x30 cm (Appendix 4).

3.4.2. Insect population

The study was carried out in representative study plots, both in forest patches and in the adjacent agro-ecosystems at both site I and site II. Observations were made for a period of 6 months from November 1999 to May 2000 at site I and for a period of 4 months from July 2001 to October 2001 at Site II.

Sampling of insects was done from grids of 25x25 m from November 1999 to May 2000. The plots were randomly laid out in each of the study locations in such a way, that different vegetation classes and gradients are represented. From the data gathered, indices of diversity, dominance, evenness, species richness etc., were computed. The values were pooled for deriving the overall values for the locality. Details of the methods used for studying the insect community are given below.

3.4.2.1. Sampling methods

A battery operated Mathew's-model light trap specially fitted with a timer switching device was used for sampling (Mathew, 1996). The trap was operated continuously for five hours at night from 6.30 pm to 11.30 pm. Within each plot, the trap was operated continuously for a week and then moved to the next plot. In order to cover maximum diversity, the trap position was changed daily. In addition to trap catches, collections were made during day (8 am to 1 pm) using hand nets. The insects collected were sorted out to species and the number of individuals for each species was recorded on data sheets. As it was not possible to identify readily all the species, code numbers were assigned to the various species. The insects were later identified by comparison with authentic

specimens available in KFRI collection, and also by referring to experts in different institutions.

3.4.2.2. Diversity index

The quantification of diversity must address two statistical properties common to any mixture of different objects. The first property is the number of different classes or types of object i.e. species, genera, families, different habitats and so on. The second property is the distribution of objects among classes, such as the relative abundance of individuals of different taxa or the relative area of the habitat that falls into different habitat types. In this study only species diversity was studied, hence, the Shannon-Weiner diversity index (H') was used (Margalef, 1968):

$$H' = -\sum_i P_i \log_e (P_i) \quad (3)$$

Where 'H'' is the Shannon's index of species diversity and P_i is the proportion of individuals in the i^{th} species. In order to find out whether any significant differences existed in the insect diversity between the two localities or between the disturbed and undisturbed areas within a locality, a 't' test was done (Magurran, 1988) using the following formula:

$$t = \frac{H_1 - H_2}{\left[\text{var}(H_1 + \text{var}(H_2)\right]^{1/2}} \quad (4)$$

Where, 'H_1' and 'H_2' are diversity indices of first and second locality, and var (H_1) and var (H_2) are their variances. Variance of diversity index (Magurran, 1988) is defined as follows:

$$\text{Var}(H') = \frac{\sum_i \left[P_i (\log_e (P_i \right]^2 - \left[\sum_i P_i \log_e (P_i)\right]^2}{N} - \frac{S-1}{2N^2} \quad (5)$$

3.4.2.3. Similarity measures

Similarity coefficients are based solely on the presence (indicated with a 1) or absence (indicated with a 0) of data. This analysis reveals the degree of similarity in species composition between each pair of sampling units (columns of data matrix). In this study, Jaccard's index which is essentially the proportion of the number of sampling units where both species occur to the total number of sampling units where at least one of the species is found.

Jaccard's index $JI = (a)/(a+b+c)$ (6)

Where a = the number of sampling units where both species occur

b = the number of sampling units where species A occurs, but not B

c = the number of sampling units where species B occurs, but not A

3.4.2.4. Cluster analysis

Cluster analysis is a classification technique for placing similar entities or objects into groups or "clusters". Hierarchical clustering was done with Jaccard's similarity coefficient as distance measure. The analysis was carried out using presence or absence data. The results obtained were plotted as a dendrogram.

3.4.2.5. Dominance index

The patterns of relative abundance of species determine the dominance of each insect Order in a locality, which was determined by calculating the dominance index using the following formula:

$$\text{Relative dominance} = n_i \times \frac{100}{N} \quad (7)$$

Where n_i = number of insect species in the i^{th} Order, and N = the total number of insect species in all the orders collected during the study period.

3.4.2.6. Evenness or equitability index

This index, which measures the evenness of species abundance, is complimentary to the diversity index concept and it indicates how the individuals of various species are distributed in the community.

For estimating evenness, Shannon's evenness index was calculated (Pielou, 1975). Mathematically, the evenness of frequency distribution of species abundance in a community with 's' component species, is the degree to which it approximates the uniform distribution for 's' species i.e., equal abundance of all species in the sample or community (Pielou, 1977).

In a collection or in a community with 's' component species, diversity will be greater if all 's' species are well represented. In this condition, there is high evenness and low dominance. On the contrary, if a few of the species, say 't' are very common and the rest (s-t) are very rare, then it is a case of low evenness and high dominance.

The Shannon's evenness index of the community (E) was calculated following Pielou (1975).

$$E = H'/\log_e(s) \quad (8)$$

Where, 's' is the number of species recorded and 'H'' is the Shannon-Weiner index of diversity.

3.4.2.7. Species richness index

The index of species richness (d) was calculated using the formula given by Menhinick 1964):

$$D = s/\sqrt{n} \quad (9)$$

Where, 's' is the number of species recorded and 'n' is the total number of individuals summed over all species.

3.4.2.8. Insect herbivory

Systematic observations were also made on insect herbivory by collecting the insects feeding on different plants and recording the nature and intensity of damage. Based on the observations made, the role of insects as pests and their potential to cause damage on a plantation scale was assessed.

3.5. Socioeconomics

3.5.1. The stakeholders

The study is mainly based on primary estimates. In Site I, a random sampling method was adopted for the selection of samples, the unit of study being a household (Map 4.).

Box 1: The stakeholders

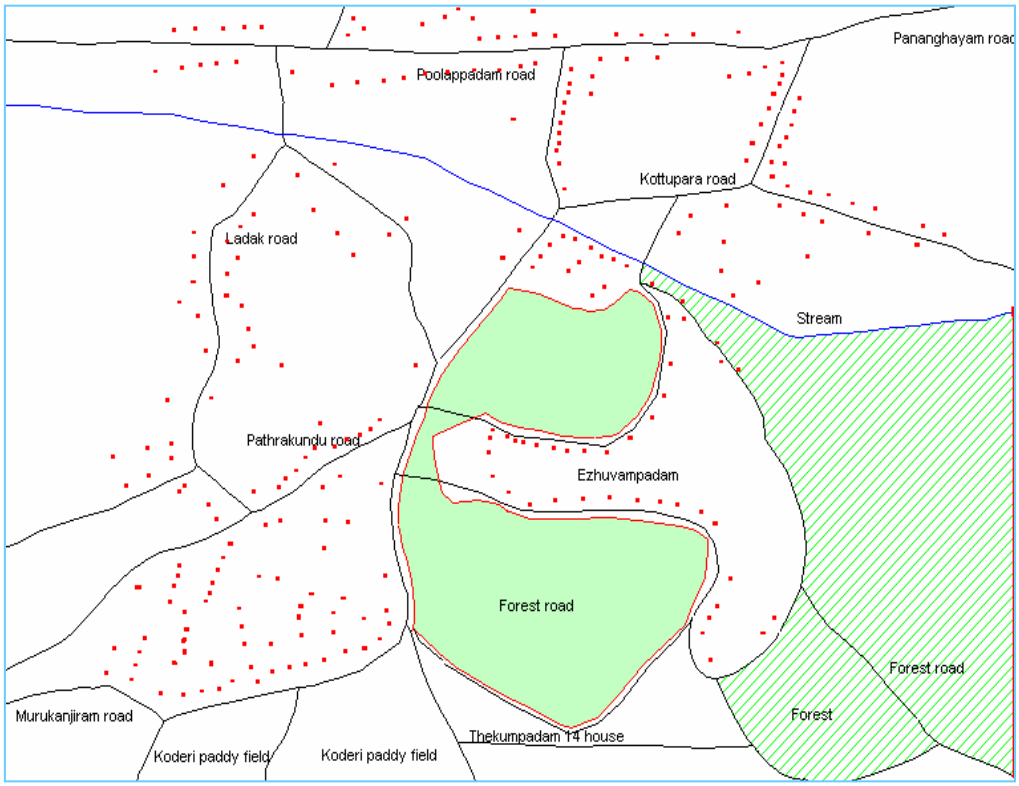
Sites	Primary stakeholders	Secondary/tertiary stakeholders
I	Farmers (25 %) Labourers (59 %) Tribals (1 %) Disadvantaged (6%) Others (9 %)	Forest Department Panchayath
II	Paniyans (Scheduled Tribes)	Forest Department Panchayath Tribal Welfare Department Kalkulam Tribal Service Cooperative Socierty

The reconnaissance survey revealed that the economy in site I is basically agrarian and in site II it is forest-based. Here, the stakeholders are classified into primary and secondary based on their dependency level on the resources. The rationale for classification of primary stakeholders (Box 1) was based on the primary occupation of the households with only the employment pattern of the head of the family being taken into consideration. The primary occupation of the selected households represented the general cross section of the employment opportunities available in the area. As the forest area in site I is just 42.30 hectare, a total of 300 households were selected based on the following criteria[1]: (a) Proximity/ access to the forest bit, (b) current users / beneficiaries and (c) the need to focus on finite number of households as there is only 42.30 hectares to be managed. Primarily information on employment (nature of employment and number of days engaged) was collected using data sheets. This was done with the help of local women (*Mahila Samajam*) who were familiar with the area and selected households. The

[1] Criteria were decided in the public meetings with the participation of primary stakeholders.

investigators conducted regular check-up. Socioeconomic survey was conducted (year round monitoring) among the selected primary stakeholders to collect the detailed information on basic household details, land holdings and agricultural practices, income pattern & sources, dependence on forest in terms of food fodder, fuel, NWFP, miscellaneous, atti-tude towards forests and wildlife conser-vation and institu-tional arrangements. On various social problems the partici-patory approach was resorted to. Participatory rural appraisal (PRA) and Rapid Rural Appraisals (RRA) were conducted along with the primary stakeholders and Forest Department staff of both sites.

Map 4: Surrounding roads and selected houses (site I)



4. RESULTS

4.1. Vegetation analysis

4.1.1. Site I

4.1.1.1.Forested area

Complete enumeration of trees (girth ≥10.1 cm) and bamboo in the Vellimuttom forest landscape revealed 68 species. The total number of individuals of trees and bamboo clumps recorded was 4089 (an average of 98 individuals ha^{-1}) of which 55 per cent were bamboo clumps **(Table 2).** Basal area of the trees and bamboo community in the forest patch was 1933.7 m^2 (46.4 m^2 ha^{-1}) with about 80 per cent contribution by bamboo alone. Only four species, namely, *Bambusa bambos, Terminalia paniculata, Xylia xylocarpa* and *Aporusa lindleyana* recorded the importance value index (IVI) more than 10 and, their contribution to the total IVI of the area was 71.7 per cent **(Appendix 5).**

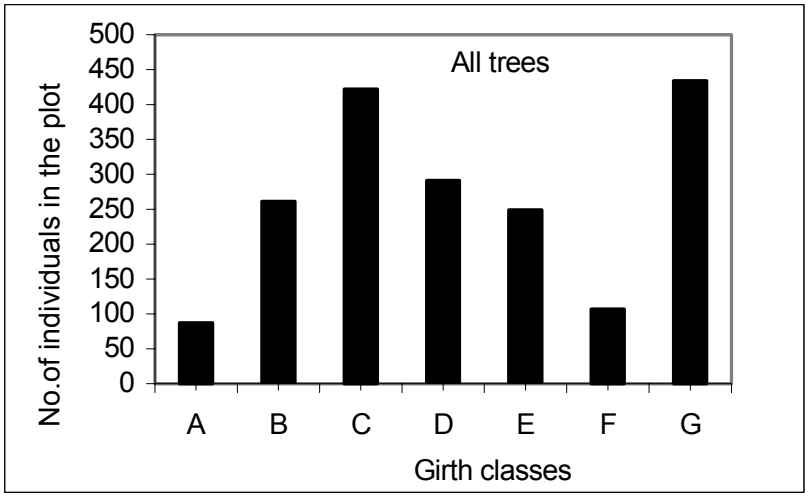
Table 2. Baseline information of tree community (Site I)

Total area	41.71 ha.
No. of quadrats (25m x 25m)	667
No. of tree species recorded	68
No. of inidividual plants (girth 10.1 cm)	
Trees	1851 (44 ha^{-1})
Bamboo clumps	2238 (54 ha^{-1})
Total	4089 (98 ha^{-1})
Total basal area of plants (girth 10.1 cm)	
Trees	385.21 m2 (9.24 m^2 ha^{-1})
Bamboo clumps	1548.48 m2 (37.15 m^2 ha^{-1})
Total	1933.69 m2 (46.39 m^2 ha^{-1})
Species with IVI more than 10	*Xylia xylocarpa* (14.3) *Aporusa lindleyana* (12.02) *Bambusa bambos* (166.0) *Terminalia paniculata* (22.7)
Total no.of tree seedlings (natural)	28150 (674 ha^{-1})

In the seedling populations, 73 tree species were recorded **(Appendix 6),** of which 57 species were represented in the mature phase as well. The density of seedlings was 674 individuals ha^{-1} with about 53 per cent contribution from a few species such as *Xylia xylocarpa* (220 ha^{-1}), *Terminalia paniculata* (81 ha^{-1}) *Tabernaemontana coudata* (28 ha^{-1}) and *Cassia fistula* (26 ha^{-1}).

Girth class distribution pattern of the tree component in the forest site did not show a negative exponential with a clear preponderance of stem of small girth classes **(Fig. 1).** In the forest patch, only 13 species were present with their density in tree phase one or more than one ha^{-1}. Further analysis of girth class distribution in these species separately indicated the occurrence of three patterns **(Fig. 2a,b,c)**. In *Alstonia scholaris,* the number of individuals recorded was more (15 individuals) in the girth class 30.1 to 60.0 cm followed by the girth class =>180.1 cm **(Fig. 2a).** This species was represented poorly in

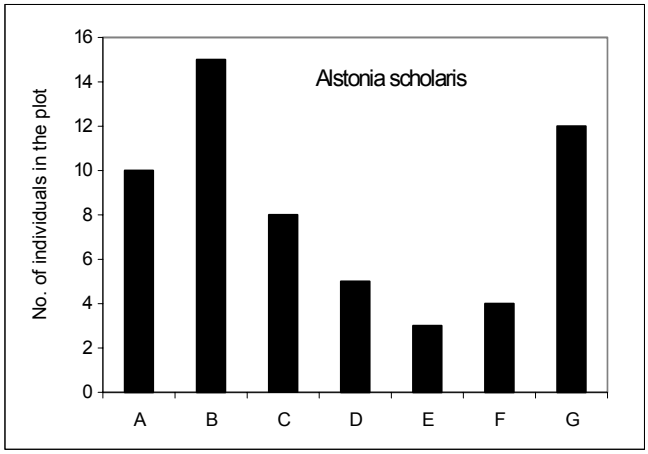
Fig. 1. Girth class distribution of trees (Site I)

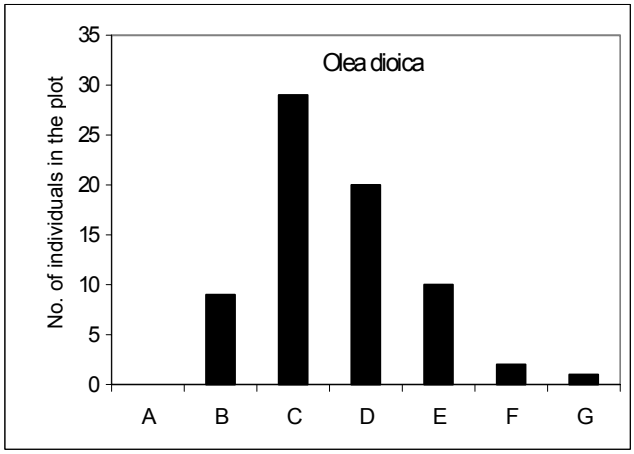


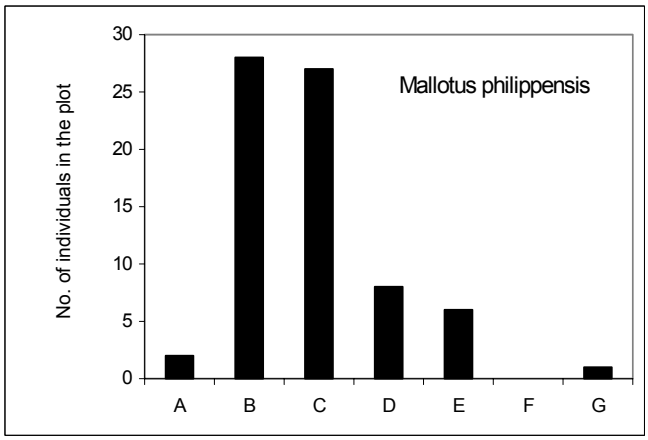
Girth classes: A= 10.1-30.0 cm, B=30.1-60.0 cm, C= 60.1-90.0 cm,
D=90.1-120.0 cm, E=120.1-150.0 cm,
F=150.1-180.0 cm, G= >180.1 cm gbh

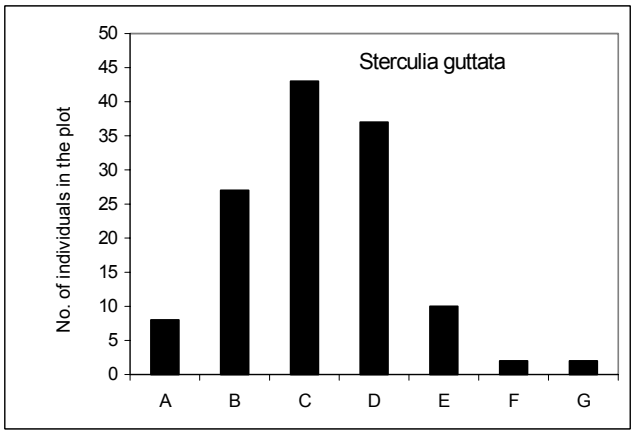
number of trees was more in the girth class 60.1 –120.0 cm gbh **(Fig. 2 b-j)**. *Xylia xylocarpa* showed better representation of its individuals in the girth class 120.1 cm and 150.0 cm **(Fig. 2k)** when T*erminalia paniculata and* S*trychnos nux-vomica* represented well in the girth class = >180.1 cm gbh **(Fig. 2 a-c)**. All these observations indicated the poor recruitment of stems to the higher classes from the lower girth classes or the poor representation of stems of smaller girth classes. In order to determine the rate of recruitment of seedlings into sapling (gbh 10.1 to 30.0 cm) phase, ratio between number of saplings/seedlings was calculated. In *Terminalia paniculta, Xylia xylocarpa,* S*trychnos nux-vomica, Olea dioica, Dillenia pentagyna and Mallotus philippensis,* the ratio, when expressed as a percentage was below 1 per cent. This may be attributed to the preference of local people to biomass collection in the form of poles and foliage of these species. In spite of drastic decline in the disturbance to this forest patch since 3-4 years, recruitment to poles (saplings) phase was not progressing well.

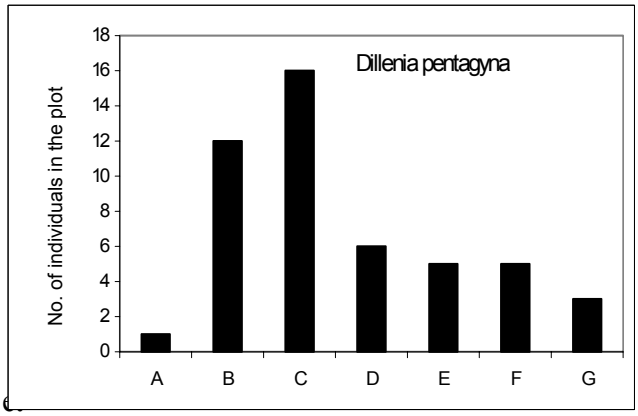
As mentioned already bamboo is the dominant component in the tree community. Enumeration of bamboo clumps and culms in the 667 quadrats indicated the occurrence of bamboo in 635 quadrats (Appendix 7). Number of clumps per quadrat varied from 1 to 11. In about 52 per cent of the quadrats, 1 to 3 clumps were present while in 38 per cent and 6 per cent of total quadrats, 4-6 clumps and 7-9 clumps were present respectively. Only one quadrat contained 11 clumps. Number of culms per quadrat ranged from 1 to 138 (Appendix 8). In 239 quadrats, number of culms per quadrat was 1 to 25 while in another 252 quadrats it was 26-50. About 15 per cent and 7 per cent of total quadrats had 51-75 culms and 76-138 culms per quadrat respectively.











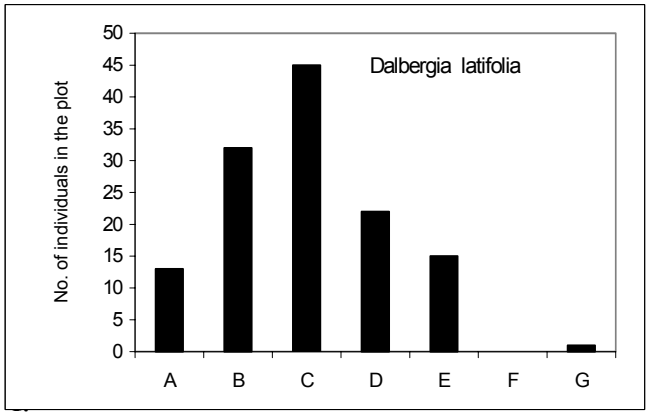


Fig. 2a. Girth class distribution of trees (Site I)

Girth classes: A= 10.1-30.0 cm, B=30.1-60.0 cm, C= 60.1-90.0 cm, D=90.1-120.0 cm, E=120.1-150.0 cm, F=150.1-180.0 cm, G= >180.1 cm gbh

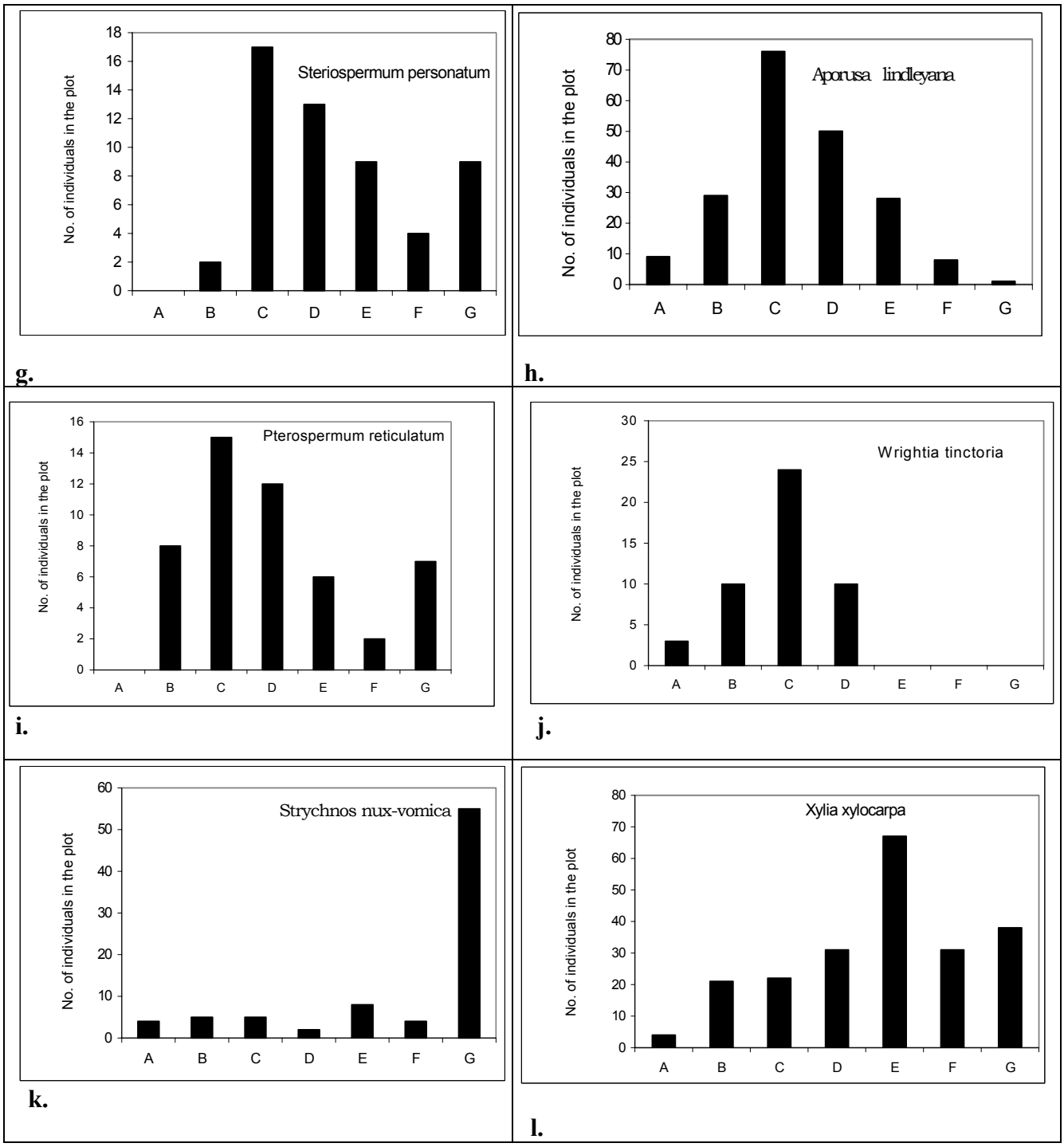
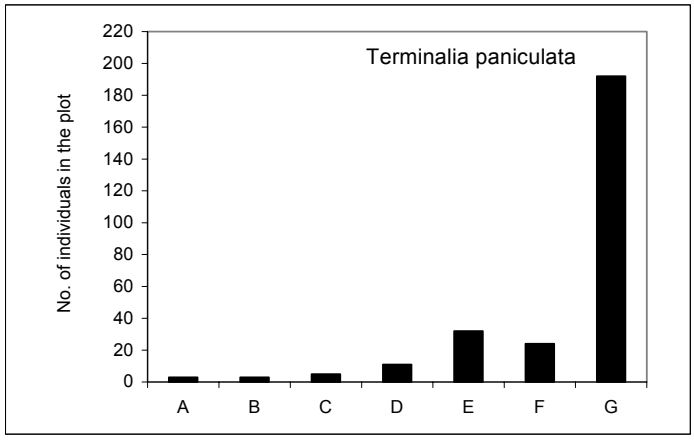


Fig. 2 b. Girth class distribution of trees (SiteI)

Girth classes: A= 10.1-30.0 cm, B=30.1-60.0 cm, C= 60.1-90.0 cm, D=90.1-120.0 cm, E=120.1-150.0 cm, F=150.1-180.0 cm, G= >180.1 cm gbh



Girth classes:
A= 10.1-30.0 cm
B=30.1-60.0 cm
C= 60.1-90.0 cm
D=90.1-120.0 cm
E=120.1-150.0 cm
F=150.1-180.0 cm
G= >180.1 cm gbh

Fig. 2 c. Girth class distribution of trees (Site I).

Distribution of tree saplings and mature trees was sparse. While saplings were totally absent in 600 quadrats **(Appendix 9),** mature trees were absent in 140 quadrats **(Appendix 10).** Even in the quadrats with saplings, the number of saplings ranged from 1 to 3. When about 75 quadrats had 6-10 trees per quadrat only 4 quadrats contained 11-16 trees per quadrat. The remaining 448 quadrats recorded only 1-5 trees per quadrat. All 667 quadrats had wildlings (seedlings not planted) ranging from 1 to 154 per quadrat **(Appendix 11).** Number of quadrats with 1-25, 26-50, 51-75 and 76 –154 wildlings per quadrat was 167, 308, 130 and 62 respectively.

Statistical analyses to determine whether there is a correlation between the number of bamboo clumps and wildlings indicated that there is statistically significant negative correlation at 1 per cent level (r = -0.1111, n = 667) and between the number of bamboo culms and wildlings (r = -0.1694, n = 667). However, the observed degree of relationship is not very high in both cases. Thus the probability exists for other factors also influencing the density distribution of wildlings at the study site. Harvest of wildlings along with shrubs as green manure, damage of wildlings during weeding operations etc. could be attributed to both poor density of wildlings and failure of established wildlings to recruit into sapling phase.

Shrub community in the forest plot was dominated by *Chromolaena odorata* (IVI =93.9) followed by *Helictres isora* (IVI= 65.5), *Clerodendrum viscosum (*IVI=56.7) and *Calycopteris floribunda* (IVI= 53.9). Other shrubs in the plot are *Acacia intsia*, *Hibiscus furcatus*, *Musaenda frondosa*, *Caesalpinia mimosoides* and *Desmodium triquetrum.* The estimated basal area was 894 cm^2 ha^{-1}, which indicates the sparse distribution of shrubs in the site.

Table 3. Number and area of homesteads (n=54) (Site I)

Homestead categories (area in *cents*)	No. of home-steads	Total area (cents)
5-50	28	480
51-100	9	830
101-200	5	850
201-300	5	1375
301-400	2	700
401-500	1	500
501-600	2	1200
601-700	2	1400

Note: A cent = one-hundreth of an acre = 0.00405ha

4.1.1.2.Homesteads (Site I)

Fifty-four homesteads covering about 29.3 ha adjacent to the forest site constituted the agricultural landscape unit of the Vellimuttom landscape. Size of these homesteads varied from 40 m^2 to 2.8 ha, with about half of the homesteads less than 0.2 ha **(Table 3).** These small homesteads, however, covered only 6.5 per cent of the total area under homestead farming. On the other hand, 7 homesteads with an area in the range 1.2 - 2.8 ha covered about 52% of the total area. *Musa paradasiaca*, *Colocasia esculenta*, *Manihot esculenta*, *Dioscorea* sp., *Zingeber officinale*, *Capsicum annuum* were the important annual and biennial food crops in these homesteads. In 12 homesteads, cultivation of pepper (*Piper nigrum*) was recorded. Two homesteads had a small area under rice (*Oryza sativa*) cultivation. Out of 8 species, only two species, *Musa paradisiaca* (banana) and *Colocasia esculenta* (taro) were present in homesteads of all size categories **(Table 4**). Banana was a common crop in almost all homesteads that had more than an acre.

Table 4. Agricultural crops (n= 54) (Site I)

Crops	Homestead categories (area in *cents*)			
	5-50 (n=28)	51-100 (n=9)	101-300 (n=10)	301-700 (n=7)
Musa paradisiaca	8	1	9	7
Colocasia esculenta	11	2	7	6
Piper nigrum	4	0	6	2
Zingiber officinale	1	0	0	0
Oryza sativa	0	1	1	0
Manihot esculenta	5	1	5	5
Dioscorea pentaphylla	4	0	2	4
Capsicum annuum	0	1	0	0

Note: A cent = one-hundreth of an acre = 0.405 ha

Among the tree components in homesteads, *Areca catechu*, *Hevea braziliensis*, *Cocos nucifera*, *Artocarpus heterophyllus* and *Mangifera indica* were the most important. In all 4 categories of homesteads, *Areca catechu* was the dominant tree component **(Appendix 12)**. *Cocos nucifera*, *Artocarpus heterophyllus* and *Mangifera indica* were the 2nd, 3rd and 4th dominant trees respectively in homesteads of size between 5 cents and 100 cents. However, in homesteads of size 501 cents to 700 cents, *Hevea braziliensis* and *Cocos nucifera* were the 2nd and 3rd important tree crops.

Out of 38 tree species recorded in homesteads, 16 species were observed in the forest landscape unit either in seedling or mature or both phases. However, species such as *Artocarpus heterophyllus*, *Mangifera indica, Psidium guajava, Tamarindus indica* and *Tectona grandis* were totally absent in mature phase in the forest plot. In addition, *Artocarpus hirsutus, Emblica officinalis* and *Macaranga peltata* were represented poorly in the forest plot compared to homesteads.

Absence of *Artocarpus heterophyllus*, *Mangifera indica* and *Tectona grandis* and poor representation of *Artocarpus hirsutus, Emblica officinalis* and *Macaranga peltata* in the forest plot could be attributed to factors such as arrest of recruitment due to grazing and fire damage at the pole stage. Occurrence of *Artocarpus heterophyllus*, *Mangifera indica*

and *Tectona grandis* in homesteads also could be the indication of farmers' preference to these multipurpose or commercially important tree species.

4.1.2. Site II

4.1.2.1.Forest plots

Baseline information including species distribution and girth class distribution patterns collected on tree community in three forest types i.e., evergreen forest, semi-evergreen forest and moist deciduous forest are given below.

4.1.2.1.1. Evergreen forests

Comparison of disturbed and undisturbed evergreen forest plots in terms of species composition indicated that no significant difference existed between these two plots **(Appendix 13 & 14)**. However, in the undisturbed forest plots seedling density was significantly more **(Table 5)** and about 75 to 85 per cent of the total seedling density was contributed by the shade tolerant species. On the other hand, in disturbed plots, trees (girth≥10.1cm) of lower girth classes were mainly light demanding

Table 5. Basic statistics of tree community in evergreen forest plots (Site II)

Parameters	Plots					
	Undisturbed plots			Disturbed plots		
	1	2	3	1	2	3
No. of species recorded in mature phase	30	27	35	36	36	35
No. of species recorded in tree seedling phase	28	28	30	23	24	21
No. of individuals of trees per ha^{-1} (girth ≥ 10.1cm)	820	892	1212	1340	1232	1624
No. of individuals of tree seedlings per ha^{-1}	14520	18880	10000	5400	3880	4560
Basal area (m2 ha^{-1}) of trees	47.82	32.78	64.20	38.76	34.8	47.56

species such as *Antiaris toxicaria, Calicarpa tomentosa, Clerodendrum infortunatum, Pterygota alata* and *Sterculia guttata.* In both the plots, girth class distribution pattern of the tree component showed a negative exponential with a clear preponderance of stems of smaller girth classes **(Table 6).** However, this does not indicate that regeneration in disturbed forest is better, as the contribution to lower girth classes is mainly by species adapted to disturbance rather than by the species characteristic to relatively undisturbed plots.

Table 6. Girth class distribution of tree community in evergreen forests (Site II)

Plots	Girth classes*									
	A	B	C	D	E	F	G	H	I	J
Undisturbed plots										
Plot 1	272	244	112	104	60	8	4	4	0	12
Plot 2	172	320	256	104	24	16	0	0	0	0
Plot 3	532	320	152	132	40	4	8	12	8	4

Disturbed plots										
Plot 1	560	412	184	88	76	16	4	0	0	0
Plot 2	404	480	216	80	28	16	8	0	0	0
Plot 3	732	472	216	112	52	24	0	8	8	0

*,A: 10.1-30.0, B: 30.1- 60.0, C: 60.1-90.0, D: 90.1-120.0, E: 120.1-150.0, F:150.1-180.0, G:180.1-210.0, H:210.1-240.0, I:240.1-270.0 and J:>270.1 cm gbh.

4.1.2.1.2. Semi-evergreen forests

In this landscape unit, tree density varied from 616 individuals ha^{-1} to 880 individuals ha^{-1} with seedling density 3560 to 6640 individuals ha^{-1} **(Table 7).**

Table 7. Basic statistics of tree community in semi-evergreen forest plots (Site II)

Parameters	Plots		
	1	2	3
No. of species recorded in mature phase	43	40	39
No. of species recorded in tree seedling phase	33	33	28
No. of individuals of trees per ha^{-1} (girth ≥ 10.1cm)	880	772	616
No. of individuals of tree seedlings per ha^{-1}	6640	5280	3560
Basal area (m2 ha^{-1}) of trees	33.76	31.63	36.09

Girth class distribution pattern of the tree component showed a negative exponential with a clear preponderance of stem of small girth classes (Table 8). Here the regeneration of all major species is good and thus the existing vegetation structure and composition may continue to remain provided there is no major disturbance in these plots.

Table 8. Girth class distribution of tree community in semi-evergreen forests (Site II)

Plots	Girth classes*									
	A	B	C	D	E	F	G	H	I	J
Plot 1	412	236	116	44	36	12	4	12	0	8
Plot 2	296	208	108	92	28	24	12	4	0	0
Plot 3	196	168	116	52	28	28	16	0	4	8

*, A: 10.1-30.0, B: 30.1- 60.0, C: 60.1-90.0, D: 90.1-120.0, E: 120.1-150.0, F:150.1-180.0, G:180.1-210.0, H:210.1-240.0, I:240.1-270.0 and J:>270.1 cm gbh.

A wide difference among the three plots was noticed for the tree species composition **(Appendix 15 & 16).** Thus for landscape analysis, establishment of more number of sample plots in each landscape unit is important.

4.1.2.1.3. Moist deciduous undisturbed forests

Compared to evergreen and semi-evergreen forests, the moist deciduous forests had lower number of species and density in the tree and seedling phases **(Table 9).**

Table 9. Basic statistics of tree community in moist deciduous forest plots (Site II).

Parameters	Plots		
	1	2	3
No. of species recorded in mature phase	23	22	17
No. of species recorded in tree seedling phase	15	20	19
No. of individuals of trees per ha^{-1} (girth ≥ 10.1cm)	396	516	256
No. of individuals of tree seedlings per ha^{-1}	3720	5520	3600
Basal area (m2 ha^{-1}) of trees	36.53	32.26	38.85

However, no significant difference was recorded among different types of forests for tree basal area. Girth class distribution pattern of the tree component **(Table 10)** did not show a negative exponential curve.

Table 10. Girth class distribution of tree community in undisturbed moist deciduous forests (Site II).

	Girth classes*									
	A	B	C	D	E	F	G	H	I	J
Plot 1	92	104	76	40	28	16	20	12	4	4
Plot 2	92	156	128	88	16	4	12	8	12	0
Plot 3	60	48	32	20	24	32	12	8	4	16

*, A: 10.1-30.0, B: 30.1- 60.0, C: 60.1-90.0, D: 90.1-120.0, E: 120.1-150.0, F:150.1-180.0, G:180.1-210.0, H:210.1-240.0, I:240.1-270.0 and J:>270.1 cm gbh.

A sudden fall in the number of individuals in the intermittent girth classes may be an indication of the past disturbance leading to mortality of seedlings and saplings.

Out of 34 tree species, 9 species were recorded in all three plots while 8 species were found in two plots **(Appendix 17)**. Similarly, in the seedling phase, out of 30 species, 9 species were recorded in all three plots while 6 species were found in two plots **(Appendix 18).** More number of sample plots needs to be established and studied in order to appreciate the wide variation in species composition and structure of vegetation in this landscape unit.

4.1.2.1.4. Impact of disturbance on vegetation structure (Site II)

In moist deciduous forest plots disturbed due to firewood and NWFP collection the density of trees in the girth class 10.1 cm to 30.0 cm was generally low **(Table 11).**

Table 11. Girth class distribution of tree community in disturbed moist deciduous forests (Site II)

Plots	Girth classes*									
	A	B	C	D	E	F	G	H	I	J
Plot 1	56	96	56	48	48	20	0	12	0	4
Plot 2	104	128	68	56	56	12	20	0	0	0
Plot 3	60	60	36	52	44	16	12	8	8	0

*, A: 10.1-30.0, B: 30.1- 60.0, C: 60.1-90.0, D: 90.1-120.0, E: 120.1-150.0, F:150.1-180.0, G:180.1-210.0, H:210.1-240.0, I:240.1-270.0 and J:>270.1 cm gbh.

Although the density of seedlings was not much different from that in undisturbed plots **(Table 12)**, girth of most of the seedlings was less than 5 cm and thus recruitment to higher girth classes seemed to be very slow.

Table 12. Basic statistics of tree community in moist deciduous forest plots (Site II)

Parameters	Plots		
	1	2	3
No. of species recorded in mature phase	13	14	13
No. of species recorded in tree seedling phase	22	19	17
No. of trees per ha^{-1} (girth $\geq$ 10.1cm)	340	444	296
No. of tree seedlings per ha^{-1}	5800	6640	7240
Basal area of trees (m^2 ha^{-1})	32.23	27.24	28.66

4.1.3. Fire Ecology of selected species

Disturbance due to occasional fire (before about 2 years) in moist deciduous forests:
In the fire-affected plots, number of tree species was as low as 7 to 21 **(Table 13).** Here also trees of lower girth classes were comparatively less in number **(Table 14).**

Table 13. Basic statistics of tree community in Fire affected MDF (Site II).

Parameters	Plots		
	1	2	3
No. of species recorded in mature phase	13	20	7
No. of species recorded in tree seedling phase	21	20	9
No. of individuals of trees per ha^{-1} (girth $\geq$ 10.1cm)	656	556	508
No. of individuals of tree seedlings per ha^{-1}	5680	7080	2280
Basal area (m2 ha^{-1}) of trees	27.14	27.79	30.70

Table 14. Girth class distribution of tree community in fire affected MDF (Site II)

Girth classes*	Plot		
	1	2	3
A	204	112	76
B	212	192	144
C	140	116	108
D	40	60	96
E	32	56	60
F	16	12	8
G	8	0	16
H	0	8	0
I	0	0	0
J	4	0	0

*, A: 10.1-30.0, B: 30.1- 60.0, C: 60.1-90.0, D: 90.1-120.0, E: 120.1-150.0, F:150.1-180.0, G:180.1-210.0, H:210.1-240.0, I:240.1-270.0 and J:>270.1 cm gbh.

Despite the fact that there was recruitment of species like *Anthocephalus cadamba*, *Artocarpus hirsutus*, *Litsea* sp. *Schleichera oleosa* etc., they were not represented in the tree phase **(Appendix 19 & 20)**. This might suggest that because of fire, these species could not establish or they were in progressive succession with recruitment of seedlings of above-mentioned species.

In the fire affected moist deciduous forest plots, studies were conducted to assess the density and IVI of herbs, shrubs and climbers. The study indicated that the number of species as well as density of herbs, shrubs and climbers were significantly low in fire affected area than in control plots **(Appendix 21, 22 and 23)**. Out of 9 herb, 4 shrub and 11 climber species collected by tribes for their food or medicine only 3 herbs, 1 shrub and 6 climber species were recorded from the fire affected plot. In addition, all these species showed sparse distribution and low density.

A comparison of relatively undisturbed forests and forests near the settlements indicated that although the density of trees was higher near the tribal settlement, basal area was generally same in both the areas **(Table 15).** This suggests that the number of trees of higher girth classes is less near the tribal settlements, as also indicated in the girth class distribution patterns **(Table 16).** Less number of larger trees is an indication of intensive cutting of poles and small trees in the recent past.

Number of damaged trees, mainly in the form of poles and branch cuttings was 165 individuals ha^{-1} while those of dead trees, mainly damaged by the people, was 35 individuals ha^{-1}. 70 stumps per ha^{-1} and most of them <60 cm gbh were recorded. In addition, occurrence of *Clerodendrum infortunatum*, *Ziziphus* sps. and *Bombax ceiba*

Table 15. Basic statistics of tree community in the MDF (SiteII)

Parameters	Plots		
	1	2	3
No. of species recorded in mature phase	19	14	19
No. of species recorded in tree seedling phase	11	14	15
No. of individuals of trees per ha^{-1} (girth ≥10.1cm)	404	420	380
No. of individuals of tree seedlings per ha^{-1}	3760	3440	4880
Basal area (m2 ha^{-1}) of trees	36.37	33.40	34.05

Table 16 Girth class distribution of tree community in MDF (Site II)

Girth classes*	Plot		
	1	2	3
A	92	20	84
B	144	100	100
C	60	128	56
D	44	108	52
E	8	12	36
F	32	32	32
G	4	8	12
H	12	8	4
I	4	0	0
J	4	4	4

*, A: 10.1-30.0, B: 30.1- 60.0, C: 60.1-90.0, D: 90.1-120.0, E: 120.1-150.0, F:150.1-180.0, G:180.1-210.0, H:210.1-240.0, I:240.1-270.0 and J:>270.1 cm gbh.

near the tribal settlements suggests that forest was still experiencing other types of perturbations. They included formation of large canopy gaps by damaging large trees by the local people for subsequent collection of biomass and firewood, infrequent fire and increase in the number of footpaths crisscrossing the forest. Even in the relatively undisturbed forest 18 stumps ha^{-1} and eight damaged trees ha^{-1} were recorded.

Density of tree seedlings was more in forests near the tribal settlement than in the relatively undisturbed forest plots. Dominance of species such as *Ziziphus sps. and Clerodendrum infortunatum* in the seedling community in forest near tribal settlements also confirms that these plots are being disturbed by the people even now. In the forests near the tribal settlement, *Ammomum* sp., *Cuculigo orchioides* and grasses were dominant in the herb community **(Appendix 24)**. *Helictres isora, Strobilanthus sp.* and *Strobilanthus decurrens* were dominant in shrub community **(Appendix 25).** Climbers such as *Acacia torta, Anamirta cocculus, Acacia intsia, Moullava spicata, Calycopteris floribunda* and *Jasminum* spp. were frequent **(Appendix 26)**. Many trees were overloaded with *Acacia torta, Acacia intsia and Calycopteris floribunda* resulting in damage to the trees.

3.1.4. Leaf Area Index

It may be pointed out that the LAI values **(Table 17)** here include only the leaf area index of the canopy trees, and not the seedlings planted or already existing at the site.

LAI values ranged between 0.81 and 3.5 for the entire area (**Fig. 3)**. Glancing through the corresponding plot numbers indicate that the LAI is distributed more or less randomly within the site. This can mean that the disturbance to the forest is uniform from all the surrounding areas.

Table 17 . LAI measurements along with the standard error (S.E.), (Site I)

Qud.No.	LAI	S.E.	Qud.No.	LAI	S.E.
7	3.17	0.15	227	1.94	0.14
21	3.19	0.15	242	1.88	0.2
24	3.19	0.15	251	1.85	0.21
38	3.5	0.15	254	1.85	0.22
55	0.81	0.07	267	1.8	0.13
69	0.85	0.13	281	2.12	0.21
72	0.81	0.13	283	2.06	0.15
86	0.91	0.14	284	3.12	0.29
98	0.93	0.07	286	2.06	0.29
106	1.8	0.24	289	2.06	0.3
113	1.01	0.31	312	2.13	0.21
116	1.04	0.26	333	2.14	0.16
121	1.77	0.23	346	2.16	0.16
124	1.76	0.31	413	2.58	0.06
131	1.16	0.26	426	2.78	0.08
139	1.73	0.01	437	2.73	0.06
146	1.27	0.03	483	2.17	0.21
161	1.34	0.13	498	2.22	0.48
164	1.39	0.15	507	2.23	0.4
171	3.1	0.14	519	2.81	0.18
172	1.6	0.15	534	2.96	0.23
179	1.52	0.14	543	2.98	0.23
187	1.58	0.04	583	2.31	0.09
194	2.06	0.13	596	2.4	0.16
209	2.03	0.14	606	2.56	0.2
212	2.01	0.17			

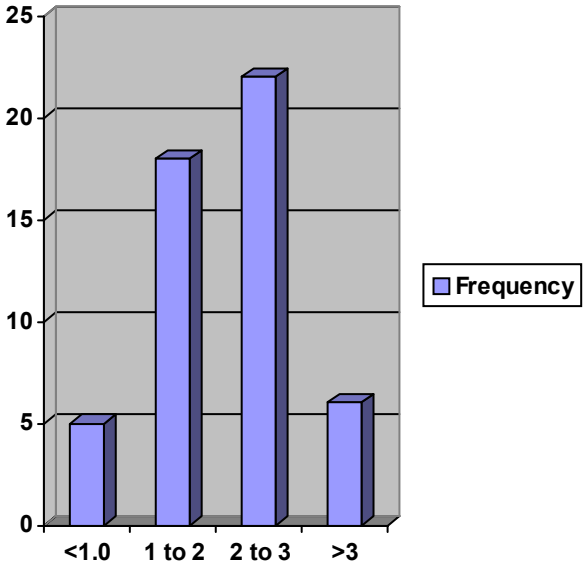


Fig. 3. Frequency of LAI ranges in the

Site II : The LAI measurements at this site was restricted to the sample plots selected for the vegetation analysis.

The LAI at site II ranged from 1.74 to 3.50 **(Table 18**). The different types of forests chosen as sample plots showed a range of degradation. The values of LAI are good indicators for quantifying the degradation.

Table 18. LAI measurements in the sample plots (site II)

Plot	LAI	S.E.
Evergreen (6)	1.74	0.23
Tribal settlement plot (1)	1.99	0.22
Moist deciduous (2)	2.00	0.11
Tribal settlement plot (2)	2.21	0.04
Fire affected area (1)	2.29	0.28
Tribal settlement plot (3)	2.31	0.10
Evergreen (2)	2.36	0.19
Evergreen (1)	2.37	0.16
Evergreen (4)	2.60	0.16
Moist deciduous (1)	2.63	0.18
Moist deciduous undergrowth (2)	2.74	0.10
Semievergreen (1)	2.77	0.32
Semievergreen (2)	2.80	0.38
Fire affected area (2)	2.85	0.11
Evergreen (5)	3.00	0.15
Moist deciduous undergrowth (1)	3.23	0.10
Evergreen (3)	3.50	0.13

Plot numbers are shown in parenthesis.

4.2. Faunal Diversity

4.2.1. Birds, mammals and invertebrates

4.2.1.1. Site I

Thirty-eight species of birds were observed with a total tally of 161 birds from 30 ha area. Most of the birds were residents with a preference to moist deciduous forest. The highest number of birds sighted during the observation is jungle babbler followed by black drongo and red-vented bulbul **(Appendix 27)**. The occurrence of the migratory Eurasian golden oriole was noteworthy. Some of the rare birds are blue-faced malkoha and white rumped shama. The list of birds observed in this location are given in **Appendix 28 (- repetition of birds list of Site II, Site I list missing).** The presence of diurnal mammals is limited to the three-striped palm squirrel (*Funambulus palmarum*) which is seen throughout the area.

Responses of Populations of Selected Species: It has been observed that there exists no relationship between the earthworm / quadrates and Bamboo basal area per quadrat **(Fig.4, 5) .**

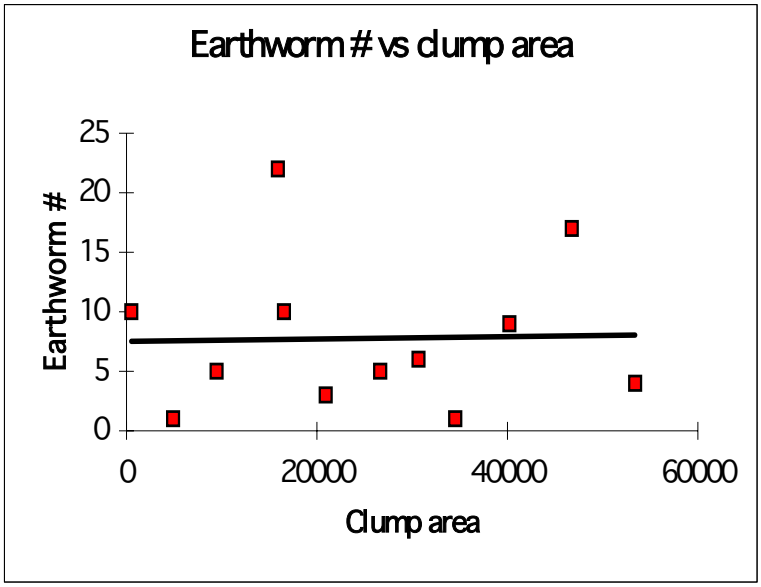


Fig. 4 – Relationship between the area occupied by the bamboo clumps and the number of earthworms

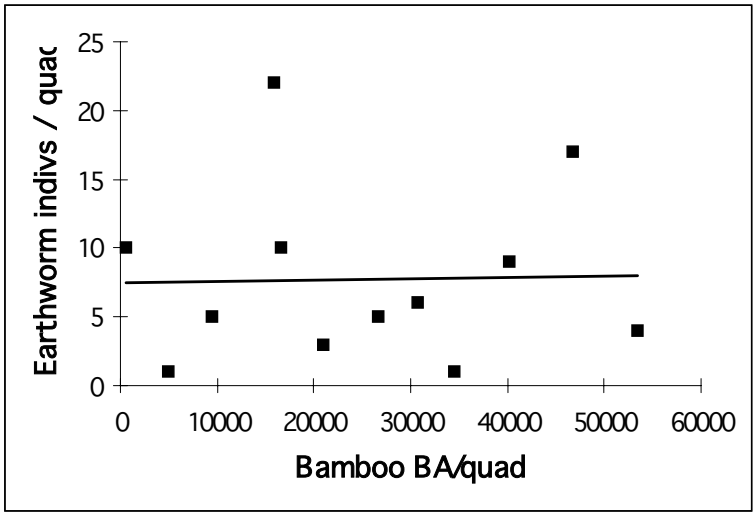


Fig .5. The relationship between bamboo basal area per quadrat and the number of earthworms per quadrat.

4.2.1.2. Site II

Bird population here was fairly rich with 75 species of birds identified, including migratory species, of which ten species were wetland birds **(Appendix 29).** Birds found breeding in the area included Black naped monarch flycatcher, yellow browed bulbul; black headed babbler and bronze drongo. Nests of black naped monarch flycatcher and black-headed babbler. The main diurnal mammals sighted here include the following: Indian elephant (*Elephas maximus*), Three striped palm squirrel (*Funambulus palmarum*), Malabar giant squirrel (*Ratufa indica maxima*), and the Bonnet macaque (*Macaca radiata*). Sambar deer (*Cervus unicolor*), Indian bison/gaur (*Bos gaurus*) and

the Nilgiri langur (*Trachypithecus johnii*) were recorded through indirect evidences by way of dun / hoof mark / call.

4.2.2. Insect community

Altogether, 409 species of insects have been recorded from both the locations of which 135 species are from the degraded forest at site I, 104 species from the agro ecosystem and 165 species from the forest ecosystem at site II and 144 species from the agro eco system. At Vellimuttam 7 orders were represented in the forest ecosystem and 10 in the agro ecosystem. In case of Vaniyampuzha, 11 orders were represented.

4.2.2.1. Species richness index

The richness index was found to be highest in the forest ecosystems: site I had a richness index of 3.799 and Site II 7.242. The agro-ecosystems had comparatively low indices of species richness: 2.810 at site I and 4.386 at Site II.

4.2.2.2. Dominance index

Coleoptera followed by Lepidoptera was the most dominant order in natural forest patches and the agro-ecosystem at both sites **(Table 19).** This was followed by Hemiptera. The dominance of these insect orders was due to the abundance of herbivorous feeding forms present in these groups. Most other groups had only moderate representation.

Table 19. Relative dominance of insect groups

Insect groups	Site I		Site II	
	Degraded forest	Agro-ecosystem	Degraded forest	Agro-ecosystem
Coleoptera	41.48	39.42	35.15	31.94
Lepidoptera	29.63	21.15	32.73	36.81
Hemiptera	12.59	15.38	10.91	11.81
Hymenoptera	7.41	3.85	4.24	3.47
Diptera	5.19	4.81	3.64	3.47
Orthoptera	2.96	5.77	3.64	6.25
Trichoptera	0.74	3.85	4.24	3.47
Dermaptera	0.00	0.96	0.00	0.69
Dictyoptera	0.00	0.96	0.61	0.69
Ephemeroptera	0.00	0.00	1.21	0.69
Neuroptera	0.00	3.85	2.42	0.00
Odonata	0.00	0.00	0.61	0.69
Unidentified	0.00	0.00	0.61	0.00

4.2.2.3. Species diversity

Shannon's diversity and evenness for different sites have been tabulated in **Table 20**. There was marked difference in the diversity of insects in different areas. The Shannon's index was highest for site II with 4.863 for the forest and 3.796 for the agroecosystem. At site I, the values were 3.299 for the forest and 2.867 for the agro ecosystem. The higher values obtained for site II was due to the less degraded vegetation present in this area compared to site I. Similarly, the agro ecosystem at site II had more ground vegetation, which is reflected in the higher diversity values obtained for this location.

With regard to evenness, forest ecosystem at site II had the highest value indicating a more uniform distribution of faunal elements. This shows that the disturbance to forest in this area was not so great, as to adversely affect the faunal diversity, as compared to site I. With regard to the agro ecosystem also, site II has higher values, which is attributed to the proximity to less disturbed forest and also due to the profuse ground vegetation present in this site.

Table 20. Species diversity

Diversity indices	Site I		Site II	
	Degraded Forest	Agro-ecosystem	Degraded Forest	Agro-ecosystem
Shannon's diversity index	3.2988	2.8673	4.8637	3.7961
Shannon's Evenness	0.6725	0.6174	0.9526	0.7638

The t-test carried out for Shannon's diversity to find whether there existed any significant difference among the different study areas showed that there existed highly significant difference between all the study sites.

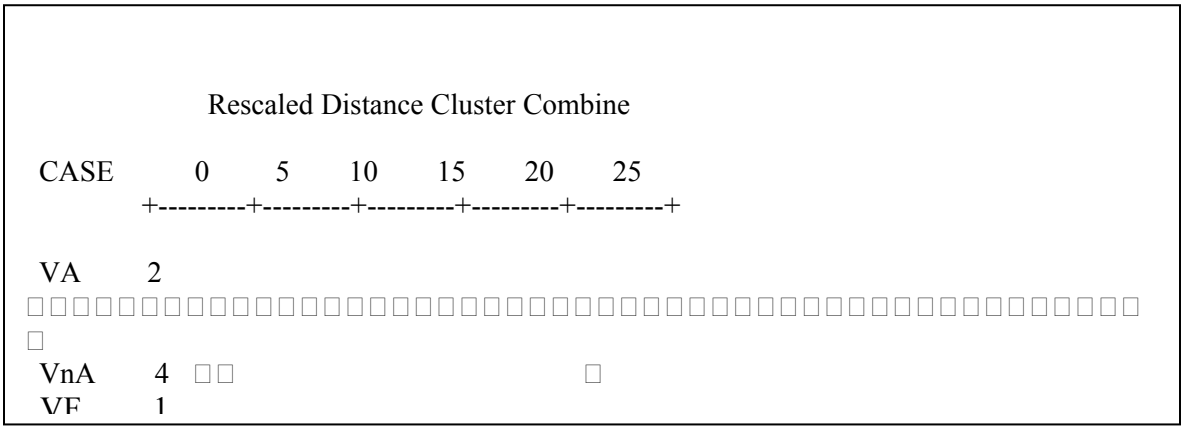
Table 21. Similarity values

Location	Site I	Site I (agro-ecosystem)	Site II
Site I (agro)	.0127		
Site II	.1407	.1070	
Site II (agro)	.0772	.1754	.0919

4.2.2.4. Similarity measures and cluster analysis

Jaccard's similarity index based on presence or absence data of species for different pairs of study areas have been tabulated in **Table 21**. The agro ecosystems at site I and site II having a similarity index of 0.1754 were the most similar followed by the forest patches at these locations having an index of 0.1407. The forest and agro ecosystems at site I were the least similar.

Fig. 6. Dendrogram showing similarity of different insect assemblages at site I & Site II



VA – Vellimuttam agro ecosystem, VnA - Vaniyampuzha agro ecosystem, VF -Vellimuttam forest patch, VnF - Vaniyampuzha forest patch

The dendrogram **(Fig.6)** obtained from the cluster analysis based on the distance measure as Jaccards similarity coefficient revealed that forests at site I and site II formed a cluster indicating that the insect assemblages in the forest patches at these locations had more or less similar species composition. Similarly, the agro ecosystems at both sites formed another cluster having close affinity.

4.2.2.5. Insect herbivory

Brisk insect activity was observed immediately after the rains as new flushes of foliage appeared. Leaf feeding by caterpillars and beetles was the common type of damage. Data gathered on insects recorded from various host plants are summarized in **Appendix 30**. Incidence of insect pests was found to affect the establishment of some of the plants introduced in the study area. This included the termites, which fed on the roots of *Artocarpus heterophyllus* and *Terminalia bellerica* causing seedling mortality; various caterpillars and beetles feeding on the foliage of *Cassia fistula, Dalbergia latifolia, Wrightia tinctoria* and *Cinnamomum zeylanicum*.

The vegetation and faunal diversity analysis in this project has revealed that Site I is highly degraded and this is mainly due to anthropogenic interventions. Altogether, 409 species of insects have been recorded from both the locations, of which 135 species were from the degraded forest at site I, and 165 species from site II. While 104 species were recorded from homesteads at site I, 144 species were recorded from site II. The latter also had the highest representation of insect groups. The faunal diversity was also highest at site II due to the presence of a comparatively less disturbed forest in the area. The values were 4.863 for the forest and 3.796 for the agro ecosystem. In the case of site II, the values were 3.299 for the forest and 2.867 for the agro ecosystem. The reduction in species diversity in the agro ecosystem is attributed to the typical farming practices followed in the area where only selected agricultural / vegetable crops were grown depending on the season. Similarly, application of pesticides and chemical fertilizers in the farms also might have led to a decline in the species richness in this ecosystem. Results of cluster analysis have revealed that the forest patches of the two areas were similar and formed a cluster, and the agro-ecosystem at the two areas formed another cluster.

The faunal elements at the two sites showed specializations and included several rare and endemic species. Insects recorded on various plant species in the forest habitats included several species that have been already reported as serious pests of various agricultural and forest plants. This included the lemon butterfly *Papilio demoleus* (attacking citrus and curry leaf); the castor butterfly *Ergolis ariadne*, the castor hairy caterpillar *Pericallia ricini* (attacking castor); the common crow butterfly *Euploea core* (attacking Ficus, cherry); the grass yellow *Eurema hecabe* (attacking cow pea and albizia), the paddy butterfly *Melanitis leda* (attacking paddy); *Achaea janata*, *Mocis frugalis*, *Spodoptera mauritia*, *Euproctis fraterna Sylepta derogata*, *Aulocophora unicolor* (attacking vegetables*); Psara bipunctalis, P. basalis* (attacking pulses)*;* the palm butterfly *Elymnias caudata,* the skipper *Gangara thyrsis* and the palm borer *Oryctes rhinocerus* (attacking palms) as well as *Atteva fabriciella* and *Eligma narcisus* (attacking Ailanthus). In addition to the above, various insects have been recorded from fallen logs and litter. In

the agro-ecosystem no major pest incidence was noticed during the study period since all crops were well protected by timely pesticide schedules. Several groups of insects collected in the study could not be fully identified. Of the fifty-nine species of butterflies identified, two species were having protected status under the Indian Wildlife Act (GOI, 1982) and many species were either endemic or rare **(Appendix 41).**

The people in site I fear a probable threat by way of wild boar (*Sus scrofa*) which are sheltered in the thickets of the forest area, and they can be a potential threat to their crops in the homestead. Another threat the people foresee in a regenerated forest block is the probability of arrival of Bonnet macaque (*Macaca radiata*) which can be a menace to the homesteads and to some extend have a pest status. So far, there has not been any sighting of wild boar and of bonnet macaque in the area. It is a possible threat, which they are quite aware of due to the greater awareness from the media about these two animals, which can attain a pest status. Both these animals have attained pest status in certain parts of Kerala requiring action to mitigate the same.

In such a location it is important to give more environmental education to the people and drive the point of sustainable management for the survival of the forests. The man-wildlife conflict and the provision of income through labour approach should be treated as most important. At site II, since the linkages between forest and people are stronger than at Site I, it may be necessary to follow a very different approach in preventing degradation and effect sustainable management.

4.3. Socioeconomics

4.3.1. The socioeconomic profile

4.3.1.1.The people

The socioeconomic details of the primary stakeholders are given in **Appendix 31**. In site I and II the average size of a household is 4.9 and 5 respectively, as against the State average of 5.3 persons. The density of population in site I reflect an overcrowding with 1022 persons in a km^2, which is higher than the State average (749 persons per km^2), but there is variation at the micro-level. The sex ratio has a preponderance of females over males, which is in par with the State sex ratio attributable to good community health. An opposite picture is portrayed in site II, suggestive of poor health of the community. In site I, 42 per cent constitute the general category i.e. (Hindus and Christians), 53 per cent constitutes other backward classes (Muslims and Thiyyas), 4 per cent scheduled castes (Harijans and Pulayas), and the remaining 1 per cent scheduled tribes (Paniyans). The political structure is based on the Panchayathi Raj i.e., the system of local self governance, and among the Paniyans of site II leadership patterns mirror traditional social system where they have a village head, here called the tribal head (*Moopan*), who has a significant role in managing, regulating and resolving conflicts as well as matters of general development in their settlement. Of late, the role and importance of the tribal chieftain is gradually declining as a result of cultural and social changes.

The overall literacy of site I is 95.84 per cent, which reflects the quality of life. In site II, 44 per cent have no formal education. This is contributory to unemployment and low income that make them vulnerable to exploitation. Illiteracy is rampant among the older generation. One Anganwady and DPEP school is functioning within the settlement.

4.3.1.2.**Occupation**

A sector-wise analysis of the occupational pattern in both sites highlights a dominance of the primary sector (73 %) followed by the tertiary sector (26 %) and a meager 1 per cent in the secondary sector in site I , and in site II occupation pattern and work participation rates are very discouraging **(Appendix 31).** Majority of the total population is dependent on the primary sector for their livelihood, i.e. collection of Non Wood Forest Products, whereas, the secondary and tertiary sectors hardly figure.

Agricultural workers (labourers) constitute a large section of the rural population in site I. Wage employment forms the major source of income. Low agricultural activity is observed in the summer months of March-June when there is a dearth of water. On the whole the occupational scenario is not very discouraging. In site II, Non-Wood Forest Products (NWFPs) collection forms the major occupation of 44 per cent of the primary stakeholders. The tribals visit different forested landscape units to collect several plants belonging to herb, shrub and climber communities. Ethno botanical information such as common name, habitat, availability, etymology, uses, season of collection, marketing aspects etc. for about 68 species were collected from the respondents in the settlements **(Appendix 32).**

Here, two marketing channels have been identified **(Box 2).** The NWFP market is highly imperfect with intermediaries dominating the scene. The presence of intermediaries makes marketing a difficult process beset with problems. Maximum exploitation takes place in the unauthorised channel whose decisions are often governed by the existence of the authorised channel. The market anomaly is the imperfections, i.e., the presence of intermediaries who accost exorbitant margins in various market transactions.

Box 2: NWFPS marketing channels (site II)

Channel I (Authorised)

Primary stakeholder - Tribal Girijan Service Society (TSCS) - Federation (apex body of TSCSs) - First wholesaler - Second wholesaler - Retailers - Consumers.

Channel II (Unauthorised)

Primary stakeholder - Agents (private) - Wholesalers - Retailers - Consumers.

However, a noticeable factor is the negligible work participation of the women. Very few of them go out to seek alternate sources. In the plantation they get a wage of Rs.80 and outside work fetches them Rs.65/day. The most difficult months are the monsoon months when the river is in spate and mobility is relatively restricted. They then literally starve and live by whatever they get from the forest. Though dependence on forest for

subsistence still continues, the Forest Department offers them alternate employment opportunities in their plantations and various forestry operations. Almost 60 per cent of them get work in the nearby rubber plantation and other forestry operations like weeding, planting boundary work and fire line marking. But, all these are not sustained sources and hence the only source of income is from the collection of NWFPs.

4.3.1.3.Land use and operational holding

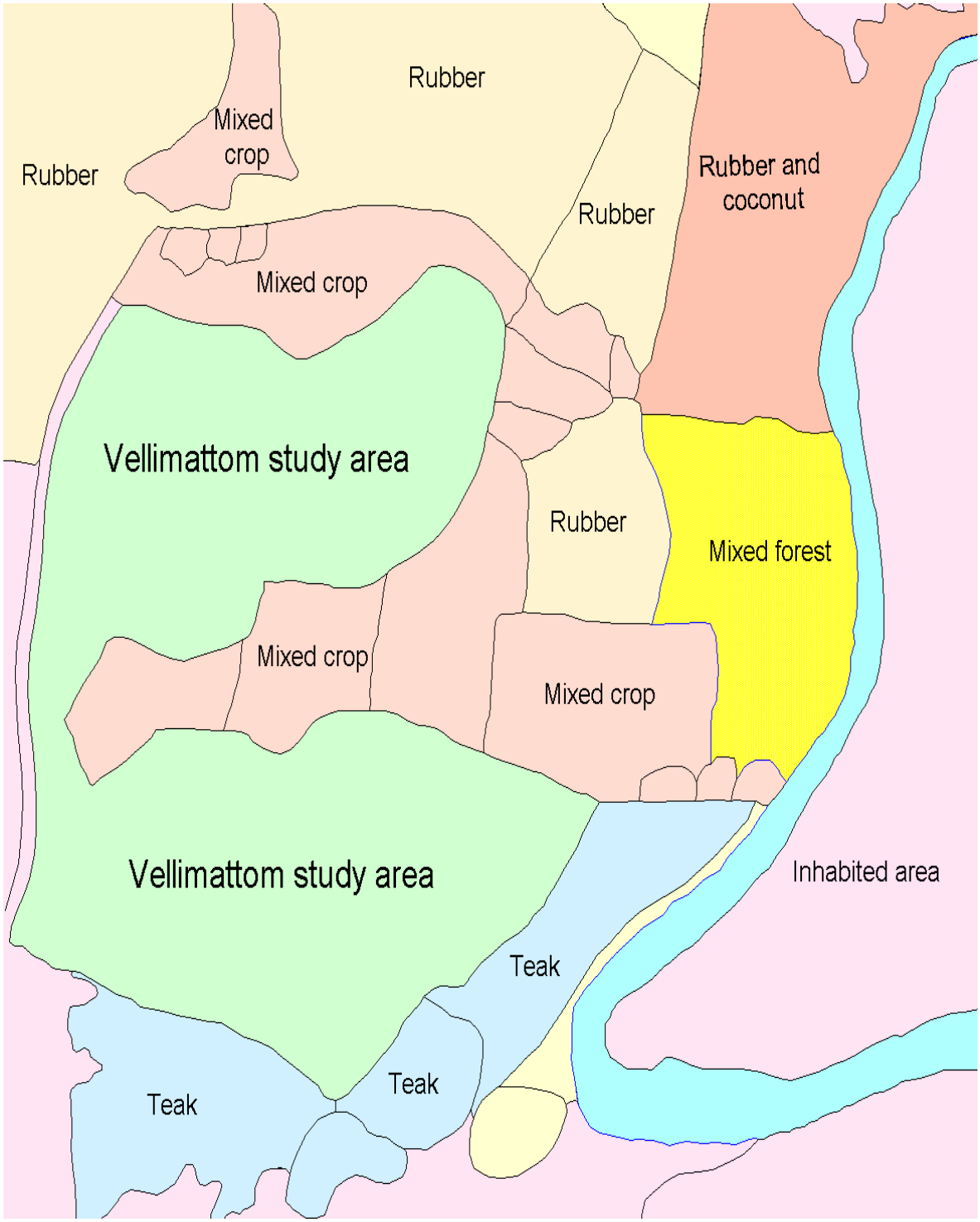
There is an interesting land holding scenario in site I. Majority of the stakeholders are marginal, small and medium holders while number of large holders is very low (12 %). Large land holding have been fragmented in the last ten to fifteen years. Over the years change in the land use pattern resulted in paddy being replaced by annuals and biennials, like rubber, areca nut, coconut and other homestead crops. The cropping pattern as seen now consists of mixed crops (79 %)(vegetables, banana, pepper, combinations of rubber, coconut, cashew, areca nut), rubber and paddy. The land use pattern (Map 5) reflects homestead mixed cultivation of tapioca, paddy, banana, coconut, rubber and teak plantation with the Chaliyar flowing on the right side. On account of the intervention of market forces the traditional crops which comprised of cereals such as ragi, millets etc. have given place to diversified agriculture with commercial crops claiming more weightage.

Investment in agriculture in site II is negligible. The original cropping system of the tribal has undergone conspicuous changes as a result of extraneous competing pressures as well as internal changes. Now, they practice low value agriculture in and around their settlements and indulge in low impact patterns and techniques of resource extraction, which coupled with tenurial insecurity has made existence difficult. In Vaniampuzha settlement approximately 2.4 ha area around the settlement has been used for cultivation and other purposes. *Colocasia antiquorom* (taro), *Anacardium occidentale* (cashew nut), *Artocarpus heterophyllus* (jack tree), *Carica papaya* (Pawpaw), *Areca catechu* (arecanut), *Cocos nucifera* (coconut), *Manihot utilissima* (cassava), *Musa paradisiaca*

(banana), *Mangifera indica* (mango), *Garcinia gummi-gutta* (*Kodappuli (in Malayalam*) and *Hevea braziliensis* (natural rubber) were the major crops recorded here. Most of the fruit yielding trees were yet to give their yields.

In Tharippapetty tribal settlement, about 2 ha area around the settlement was for cultivation and other purposes. *Colocasia antiquorom* (taro), *Anacardium occidentale* (cashew), *Artocarpus heterophyllus* (jack tree), *Carica papaya* (pawpaw), *Cocos nucifera* (coconut), *Manihot utilissima* (cassava), *Musa paradisiaca* (banana), *Mangifera indica* (mango), *Ipomoea batatus* (sweet potato), *Cajanus cajan* (bean variety), *Dioscorea* sps. (yam) and *Moringa oleifera* (drumstick) were the major crops recorded here. Since the people came to settle here in the recent past, most of the trees were still young.

Map 5: Land use based on aerial photo (1992)-Site I



In the third settlement Iruttukuthi, about 2.6 ha area around the settlement is under cultivation and used for other purposes. *Colocasia antiquorom* (taro), *Anacardium occidentale* (cashew nut), *Artocarpus heterophyllus* (jack tree), *Carica papaya* (pawpaw), *Cocos nucifera* (coconut), *Manihot utilissima* (cassava), *Musa paradisiaca* (banana), *Mangifera indica* (mango), *Ipomoea batatus* (sweet potato), *Cajanus cajan* (bean), *Dioscorea* sps. (yam), *Piper nigrum* (black pepper), *Capsicum annuum* (chilli), *Areca catechu* (arecanut), *Ananas comosus* (Pineapple) and *Moringa oleifera* (drumstick) were the major crops recorded here. Crop cultivation has become a regular practice for the people here only recently.

Livestock in site II is almost nil. Earlier they had a few catttle, but, mainly due to constant wildlife threat they were forced to sell them out. In site I primarily because of affordability, non-availability of fodder, debt problem, lack of people to rear cattle and lack of interest among the younger generations, 59 per cent of the local stakeholders do not possess cattle. In the past, the system of dairy farming and poultry rearing was an important avocation in site I with the active participation of the women. It has declined with increasing urbanisation and the present situation causing change in the attitude towards farming and also due to shift in cropping pattern (based on the PRA/RRA exercise). Due to continuous depletion of feed and fodder base as a result of a shift in the cropping pattern in favour of cash crops and further marginalisation of the operational holdings the feed and fodder base has become very weak. For instance, with the area under rice being low, the availability of straw from internal sources has declined drastically.

Among the primary stakeholders in site I, 65 per cent fall in the income group of 10,000-50,000 followed by 24 per cent in the 1000-10,000-income group. A negligible representation is seen in the income group < 1000 and > 2,00,000. Among them, 24 per cent fall in Low Income Group with an annual income < 10,000 who belong to the socially and economically weaker sections.

4.3.1.4. Infrastructure

Most of the roads were metalled in site I, thereby making accessibility easy to the modern amenities of life like, ration shop, provision store, market, banking, hospital, school etc. With regard to other infrastructural facilities, 85 per cent of the stakeholder houses are not electrified. The main water source is the Chaliyar river which also forms the southern borders of the site. However, due to inadequate rainfall they often face acute water shortages particularly in the summer months from March to June. Water drains of quickly due to the terrain and most of the watercourses dry up in the summer months. Of the local stakeholders 55 per cent have their own source of water, wells and they are basically the early settlers. The rest constitutes other sources such as the public wells, i.e., do not have access to safe potable water. Majority of the stakeholders, i.e., 61 per cent avail of allopathic treatment. This is mainly due to the easy availability, accessibility and quick recovery from diseases.

Most of the primary stakeholders in site I live in concrete/tiled houses with adequate plinth area. Most houses are either medium or small with thatched or tiled roofs. Toilet facilities are almost absent. Approximately 55 per cent of the stakeholders do not possess toilet in their house and hence there is moderate dependence on the forest for the same. This can subsequently lead to health hazards.

Inaccessibility is the major detrimental factor in site II. There is no electricity connection to the settlement, but for a couple of solar lamps. With very little plinth area they live in a minimum of 1-2 rooms with absolutely no ventilation. Some of them still live in single-roomed thatched (grasses) huts supported by bamboo frame. Some walls are made up of bamboo while some are with mud. The houses are not strong and are just make to do, while some are concrete with no proper toilet facilities. Living within the forest, until lately, they were leading a nomadic life. The region woefully lags behind in the development of medical facilities- health details. Morbidity rate among them was found to be 71 per cent, which is so high compared to the State level average morbidity rate of 20.63 per cent **(Appendix 31)**. Here, 69 per cent were diagnosed as suffering from various ailments of which 38 per cent were males and 62 per cent were females. Common health problems noted among them are diarrhoea, headache, fever, intestinal colic, anemia due to malnutrition and various other infections **(Appendix 33).** The health and hygiene among them leaves much to be desired.

Unlike in the past there were very few tribal physicians or elderly people with knowledge of the tribal and traditional remedies. The basic factors responsible for the poor health condition in site I as revealed by the PRA exercise are poor sanitation and hygienic practices, lack of clean clothing, timely medication, financial stringency, addiction to chewing tobacco and alcohol, irregular and untimely food habits etc **(plate- snap of the settlement with tribal children)** . Lack of potable water is an added reason for the poor health condition. There was total reliance in the traditional mode of treatment using herbs from the forest. The older generation are of the opinion that the incidence of diseases has increased in the recent years. Ignorance of the disease in the past and prevalence of superstition are factors to be borne in mind while taking this into account. Increase in population is also a factor contributing to the worsening of hygiene.

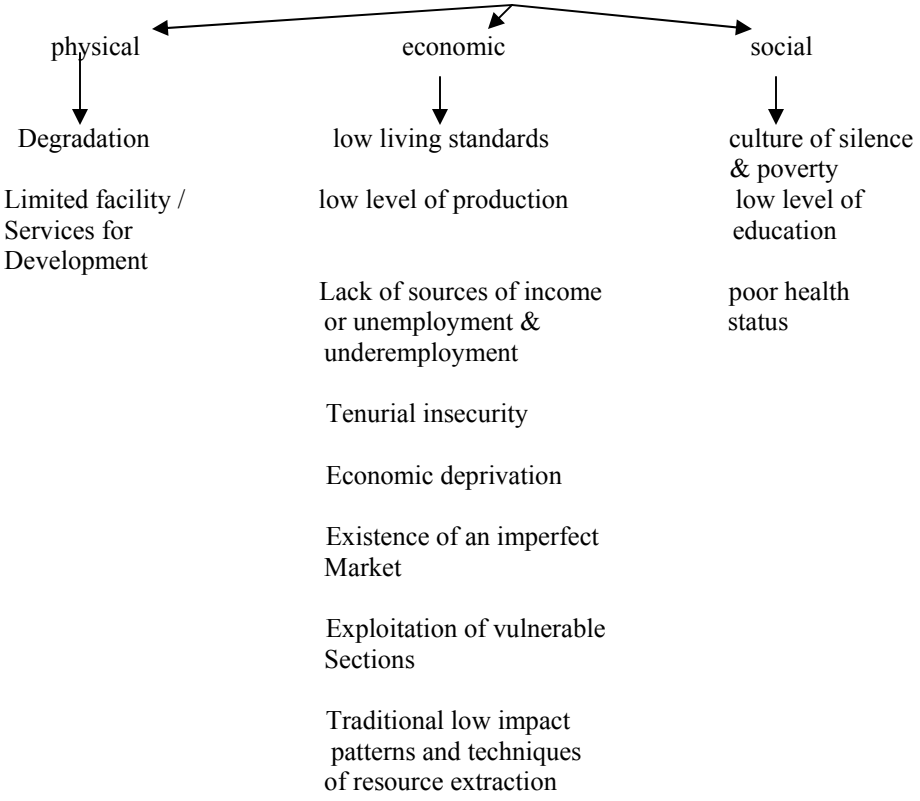
4.3.1.5. Human Resource Development

High literacy level coupled with awareness of present day farming techniques, market situations and government assistance, the primary stakeholders in site I are in a better position to harvest sufficient returns from their land. Due to lack of proper irrigation facilities agricultural yields are largely dependent on rains and productivity is low. However, sex ratio, an important indicator of women's status, provides a very positive picture.

Owing to low levels of education, majority of the population in site II are dependent on the forest for their sustenance. On the other hand, inaccessibility and backwardness of the region and the low buying capacity thwarts them from venturing out in search of alternate sources. Consequently earning capacity is extremely low, does not fulfil family requirements. People, here, therefore live in abject poverty and deprivation **(Box 3).** Areas that are covered by formal credit facilities also have a huge number of defaulters. All this results in a severe dependence on informal moneylenders for buying essentials from the market, who easily cheat the vulnerable section. However, sex ratio, an important indicator of women's status, provides a very depressing picture. In brief, they

Box 3: Poverty Analysis (site II)

The framework



are trapped in vicious circle of poverty needing urgent intervention.

4.3.1.6. Social problems

The PRA / RRA conducted highlighted the existing social issues / problems in both sites. The social analysis of site I has highlighted a highly tense political atmosphere, whereas in site II a number of problems like, large family, alcoholism, poverty, illiteracy, decreasing availability of forest produce, poor health, among others were identified. All these have led to poor quality of life. A problem tree analysis **(Appendix 34)** in site II has listed out poverty and social deprivation among others to be causatives for their miserable state of affairs. Lack of expertise in non-forest based activities, erosion of

traditional knowledge, limited options outside forests, all these together force them to indulge in anti-social activities. Alcoholism is one of the major social problems here. Alcohol consumption is extremely high during the off-season, (i.e. the rainy season) during which period they experience an economic breakdown **(Appendix 35)**. The cause-effect analysis of alcoholism has categorised the causes as familial, economic, cultural, psychological and social **(Appendix 36)**. Though, efforts are made to improve their economic conditions, they still to a large extent prefer their traditional unfettered free life.

4.3.1.7. Intensity of forest dependence

The degree of dependence on forest depends upon several factors. These factors include their socioeconomic status, living conditions, cultural and religious norms, literacy level etc. Considering the dependence parameters for both the sites, varying degrees of dependencies were observed **(Box 4).** Site I on the whole depicts low level of dependence while site II clearly indicates high dependence on forest for their livelihood.

Box 4: Intensity of dependence on forests

Dependence parameters	Landscape I	Landscape II
1. For survival	Nil	* * *
2. Food	Nil	* *
3. Potable water a. Forest streams	Nil	* * *
4. Income a. Forest employment (watchers) b. NWFP sale	* * Nil	* * * * * *
5. Materials a. Firewood b.Construction material c. Fodder	* * * * * * *	* * * * * * * Nil
6. Facilities a Open toilet	* *	* * * *
7. Medicine	Nil	* *
8. Cultural / religious / Cemetery	Nil	* * * *

Degree of dependence -Nil = no dependence; * = 25%

Fuel utilisation is an important indicator of people's dependence on forest. 60 per cent of the primary stakeholders in site I depend exclusively on forest for meeting their fuel wood requirements. Among them 90 per cent dependence is by the disadvantaged group followed by 80 per cent of the tribal community. The least dependent are the farmers (32 %) and this is because their fuel needs are largely met from their own land and other sources like kerosene and LPG. Of the 21 per cent not depending on the forest, the farmers group constitutes the highest percentage (43 %) for reasons stated above. Among partial dependence the others group constitute 34 per cent indicating their access to other sources of fuel. Firewood is the only of fuel for which primary stakeholders in site II depend on the forest entirely. There is an interesting 81 per cent dependence (site I) on forests for Non Wood Forest Products **(Table 22)**. Bamboo is mainly utilised for construction purposes. NWFP collection forms the dominant source of income for the Paniyans (site II) and their dependence on the forest for the same is absolute. Of the listed 120 items by the FD the society collects only 20-30 products yearly. Small part of the collected produce is retained by them for their own needs while the rest is given either to the society or sold to private traders. The seasonality **(Appendix 37)** of the different products collected **(Appendix 38)** does not ensure them a regular income year round. Above all is the fact of declining resources. The cause-effect analysis of NTFP resources **(Appendix 39)** has highlighted

unemployment (seasonality factor) and increased dependence on outside employment as the main effects of declining resources.

Table 22. NWFPs dependence pf primary stakeholders (site II)

Primary stakeholders	V1	V2	V3	V4	V5
Farmers	1 (1.22)	23 (28.05)	17 (20.73)	30 (36.59)	11 (13.41)
Labourers	1 (0.51)	87 (44.39)	35 (17.86)	33 (16.84)	40 (20.41)
Tribals	0	1 (20.00)	0	0	4 (80.00)
Disadvantaged	1 (3.45)	11 (52.38)	1 (4.76)	4 (19.05)	4 (19.05)
Others	4 (1.20)	16 (55.17)	1 (3.45)	6 (20.69)	5 (17.24)
TOTAL		138 (41.44)	54 (16.22)	73 (21.92)	64 (19.22)

Figures in parenthesis represent percentages
Codes: V1 medicinal plants, V2 bamboo, V3 green manure, V4 fodder, V5 no collection

Living within the forest the primary stakeholders of landscape naturally retain their traditional means of living by the forest. Further, due to lack of tenurial security they cannot produce their own food. Inaccessibility is another factor that forces them to look for edibles within their surroundings though, once in a while they come to the nearest township to purchase a few basics like tea, sugar, coffee, rice etc. Thus, there is high dependence on forest for food. Dependence on forest for household crafts is almost complete. But, for a few concrete houses, the remaining resides in small hut like structures, which is suggestive of their primitive style of living. None of them possess ration cards. There is partial dependence on forest for medication, because modern facilities of medical science are not easily accessible to them. There is an erosion of traditional local knowledge in relation to medicinal plants in the forest among the present generations.

An analysis of the current indices of development such as size of holding, income, employment, health, housing and their dependence on forest reveals that the present socioeconomic conditions in site II are still depressing. The economic standards and living conditions are still backward. This can be attributed to two factors, one the development schemes are not implemented in earnest and monitored throughout due to inadequate communication facilities and inaccessibility. The traditional outlook and negative attitude of the tribes to development and absence of employment in avenues in the secondary and tertiary sectors are the other major stumbling blocks, which keep them in a backward state.

Site I- The socioeconomic attributes of site I are very much similar to any other area in the Sate with a heterogeneous community feature and a purely agrarian economy. Forest degradation is defined in terms of density of trees. Ecologically it is a bamboo forest managed for bamboo production for a pulp mill. KFD perceived the need for rehabilitation as an action oriented Programme (KFRI, KFD and the AusAID). Great publicity was given to this venture and the local people responded with enthusiasm. When the local people realized that under forestry activities two programmes cannot go

hand in hand, their initial enthusiasm waned and they responded with indifference or hostility. They even protested with by setting fire to some regenerated patches. Three successive meetings to form local committee were thwarted by vociferous protests. The underlying social and political conflicts in the community fostered suspicion of each others motives. Participatory Forest Management (PFM) is almost impossible under such tense situation.

Site II - The socioeconomic attributes here are very significant, highly specific and relevant for management and development of forest resources through the PFM initiatives. A small homogeneous nature of the population is essential for the initiation of PFM for natural resource management. Forest degradation was most glaring in the quality of life of the tribal people within the forest. Rehabilitation was needed for the human component of the landscape and ensuring sustainable livelihood. The strategy of rehabilitation was to entrust and empower the tribal community to manage its own NWFP resources. This required some policy changes as a State level Federation under the Ministry of Co-operation that enjoyed rights over all NWFPs in the Kerala Forests and they naturally resisted change. The PFM institution has now started functioning in a modest way beginning with control over collection and marketing of NWFP, which is a very positive change. The high dependence of the tribals on the forests for their livelihood and survival show that they are the true stakeholders. This may yet be one of the classic cases of forest rehabilitation begun from the human component in the landscape. That empowers them to manage the resources in a sustainable manner.

5. DISCUSSION

5.1. Landscape ecology and participatory forest management – Interactions

Two landscapes were selected for the study (1) Vellimuttom and (2) Vaniampuzha, both in the Nilambur range of the Nilambur North Forest Division. Both the sites are close to each other, the distance between them is around 15 km. The landscape approach adopted in this project enables one to see the differences in the landscape elements, their interactions, their dynamics, differences in landscape chronology, and health of the ecosystem and the socio economic status of the people within the landscape.

Basically the differences in both the landscapes stem from the biotic interactions that have taken place during the last century. Although the altitude, original vegetation and microclimate are very similar, the history of human interactions has made the two landscapes so very different in all aspects. In landscape analysis very often it is the human element that is the most dynamic agent and the change driver. Human interactions cause landscape changes quite rapidly and often dramatically. Therefore studying the human element is an important subject in landscape analysis.

Forests which are under public management and which have been constituted as reserves for environmental services to society and for the conservation of the biodiversity require to be monitored for the land and water quality and for conformity to sustainable management. The environmental status of the landscape needs to be assessed. The changes that happen now and potential changes can be understood and managed only when the human interactions are studied. Changes in any landscape are inevitable. Changes due to climatic factors are slow and beyond the control of local managers. However, changes due to management decisions and human interactions are quicker and there is a need to manage such changes in a way that do not compromise the long-term sustainability of the resource base and the options available.

At the conceptual level different elements such as landscape analysis, rehabilitation of forest and participatory forest management were all new areas of enquiry for the KFRI team. For the Forest Department, rehabilitation of forest was familiar. To them it involved making an assessment of the number and species of tree seedlings that can be planted on the site. A nursery of the required seedlings has to be made close to the site and the seedlings have to be planted out just when the South-West monsoon starts. It is a simple and routine operation for them. Landscape analysis is more sophisticated method to look into the nature and interactions of different landscape components that include geographic features, water availability, soil parameters, vegetation, land use, fauna, human interactions, institutional arrangements etc. A key requirement is the preparation of GIS maps showing the different elements, their status, their quality, their vulnerability, their value and their potential. When field level information is presented in the form of a series of landscape level maps, the quality of landscape level planning, monitoring and management can become more efficient and scientific. Analysing the value, potential and quality of resources in the landscape and their current status can lead to measures to improve the resource for conservation, production or for environmental priorities that

may be relevant at a particular time. Degradation of resource or the vulnerability to degradation can be mapped and monitored, focusing on the margins so that remedial or ameliorative measures can be taken in time.

Man is the most important element of the landscape, particularly in his ability to modify the landscape on a scale and a pace no other agent can. Human interactions on the landscape are therefore the most important feature of a landscape analysis. Land use status and changes, environmental quality, conservation status etc. can be assessed to verify whether the current situation is optimal. If the status of the some component is sub-optimal, then the reasons for such can be enquired into and appropriate measures taken to improve the situation.

Participatory Forest Management is one of the options to harmonise the interactions of different landscape components in such a way that the local community becomes aware of the issues involved and empowered to make rational decisions to optimise the resource status and ensure that the benefits are equitably shared among the community, between the local community and the larger society and also across generations. Ideally it is a learning experience, an awareness creation enterprise, a capacity building exercise and an institution-building programme.

The theoretical framework of landscape analysis helps to understand and monitor the changes for bringing about sustainable management. The prime focus of landscape analysis is the interactions between the different landscape elements. The nature of the impacts during the interactions, their contribution to changes in land, vegetation and water quality are to be assessed. The human element is not a homogenous component. There is a lot of diversity within the human element. To understand the diversity a social assessment is carried out in which the different stakeholders are identified, a socio economic survey of the people in the locality carried out and a study of the needs, attitudes and aspirations of the people are fundamental. Naturally the needs of the different stakeholders vary, so do their resource endowments. A wealth and power ranking exercise is often done to understand the groups that dominate and the groups that are dominated. As the aspirations and opportunities available to different social and economic groups are different their nature of actions and motivations are different.

Preliminary to the understanding of the interactions and interrelations of the different stakeholder groups between themselves and with the natural resources a study of the land use in the area, the settlement pattern, the population pressure, the socio-economic status of the households, their source of livelihood, dependence on forests, etc. are to be assessed. This will serve as a baseline reference or a bench mark so that the changes that happen over time can be linked to the changes that take place in relation to an ongoing program or due to external factors.

Ausaid conceived of this project as a capacity building programme for the researchers and foresters in landscape analysis. Australia has made advances in landscape level planning using advanced GIS tools and also in community participation in land use decision-making through formalised negotiation among stakeholders. India is far behind

in such institutional negotiations and agreements. The training package as originally conceived was to familiarise their formal community participation processes in forest management and also to introduce landscape analysis concepts to the participants. KFRI requested Ausaid to modify the training programme in such a way that the senior scientists and senior foresters are not made to sit through lectures on introduction to participatory forest management. Rather, KFRI wanted the selected scientists to be exposed to the latest developments in their own particular field at the institutions in Australia. This thinking had its own merits and dividends. A researcher in GIS got the opportunity to visit the best GIS facilities in Australia and familiarise himself with the latest mapping technology being used there. The trainees were split up into the different groups and programmes, discarding its initial integrity. Towards the end of the training, all the groups came together to design a participatory field project to be implemented in Nilambur.

The Vellimuttom site is a small island of 42 ha forest. It is a small hillock. In the valley in between and all around, migrant farmers have settled down during the last 50 years and they are doing fairly intense agriculture. The population is continuous in all directions. Unlike in usual forest settlements, where small populations reside within a large forest, here a small pocket of forest has survived. Forestry operations for selection felling of valuable timber and bamboo carried out by the forest department have not been followed by any regeneration efforts till the site specific plan under the World Bank aided Rehabilitation of Degraded Forests program. The people residing on the periphery have also contributed to the degradation of site through their activities such as firewood and green manure collection. All the local stakeholders in the area have migrated to Vellimattom during the last few decades and are dependent on agriculture. They have cleared the forests during earlier periods when forest clearance for food production was promoted by the government.

The dependence of the people on this forest is marginal. The forests supply firewood, green manure, fodder, bamboo, etc. However, it is not the sole source of fuel wood or any of the other items. Some farmers in the neighbourhood have cooking gas in their kitchen and have substantial agricultural lands from which fuel, fodder, green manure, poles, etc. are available. The demand of the farmers is title deeds for the lands they cultivate. Some holdings have title deeds for the whole farm; some have only title deeds for a part of it and some others none at all. Although there is no real threat of eviction of farmers from areas without title deeds, the possession of title deeds enable them to avail bank credit for agricultural operations and the market price of such land is also higher.

The Forest Policy during the last 20 years do not allow any more clearance of forests for agriculture or other purpose. This small patch of forests was worked under selection felling system for their valuable timber by the forest department many decades ago and later it was a bamboo coup for the Grasim Industries for several decades. The local people were not involved in the management of this forest or included as a beneficiary in the harvesting of the produce. The Grasim Industries entrusted bamboo extraction to contractors and the contractor brought in labour from outside for this operation. The local people did get firewood, green manure and fodder from this patch. But this was through

an informal arrangement with the local forest staff. The site-specific plan under the RDF program was the first attempt in regenerating this area.

5.2. The expectation

When this project was initiated in KFRI, the concept of PFM was already a decade old in other states in India. There, PFM had taken a much more bolder form of Joint Forest management. Kerala was lagging behind rest of India in participatory approaches to forest management. Yet, the successful experiment in Periyar Tiger Reserve in mobilising and utilising communities inside and on periphery of the premier Protected Area in Kerala had been widely noticed. KFRI with its focus on biological sciences was yet to begin serious research in the changed context of PFM, which was expected to become the pattern of mainstream forest management in the country.

The PFM expectation in this project was that KFRI will quickly learn the intricacies of PFM by an actual field experiment and will be able master the technique to such an extent that, by the end of the project period, we will have two demonstration sites which will be successful examples of forest management carried out on scientific principles of landscape analysis and managed by the local community in a responsible, sustainable, equitable and participatory manner. These demonstration sites will be the open schools for every one interested to learn.

As this was a multidisciplinary project the experience in designing and implementing a project involving specialists in different fields in a well-coordinated and complementary fashion would strengthen our capacity to handle multidisciplinary tasks. This was also an opportunity to work on a multi-institutional project with the Forest Department as a partner and integrate field implementation of a participatory programme with scientific research. Integrating research and implementation was expected to enhance not only the design aspects but also the monitoring and evaluation aspects of a project so that changes can be made quickly to remedy any problem or unexpected happening that may complicate implementation of PFM.

The mandate of PFM implementation was with the Forest Department and the mandate of research was with KFRI. The expectation was that both would be carried out simultaneously so that a cooperative learning exercise will be accomplished and that research will go hand in hand with implementation.

5.3. The experience

As soon as the sites were selected and announced in a workshop attended by AusAID experts, senior forest officers and KFRI researchers, a series of public meetings were organised at Vellimattom. The visit of an Australian team, KFRI scientists and forest officials to Vellimattom conveyed the impression that a major activity was imminent. The series of public meetings organised at Vellimattom conveyed the message of PFM implementation at the site. A series of community meetings were organized starting from April 1999 at various places near the Vellimattom project site and at Vaniampuzha Tribal

Colony. The meetings were to announce the PFM programme and to seek the co-operation and participation of the local people. Officials of the Kerala Forest Department were also present in the meetings. The participants suggested several suggestions of forest management options and many questions were raised in these meetings.

Tree planting at Vellimattom was organized as a local festival (*Haritholsavam*) on June 22, 1999. Politicians, people's representatives, Forest Department officials and local people participated. Subsequently weeding and cultural operations were carried out according to the approved programme of the Kerala Forest Department under the Site Specific Plan for Rehabilitation of Degraded Forests (RDF).

A series of meetings were again conducted to facilitate the formation of the VSS. These meetings have served to initiate the dialogue with the local stakeholders and motivate them to participate in the rehabilitation of the forests. Altogether there were over 20 meetings. There was wide-spread enthusiasm which was reflected in the large gathering which attended the public meeting on the day of the planting. The planting was truly a community affair with not only the local residents but also people from neighbouring areas and non-government organisations from outside the area and school children from slightly far of places participated. The media publicity gave good coverage for the programme.

The planting programme at Vellimattom under the RDF scheme was sought to be projected as a PFM programme with a community meeting and lunch for the participants who joined in the first day of planting. Actually this was the beginning of a misunderstanding in which the community members, the Forest Department and KFRI investigators were all having divergent expectation of the role of community participation.

The great expectation generated during the inauguration of the tree planting programme under the KFD's, RDF scheme, less than a week after the new DFO took charge was sought to be maintained by the announcement that the *Vana Samrakshana Samithi* (VSS) executive committee to implement the PFM programme will be elected at a meeting in the community hall of *Chungathara* (around 15 kilometres from the site) after a fortnight.

On the specified day for the public meeting and election of the executive committee, there happened to be a local *Harthal* (forced closure of shops and vehicles asked to be kept off the roads by some agitating political group). At the community hall two groups of political party-men had arrived in hired vehicles from Site 1. Their aim was to capture all the positions in the executive committee which they hoped would be handling substantial amount of money at the site. The election of the executive committee for PFM implementation was not conducted then, as several questions remained to be resolved regarding the implementation of PFM. The meeting was converted into a workshop to discuss the social problems at the site. It was decided that another meeting would be held at Vellimattom where a wider discussion could be continued.

The people who participated in the planting programme naturally expected to be included in the PFM programme. In the second public meeting after the planting conducted at the Vellimattom Anganwadi the question of who all will be included in the PFM programme was discussed. It was suggested that too many members will be impractical to manage a small 40 hectare bit of forest and that the membership should be limited to those on the periphery of the forest. This was unacceptable to the large number of people who had gathered there since the publicity at the time of planting gave the impression that substantial benefits are going to flow into the PFM programme. If a household were not included it would mean that they would lose out on the potential benefits. There was even a walkout by a few ladies after making a statement that 'you wanted our free labour for planting but when the PFM committee is to be selected you want to keep us out'. The president of football club who had mobilised a large contingent during the planting stood up and said that their club does not press for positions in the committee since all of them were from a slightly distant place. After much discussion a geographic boundary was settled upon based on roads around Vellimattom and other natural landmarks with the consideration of proximity. The boundary was quite arbitrary since the settlements continue unbroken in all directions. A survey to find out the socio economic details of the households within the selected boundary was carried out soon after using the women of the area as investigators.

The regular RDF programme and its activity of planting and aftercare continued. Scepticism on whether the two programmes with the same objectives could be carried out simultaneously with money spend from the same government source arose. When the matter was clarified with the senior forest officers at the headquarters it was emphatically declared that both could not be carried out simultaneously and the RDF programme has to be converted into a PFM programme if that is required. However, the RDF programme continued unchanged throughout the period.

In order to set right the problems and to proceed with the Participatory Forest Management at the two selected sites, a meeting was organised at KFRI in November 1999 in which the Chief Conservator of Forest (World Bank) participated. Although this meeting raised expectations regarding the initiation of a Participatory Forest Management in the selected sites, which requires a formal commitment from the Forest Department, in the field there was no improvement.

Again the Chief Conservator of Forest (Eco-development and tribal welfare) held a meeting at the KFRI Sub centre Nilambur with the project investigators of KFRI and the Forest Department Officers on 30 December 2001. The Chief Conservator (Eco-development and tribal welfare) visited Vaniampuzha along with the DFO and KFRI scientists and all the community members were present. The visit of the CCF again raised hopes of PFM implementation immediately. However no change in the ground situation took place.

In the meantime the DFO (Nilambur North) had prepared a project on Assisted Natural Regeneration (ANR) at Vaniampuzha which was in the nature of planting tree seedlings within and around the tribal settlement at Vaniampuzha. However it was later abandoned

since it was pointed out by KFRI investigators that an ANR project implemented by Forest Department at Vaniampuzha will foreclose opportunity for a regular PFM programme at Vaniampuzha.

The RDF programme at Vellimattom was already proposed and approved by KFD even before the project design framework was prepared during the training in Australia. The Forest Department participants at that time did not perceive that a regular PFM programme and a departmental RDF programme could clash and that it would be unacceptable to the government, auditors and even the local community, because, for the same purpose of 'Rehabilitation of Degraded Forest', government money could not be spent through two different programmes. The RDF project of KFD has provided sufficient funds for complete rehabilitation of the site. Any further funding was redundant.

There is a substantial difference in the process of RDF and PFM. While the RDF programme utilises a convenor (The Forest Department's equivalent of a contractor) to carry out the work using the man power mobilised by him, the PFM process envisages the participation of all the community members in the planning, design, implementation, monitoring and evaluation of the work. The RDF programme was an approved departmental activity in which community participation could be only in the form of paid or free labour. As the funds were already released and preliminary work including nursery raising, site preparation, digging of pits were already completed by the time the team members returned after the AusAID training programme wherein the project design was finalised.

The community mood at Vellimattom turned to antagonism when a fence was erected around the forest bit to protect the planted seedlings. In all our interactions it was conveyed to the community that they would be consulted regarding all the activities on the site.

On 6.4.2000 a meeting at the Nilambur DFO Office decided to go-ahead with the formation of VSS and Manoj, the forest guard at Vellimattom was nominated as the Secretary. All the 333 households identified as the local stakeholders in the KFRI survey were to be invited to a meeting on 16.4.2000 at Vellimattom by the Secretary. In this meeting at Vellimattom, the Deputy Range Officer and his forest staff and community members in the locality were present. KFRI distributed photocopies of the PFM guidelines issued by the Forest Department and presented the results of the survey showing the list of disadvantaged households. In the discussion that followed some more households were included in the list with the idea that they will be given preference in the sharing of benefits under the PFM programme. Two NGOs working in the site were identified for selection as the official local NGO by the DFO. The fact that people were losing their interest in PFM was quite evident. The transfers given to the KFD officials during this period caused loss of continuity in the communication or commitment made to the community.

In spite of this, the next meeting at Vellimattom was held on 17 June 2000, presided over by the DFO. There was objection to the forming of an executive committee of the VSS by the participants as they feared that permission to gather firewood, bamboo or fodder grass may require the approval of every committee member and the forest guard. They further feared that they may have to pay for a privilege they now enjoy free. Since no agreement was reached another meeting to make a final decision whether to go a-head with the VSS formation was scheduled for 10 July 2000. In that meeting presided over by the ADCF 65 people attended. When the vote was taken only two persons supported the formation of VSS while 63 voted against. This put an end to the participatory forest management programme at Vellimattom. Later, a micro plan was prepared by a team of forest staff and some community members at Vellimattom. It was submitted to the conservator for approval through the Range Officer and DFO. It was rejected.

At Vaniampuzha, the community who are depending on the forest for their livelihood have been anticipating that the PFM programme will be implemented soon. The ten-day workshop and the survey conducted at Vaniampuzha confirmed their enthusiasm for the VSS formation. However, the monopoly rights over the collection and sale of NWFP remained with the Kalkulam society up to the end of 2002, so that an NWFP based Tribal VSS could not be formed. A micro plan for the PFM programme at Vaniampuzha was prepared and submitted to the Conservator of Forest just before the DFO was transferred. The approval for micro plan and PFM activities came in 2003 after the project period.

5.4. Policies and their implementation - problems

Unfortunately, the three forest officers selected for a training could not get government permission in time to attend the first week of training when the module of Participatory Forest Management was taken up. This resulted in each of the participants maintaining a different concept of PFM. Had the training in PFM being common, and had the participants attended the participatory management module together then it was likely that a consensus on the approach and content of participation would have emerged. In fact no such common consensus was arrived at and divergent views on the nature and level of participation by the community was held by the different investigators in this project.

One of the most complex issues at the time of project formulization was the question of site selection. This problem was addressed in the first workshop held in KFRI in which selected Forest Department officials, Ausaid experts and KFRI scientists participated. The complexity of the problem led to three field visits, prolonged workshop meetings and a formal SWOT Analysis led by Dr. S. Nambiar of CSIRO, Australia. The decision on Nilambur therefore was taken in the belief that funds will be available from the World Bank project to carry out the PFM research project and that senior forest officers preferred the site. However, the delay in converting an RDF site to a PFM site was greatly delayed, that the PFM could not be implemented, thereby there was problem in getting funding at this site, which was unexpected. Fortunately, the Western Ghats cell under the Planning and Economic Affairs Department of the Government of Kerala agreed to sponsor this project to KFRI. For the participatory programme to be

implemented the first step to be taken was to declare site as a PFM site, and approval granted by the Conservator of Forest. Unfortunately this first step could not be implemented in either of the selected sites throughout the period of this project.
The experience in trying to work on a PFM programme reveals that the problems are complex and often far different from that anticipated in the beginning. Sometimes it could be painfully difficult. Different actors have different goals, expectations and attitudes. The role of the most powerful actor is crucial. In this particular instance, the forests are Reserved Forest where the Forest Act is in force. The Forest Department controls the land and all the resources in it. Any change in the status of the site including the fact whether a participatory programme will be implemented depends on the approval by the Forest Department at an appropriate level. If this approval is not forthcoming through necessary orders, nothing can take place nor proceed. The Forest Department as the legal, formal and de facto owner of the forest has to take the lead in changing the status and nature of forest management in a Reserved Forest site.

The focus of PFM in Site 1 was in carrying out a rehabilitation programme in a small patch of forest. The fact that an intensive and substantial rehabilitation programme as a regular departmental activity had not only been approved but also initiated, was not considered worthy of mention during the planning exercise in the beginning of the project. Perhaps it was thought that the approved RDF programme could be modified into a PFM programme or that PFM involved only some environmental awareness creation which could be conducted irrespective of whether the RDF programme was carried out or not.

A more serious problem was the sequence of working in the selected sites. In the beginning all the work was focused on Site 1 and work on Site 2 was postponed thinking that the available funds may not be sufficient for both the sites together. Complexities regarding administrative approvals and social complexities at Site 1 continued to the very end of the project so that a sufficiently serious effort could not be made in Site 2. The progress made in analysing the vegetation component in Site 1 which was just 40 hectares impressed the investigators and the AusAID visitors that attention was riveted to Site 1 in all the components.

This project for the rehabilitation of degraded forests through a landscape level participatory action program has two key words: one is ‘landscape’ and the other is ‘participatory’. The landscape serves as a theoretical frame to observe the interrelationships and understand the dynamics in a wider canvas. The essence of this project is the participatory action program. This is the fulcrum on which every action should move. In this process the role of the Forest Department is critical. The mandate for the formation of the VSS, creating an awareness about forest conservation, prepare a microplan for the area after a participatory rural appraisal and carrying out the activities through the VSS all rest with the Forest Department. The Forest Department had a constraint at Vellimattom to initiate the formation of VSS as an approved Site Specific Plan under the Rehabilitation of Degraded Forests was ongoing. As the site specific plan was carried out under the World Bank sponsored project which had an elaborate procedure for approval and monitoring, decisions on shifting course from one scheme to

another rests with the government and not with the local DFO. Naturally these decisions take time. The problem here was the identification of a site which was already ear-marked for rehabilitation under one scheme was proposed for rehabilitation under another scheme which had a totally different process of management. Perhaps the difference between the two schemes viz., Site Specific Plan under RDF and Participatory Forest Management were not perceived in the beginning of the project thinking that same site specific plan could be worked under the participatory method. In course of time it was realised that participatory management involved a totally different method of working in which the control over decision making on each and every aspect has to rest with a VSS who is empowered to choose their representatives in the executive committee to manage the funds as well as the activities. Under the approved site specific plan there is no role for the VSS, in either decision making or in carrying out the activities. The divergence between both the schemes was one reason for the delay in initiating the participatory action program. Another important reason was the non-synchronization of the research activities under various components with the activities of the Forest Department. The visit of the AusAID experts Dr. Tim O'Meera and Rowan Reid and their report has helped to understand the problems facing this project and many of the issues were discussed but the field situation remained unchanged. If the healthy functioning of the participatory institution in forest management and community development in both the sites is an important milestone, it is yet to be crossed. If rehabilitation of the vegetation alone is considered the work has been a spectacular success.

The forest produce such as firewood, fodder, etc. collected by the small farmers, labourers and the destitute from the forests at Vellimattom is obtained free of charge and without hindrance from anybody. All these people have co-operated whole heartedly in preserving and maintaining the planted tree seedlings under the site specific plan of the Forest Department. The community viewed the construction of a fence along the outer boundary of the Vellimattom site even after assurances that no fence is envisaged as an indication of lack of faith and a sign of further restrictions on access to the forest.

The fact that regeneration of the forests according to the site specific plan of the forest department is a grand success points to the fact that regeneration efforts can succeed even without participatory involvement of the people. The regeneration activity at Vellimattom is a good example to prove this point. Whether the initial success can be sustained is a different question.

A participatory mechanism to ensure maintenance of the site after the RDF program may be an option. However, the situation in Vellimattom is complex. In the three public meetings after the stopping of the Site Specific Plan under RDF the community members have come out unequivocally against forming a VSS at Vellimattom. The primary objection is that once an executive committee is elected from the VSS the executive committee members may assume powers which could be detrimental to people who have no relation to them either through family connections, political connections, etc. A serious fear expressed by many people in the locality is that they will have to go after the different executive committee members residing in different areas to obtain permission to collect some firewood or fodder. There is always the risk of refusal or the need to pay a

charge for the same. Due to the diversity among the stakeholders and the social and political conflicts that exist, the powers of the executive committee members could accentuate the conflicts or favour one group and deprive another. The people does not seriously believe the explanation that the VSS can always control the office bearers and executive committee members. At the moment the majority of the people at Vellimattom seem to trust the Forest Department officials to be impartial and serve the community interests than a small group of executive committee elected by the people. This is an indication of the lack of homogeneity of interests among the community, which is essential in a PFM programme, which requires mutual trust and a common purpose.

Indeed PFM was the foundation on which this project edifice should have been built. It should have been the axle on which the rehabilitation effort moved forward. Unluckily this was the weakest link in the chain due to several reasons, the most important of which was the technical difficulty to convert an ongoing Departmental rehabilitation programme into a participatory one at Vellimattom (Site 1) and the problems with the monopoly rights granted to the SCST Federation in the collections of NWFP from Vaniampuzha (Site 2).

The project was conceived as a joint endeavour by KFRI and KFD with a division of labour between the parties such that the PFM implementation as the mandate of the KFD and research, the mandate of KFRI. Unfortunately, factors within the Forest Department arrested the designation of both sites as PFM areas, prior to or during the project period. The accompanying research component naturally could not go far. The dichotomy between the policy statements and practice in the field in India has been evident in most spheres of government functioning. In course of time, the practice moves forward towards the policy declarations. The Joint Forest Management policy announcements by the government of India came in the late 1980s. It took almost a decade to find its place in the Kerala forest management milieu.

The Joint Forest Management policy of the government of India is endorsed by the Kerala Forest Department and it has its own brilliant initiative at the level of the Chief Conservator of Forest (Eco-development tribal welfare). The Participatory Eco-development Project of the Periyar Tiger Reserve has been a noted successful experiment appreciated all over the country. The articulate women of Vellimattom who impressed the AusAID experts on their field visit by accepting the challenge and responsibility of forest management in the patch of forest right in front of their homesteads could be described as potential stake gainers, if they were given the opportunity and authority promised to them.

5.5. Resistance to change

PFM involves forest management and community welfare. Community welfare is the mandate of several other government departments including the local Panchayats, the Tribal Welfare Department, the Rural Development Department, the Water Authority, the Civil Supplies Department, the Integrated Child Development Scheme (ICDS), the Education Department, and the Electricity Board etc. All these departments have their

own programme of community welfare. In Vaniampuzha, as the community members all belong to a scheduled tribe, the tribal welfare department has a very special place. The Kalkulam tribal society functioning under the SCST Federation has the monopoly right to collect NWFP from the forest. As an entry point activity of this project a ten day workshop was organised with the faculty members and senior students of MSW course of the Sri Sankara University, Kalady at Vaniampuzha. Out of 27 students, 18 were women. Their presence among the community for ten days was intended to improve communication with the women of the tribal community. The academically trained social work students and faculty was expected to improve the rapport between the KFRI researchers, the community and the forest officials in the field.

Participatory Forest Management calls for a change in the attitude of the traditional government departments and their functioning so that the ultimate aim of sustainable resource management and community development can be promoted in the field. Naturally traditions, which have survived for over a century, cannot be modified overnight. It takes time and patience to achieve a change of attitude and mindset among officials who are threatened by lawbreakers on the one side, and on the other side politicians who can influence transfers, auditors who can penalise a wrong judgement and rival Departments that intrude into their turf. The defensive reaction of most officials is to hold on to traditions and resist change.

5.6. Where did we falter?

The conceptual framework of this project aimed to create a demonstration forest using the landscape analysis as a tool and participatory action programme as the means of achieving the goal. The demonstration forest has the natural resources component and also the human element in a mutually sustaining and harmonious relationship. The resource status, environmental quality and the quality of life of the human population have all to be raised to the highest level possible so that they become an effective demonstration forest in course of time. This conceptual framework requires a multidisciplinary approach and a method to integrate different components into the larger programme. To begin with however the bench mark status of different components have to be analysed. All the investigators attended to this phase diligently. The participatory management programme however failed to start and stranded the project.

In retrospect we faltered in (1) the selection of sites, (2) the sequence of working, (3) giving primacy to vegetation rehabilitation and sidelining participatory management, (4) considering PFM as an independent research component and (5) the inability to find solutions to the problems faced within the time limit of the project.

(1) Selection of sites

The choice of Vellimattom (Site 1) for the PFM was inopportune in the sense that there was no possibility of carrying out another rehabilitation programme through PFM when a regular rehabilitation work was taking place. Had the site been replaced with another more desirable and favourable site, there could have been substantial progress. Site 2,

which had much more potential, required a different type of rehabilitation. While in site1 the rehabilitation effort was focused on the tree vegetation, in site 2 the tree cover was fairly complete and scars of previous degradation due to charcoal burning several decades back were all recovering naturally with profuse tree growth. The rehabilitation requirement was for the human element in the landscape. The Forest Department with its focus on trees does not have the experience or mandate to rehabilitate forest communities particularly since several other government departments and agencies have been entrusted with the task. However, had we focused on Site 2 from the beginning we could have achieved success in persuading the Forest Department to declare Site 2 as a PFM Site and activities related to rehabilitation could have been initiated.

(2) Sequence of working

As mentioned above, had we together focused on Site 2 from the beginning of this project period we could have at least initiated the rehabilitation effort or at least started on the track of capacity building of the forest dependent community at Vaniampuzha. Even then the monopoly which the Kalkulam Society enjoyed in the collection of NWFP continued throughout the project period so that it was not possible to arrange for the collection and marketing of NWFP which was the dominant form of livelihood for the tribal community at Vaniampuzha.

(3) Giving primacy of vegetation rehabilitation and sidelining participatory management

Landscape analysis of the Site 1 revealed that the vegetation component in the first Site was degraded while the human component was at par with the general level of human development in the rest of rural Kerala. Whereas in Site 2 the vegetation component was at par or healthier than the natural moist deciduous forest in other parts of Kerala, while the human development indices showed an appalling degradation. The quality of life, access to services and technological capability was abysmally low. The rehabilitation requirement therefore was for the human element in the landscape. Resources in the form of NWFP was available but the monopoly over the resource by the Kalkulam society and the activities of the private traders from outside did not benefit the community as much as it should have, had a VSS or a community organisation directly marketed the produce.

The fact that a departmental rehabilitation was taking place in Site 1 obscured the fact that rehabilitation through the participatory mode was the objective of this project. Even in Site 2 the thinking among the Forest Department people and some researchers was that the rehabilitation concept was limited to tree growing. In fact a project for Assisted Natural Regeneration (ANR) was prepared by the KFD for rehabilitation in Site 2.

(4) Considering PFM as an independent research component

PFM was the means or the method to achieve rehabilitation. But it was considered as an independent component in this project so that a unifying purpose or opportunity was lost sight of. The necessity for a PFM programme was not considered as a compelling requirement for the other components in this project, giving the appearance that except

for component of PFM, the rest of the components were complete. Actually PFM is the only method for rehabilitation that was envisaged in this project and that the absence of PFM component affects the entire process.

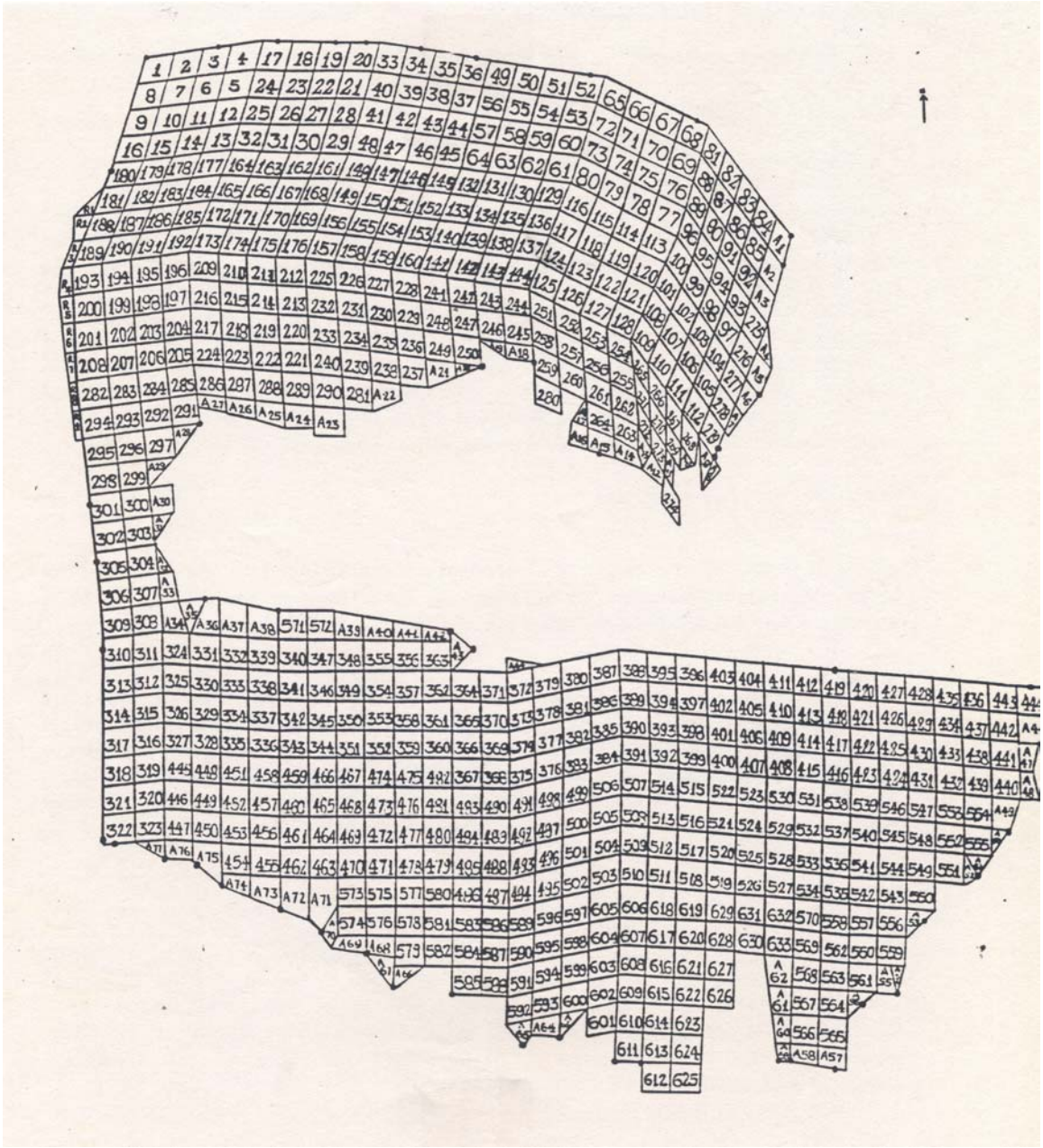
(5) Inability to find solutions to the problems faced within the time limit of the project.

The assumptions, which formed the basis for this project, proved to be untenable very early in the period of this project. In fact the situation was discussed in a meeting of all investigators in KFRI within 3 months of the start of this project. However, remedial measures could neither be found nor an alternate programme could be devised during the period of this project. This naturally led to a disappointment among the research team and a greater disappointment among the communities who expected a better deal since a reputed research institution was also underwriting the promises made regarding community participation and empowerment.

Designing and implementing a successful PFM programme is quite complex. It has to take into account the needs of forest management, the social background, the resources available and the commitment by the Forest Department to a participatory system of management. The shift from a bureaucratic management to a participatory one requires a change in the attitude of the officials. A mutual trust has to be built up so that shared goals can be pursued. This requires better communication and transparency in all decision-making. Flexibility in approach to respond to changing field situations and problem solving skills of a high capability are required.

Appendices

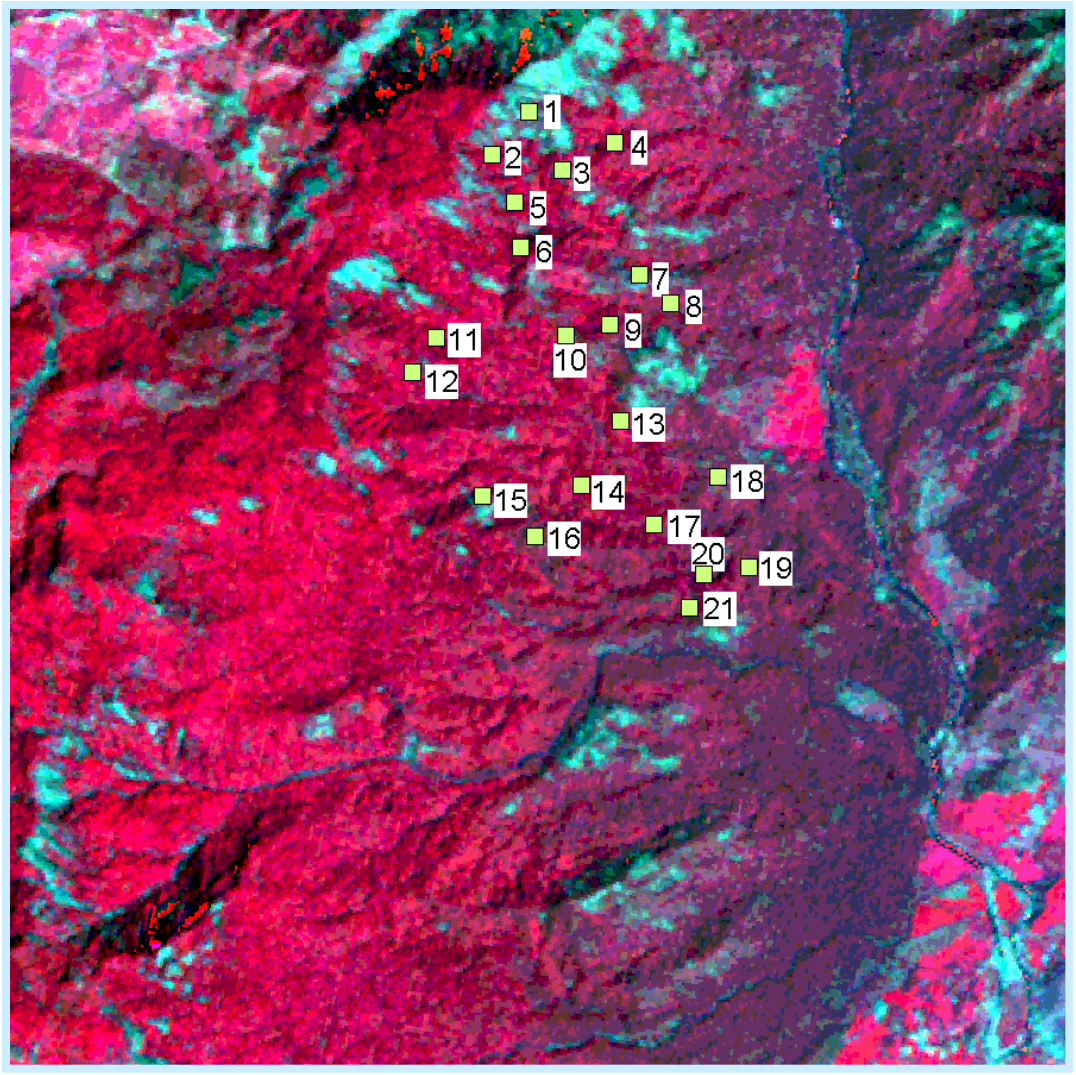
1. Forest plot divided into grids (site I)



2. Geographic position of plots and density and basal area of trees in each established plot (site II)

Forest plots	Geographic position		Elevation (m above msl.)
	North	East	
Evergreen forests (undisturbed)			
Plot No.1	11.28.226	76.12.490	305
Plot No.2	11.28.077	76.12.590	273
Plot No.3	11.27.896	76.12.855	225
Evergreen forests (disturbed)			
Plot No.1	11.28.383	76.12.361	330
Plot No.2	11.28.140	76.12.576	276
Plot No.3	11.27.930	76.12.676	245
Semi-evergreen forests			
Plot No.1	11.27.702	76.13.134	192
Plot No.2	11.27.649	76.13.145	210
Plot No.3	11.27.754	76.13.298	163
Moist deciduous forest (undisturbed)			
Plot No.1	11.27.003	76.14.220	77
Plot No.2	11.27.917	76.13.438	140
Plot No.3	11.27.520	76.13.459	158
Moist deciduous forest (disturbed)			
Plot No.1	11.27.769	76.13.072	207
Plot No.2	11.27.794	76.13.084	217
Plot No.3	11.27.160	76.13.893	94
Moist deciduous forests (fire affected)			
Plot No.1	11.27.765	76.13.504	145
Plot No.2	11.27.176	76.13.336	162
Plot No.3	11.27.129	76.13.293	157
Moist deciduous forest (near the tribal settlement)			
Plot No.1	11.27.105	76.14.175	75
Plot No.2	11.27.467	76.13.868	95
Plot No.3	11.26.939	76.14.133	82

3. Satellite map of site II howing location of the quadrate (numbered) laid out for vegetation analysis.



4. Details of earthworm biomass from sampled quadrats

rable 49. Showing the details of earthworm biomass from the sampled luadrats.

Plot No.	Original Quadrat No.	Earthworm Nos.			Wt/worm (g)	Worm biomass (g)	Spider Nos	Centi-pede Nos.	Millip-ede Nos.	Woodlouse Nos.
		Adult	Juvenile	Total						
1	349	0	1	1	0.014	0.014	0	0	0	0
2	350	1	0	1	0.049	0.049	3	0	4	1
3	233	3	0	3	0.008	0.024	2	0	0	1
4	211	3	3	6	0.043	0.258	2	0	0	1
5	173	12	5	17	0.0344	0.5848	0	1	0	4
6	195	9	1	10	0.0691	0.691	1	0	0	6
7	309	3	2	5	0.015	0.075	6	0	0	0
8	364	4	1	5	0.019	0.095	4	1	0	0
9	361	8	2	10	0.0227	0.227	3	1	0	0
10	372	20	2	22	0.07	1.54	5	0	0	0
11	442	4	5	9	0.0145	0.1305	1	0	0	0
12	438	1	3	4	0.359	1.436	0	1	1	0
Total		68	25	93	0.7177	5.1243	27	4	5	13

-

5. Number of individuals, basal area (cm^2) and Importance Value Index (IVI) of different tree species (site I).

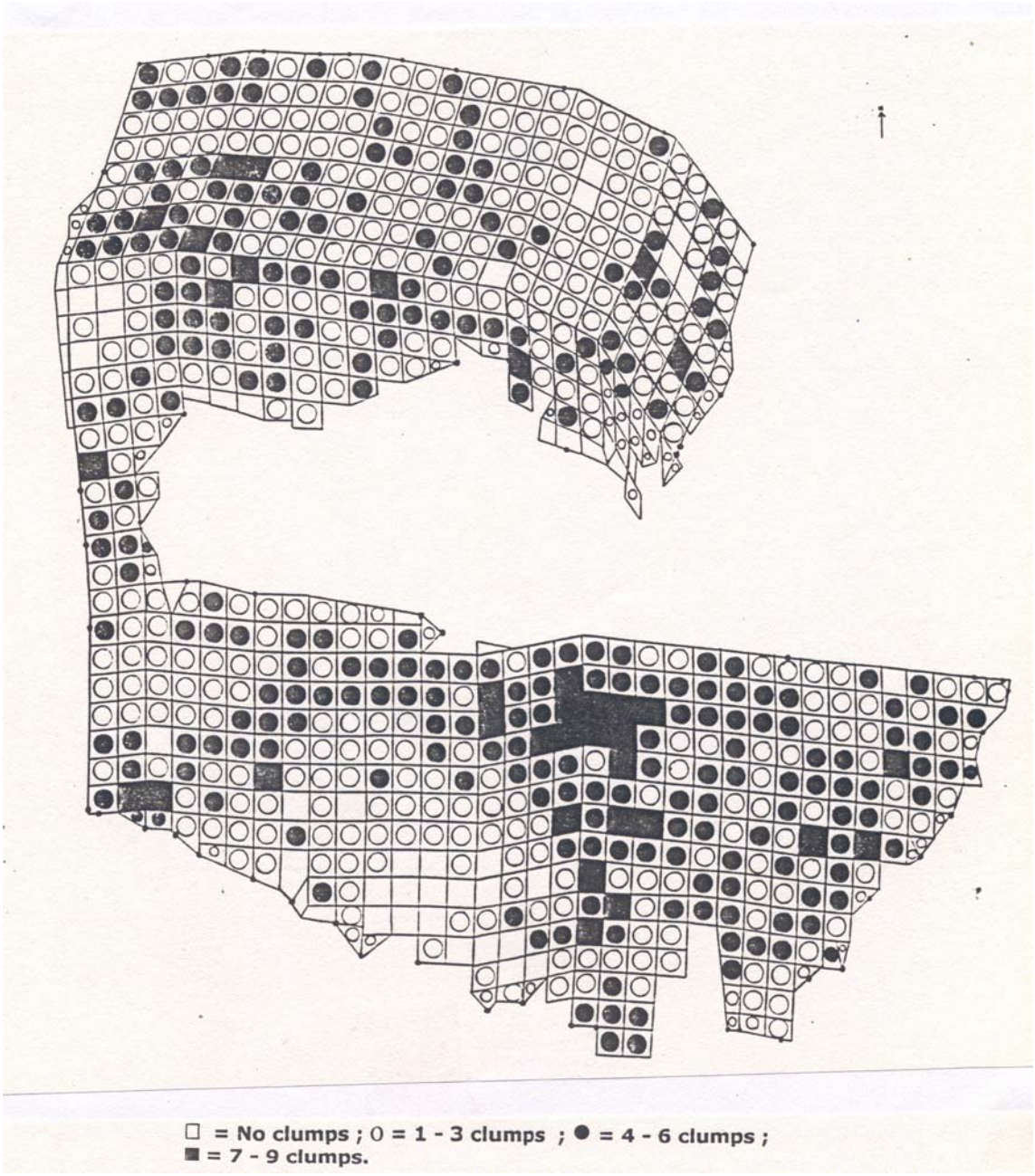
Species	Number of individuals in the plot	Total basal area (cm^2)in the plot	IVI
Ailanthus triphysa	1	4608.00	0.0924
Albizia chinensis	1	4250.42	0.5247
Albizia odoratissima	13	14100.38	0.4374
Allophylus serratus	1	288.00	0.0701
Alseodaphne semecarpifolia	4	5693.89	0.3243
Alstonia scholaris	57	139756.92	4.5803
Anthocephalus cadamba	13	20064.52	1.0471
Aporusa lindleyana	201	144636.91	12.0289
Ardisia sps	1	18.00	0.0687
Artocarpus gomezianus	16	29878.45	1.3139
Artocarpus hirsutus	1	1922.00	0.0785
Bambusa bambos	2238	15484828.47	166.8641
Bauhinia sps	3	517.92	0.2188
Bombax ceiba	9	9525.29	0.6596
Bridelia retusa	4	1176.17	0.3010
Canthium rheedii	2	614.72	0.1507
Careya arborea	10	5392.40	0.7068
Cassia fistula	11	4255.57	0.7696
Cinnamomum verum	3	2172.28	0.1791
Cipadessa baccifera	1	216.32	0.0697
Dalbergia lanceolaria	1	200.00	0.0696
Dalbergia latifolia	128	67254.01	8.4928
Dillenia pentagyna	48	42229.20	3.5621
Drypetes oblongifolia	1	11.52	0.0687
Elaeocarpus serratus	1	11.52	0.0687
Emblica officinalis	1	62.72	0.0689
Ficus crenulata	11	79957.10	1.2094
Ficus exasperata	7	1290.54	0.5177
Ficus talbotii	27	166200.78	2.8249
Ficus tomentosa	8	116768.13	1.1836
Garcinia morella	4	13097.05	0.3626
Grewia tiliifolia	20	9542.10	1.4072
Holigarna arnottiana	4	7781.85	0.3351
Holoptelea integrifolia	7	18242.88	0.6053
Hydnocarpus pentandra	18	19414.05	1.3591
Kydia calycina	5	624.40	0.3668
Lagerstroemia lanceolata	14	37978.97	1.2186
Lagerstroemia reginae	12	44344.18	1.1040
Lepisanthes erecta	16	9006.71	1.1096
Linociera macrophylla	1	567.17	0.0715
Litsea laevigata	21	15192.41	1.5534
Macaranga peltata	9	4928.15	0.6840

Mallotus philippensis	72	34418.78	4.3063
Miliusa tomentosa	5	6814.24	0.3988
Naringi crenulata	8	2212.84	0.5428
Olea dioica	71	53025.19	5.0954
Persea macrantha	26	69101.47	2.1957
Pterocarpus marsupium	1	1198.54	0.0748
Pterospermum reticulatum	50	58004.28	3.7429
Sapindus laurifolia	3	1434.58	0.2235
Schleichera oleosa	11	38011.08	0.5101
Sterculia guttata	129	79597.68	8.2876
Stereospermum personatum	54	95782.39	1.8698
Strychnos nux-vomica	83	367201.16	7.2541
Syzygium chavaran	5	16790.19	0.4504
Tabernaemontana caudata	4	521.12	0.2012
Tabernaemontana heyneana	6	208.36	0.4333
Terminalia bellirica	25	19855.68	1.9206
Terminalia paniculata	270	1366829.86	22.7440
Terminalia tomentosa	31	165920.15	2.6258
Tetrameles nudiflora	5	18748.41	0.4123
Trewia polycarpa	6	36098.31	0.6189
Unidentified-1	1	392.00	0.0706
Unidentified-2	1	768.32	0.0726
Unidentified-3	1	464.52	0.0710
Wrightia tinctoria	47	20673.23	2.3691
Xylia xylocarpa	214	352912.59	14.3387
Ziziphus rugosa	6	1368.40	0.4393

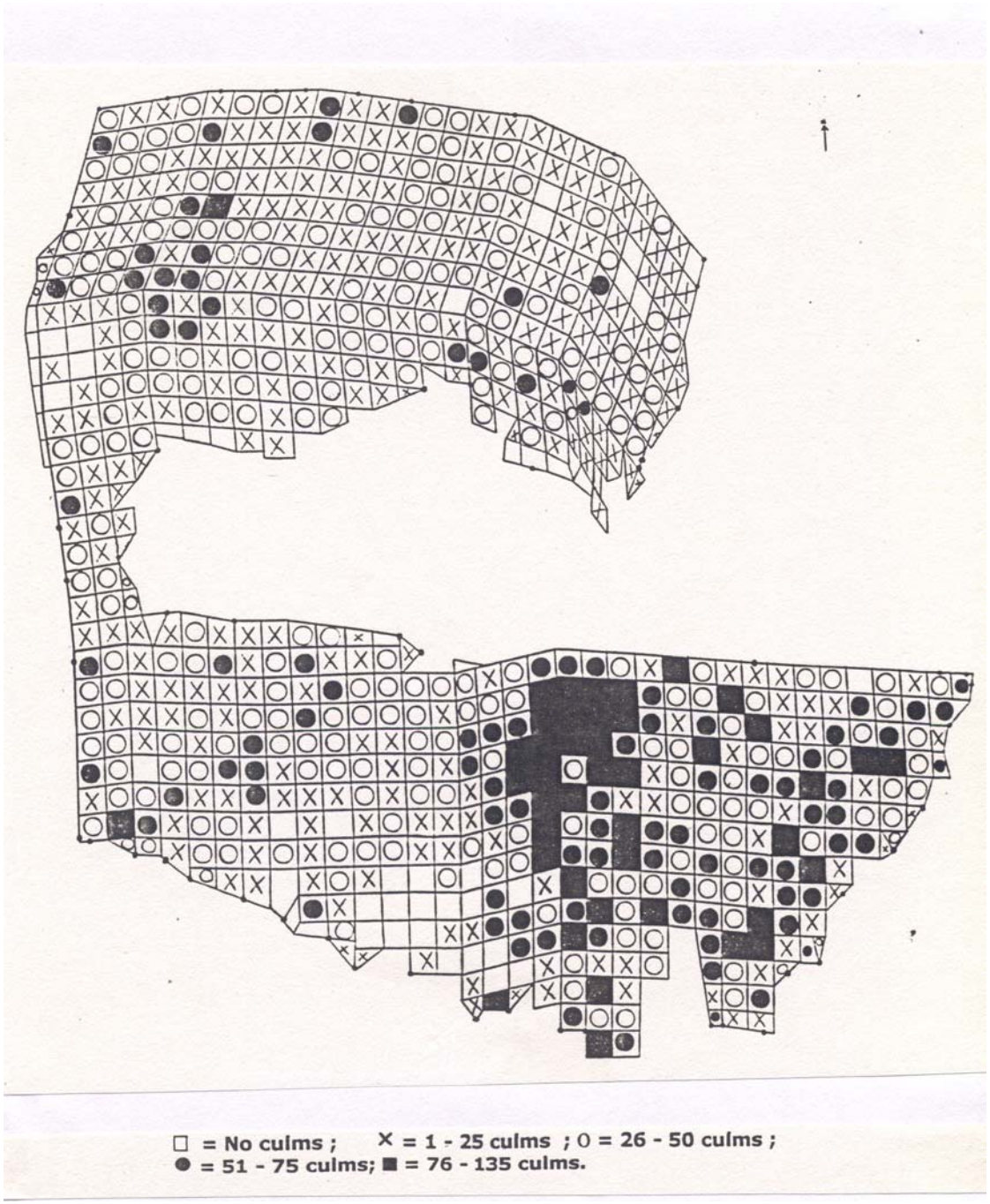
6. Number of natural seedlings (Site I)

Species	Number	Species	Number
Ailanthus triphysa	4	*Lagerstroemia reginae*	5
Albizia chinensis	12	*Lepisanthes erecta*	57
Albizia odoratissima	28	*Linociera macrophylla*	10
Allophylus serratus	107	*Litsea laevigata*	386
Alseodaphne semecarpifolia	32	*Macaranga peltata*	169
Alstonia scholaris	14	*Mallotus philippensis*	244
Anthocephalus cadamba	840	*Mangifera indica*	1
Aporusa lindleyana	518	*Miliusa tomentosa*	573
Artocarpus gomezianus	19	*Mitragyna parvifolia*	4
Artocarpus heterophyllus	3	*Naringi crenulata*	91
Artocarpus hirsutus	1	*Olea dioica*	842
Bambusa bambos	10	*Persea macrantha*	330
Bauhinia sps	4	*Pongamia pinnata*	45
Bombax ceiba	5	*Psidium guajava*	29
Bridelia retusa	79	*Pterocarpus marsupium*	4
Canthium rheedii	1	*Pterospermum reticulatum*	381
Careya arborea	49	*Sapindus laurifolia*	57
Cassia fistula	1076	*Schleichera oleosa*	739
Cassia sps*	210	*Sterculia guttata*	378
Cinnamomum verum	5	*Stereospermum personatum*	89
Dalbergia latifolia	686	*Strychnos nux-vomica*	3117
Dillenia pentagyna	271	*Syzygium chavaran*	4
Drypetes oblongifolia	10	*Tabernaemontana caudata*	1186
Elaeocarpus serratus	278	*Tamarindus indica*	1
Emblica officinalis	2	*Tectona grandis*	25
Ficus duex	3	*Terminalia bellirica*	276
Ficus exasperata	101	*Terminalia crenulata*	459
Ficus talbotii	4	*Terminalia paniculata*	3382
Ficus tomentosa	1	*Trema orientalis*	8
Garcinia morella	12	*Trewia polycarpa*	513
Grewia tiliifolia	413	*Vitex altissima*	1
Holarrhena pubescens	249	*Wrightia tinctoria*	151
Hydnocarpus pentandra	7	*Xylia xylocarpa*	9200
Kydia calycina	115	*Ziziphus rugosa*	81
Lagerstroemia lanceolata	136		

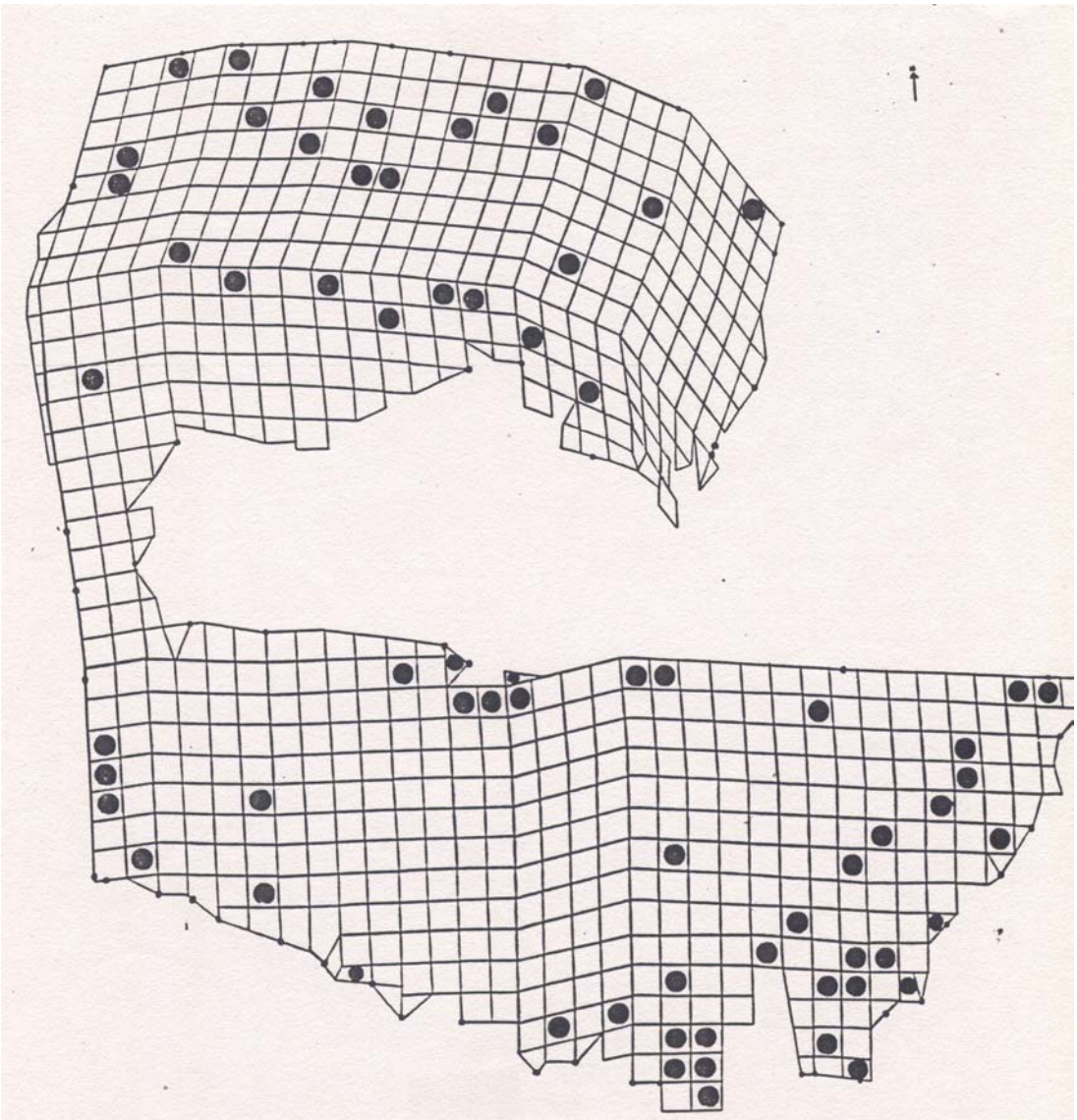
7. Distribution pattern of bamboo clumps (site I)



8. Distribution pattern of bamboo culms (site I)

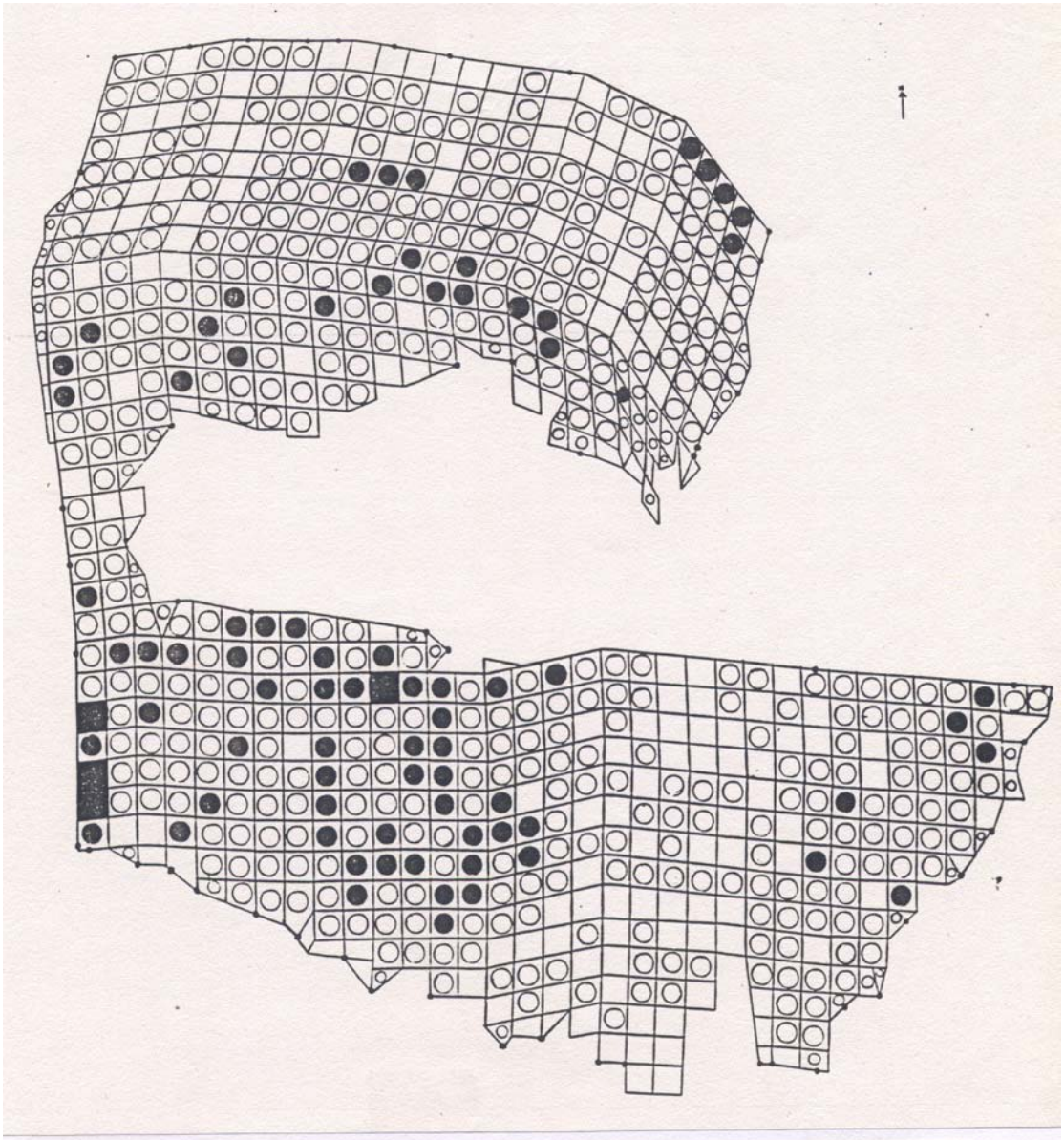


9. Distribution pattern of saplings (site I)



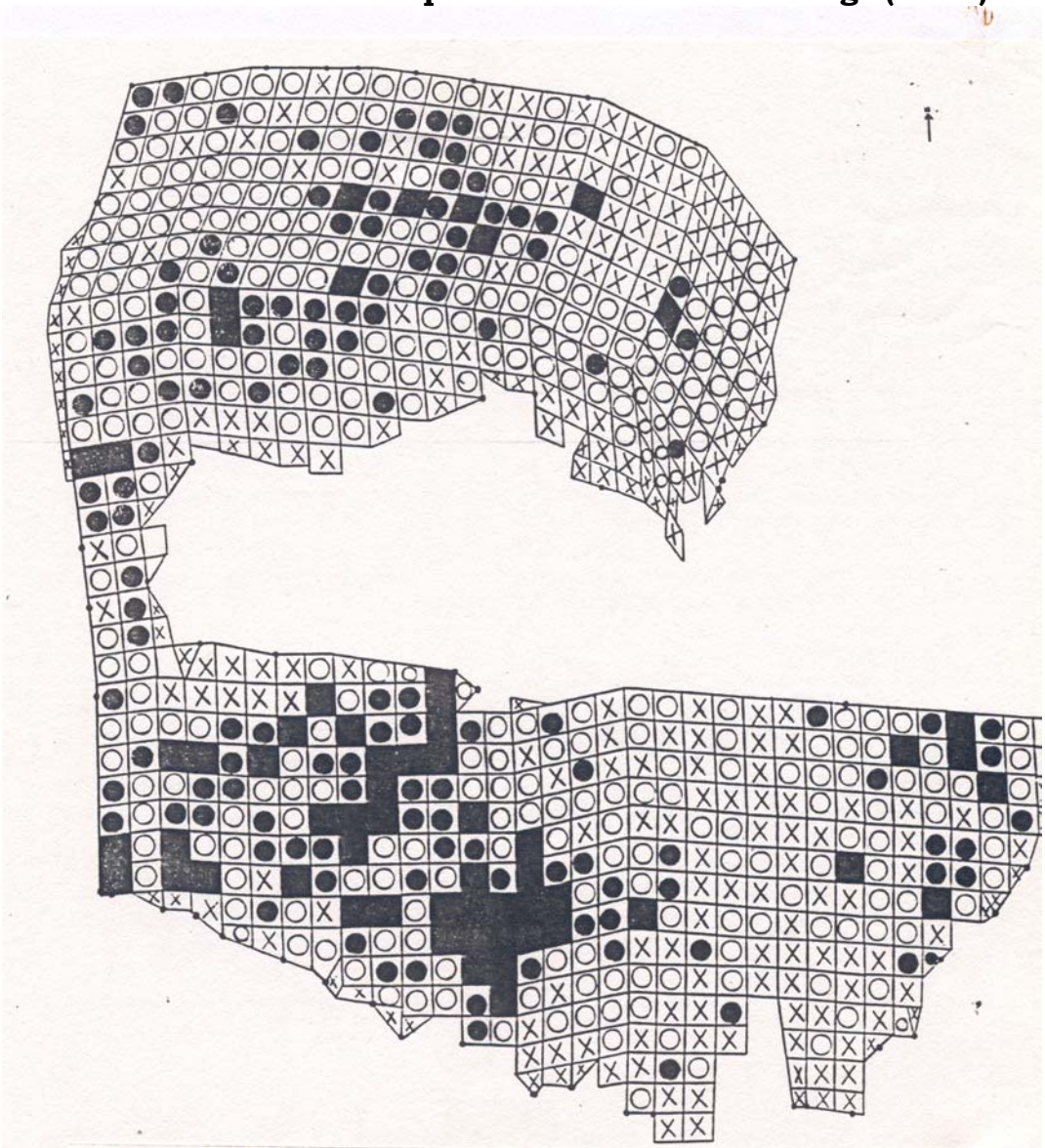
Distribution pattern of saplings (girth 10.1 to 30.0cm)in the Vellimuttom plot.
□ = No saplings ; ● = 1 - 3 individuals.

10. Distribution pattern of trees (site I)



Distribution pattern of trees (girth ≥ 30.1cm) in the Vellimuttom plot.
□ = No trees ; ○ = 1 - 5 individuals ; ● = 6 - 10 individuals ;
■ = 11 - 16 individuals.

11. Distribution pattern of natural seedlings (site I)



. Distribution pattern of natural seedlings (girth < 10.0cm; height ≥ 1m) in the Vellimuttom plot.
□ = No seedlings ; × = 1 - 25 individuals ;
o = 26 - 50 individuals ; ● = 51 - 75 individuals ;
■ = 76- 154 individuals.

12. Density (individuals ha^{-1}) and importance value index (IVI) of different tree species in homesteads of different size (site I) (n=54 homesteads)

	Size of homesteads (in cents)							
	5- 50cents (n=28)		51-100 (n=10)		101-300 (n=9)		301-700 (n=7)	
Species	Density	IVI	Density	IVI	Density	IVI	Density	IVI
Acacia sps.	0	0.00	0.3	1.82	0	0.00	0	0.00
Aegle marmelos	0	0.00	0	0.00	0	0.00	0.6	1.13
Ailanthus triphysa	0.52	0.88	0	0.00	0	0.00	0	0.00
Alstonia scholaris	0	0.00	0	0.00	0.11	1.21	0	0.00
Anacardium occidentale	3.65	1.97	17.16	14.24	11.23	5.44	5.06	4.01
Areca catechu	406.25	78.40	168.07	65.93	250.56	64.52	233.55	52.18
Artocarpus communis	0	0.00	0	0.00	0	0.00	0.6	2.14
Artocarpus heterophyllus	14.06	17.25	9.33	15.25	4.6	12.91	2.63	7.58
Artocarpus hirsutus	0.52	0.88	0	0.00	0.22	1.24	0.85	2.18
Azadirachta indica	0	0.00	0	0.00	0.11	1.21	0	0.00
Carica papaya	3.65	5.59	0.6	1.91	1.34	6.25	1.18	6.29
Cinnamomum sps	0.52	0.88	0	0.00	0	0.00	0.06	1.02
Citrus sps	0.52	0.88	0.9	3.73	0.11	1.21	0.13	1.04
Cocos nucifera	113.54	35.37	53.01	29.6	39.32	19.3	61.18	19.90
Coffea sps	0	0.00	0	0.00	5.61	2.42	65.78	14.73

cyprus	0	0.00	0	0.00	0.11	1.21	0.6	1.13

Emblica officinalis	0.52	0.88	0	0.00	0	0.00	0.72	3.17
Eugenia caryophyllata	1.96	1.71	0	0.00	0	0.00	0	0.00
Garcinia gummi-gutta	4.69	2.94	0	0.00	0.67	4.91	0.46	5.14
Glyricidia sepium	8.33	2.70	0	0.00	0	0.00	0	0.00
Heavea braziliensis	39.06	7.50	22.6	10.89	129.21	36.70	131.57	32.49
Lagerstroemia lanceolata	0	0.00	0	0.00	0.11	1.21	0	0.00
Macaranga peltata	0	0.00	2.4	4.22	0	0.00	0.79	2.17
Mangifera indica	14.06	15.04	7.83	14.60	1.91	7.56	0.32	5.11
Michelia champaca	0.52	0.88	0.6	3.63	0.337	3.65	0.13	1.04
Moringa oleifera	1.04	1.57	0.9	3.73	0	0.00	0.39	4.12
Myristica fragrans	0.52	0.88	0	0.00	0	0.00	0	0.00
Psidium guajava	6.77	8.89	2.1	5.84	0.89	6.15	0.85	5.21
Spondias pinnata	0.92	0.95	0	0.00	0	0.00	0	1.01
Sterculia guttata	0	0.00	0	0.00	0.11	1.21	0	0.00
Syzygium cumini	0	0.00	0.3	1.82	0	0.00	0	0.00
Tamarindus indica	1.04	1.57	0.9	2.01	0.56	4.88	0.85	6.22
Tectona grandis	11.46	6.81	10.24	10.24	2.8	5.38	4.93	6.00
Terminalia bellirica	0	0.00	0	0.00	0	0.00	0.6	1.13
Terminalia paniculata	1.04	0.97	1.2	3.83	2.47	3.52	1.57	5.35
Xylia xylocarpa	4.69	2.94	4.21	4.82	2.8	5.38	0.98	4.23

13. Occurrence of different tree species in evergreen forests plots (Site II)

Species	Plots					
	Undisturbed plots			Disturbed plots		
	1	**2**	**3**	**1**	**2**	**3**
1. Actinodaphne angustifolia	-	-	-	+	+	-
2. Aglaia lawii	+	+	+	+	+	+
3. Alstonia scholaris	-	-	-	+	-	+
4. Antiaris toxicaria	+[2]	-	+	-	+	+
5. Aporusa lindleyana	-	+	+	+	+	+
6. Artocarpus hirsutus	-	+	+	-	+	+
7. Baccaurea courtallensis	+	+	+	+	+	+
8. Beilschmiedia wightii	-	-	-	+	-	-
9. Callicarpa tomentosa	-	-	-	+	-	-
10. Calophyllum polyanthum	+	-	-	-	+	+
11. Canarium strictum	-	+	+	-	-	-
12. Carallia brachiata	-	-	-	-	+	-
13. Casearia sps	+	-	+	+[5]	+	+
14. Chelinga	-	-	-	-	-	+
15. Cinnamomum sps	+	+	+	+	+	+
16. Clerodendrum infortunatum	-	-	-	-	-	+
17. Diospyros bourdillonii	+[1]	+[4]	+[1]	+[3]	+[2]	+[1]
18. Diospyros candolleana	+	+	+	-	+	+
19. Diospyros sylvatica	-	-	+	-	-	+
20. Drypetes elata	+	-	-	-	-	-
21. Fahrenheitia zeylanica	-	+	+	-	+	-
22. Garcinia morella	+	-	+	-	+	+
23. Garcinia pictorius	-	-	-	+	-	-
24. Harpullia arborea	+	-	+	+	+	+
25. Holarrhena pubescens	-	-	+	-	-	-
26. Holigarna arnottiana	-	-	+	-	-	+
27. Hopea parviflora	-	-	-	-	+	+
28. Hydnocarpus pentandra	+	+	+	+	+	+
29. Ixora nigricans	+	+	+	+	+[5]	+
30. Diopyros sp.	-	-	-	+	+	+
31. Karutharingi	+	-	+	+	+	-
32. Syzygium montanum	+	-	-	-	-	-
33. Lagerstroemia lanceolata	-	-	-	+	-	-
34. Lepisanthes decipiens	+	+	-	+	+	-
35. Litsea insignis	-	-	-	-	-	+
36. Litsea mysorensis	-	+	-	-	-	-
37. Litsea sps.	-	-	-	+	-	-
38. Lophopetalum wightianum	-	-	-	-	-	+
39. Macaranga peltata	+	-	-	-	-	-
40. Mallotus philippensis	+	+	+	+	+	-
41. Mangifera indica	+	+	+	-	-	+
42. Mitragyna tubulosa	+	-	-	-	-	-
43. Myristica dactyloides	+[5]	+[5]	+	+	+	+

44. Myristica malabarica	-	-	-	+	-	+5
45. Myristica sps	+	+	+	+	+	+
46. Bischofia javanica	-	-	-	+	-	-
47. Neonauclea purpurea	-	-	-	+	-	-
48. Olea dioica	-	-	+	+	+	-
49. Otonephelium stipulaceum	+3	+1	+4	+2	+3	+3
50. Pali	-	-	-	-	-	+
51. Parakam	-	-	-	+	-	-
52. Persea macrantha	-	-	-	-	+	-
53. Pajanelia longif *54. olia*	-	-	-	-	-	+
55. Polyalthia fragrans	+	+3	+	+4	+4	+
56. Pterospermum sps	-	+	-	-	+	+
57. Pterygota alata	+4	+2	+3	+1	+1	+4
58. Sapindus laurifolia	-	+	+	+	+	-
59. Sterculia guttata	+	-	-	+	+	-
60. Syzygium caryophyllatum	+	-	-	-	-	-
61. Syzygium laetum	-	-	+	-	-	-
62. Syzygium sps	+	+	+	+	+	+
63. Tabernaemontana heyneana	-	+	+	-	-	-
64. Terminalia paniculata	-	-	+	-	-	-
65. Thaluppa	-	-	-	+	-	-
66. Ficus sp.	-	-	+2	-	-	-
67. Nothopegia sp.	-	-	-	+	-	-
68. Syzygium mundakam	+	-	-	-	-	-
69. Unidentified	-	+	+	-	-	-
70. Vepris bilocularis	-	-	-	-	+	-
71. Xanthophyllum flavecens	+	+	+5	+	+	+2
72. Xylia xylocarpa	-	+	-	-	+	-

+ = Present, - = Absent,

$+^1$, $+^2$, $+^3$, $+^4$, $+^5$: first, second, third, fourth and fifth dominant species respectively in a given plot.

14. Occurrence of different tree species in seedling phase in evergreen forest plots (site II)

Species	Plots					
	Undisturbed plots			Disturbed plots		
	1	**2**	**3**	**1**	**2**	**3**
1. *Actinodaphne anguistifolia*	-	-	-	-	+	-
2. *Aglaia lawii*	+	-	+	+	-	+
3. *Antiaris toxicaria*	+5	+	+	-	-	-
4. *Aporusa lindleyana*	-	+	+	+	+	-
5. *Artocarpus hirsutus*	+	+	+1	+4	+	+
6. *Baccaurea courtallensis*	+	+	+	+	+	+5
7. *Calophyllum polyanthum*	+	-	-	-	-	-
8. *Casearia sps*	+	+	-	+3	+	+
9. *Cinnamomum sps*	+1	+5	+	+	+1	-
10. *Clausena dentata*	-	+	-	-	-	-
11. *Diospyros bourdillonii*	+	+3	+3	-	+5	+
12. *Diospyros candolleana*	+	+	+4	-	-	-
13. *Drypetes elata*	-	-	-	-	+	-
14. *Fahrenheitia zeylanica*	-	+	+	-	-	+
15. *Garcinia gummi-gutta*	+	+	-	+	-	+
16. *Garcinia morella*	+	-	-	-	-	-
17. *Harpullia arborea*	+	-	+	+5	+	-
18. *Holigarna arnottiana*	-	-	+	-	-	+3
19. *Hydnocarpus pentandra*	+	+	+2	-	-	+
20. *Ixora nigiricans*	+	+	+	+2	+	+1
21. *Karutharingi*	+	-	-	-	-	-
22. *Leptonychia moacurroides*	-	-	-	-	+	-
23. *Litsea sps*	+	+	+	-	-	-
24. *Macaranga peltata*	-	-	-	+	-	-
25. *Mallotus philippensis*	+	+	+	+	+4	-
26. *Mitragyna sps*	-	-	-	-	+	-
27. *Mitrephora grandiflora*	-	-	-	+	-	-
28. *Myristica dactyloides*	+3	+1	+	+	+	+
29. *Myristica sps*	+	+	+	+	-	+
30. *Bischofia javanica*	-	-	-	+	-	-
31. *Olea dioica*	-	+	+	-	+	-
32. *Otonephelium stipulaceum*	+	+2	+5	+	+2	+2
33. *Padathi*	-	-	-	-	+	-
34. *Persea macrantha*	-	+	-	-	-	-
35. *Polyalthia fragrans*	+	+	+	+	+3	+
36. *Pterospermum sps*	-	+4	-	+	+	+
37. *Pterygota alata*	+4	+	+	+	+	+
38. *Sapidnus laurifolia*	+	+	+	+	+	+
39. *Schleichera oleosa*	+	-	+	-	-	-
40. *Sterculia guttata*	-	+	+	+	+	+
41. *Stereospermum tetragonum*	-	-	+	-	-	-
42. *Strychnos nux-vomica*	-	-	+	-	-	-
43. *Syzygium sps*	+2	+	+	+1	+	+

44. *Tabernaemontana heyneana*	-	+	+	-	+	-
45. *Thaluppa*	+	-	-	-	-	-
46. *Valiyavattu*	-	+	+	-	-	-
47. *Vepris bilocularis*	+	-	-	+	-	+
48. *Xanthophyllum flavescens*	+	-	+	-	-	**+⁴**

+ = Present, - = Absent.

+[1], **+**[2], **+**[3], **+**[4], **+**[5] : first, second, third, fourth an fifth dominant species respectively.

15. Occurrence of different tree species in semi-evergreen plots at Vaniampuzha

Species	Plots		
	1	2	3
1. *Actinodaphne angustifolia*	-	-	+
2. *Alstonia scholaris*	+	-	-
3. *Antiaris toxicaria*	+	-	+
4. *Aporusa lindleyana*	+4	+1	+2
5. *Artocarpus hirsutus*	+	-	+
6. *Baccaurea courtallensis*	+	+	-
7. *Calophyllum polyanthum*	+	-	-
8. *Casearia sps*	+	-	-
9. *Cassia fistula*	-	-	+
10. *Chionanthus leprocarpa*	+5	-	-
11. *Cinnamomum malabatrum*	-	-	+
12. *Cinnamomum sps*	+	+	-
13. *Clausena dendata*	+	+	+
14. *Clerodendrum infortunatum*	-	+	+
15. *Dillenia pentagyna*	+	-	-
16. *Diospyros bourdillonii*	+1	+	+
17. *Diospyros candolleana*	+3	+	+
18. *Diospyros sylvatica*	-	-	+
19. *Fahrenheitia zeylanica*	+	-	+
20. *Flacourtia montana*	+	-	-
21. *Garcinia gummi-gutta*	-	-	+
22. *Garcinia morella*	-	+	-
23. *Harpullia arborea*	+	-	+
24. *Holarrhena pubescens*	+	-	-
25. *Holoptelia integrifolia*	-	+	-
26. *Hydnocarpus pentandra*	+	-	+
27. *Ixora nigricans*	+	+	+5
28. *Karutharingi*	+	-	-
29. *Lagerstroemia lanceolata*	+	-	-
30. *Lepisanthes decipiens*	+	+	-
31. *Leptonychia moacurroides*	-	+	+
32. *Litsea mysorensis*	+	-	-
33. *Litsea sps*	-	+	+
34. *Macaranga peltata*	-	+	+
35. *Mallotus philippensis*	+	+	+
36. *Mangifera indica*	+	-	-
37. *Microtropis wallichiana*	+	+	+
38. *Mitragyna tubulosa*	+	+	+
39. *Myristica dactyloides*	+	+	-
40. *Myristica sps*	+	+	+
41. *Naringi crenulata*	-	+	+
42. *Neeli*	-	-	+
43. *Olea dioica*	+	+	+
44. *Otonephelium stipulaceum*	+	-	-

45. Persea macrantha	+	+	+
46. Polyalthia fragrans	**+2**	+	**+3**
47. Pterospermum sps	+	+	+
48. Pterygota alata	+	**+5**	+
49. Sapindus laurifolia	+	+	+
50. Schleichera oleosa	-	+	+
51. Sterculia guttata	+	+	+
52. Stereospermum sps	+	**+4**	+
53. Strychnos nux-vomica	-	-	**+4**
54. Syzygium sps	+	+	-
55. Tabernaemontana heyneana	-	+	-
56. Terminalia paniculata	-	**+2**	-
57. Thaluppa	+	+	+
58. UIA	-	+	-
59. UIB	-	+	-
60. UIC	-	+	-
61. UIVaka	-	-	+
62. Valiyavattu	+	+	-
63. Vitex altissima	-	+	+
64. Xanthophyllum flavecens	+	+	-
65. Xylia xylocarpa	+	**+3**	**+1**

+ = Present, - = Absent.

$+^1$, $+^2$, $+^3$, $+^4$, $+^5$; first, second, third, fourth and fifth dominant species respectively in a given plot.

16. Occurrence of different tree species in seedling phase in semi-evergreen forests of Vaniampuzha

Species	Plots		
	1	2	3
1. *Actinodaphne angustifolia*	-	-	+
2. *Antiaris toxicaria*	+	+	+
3. *Aporusa lindleyana*	+	-	+
4. *Artocarpus hirsutus*	+	+	-
5. *Baccaurea courtallensis*	+	+	-
6. *Bischofia javanica*	+	+	+4
7. *Calophyllum polyanthum*	+	-	-
8. *Cinnamomum sps*	+	+	-
9. *Clerodendrum infortunatum*	-	+	+
10. *Diospyros bourdillonii*	+1	+	+
11. *Diospyros candolleana*	+2	+	-
12. *Diospyros sylvatica*	+	-	-
13. *Fahrenheitia zeylanica*	+	+	+
14. *Ficus exasperata*	-	+	+
15. *Garcinia gummi-gutta*	+	-	-
16. *Garcinia rubro-echinata*	-	+	-
17. *Harpullia arborea*	-	-	+
18. *Holigarna arnottiana*	+	-	+
19. *Hydnocarpus pentandra*	+	-	-
20. *Ixora nigricans*	+	+2	+2
21. *Leptonychia moacurroides*	-	+	+
22. *Litsea sps*	+	+	-
23. *Macaranga peltata*	-	-	+
24. *Mallotus philippensis*	+	+4	+
25. *Mangifera indica*	+	+	-
26. *Microtropis wallichiana*	+	+	+5
27. *Mitragyna tubulosa*	+	-	+
28. *Myristica dactyloides*	+5	+	-
29. *Myristica sps*	+	+	+
30. *Naringi crenulata*	-	+	+
31. *Olea dioica*	+	+1	+
32. *Otonephelium stipulaceum*	+	+	-
33. *Persea macrantha*	+	-	-
34. *Polyalthia fragrans*	+3	+5	+
35. *Pterospermum sps*	+	+	+3
36. *Pterygota alata*	+	-	-
37. *Sapindus laurifolia*	+	+3	+
38. *Persea macrantha*	+	-	-
39. *Polyalthia fragrans*	+3	+5	+
40. *Pterospermum sps*	+	+	+3
41. *Pterygota alata*	+	-	-
42. *Sapindus laurifolia*	+	+3	+
43. *Schleichera oleosa*	-	+	-
44. *Sterculia guttata*	+	+	+1

45. *Strychnos nux-vomica*	-	+	-
46. *Syzygium sps*	+	+	+
47. *Tabernaemontana heyneana*	-	+	+
48. *Thaluppa*	-	-	+
49. *Valiyavattu*	**+4**	+	-
50. *Vitex altissima*	-	-	+
51. *Xanthophyllum flavescens*	+	-	-
52. *Xylia xylocarpa*	-	+	+
53. *Ziziphus sps*	-	+	-

+ = Present, - = Absent.

$+^1$, $+^2$, $+^3$, $+^4$, $+^5$; first, second, third, fourth and fifth dominant species respectively in a given plot.

17. Occurrence of different tree species in moist deciduous forest plots (Site II)

Species	Plots		
	1	**2**	**3**
1. Aporusa lindleyana	-	+	+
2. Bauhinia racemosa	+	-	-
3. Bombax ceiba	+	+	-
4. Bridelia retusa	+	-	-
5. Cassia fistula	+	+	
6. Dalbergia lanceolaria	+	-	-
7. Dalbergia latifolia	$+^5$	+	+
8. Dillenia pentagyna	+	$+^3$	+
9. Emblica officinalis	+	-	+
10. Garcinia morella	+	-	-
11. Kalassu like	+	-	-
12. Lagerstroemia lanceolata	$+^3$	+	+
13. Lagerstroemia reginae	-	-	+
14. Leptonychia moacurroides	-	+	+
15. Litsea laevigata	+	-	-
16. Litsea sps	-	+	-
17. Macaranga peltata	-	+	-
18. Mallotus philippensis	+	-	-
19. Mitragyna tubulosa	+	+	$+^5$
20. Naringi crenulata	-	+	+
21. Olea dioica	+	+	-
22. Persea macrantha	-	+	-
23. Sapindus laurifolia	-	-	+
24. Schleichera oleosa	$+^4$	$+^5$	$+^2$
25. Sterculia guttata	+	+	-
26. Stereospermum sps	+	$+^4$	$+^4$
27. Strychnos nux-vomica	-	-	+
28. Tabernaemontana heyneana	+	+	+
29. Terminalia bellirica	+	+	+
30. Terminalia paniculata	$+^1$	$+^2$	$+^3$
31. uimelia like	-	+	-
32. vattakumil like	-	+	-
33. Wrightia tinctoria	+	-	-
34. Xylia xylocarpa	$+^2$	$+^1$	$+^1$

+ = Present, - = Absent.

$+^1$, $+^2$, $+^3$, $+^4$, $+^5$; first, second, third, fourth and fifth dominant species respectively in a given plot.

18. Occurrence of tree species in seedling phase in moist deciduous forest plots (Site II)

Species	Plots		
	1	**2**	**3**
1. *Anthocephalus cadamba*	-	+	-
2. *Aporusa lindleyana*	$+^3$	+	+
3. *Artocarpus hirsutus*	+	-	-
4. *Bauhinia racemosa*	-	-	+
5. *Bischofia javanica*	-	$+^4$	$+^3$
6. *Clerodendrum infortunatum*	-	+	-
7. *Dalbergia latidfolia*	-	-	$+^4$
8. *Ficus exasperata*	-	+	-
9. *Ficus sps*	-	-	+
10. *Holarrhena pubescens*	-	+	-
11. *Hydnocarpus pentandra*	+	-	-
12. *Leptonychia moacurroides*	+	-	+
13. *Litsea laevigata*	+	+	+
14. *Maacranga peltata*	-	+	-
15. *Mallotus philippensis*	$+^1$	+	+
16. *Microtropis wallichiana*	$+^5$	+	$+^5$
17. *Miliusa tomentosa*	+	-	-
18. *Naringi crenulata*	+	+	+
19. *Olea dioica*	-	+	+
20. *Persea macrantha*	$+^4$	+	-
21. *Polyalthia fragrans*	-	$+^5$	$+^2$
22. *Pterygota alata*	-	+	-
23. *Sapindus laurifolia*	+	+	+
24. *Schleichera oleosa*	$+^2$	$+^1$	+
25. *Sterculia guttata*	+	$+^2$	+
26. *Strychnos nux-vomica*	+	-	+
27. *Tabernaemontana heyneana*	-	-	+
28. *Terminalia paniculata*	-	-	+
29. *Xylia xylocarpa*	+	$+^3$	$+^1$
30. *Ziziphus sps*	-	+	-

+ = Present, - = Absent.

$+^1$, $+^2$, $+^3$, $+^4$, $+^5$; first, second, third, fourth and fifth dominant species respectively in a given plot.

19. Occurrence of different tree species in fire affected areas (site II)

Species	Plots		
	1	2	3
1. *Antiaris toxicaria*	+	-	-
2. *Aporusa lindleyana*	-	+	-
3. *Bombax ceiba*	-	+	-
4. *Careya arborea*	-	+	-
5. *Dalbergia latifolia*	+	$+^4$	$+^5$
6. *Dillenia pentagyna*	$+^5$	$+^3$	$+^4$
7. *Emblica officinalis*	-	+	-
8. *Holarrhena pubescens*	+	+	-
9. *Litsea sps.*	+	+	-
10. *Microtropis wallichiana*	-	+	-
11. *Mitragyna tubulosa*	+	+	-
12. *Naringi crenulata*	-	+	+
13. *Olea dioica*	+	-	-
14. *Sterculia guttata*	-	+	-
15. *Stereospermum sps*	$+^3$	+	$+^3$
16. *Strychnos nux-vomica*	+	-	-
17. *Tabernaemontana heyneana*	-	+	-
18. *Terminalia bellirica*	+	$+^5$	+
19. *Terminalia paniculata*	$+^2$	$+^2$	$+^2$
20. *Vellathakara*	-	+	-
21. *Vitex altissima*	-	+	-
22. *Wrightia tinctoria*	$+^4$	-	-
23. *Xylia xylocarpa*	$+^1$	$+^1$	$+^1$
24. *Ziziphus sps*	-	+	-

+ = Present, - = Absent.

$+^1$, $+^2$, $+^3$, $+^4$, $+^5$; first, second, third, fourth and fifth dominant species in the given plot respectively.

20. Occurrence of different tree species in seedling phase in the fire affected areas (Site II)

Species	Plots		
	1	2	3
1. *Anthocephalus cadamba*	+	+	-
2. *Antiaris toxicaria*	+	-	-
3. *Artocarpus hirsutus*	+	-	-
4. *Bambusa bambos*	-	$+^2$	-
5. *Bauhinia racemosa*	-	-	+
6. *Bischofia javanica*	+	+	-
7. *Careya arborea*	-	+	-
8. *Clerodendrum infortunatum*	$+^5$	-	-
9. *Dalbergia lanceolaria*	-	+	-
10. *Dalbergia latifolia*	-	+	-
11. *Dillenia pentagyna*	+	+	+
12. *Emblica officinalis*	-	+	-
13. *Ficus exasperata*	+	+	-
14. *Holarrhena pubescens*	+	$+^4$	+
15. *Litsea sps*	+	-	-
16. *Macaranga peltata*	+	-	-
17. *Mallotus philippensis*	+	-	-
18. *Miliusa tomentosa*	-	+	+
19. *Mitragyna tubulosa*	+	+	+
20. *Naringi crenulata*	+	$+^3$	$+^1$
21. *Olea dioica*	+	-	-
22. *Polyalthia fragrans*	$+^4$	+	-
23. *Schleichera oleosa*	$+^3$	-	-
24. *Sterculia guttata*	-	+	-
25. *Stereospermum sps*	-	+	-
26. *Tabernaemontana heyneana*	+	+	-
27. *Terminalia paniculata*	+	$+^5$	$+^4$
28. *Wrightia tinctoria*	+	-	-
29. *Xylia xylocarpa*	$+^1$	$+^1$	$+^2$
30. *Ziziphus sps*	$+^2$	+	$+^3$

+ = Present, - = Absent.

$+^1$, $+^2$, $+^3$, $+^4$, $+^5$; first, second, third, fourth and fifth dominant species in the given plot respectively.

21. Density and IVI of herbs in the fire affected moist deciduous forests.

Name	Density (individuals ha$^{-1)}$	IVI**
Channakoova (*Costus speciosus*)	240 (1640)	5.8 (7.9)
Churali (*Pteridium*) *	0 (560)	0 (2.7)
Chuvannakuringi (*Strobilanthes* sp.)	0 (2160)	0 (3.8)
Churali-2 (fern)	0 (560)	0 (1.7)
Kattu nellu (*Oriza* meyeriana) *	0 (1250)	0 (1.8)
Kattuchena (*Amorphophallus peonifolius*)	0 (525)	0 (2.1)
Kattukoova (*Curcuma* sps.) *	2960 (21575)	43.7 (39.1)
Kurumthotti (*Sida acuta*) *	0 (6250)	0 (9.5)
Mathurakuringi (*Strobilanthes* sp.)	0 (4250)	0 (4.3)
Narukku (Boesenbergia sp.)	0 (37500)	0 (36.9)
Nilamparappi (*Elephantopus scaber*) *	200 (5450)	5.9 (5.8)
Nilanarakam (*Naregamia alata*)	880 (1125)	30.7 (6.2)
Nilapana (*Curculigo orchioides*) *	6760 (16640)	80.1 (16.2)
Oorappan (*Abutilon* sp.)	280 (1250)	19.7 (2.4)
Padappan pullu	0 (3580)	0 (3.8)
Neykarichedi (Pouzolzia indica) *	0 (3680)	0 (4.3)
Grass-unidentified1	0 (17500)	0 (26.8)
Urumunda (Justicia sp.) *	0 (17560)	0 (20.1)
Vazhampola (*Commelina obliqua*) *	0 (960)	0 (4.6)
Unidentified 1	400(0)	7.2 (0)
Zingiber sp.	280 (0)	6.2 (0)
Grand Total	**12000 (144015)**	**200.0 (200.0)**

Values in parentheses are for moist deciduous forests not affected by fire.
*, Collected by tribes as food or medicine.
**, IVI was calculated based on density and frequency of distribution.

22. Density and IVI of shrubs in the fire affected moist deciduous forests.

Species	Density (individuals ha^{-1})	IVI**
Kayyoona (*Helicteres isora*) *	2200 (9255)	100.6 (97.0)
Karumkuringi (*Strobilanthus deccurrens*) *	0 (1225)	0 (21.0)
Mathurakuringi (*Strobilanthus* sp.) *	0 (8750)	0 (24.0)
Mullankaya (*Bridelia scandens*)	360 (1120)	30.6 (19.0)
Mullanpazham (*Zizyphus oenoplia*)	640 (560)	38.1 (7.1)
Peru (*Clerodendrum infortunatum*)	240 (575)	11.7 (13.5)
Poolakkan (*Uraria rufescens*) *	0 (1200)	0 (12.0)
Poomullu (*Pterolobium hexapetalum*)	0 (550)	0 (6.5)
Kara (Canthium sp.)	320 (0)	19.0 (0)
Grand Total	**3760 (23235)**	**200.0 (200.0)**

Values in parentheses are for moist deciduous forests not affected by fire.
***, Collected by tribes as food or medicine.**
****, IVI was calculated based on density and frequency of distribution.**

23. Density and IVI of climbers in the fire affected moist deciduous forests.

Species	**Density (individuals ha$^{-1)}$**	**IVI****
Eruvalli (*Clematis gouriana*) *	320 (1125)	24.2 (10.5)
Onapoovu(*Gloriosa superba*) *	0 (1250)	0 (4.80)
Ieenja (*Acacia intsia*) *	2080 (7650)	89.77 (41.2)
Kattukachil (*Dioscorea bulbifera*)	0 (560)	0 (4.2)
Kattukurumulaku (*Piper* sp.) *	80 (960)	7.3 (11.7)
Kattumulla (*Jasminum* sp.)	0 (2225)	0 (24.5)
Kaayeenga(*Acacia concinna*) *	0 (500)	0 (4.1)
Kollakkavalli (*Anamirta cocculus*) *	0 (525)	0 (3.8)
Kottaruvalli (*Moullava spicata*) *	0 (2525)	0 (12.1)
Maruma (*Cissus discolor*) *	0 (525)	0 (4.6)
Palvalli (*Ichnocarpus frutescens*)	320 (500)	19.2 (4.8)
Panambu	80 (3500)	7.3 (10.6)
Poodavally (*Ipomaea cairica*)	0 (500)	0 (3.8)
Pullani (*Claycopteris floribunda*)	120 (560)	8.5 (5.4)
Thippali (*Piper longum*) *	80 (1250)	6.2 (53.7)
Nannari (Hemidesmus indicus) *	360 (0)	25.3 (0)
Sathavari (*Asparagus racemosus*) *	40 (0)	12.3 (0)
Grand Total	**(3480) (24155)**	**200.0 (200.0)**

Values in parentheses are for moist deciduous forests not affected by fire.

*, Collected by tribes as food or medicine.

**, IVI was calculated based on density and frequency of distribution.

24. Density and IVI of herbs in the forest near tribal settlement (Site II)

Name	**Density (individuals ha$^{-1)}$**	**IVI**
Channakoova (*Costus speciosus*)	1500	6.86
Churuli (*Pteridium* sp.)	500	1.89
Chuvannakuringi (*Strobilanthes* sp.)	2000	3.33
Fern sp.	500	1.68
Kattu nellu (*Oryza meyriana*)	1000	1.98
Kattuchena (*Amorphophallus peonifoius*)	500	2.31
Kattukoova (*Curcuma* sps.)	21500	34.92
Kurumthotti (Sida acuta)	6000	7.84
Mathurakuringi (*Strobilanthus* sps.)	4000	3.74
Narukku (Boesenbergia sp.)	38500	40.26
Nilamparappi(*Elephantopus scaber*)	5500	5.80
Nilanarakam (*Naregamia alata*)	1000	4.61
Nilapana (*Curculigo orchioides*)	21000	17.16
Oorappan (*Urena lobata*)	1500	2.27
Padappan pullu	4000	3.45
Neykarichedi (*Pouzolzia indica*)	4500	4.04
UI Grass	23000	27.70
Urumunda (*Justicia* sp.)	19000	21.18
Vazhampola (*Commelina obliqua*)	1000	4.20
Grand Total	158000	200.00

25. Density and IVI of shrubs in the forest near tribal settlements (Site II).

Species	Density (individuals ha^{-1})	IVI
Kayyoona (*Helicteres isora*)	9500	94.98
Karumkuringi (*Strobilanthes deccurrens*)	1000	20.83
Mathurakuringi (*Strobilanthes* sp.)	9500	26.04
Mullankaya (*Bridelia scandens*)	1000	18.00
Mullanpazham (*Zizyphus oenoplia*)	500	7.29
Peru (*Clerodendrum infortunatum*)	500	14.58
Poolakkan (*Uraria rufescens*)	1000	12.79
Poomullu (*Pterolobium hexapetalum*)	500	5.50
Grand Total	**23500**	**200.00**

26. Density and IVI of climbers in the forest near tribal settlements (Site II)

Species	**Density (individuals ha$^{-1)}$**	**IVI**
Eruvalli (*Clematis gouriana*)	1000	9.47
Onapoovu(*Gloriosa superba*)	1000	5.30
Ieenga (*Acacia intsia*)	7000	40.88
Kattukachil (*Dioscorea bulbifera*)	500	3.82
Kattukurumulaku (*Piper* sp.)	1000	9.72
Kattumulla (*Jasminum* sp.)	2000	22.32
Kaayeenga(*Acacia concinna*)	500	4.21
Kollakkavalli (*Anamirta cocculus*)	500	4.21
Kottaruvalli (*Moullava spicata*)	2500	15.12
Maruma (*Cissus discolor*)	500	3.82
Palvalli (*Ichnocarpus frutescens*)	500	6.95
Panambu	3500	11.71
Poodavally (*Ipomoea cairica*)	500	3.82
Pullani (*Calycopteris floribunda*)	500	6.95
Thippali (*Piper longum*)	10000	51.72
Grand Total	**31500**	**200.00**

27. Birds observed in the forest using Timed Area Search method (Site I) (2 ha search in 20 minutes); Total area searched = 30 ha

Sl. No.	Bird species	Total birds Sighted
1.	Jungle babbler (*Turdoides striatus*)	23
2.	Black drongo (*Dicrurus macrocerus*)	18
3.	Red-vented bulbul (*Pycnotus cafer*)	11
4.	Purple sunbird (*Nectarina asiatica*)	9
5.	Oriental magpie robin (*Copsychus saularis*)	8
6.	Spotted dove (*Streptopelia chinensis*)	8
7.	Plumpheaded parakeet (*Psittacula cyanocephala*)	7
8.	Chestnutheaded bee-eater (*Merops leschenaulti*)	7
9.	Common myna (*Acridotherus tristis*)	7
10.	**Eurasian golden oriole** (*Oriolus oriolus*)*	6
11.	Black-hooded oriole (*Oriolus xanthornus*)	5
12.	Racket-tailed drongo (*Dicrurus paradiseus*)	5
13.	Thick-billed flowerpecker (*Dicaeum agile*)	5
14.	Common woodshrike (*Lanius pondicerianus*)	4
15.	Asian paradise flycatcher (*Terpsiphone paradisi*)	4
16.	White-rumped munia (*Lonchura striata*)	4
17.	Common tailor bird (*Orthotomus sutorius*)	3
18.	Crested serpent eagle (*Spilornis cheela*)	2
19.	Blackrumped flameback (*Dinopium benghalense*)	2
20.	Bluewinged leafbird (*Chloropsis cochinchinensis*)	2
21.	Heart spotted woodpecker (*Hemicircus canente*)	2
22.	Malabar greyhornbill (*Ocyceros griseus*)	2
23.	Malabar spurfowl (*Galloperdix spadicea*)	2
24.	Dark-fronted warbler (*Rhopocichla aticeps*)	2
25.	**Blue-faced malkoha (*Phaenicophaeus viridirostris*)**	**2**
26.	Brahminy kite (*Haliastur indus*)	1
27.	Pompadour green pigeon (*Treron pompadora*)	1
28.	House crow (*Corvus splendens*)	1
29.	Indian cuckoo (*Cuculus micropternus*)	1
30.	Orange-headed thrush (*Zoothera citrina cyanotus*)	1
31.	Rufous treepie (*Dendrocitta vagabunda*)	1
32.	Shikra (*Accipiter badius*)	1
33.	Common hawk cuckoo (*Hierococcyx varius*)	1
34.	White bellied drongo (*Dicrurus caerulescens*)	1
35.	**White-rumped shama (*Copsychus malabaricus*)**	**1**
36.	Yellowbilled babbler (*Turdoides affinis*)	1
37.	Crimson breasted barbet (*Megalaima haemacephala*)	X
38.	White cheeked barbet (*Megalaima viridis*)	X
Total		161

* Migratory; X Call heard

28. List of Birds at Vaniampuzha (Site II)

Sl. No.	
	FAMILY ACCIPITRIDAE
1	Crested serpent eagle *(Spilornis cheela)*
2	Shikra *(Accipiter badius)*
	FAMILY ALCEDINIDAE
3	Common kingfisher *(Alcedo atthis)*
	FAMILY ARDEIDAE
4	Black bittern *(Dupetor flavicollis)*
5	Little egret *(Egretta garzetta)*
6	Little green heron *(Butorides striatus)*
7	Pond heron *(Ardeola grayii)*
	FAMILY BUCEROTIDAE
8	Malabar grey hornbill *(Ocyceros griseus)*
	FAMILY CAMPEPHAGIDAE
9	Scarlet minivet *(Pericrocotus flammeus)*
10	Small minivet *(Pericrocotus cinnamomeus)*
	FAMILY CENTROPIDAE
11	Greater coucal *(Centropus sinensis)*
	FAMILY CHARADRIIDAE
12	Common sandpiper *(Actitis hypoleucos)*
13	Red-wattled lapwing *(Vanellus indicus)*
	FAMILY COLUMBIDAE
14	Emerald Dove *(Chalcophaps indica)*
15	Pompadour green pigeon *(Treron pompadora)*
16	Nilgiri wood pigeon *(Columba elphinstonii)*
17	Spotted dove *(Streptopelia chinensis)*
	FAMILY CORVIDAE
18	House crow *(Corvus splendens)*
19	Jungle crow *(Corvus macrorhynchos)*
20	Rufous Treepie *(Dendrocitta vagabunda)*
21	White-bellied Treepie *(Dendrocitta leucogastra)*
	FAMILY CUCULIDAE
22	Common hawk cuckoo *(Hierococcyx varius)*
23	Indian cuckoo *(Cuculus micropterus)*
	FAMILY DACELONIDAE
24	Stork-billed kingfisher *(Halcyon capensis)*
25	White-throated kingfisher *(Halcyon smyrnensis)*
	FAMILY DICAEIDAE
26	Pale-billed flowerpecker *(Dicaeum erythrorhynchos)*
	FAMILY DICRURIDAE
27	Bronze drongo *(Dicrurus aeneus)*
28	Greater racket-tailed drongo *(Dicrurus paradiseus)*
	FAMILY HIRUDINIDAE
29	Red-rumped swallow *(Hirundo daurica)*
	FAMILY IRENIDAE
30	Common iora *(Aegithina tiphia)*
31	Asian fairy bluebird *(Irena puella)*
32	Golden-fronted leafbird *(Chloropsis aurifrons)*

33	Blue-winged chloropsis *(Chloropsis cochinchinensis)*
	FAMILY MEGALAIMIDAE
34	Coppersmith barbet *(Megalaima haemacephala)*
35	White-cheeked barbet *(Megalaima viridis)*
	FAMILY MEROPIDAE
36	Chestnut headed bee-eater *(Merops leschenaulti)*
	FAMILY MOTACILLIDAE
37	Grey wagtail *(Motacilla cinerea)*
38	Forest wagtail *(Dendroanthus indicus)*
	FAMILY MUSICAPIDAE
39	Black-naped monarch flycatcher *(Hypothymis azurea)*
40	Dark-fronted babbler *(Rhopocichla atriceps)*
41	Greenish warbler *(Phylloscopus trochiloides)*
42	Jungle babbler *(Turdoides striatus)*
43	Oriental Magpie robin *(Copsychus saularis)*
44	White-rumped shama *(Copsychus malabaricus)*
45	Malabar whistling thrush *(Myiophonus horsfieldii)*
46	Rufous babbler *(Turdoides subrufus)*
47	Indian scimitar babbler *(Pomatorhinus horsfieldii)*
48	Common tailorbird *(Orthotomus sutorius)*
49	Orange-headed thrush *(Zoothera citrina cyanotus)*
	FAMILY NECTARINIIDAE
50	Loten's sunbird *(Nectarinia lotenia)*
51	Purple sunbird *(Nectarinia asiatica)*
52	Purple rumped sunbird *(Nectarinia zeylonica)*
53	Crimson-backed sunbird *(Nectarinia minima)*
	FAMILY ORIOLIDAE
54	Black-hooded oriole *(Oriolus xanthornus)*
55	Eurasian golden oriole *(Oriolus oriolus)*
	FAMILY PHALACROCORACIDAE
56	Little cormorant *(Phalacrocorax niger)*
	FAMILY PHASIANIDAE
57	Grey junglefowl *(Gallus sonneratii)*
	FAMILY PICIDAE
58	Black -rumped flameback *(Dinopium benghalense)*
59	Lesser yellownape *(Picus chlorophus)*
60	Heart-spotted woodpecker *(Hemicircus canente)*
61	Brown-capped woodpecker *(Dendrocopos nanus)*
	FAMILY PITTIDAE
62	Indian pitta *(Pitta brachyura)*
	FAMILY PLOCEIDAE
63	Black-throated munia *(Lonchura keraarti)*
64	White-rumped munia *(Lonchura striata)*
	FAMILY PSITTACIDAE
65	Vernal hanging parrot *(Loriculus vernalis)*
	FAMILY PYCNONOTIDAE
66	Yellow-browed bulbul *(Iole indica)*
67	Red-whiskered bulbul *(Pycnonotus jocosus)*
68	Red-vented bulbul *(Pycnonotus cafer)*

69 Black crested bulbul *(Pycnonotus melanicterus gularis)*

FAMILY RALLIDAE

70 White-breasted waterhen *(Amaurornis phoenicurus)*

FAMILY STRIGIDAE

71 Brown hawk owl *(Ninox scutulata)*

FAMILY STURNIDAE

72 Common Myna *(Acridotheres tristis)*

73 Blyths Myna *(Sturnus malabaricus blythii)*

74 Hill Myna *(Gracula religiosa)*

FAMILY TROGONIDAE

75 Malabar Trogon *(Harpactes fasciatus)*

29. Insects recorded on various host plants (Site I)

Name of the plant	**Insect pests**	*Nature of damage*	**Remarks**
Artocarpus heterophyllus	1.Termites 2.Glyphodes bivitralis *(Lep: Pyraustidae)* 3.Mites	Wilting of plants Defoliation Wilting of leaves	Damge to roots causing seedling mortality. Low incidence. Leaf webbing caterpillars cause minor damage to foliage. Minor pest
Xylia xylocarpa	1.*Indomias hispidulus* (Col: Curculionidae) 2.*Boarmia sp.* (Lep: Geometridae)	Leaf damage Leaf feeding	Minor pest Potential pest of saplings
Cassia fistula	1.*Catopsilia pomona* (Lep: Pieridae)	Severe defoliation	Potential pest of saplings
Dalbergia latifolia	1.Unidentified caterpillar	Leaf feeding	Minor pest
Cinnamom zeylanicum	1.*Chilasa clytia* (Lep: Papilionid caterpillar)	Defoliation	Potential pest of saplings
Wrightia tinctoria	1.Unidentified caterpillar	Leaf rolling	Minor pest
Alstonia scholaris	1.*Parotis vertumnalis* (Lep. Pyralidae)	Leaf webbing	Serious pest
Terminalia bellerica	1.Termites	Wilting of plants	Minor pest
Emblica officianalis	1.Psyllid bug	Gall formation	Minor pest
Strychnos	1.Caterpillar	Defoliation	Minor pest

30. List of Insects reported from Vellimuttom (Site I)

	Agroecosystem	Degraded forest
Order		
Family		
LEPIDOPTERA		
RHOPALOCERA		
PAPILIONIDAE		
Chilasa clytia Lin.		✔
Troides minos Cram.	✔	✔
P. polymnestor parinda Moore	✔	✔
Graphium sarpedon teredon Felder	-	✔
G. agamemnon agamemnon Lin.	-	✔
Pachliopta aristolochiae Lin.	✔	✔
P. hector Lin.	✔	✔
Papilio polytes thesus Cramer	-	✔
P. demoleus demoleus Lin.	✔	✔
NYMPHALIDAE		
Moduza procris Cramer	✔	✔
Tanaecia lepidea (Butler)	-	✔
Cupha erymanthis maja Fruhstorfer	-	✔
J. atlites Lin.	-	✔
J. lemonias vaisya Fruhstorfer	-	✔
J. almana	-	✔
Precis iphita pluvialis Fruhstorfer	-	✔
Hypolimnas bolina Lin.	-	✔
H. missipus Lin.	-	✔
Neptis hylas varmona Moore	✔	✔
N. jumbah	-	✔
Ergolis ariadne (Johanssen)	✔	✔
AMATHUSIIDAE		
Discophora lepida lepida Moore	-	✔
DANAIDAE		
Tirumala limniace leopardus Butler	✔	✔
T.sepentrionis dravidarum Fruhstorfer	✔	✔
Danaus genuita genuita Cramer	✔	✔
D. chrysippus (Lin.)	✔	✔
Euploea core core Cramer	✔	✔
PIERIDAE		
Delias eucharis Drury	-	✔
A. albina Boisduval	-	✔
Anaphaeis aurota	✔	✔
C. pomona Fb.	-	✔
C. pyranthe Lin.	✔	✔
Eurema hecabe Lin.	-	✔
Eurema sp.	✔	✔
Leptosia nina Fb.	-	✔

SATYRIDAE		
Mycalesis sp.	-	✔
M. patnia Moore	-	✔
Lethe europa Fb.	-	✔
L. drypetis	-	✔
Ypthima baldus	-	✔
Ypthima sp.	-	✔
Elymnias caudata Butler	-	✔
Orsotrioena medus mandata Moore	-	✔
Melanitis leda Lin.	✔	✔
HESPERIDAE		
Celaenorrhinus ambareesa (Moore)	-	✔
Celaenorrhinus sp.	-	✔
Taractrocera ceramas (Hewitson)	-	✔
Telicota ancilla Lin.	-	✔
Potanthus ? palnia Fruhstorfer	-	✔
Gangara thyrsis	✔	✔
LYCAENIDAE		
Castalius rosimon (Fb.)	-	✔
Caleta caleta	-	✔
Udara akasa	-	✔
Cheritra freja (Fb.)	-	✔
Jamides alecto (Felder)	-	✔
J. celeno (Cramer)	-	✔
Chilades ?pandava	-	✔
RIODINIDAE		
Abisara echerius Stoll	-	✔
ACRAEIDAE		
Acraea violae (Fb.)	✔	✔
HETEROCERA		
NOCTUIDAE		
Achaea janata Fb.	✔	✔
Blenina sp.	-	✔
C. subtilis Walker	-	✔
Mocis frugalis Fb.	✔	✔
S. mauritia Boisduval	✔	✔
LYMANTRIIDAE		
Euproctis fraterna *Moore*	✔	-
E. diagramma Guen.	-	✔
Euproctis sp.1	✔	✔
Euproctis sp.2	✔	✔
Euproctis sp.3	✔	✔
Euproctis sp.4	-	✔
Euproctis sp.5	-	✔
ARCTIIDAE		
Rhodogastria astreas Drury	-	✔
Argina syringa Cram.	✔	✔
A. argus Koll.	✔	✔

Argina sp.	-	✔
Asura conferta Walker	-	✔
A. rubricosa Moore	-	✔
Asura sp.1	-	✔
Asura sp.2	-	✔
Chionaema peregrina Walker	-	✔
Creatonotus gangis Lin.	✔	✔
Diaphania indica	✔	✔
Eligma narcissus Cram.	✔	✔
Estigmene perotetti	-	✔
Hypsa alciphron Cram.	✔	✔
Neochera dominio Cram.	-	✔
Pericallia ricini Fb.	-	✔
Bostra ?indicator Walker	-	✔
YPONOMEUTIDAE		✔
Atteva fabriciella Swed.	✔	✔
GEOMETRIDAE		
Borbacha sp.nr.pardonica Guen.	-	✔
Buzura? suppressaria Walker	-	✔
Scopula sp.	-	✔
PYRALIDAE		
Glyphodes celsalis Walker	-	✔
G. laticostalis Guen	-	✔
G. vertumnalis Guen.	✔	✔
G. glauculalis Guen.	✔	✔
G. bivitralis	✔	✔
G. marginata Hamp.	-	✔
Psara ?bipunctalis Fb.	✔	-
P. basalis	✔	-
Pycnarmon caberalis Guen.	✔	-
Pygospila tyres Cram.	-	✔
S. derogata Fb.	✔	-
Syngamia abruptalis Walker	-	✔
AMATIDAE		
Eressa confinis Walker	-	✔
Amata extensa Walker	-	✔
Euchromia polymena	-	✔
Syntomis thoracica	-	✔
SPHINGIDAE		
Macroglossa sp.	-	✔
SATURNIDAE		
Loepa sp.	-	✔
COLEOPTERA		
Carabidae		
Omphra sp.	-	✔
Dytiscidae		
Hydaticus ? vittatus	-	✔
Cicindelidae		

Cicindela corticata	-	✔
Curculionidae		
Myllocerus viridianus Fb.	-	✔
Myllocerus sp1.	-	✔
Myllocerus sp2.	-	✔
Chrysomelidae		
Aulocophora unicolor Illig.	-	✔
Cerambycidae	-	
Prionomma atratum Gmelin.	-	✔
Cerosterna scrabarator	-	✔
Dynastidae		
Oryctes rhinocerus	✔	-
Lagriidae		
Lyprops sp1.	✔	-
Lyprops sp2.	✔	-
Lyprops Curticollis Foirm.	✔	-

31. Socioeconomic details

POPULATION DYNAMICS

Indicators	Site I	Site II
Total population	1657 (333 hh)	215 (43 hh)
Male	49.8 %	54.42%
Female	50.2%	45.58%
Average family size	4.97 (5)	5

Primary data estimates
hh : household

EDUCATIONAL STATUS

Primary stakeholders	Literate	Illiterate	Total
A. SITE I			
Farmers	414 (26.07)* (98.10)**	8 (11.59)* (1.90)**	422
Labourers	957 (60.26)* (96.08)**	39 (59.52)* (3.92)**	996
Tribals	25 (1.57)* (92.59)**	2 (2.90)* (7.41)**	27
Disadvantaged	59 (3.72)* (78.67)**	16 (23.19)* (21.33)**	75
Others	133 (8.38)* (97.08)**	4 (5.80)* (2.92)**	137
Total	1588 (100)* (95.84)**	69 (100)* (4.16)**	1657
B. SITE II			
Iruttukuthi	51 (60.71)* (42.50)**	33 (39.29)* (34.74)**	84
Vaniam-puzha	50 (55.56)* (41.67)**	40 (44.44)* (42.11)**	90
Tharipppatti	19 (46.34)* (15.83)**	22 (53.66)* (23.16)**	41
Total	120 (55.81)* (100)**	95 (44.19)* (100)**	215

Primary data estimates
*Percentage to vertical total
**Percentage to horizontal total

OCCUPATIONAL PATTERN OF TRIBES – SITE II

Sources	No. in %
NTFP collection	44
Wage labour	5
Tapping	3
NTFP & wage labour	15
Fuel wood	6
Fire watcher	6
Unemployed	21

Primary data estimates

SIZE OF LAND HOLDING (%) - SITE I

Primary Stakeholders	Marginal	Small	Medium	Large
Farmers	10	23	40	27
Labourers	27	46	21	6
Tribals	60	40	-	0
Disadvantaged	71	24	-	5
Others	24	31	28	17
Total	26	37	25	12

Primary data estimates
Marginal:0-10 cents; Small: 10-50 cents; Medium: 50-200cents; Large: 200 cents &above.

CROPPING PATTERN (%) - SITE I

Primary Stakeholders	Mixed	Paddy	Rubber
Farmers	68	1	31
Labourers	82	1	17
Tribals	60	-	40
Disadvantaged	95	-	5
Others	76	3	21
Total	78.9	0.09	20.12

Primary data estimates

MORBIDITY RATE - SITE II

Primary Stakeholders	Rate (%)
Male: site	47.8
State average	20.9
Female: site	93.8
State average	20.3
total : site	70.8
State average	20.6

Primary data estimates

32. Ethno botanical information (Site II) (Species-wise information collected from the tribes)

1. *Abrus precatorius*	
Local name	**Chuvanna kunni**
Location	All landscape units. Open and disturbed areas are more suitable.
Availability	Frequent
Seasons of availability or collection	Mainly July to February. Climbers dry off during dry season climbers.
Properties	Medicinal
Demand	Low
Marketing	No
Etymology	Fruit (**Kunni**) with red (**Chuvannna**) coloured seeds
Remarks	Crushed vines are put over the abdomen for curing urinary diseases.

2. *Acacia concinna*	
Local name	**Kayeenga**
Location	Moist deciduous forests and some open areas in Evergreen forests.
Availability	Frequent
Seasons of availability or collection	In February-March
Properties	Medicinal
Demand	High
Marketing	Yes
Etymology	**Kaya** (fruit) available from **Ieenga** plant
Remarks	Fruits are used for bathing and also used as detergent

3. *Acacia intsia*	
Local name	**Paleenga,Paleenja,Kuliyeenga**
Location	All landscape units
Availability	Frequent
Seasons of availability or collection	All seasons
Properties	Medicinal
Demand	Low
Marketing	No
Etymology	When the bark of this plant is put in water, water becomes white in colour. Hence the name of this plant is **Paleenja.** The bark is used for bathing so another name for this plant is **Kuliyeenga**.

Remarks	Bark is used for bathing and as detergent.

4. *Anamirta cocculus*	
Local name	**Kollakkavalli**
Location	All landscape units, mainly in moist deciduous forests
Availability	Frequent
Seasons of availability or collection	Seed collection from January to March
Properties	Medicinal
Demand	High
Marketing	Yes
Remarks	Used as a poison for catching fishes

5. *Aristolochia indica*	
Local name	**Karalakam**
Location	Moist deciduous forests
Availability	Not frequent
Seasons of availability or collection	June to February
Properties	Medicinal
Demand	Low
Marketing	No
Remarks	a) It is believed that, if *Aristolochia indica* and *Cyclea peltata* are growing together, these two plants can be used to make a band to tie around the shoulder. By doing so, the wild animals will not attack the wearer of this band. However, association of *Aristolochia* and *Cyclea* is very rare. b) To know whether snake poison is present or not, the leaf of the plant is given to victms for chewing. If the leaves taste sweet, the victim has snake poison. If leaves taste bitter, there is no poison in his body. A mixture made by grinding *Aristolochia* with fresh turmeric can be applied over the swellings caused by snakebite the swelling will be cured. c) A decoction made from this plant with the roots of Helicteres isora and fruit cover of *Myristica* and Apama siliquosa is used for curing stomach pain.

6. *Asparagus racemosus*	
Local name	**Chathavari**
Location	All landscape units. Grows well in sandy soil
Availability	Frequent
Seasons of availability or collection	All seasons

Properties	Medicinal
Demand	High
Marketing	Yes
Use by wild animals	During hot summer season leaves are eaten by deer and rhizomes by termites

7. *Biophytum sensitivum*	
Local name	**Urakkamarunnu , Mukkutti**
Location	Moist deciduous forests and open areas in evergreen forests
Availability	Frequent
Seasons of availability or collection	June to February
Properties	Medicinal
Demand	Low
Marketing	No
Itimology	Used for getting sound sleep(**Urakkam**)
Remarks	This plant and *Mimosa pudica* are used to keep inside the pillows for getting sound sleep

8. *Boesenbergia* sps.	
Local name	**Valiya Narukku**
Location	Marshy lands
Availability	Not frequent
Seasons of availability or collection	All seasons
Properties	Roofing
Demand	Low
Marketing	No
Remarks	Leaves are used for thatching.

9. *Bridelia scandens*	
Local name	**Kundanvalli**
Location	Moist deciduous forests and disturbed areas around the settlements
Availability	Frequent
Seasons of availability or collection	All seasons
Properties	Medicinal
Demand	Low
Marketing	No
Remarks	Sap of fruits used for curing wound on tongue

10. *Calamus hookerianus*	
Local name	**Chooral**
Location	Mainly in evergreen forests in hilly areas
Availability	Frequent

Seasons of availability or collection	All seasons, more during in July to January
Properties	Used for making baskets
Demand	High
Marketing	Yes

11. *Cissus discolor*	
Local name	**Maruma**
Location	All landscape units
Availability	Frequent
Seasons of availability or collection	All seasons
Properties	Leaves are used as vegetable
Demand	Low
Marketing	No

12. *Clematis gouriana*	
Local name	**Eruvalli**
Location	All landscape units however, more dense in moist deciduous forests
Availability	Frequent
Seasons of availability or collection	June to March
Properties	Medicinal
Demand	Low
Marketing	No
Etymology	Smell and taste are hot
Remarks	Plant is ground to apply over head or forehead to cure headache and mucous congestion. If this plant ground with seeds of wild sesame which growing in rocky area, the effect will be more.

13. *Clitoria ternatea*	
Local name	**Kalivalli**
Location	All landscape units
Availability	Frequent
Seasons of availability or collection	All seasons
Demand	Low
Marketing	No
Remarks	Children eat young fruits. The vines are used as a brush for bathing cattle.

14. *Coscinium fenestratum*	
Local name	**Maramanjal**
Location	Undisturbed, and cool areas with hardy soil
Availability	Not frequent

Seasons of availability or collection	All seasons
Properties	Medicinal
Demand	High
Marketing	Yes
Etymology	Brown bark like in trees and inner side of the climber is yellow as in turmeric
Remarks	The juice extracted from the plant is used for various ophthalmic problems

15. *Curculigo orchioides*	
Local name	**Nilappana**
Location	All landscape units
Availability	Frequent
Seasons of availability or collection	October to March
Properties	Medicinal
Demand	Medium
Marketing	No
Etymology	Leaves at the ground level (**nila**), and the structure of plant is like a palm (**pana**)
Use by wild animals	The rhizome is eaten by civets, rats, porcupine
Remarks	Powdered rhizome is used for nourishment and as an energizer.

16. *Curcuma zedoaria*	
Local name	**Manjakoova**
Location	Moist deciduous forests
Availability	Frequent
Seasons of availability or collection	March-April
Properties	Medicinal and Food
Demand	High
Marketing	No
Etymology	Yellow (**manja**) rhizome

17. *Curucma sps.*	
Local name	**Vellakkoova**
Location	Moist deciduous forests
Availability	Frequent
Seasons of availability or collection	March-April
Properties	Food

Demand	Low
Marketing	No
Etymology	Plant with white rhizome
Remarks	Powdered rhizome is used as food for children

18. ***Cycas circinalis***	
Local name	**Eenthal**
Location	Hilly open areas
Availability	Not frequent
Seasons of availability or collection	Seeds available in May-June
Properties	Food
Demand	High
Social or religious importance	Leaves are used to make *pandals* constructed during marriage, festival etc.
Remarks	After removing toxic contents of the seeds by soaking them in water for few days, they will be powdered and used to prepare various food items

19. ***Cyclea peltata***	
Local name	**Padakizhangu**
Location	All landscape units
Availability	Frequent
Seasons of availability or collection	September to January
Properties	Medicinal
Demand	High
Marketing	Yes

20. ***Desmodium gangeticum***	
Local name	**Valiya orila**
Location	Moist deciduous forests
Availability	Frequent
Seasons of availability or collection	All seasons
Properties	Medicinal
Demand	High
Marketing	Yes

21. ***Desmodium gyrense***	
Local name	**Pennumayakki**
Location	In moist deciduous forests, open areas in other types of forests and on road sides
Availability	Not frequent
Seasons of availability or collection	July to March

Properties	Medicinal
Demand	Low
Marketing	No
Etymology	Plant used to attract ladies
Remarks	It is believed that along with **Oppena** (*Desmodium* sps.) the plant is used for attracting ladies/women

22. *Desmodium laxiflorum*	
Local name	**Valiya moovila, Palathi**
Location	Moist deciduous forests
Availability	Frequent
Seasons of availability or collection	July to March
Properties	Medicinal
Demand	High
Marketing	Yes
Etymology	Leaves and fruits attach to the body of animals, hence the name **Palathi**

23. *Desmodium velutinum*	
Local name	**Orila**
Location	Moist deciduous forests and open areas in evergreen forests
Availability	Frequent
Seasons of availability or collection	All seasons ; more in September to January
Properties	Medicinal
Demand	High
Marketing	Yes
Etymology	Single leaf from one node.
Use by wild animals	Leaves eaten by wild boar, deer and porcupine

24. *Dioscorea oppositifolia*	
Local name	**Kavala**
Location	All landscape units. Less in rocky patches in evergreen forests
Availability	Frequent
Seasons of availability or collection	November to March
Properties	Food
Demand	High
Marketing	No
Remarks	a) For removing the undigested particles like hair from the digestive tracts, the cooked tuber is consumed b) Fresh tuber is consumed as antidote

	to spider bite

25. *Dioscorea pentaphylla*	
Local name	**Korana**
Location	All landscape units. More in rocky patches
Availability	Frequent
Seasons of availability or collection	November-December
Properties	Food
Demand	High
Marketing	No

26. *Dioscorea wallichii*	
Local name	**Kattukizhangu**
Location	All landscape units but less in evergreen forests
Availability	Frequent
Seasons of availability or collection	November to March
Properties	Food
Demand	High
Marketing	No
Etymology	Rhizomes (**Kizhangu**) from forest (**kadu**)

27. *Dioscorea sp.*	
Local name	**Mothakka**
Location	All landscape units
Availability	Frequent
Seasons of availability or collection	November- December
Properties	Food
Demand	High
Marketing	No
other remarks	Rhizomes are edible. Before the preparation of food the sliced tuber should be kept in water for two days to remove the toxic chemicals

28. *Dioscorea sp.*	
Local name	**Choruga**
Location	All landscape units
Availability	Frequent
Seasons of availability or collection	November – August
Properties	Food

Demand	High
Marketing	No
Itimology	Fresh rhizomes cause an irritation (**chorugu**) on tongue
Remarks	Powdered rhizome is used as food for children

29. *Diploclisia glaucescens*	
Local name	**Peenakkodi**
Location	Evergreen forests, mainly in wet areas
Availability	Not frequent
Seasons of availability or collection	All seasons
Properties	Medicinal
Demand	Low
Marketing	No
Remarks	It is believed that if we keep the mixture of **Peenari** (*Sterculia guttata*), **Penakodi** and bamboo powder extracted by abrading bamboo with any tree along with this plant, near the boarder of one's house hold area, the unwanted neighbours can be kept out.

30. *Elephantopus scaber*	
Local name	**Nilamparappi**
Location	Open areas and road sides in all landscape units
Availability	Frequent
Seasons of availability or collection	June to March
Properties	Medicinal
Demand	Low
Marketing	No
Etymology	Leaves spread over the ground
Remarks	Decoction of the leaves is used for treating stomach pain

31. *Embelia ribes*	
Local name	**Elathoori**
Location	Moist deciduous forest
Availability	Frequent
Seasons of availability or collection	All seasons
Properties	Food
Demand	Low

Marketing	No
Remarks	Leaves used for making curries

32. ***Ensete superbum***	
Local name	**Kalluvazha**
Location	Hilly areas in crevices between rocks
Availability	Not frequent
Seasons of availability or collection	February-March
Properties	Food
Demand	High
Marketing	Yes
Etymology	Similar to plantain (**vazha**) but fruits with stony seeds
Remarks	Ornamental. Fruits edible and have cooling effect

33. ***Entada scandens***	
Local name	**Kakkummottan,Kakkummotta**
Location	Near streamlets and rivulets
Availability	Frequent
Seasons of availability or collection	July-August
Properties	Medicinal
Demand	High
Marketing	Yes
Remarks	a) Seeds edible and good for curing digestive disorders. b) Powdered seeds boiled with oil can be applied over limbs for curing pain. c) Processed seeds are also used for curing rheumatism and used as an appetizer. d) Crushed vines are used for bathing for getting freshness

34. ***Euphorbia hirta***	
Local name	**Kuthippullu**
Location	Moist deciduous forest and wet open lands
Availability	Frequent
Seasons of availability or collection	June to March
Properties	Medicinal
Demand	Low
Marketing	No

Etymology	Inflorescence looks like ringworm (**Kuthi**) infected area in the body
Remarks	If the crushed roots are consumed along with along with the food the skin diseases like ringworm can be cured.

35. *Gloriosa superba*	
Local name	**Onakizhangu,Onapoovu**
Location	All landscape units with sandy soil
Availability	Frequent
Seasons of availability or collection	December-January
Properties	Medicinal
Demand	Low
Marketing	No

36. *Helicteres isora*	
Local name	**Kayyoona**
Location	Moist deciduous forests and open areas in other type of forests
Availability	Frequent
Seasons of availability or collection	All seasons
Properties	Medicinal
Demand	Low
Marketing	Yes
Etymology	Bark is used for making rope
Remarks	a) Decoction made from the root of this plant, bark of *Myristica malabarica*, *Bridelia crenulata, Elepahntopus scaber*, *Aristolochia indica* and *Curcuma longa* is used for curing stomach pain b) The bark is used to make rope

37. *Hemidesmus indicus*	
Local name	**Nannari**
Location	Mainly seen in moist deciduous forests and open areas in evergreen forests
Availability	Frequent
Seasons of availability or collection	All seasons
Properties	Medicinal
Demand	High
Marketing	Yes
Itimology	Plant with good smell
Remarks	a) High demand in summer season. b) Dried root powder is used as a flavouring agent.

	c) Used as blood purifier d) Roots of this plant with tortoise, turmeric, pepper and small cumin after boiling used for curing piles

38. *Holostemma ada-kodien*	
Local name	**Adapathiyan**
Location	Moist deciduous forests. Less in evergreen forests
Availability	Not frequent
Seasons of availability or collection	November to January
Properties	Medicinal
Demand	High
Marketing	Yes
Remarks	Rhizome is edible

39. *Ipomoea obscura*	
Local name	**Kalivalli, Bagaravalli**
Location	All landscape units bur more common in wet areas
Availability	Frequent
Seasons of availability or collection	June to March
Properties	Medicinal
Demand	Low
Marketing	No
Use by wild animals	Sambar deer and spotted deer eat the leaves
Remarks	Fried and powdered leaves boiled with oil and made into a paste (**kuzhambu**), is good for curing burns and wounds. It will give better result if the **kuzhambu** is applied using a chicken feather

40. *Ipomoea sp.*	
Local name	**Ettukalimarunnu**
Location	Mainly seen on the banks of rivulets
Availability	Not frequent
Seasons of availability or collection	All seasons
Properties	Medicinal
Demand	Low
Marketing	No
Etymology	Plants used as a medicine (**marunnu**) for spider (**Ettukali**) bite

41.	***Justicia sp.***
Local name	**Urumunda**
Location	Moist deciduous forests and open areas in evergreen forests
Availability	Frequent
Seasons of availability or collection	June to January
Properties	Food
Demand	Low
Marketing	No
Remarks	Used for preparing curry

42.	***Luffa aegyptiaca***
Local name	**Peechinga**
Location	Moist deciduous forests
Availability	Not frequent
Seasons of availability or collection	June to December
Properties	Medicinal
Demand	Low
Marketing	Yes
Remarks	Dried fruits used as a brush

43.	***Moullava spicata***
Local name	**Kottaruvalli, Kazhangikkuru**
Location	Mainly in moist deciduous forests
Availability	Frequent
Seasons of availability or collection	July-August
Properties	Medicinal
Demand	High
Marketing	Yes
Etymology	Plant with hook (Coot) like thorn
Remarks	Using the fibre for making coir.

44.	***Mucuna pruriens***
Local name	**Naikkorana, Thoova**
Location	Open areas near to streamlets
Availability	Frequent
Seasons of availability or collection	March-April
Properties	Medicinal
Demand	Low
Marketing	Yes
Etymology	Hairs on fruits cause irritation, so the name **Thoova**
Remarks	a) Crushed vines are tied on legs to

	avoid the formation of cracks due to cold. b) Young seeds are used for the preparation of curries. c) The mature seeds have demand, but irritation caused by the hairs on fruit walls causes difficulty in collection.

45. *Mussaenda frondosa*	
Local name	**Vellilam**
Location	Near to rivulets and streamlets and some other wet lands
Availability	Frequent
Seasons of availability or collection	All seasons
Properties	Special
Demand	Low
Marketing	No
Remarks	Inserting a piece of mature twig of this plant into a wooden pipe makes a wind musical instrument. Such musical instruments are usually used in death anniversary celebrations

46. *Nervilia aragoana*	
Local name	**Koovala**
Location	All landscape units
Availability	Not frequent
Seasons of availability or collection	July to January
Properties	Medicinal
Demand	High
Marketing	Yes

47. *Oryza meyeriana*	
Local name	**Kozhinellu**
Location	Moist deciduous forests
Availability	Not frequent
Seasons of availability or collection	Plants available in July to January Seeds available in November-December
Properties	Medicinal
Demand	Low
Marketing	No
Etymology	Structure like paddy (**nellu**) and seeds eaten by Wild chickens
Use by wild animals	Seeds by chickens, birds
Remarks	If, by accident, fish bones happened to

	fix in the throat, consumption of this plant and its fruits after grinding helps to clear the throat by breaking the fish bone

48. *Pancratium triflorum*	
Local name	**Kattulli**
Location	Moist deciduous forests and some areas in evergreen forests
Availability	Frequent
Seasons of availability or collection	November to January
Properties	Medicinal
Demand	Low
Marketing	No
Etymology	Looks like onion (**Ulli**)
Remarks	Diseases of nails of the foot can be cure by placing legs on the roasted rhizomes. During the course of treatment he should abstain from smoking and chewing tobacco.

49. *Pholidota imbricata*	
Local name	**Athi**
Location	All landscape units
Availability	Frequent
Seasons of availability or collection	All seasons
Properties	Medicinal
Demand	Low
Marketing	No
Remarks	After heating the stem of this plant, the juice can be squeezed out from the plant. This juice can be used to cure ear diseases

50. *Piper longum*	
Local name	**Thippali,Thuppala**
Location	All landscape units
Availability	Frequent
Seasons of availability or collection	All seasons. Collection is more in September to January
Properties	Medicinal
Demand	High
Marketing	Yes
Remarks	Root and inflorescence are used for curing toothache

51. ***Piper sp.***	
Local name	**Choraku**
Location	All landscape units
Availability	Frequent
Seasons of availability or collection	All seasons
Properties	Medicinal
Demand	High
Marketing	Yes
Remarks	Crushed roots are used for curing toothache

52. ***Piper sp.***	
Local name	**Kattukurumulaku**
Location	Mainly in evergreen forests and areas near to streamlets
Availability	Not frequent
Seasons of availability or collection	January
Properties	Medicinal
Demand	High
Marketing	Yes
Etymology	Wild (**kattu**) pepper (**kurumulaku**)

53. ***Pouzolzia indica***	
Local name	**Neykkari**
Location	All landscape units
Availability	Frequent
Seasons of availability or collection	June to January
Properties	Food
Demand	Low
Marketing	No
Etymology	Leaves and stem glaze and have ghee (**neyyu**) like appearance
Remarks	Leaves and shoots are used for making curries.

54. ***Pseudarthria viscida***	
Local name	**Moovila**
Location	Moist deciduous forest and open areas in other types of forests
Availability	Frequent
Seasons of availability or collection	All seasons
Properties	Medicinal
Demand	High

Marketing	Yes
Etymology	Trifoliate (**moovila**) leaf

55. ***Pteridum sp.***	
Local name	**Chottivalli**
Location	All regions
Availability	Frequent
Seasons of availability or collection	All seasons
Properties	Medicinal
Demand	Low
Marketing	No
Remarks	If we tie the crushed vines around abdomen, it will help to cure the urinary infection

56. ***Rauvolfia serpentina***	
Local name	**Uchalipoovan, Amalpuri**
Location	Moist deciduous forests
Availability	Not frequent
Seasons of availability or collection	All seasons
Properties	Medicinal
Demand	Low
Marketing	No
Remarks	Decoction is used for identifying the presence or absence of snake venom in one's body. If venom is there the wounded area will get irritation

57. ***Rotula aquatica***	
Local name	**Kallurmanji, Kalmanji, Cherumanji, Puzhamanji**
Location	Riverine plant. Seen in sockets between small rocks in rivulets. Prefers sandy soil
Availability	Not Frequent
Seasons of availability or collection	All seasons, but collection is more in September to January
Properties	Medicinal
Demand	High
Marketing	Yes
Etymology	a) Seen in between rocks (**kallu**)and thus called **Kalmanji** b) Seen in river (**puzha**) and thus called **Puzhamanji.**
Use by wild animals	Spotted deer and sambar deer eat the

	leaves and young twigs
Remarks	a) Pieces of the plant with *Leucas aspera*, turmeric and cumin boiled in water and mixed with broken rise kanji for curing urinary problems (**moothrachoodu**) b) Used as blood purifier and energizer.

58. *Salacia sps*	
Local name	**Eenakam**
Location	All landscape units. More in rocky patches
Availability	Frequent
Seasons of availability or collection	All seasons
Properties	Medicinal
Demand	Low
Marketing	No
Remarks	Collect the roots without using any type of iron weapon, grind it and apply on piles for curing

59. *Scleria parvula*	
Local name	**Valanpullu**
Location	All landscape units
Availability	Frequent
Seasons of availability or collection	Mainly in June-March
Properties	Medicinal
Demand	Low
Marketing	No
Etymology	The edge of the stem is like a sword (**valthala**) and the plant appears like a grass (**pullu**), so the name is **valanpullu**
Remarks	The bruised roots are consumed for abortion. After the consumption of the drug an extensive bathing is recommended

60. *Selaginella willdenovii*	
Local name	**Vettupunninidunna marunnu**
Location	All landscape units
Availability	Frequent
Seasons of availability or collection	June-February
Properties	Medicinal
Demand	Low
Marketing	No
Etymology	Plants used for curing wounds

Remarks	A mixture of this plant and white powder seen on bamboo culms is good for treating the wounds

61. *Sida acuta*	
Local name	**Kurumthotti**
Location	All landscape units but mainly in moist deciduous forest and open areas in other forest types
Availability	Frequent
Seasons of availability or collection	Collection is more during November to January
Properties	Medicinal
Demand	High
Marketing	Yes

62. *Strobilanthes deccurens*	
Local name	**Karimkuringi**
Location	All landscape units
Availability	Frequent
Seasons of availability or collection	All seasons
Properties	Medicinal
Demand	High
Marketing	Yes
Etymology	*Strobilanthes (***kuringi**) with deep green leaves and brown petioles

63. *Strobilanthes sp.*	
Local name	**Mathurakuringi**
Location	All landscape units
Availability	Frequent
Seasons of availability or collection	All seasons
Properties	Medicinal
Demand	High
Marketing	Yes
Etymology	*Strobilanthes (***kuringi**) whose roots are sweet in taste

64. *Thottea siliquosa*	
Local name	**Odakachala**
Location	All landscape units but mainly seen in areas near to streamlets
Availability	Frequent
Seasons of availability or collection	All seasons

Properties	Medicinal
Demand	Low
Marketing	No
Etymology	Stem hollow inside as in case of reed (**oda**) and thus the name **odakachala**
Remarks	The decoction made from roots or seeds are used for curing stomach pain and dysentery

65.	***Uraria rufescens***
Local name	**Poolakkan**
Location	Moist deciduous forests and open areas in evergreen forests
Availability	Frequent
Seasons of availability or collection	All seasons but collection is more during September to January
Properties	Medicinal
Demand	High
Marketing	Yes
Etymology	Root arrangement and shape of roots similar to tapioca (**poola**)

66.	***Urena lobata***
Local name	**Oorakam**
Location	All landscape units
Availability	Frequent
Seasons of availability or collection	June to March
Properties	Medicinal
Demand	Low
Marketing	No
Etymology	It is very difficult to remove fruits if they stick to hair
Remarks	By placing the fruits under the pillow one can get sound sleep

67.	***Vernonia cinerea***
Local name	**Poovamkurungil**
Location	Moist deciduous forests and open areas in other types of forests
Availability	Frequent
Seasons of availability or collection	June to February
Properties	Medicinal
Demand	Low
Marketing	No
Remarks	Extract of this plant with *Coscinium* (**maramanjal**), tamarind leaves and fresh coriander is used for curing ophthalmic

	diseases

68. *Vitis lanata*	
Local name	**Vallimanga**
Location	All landscape units
Availability	Frequent
Seasons of availability or collection	Fruits available during July- August
Properties	Food
Demand	High
Marketing	No
Etymology	A climber (**valli**) with fruits which have sour taste like in mango(**manga**)
Remarks	Fruits are used for making pickles.

33. Health report (site II)

Diagnosis	***Male***	***% of Total****	***% of Total*****	***Female***	***% of Total****	***% of Total*****	**Total**	***% of Total****
Cardiac(Hemalogy)	0	*0.00*	*0.00*	1	*1.09*	*100.00*	1	*0.68*
Intestinal disorder	12	*21.43*	*38.71*	19	*20.65*	*61.29*	31	*20.95*
Malnutrition	24	*42.86*	*42.11*	33	*35.87*	*57.89*	57	*38.51*
Opthalmology	2	*3.57*	*50.00*	2	*2.17*	*50.00*	4	*2.70*
Orthopedics	0	*0.00*	*0.00*	1	*1.09*	*100.00*	1	*0.68*
Resperatory	10	*17.86*	*35.71*	18	*19.57*	*64.29*	28	*18.92*
Skin disease	5	*8.93*	*38.46*	7	*7.61*	*53.85*	12	*8.11*
Gastro Entritis	3	*5.36*	*30.00*	7	*7.61*	*70.00*	10	*6.76*
Tuberculosis	0	*0.00*	*0.00*	1	*1.09*	*100.00*	1	*0.68*
Others	0	*0.00*	*0.00*	3	*3.26*	*100.00*	3	*2.03*
Total	**56**	***100.00***	***37.58***	**92**	***100.00***	***61.74***	**148**	*100.00*

* - Vertical Total ** - Horizontal Total

Cardiac(Hematology)

D - Congenital Heart Disease

V S D - Ventricular Septal Defect

Gastro Entritis

A P D - Acid Peptic Disorder

Intestinal disorder

A D D - Acute Diarrhoeal Disease

V F - Viral Fever

Worm Infestation

Diahoria

Acidity

Opthalmology

Squint

Thalmia

Conjuctivitis

Myopia

Malnutrition

Aneamia

Aneamia & Vit.A Deficiency

Deficiency Syndrome

Vitamin A Deficiency

Orthopedics

Arthritis

Others

Dermoid

Thyroid swelling

Lipoma

Respiratory

A R I - Acute Respiratory Infection

Acute Sinasitis

Acute Bronchitis

Chest Infection

U R I - Upper Respiratory Infection

Allergic Bronchitis

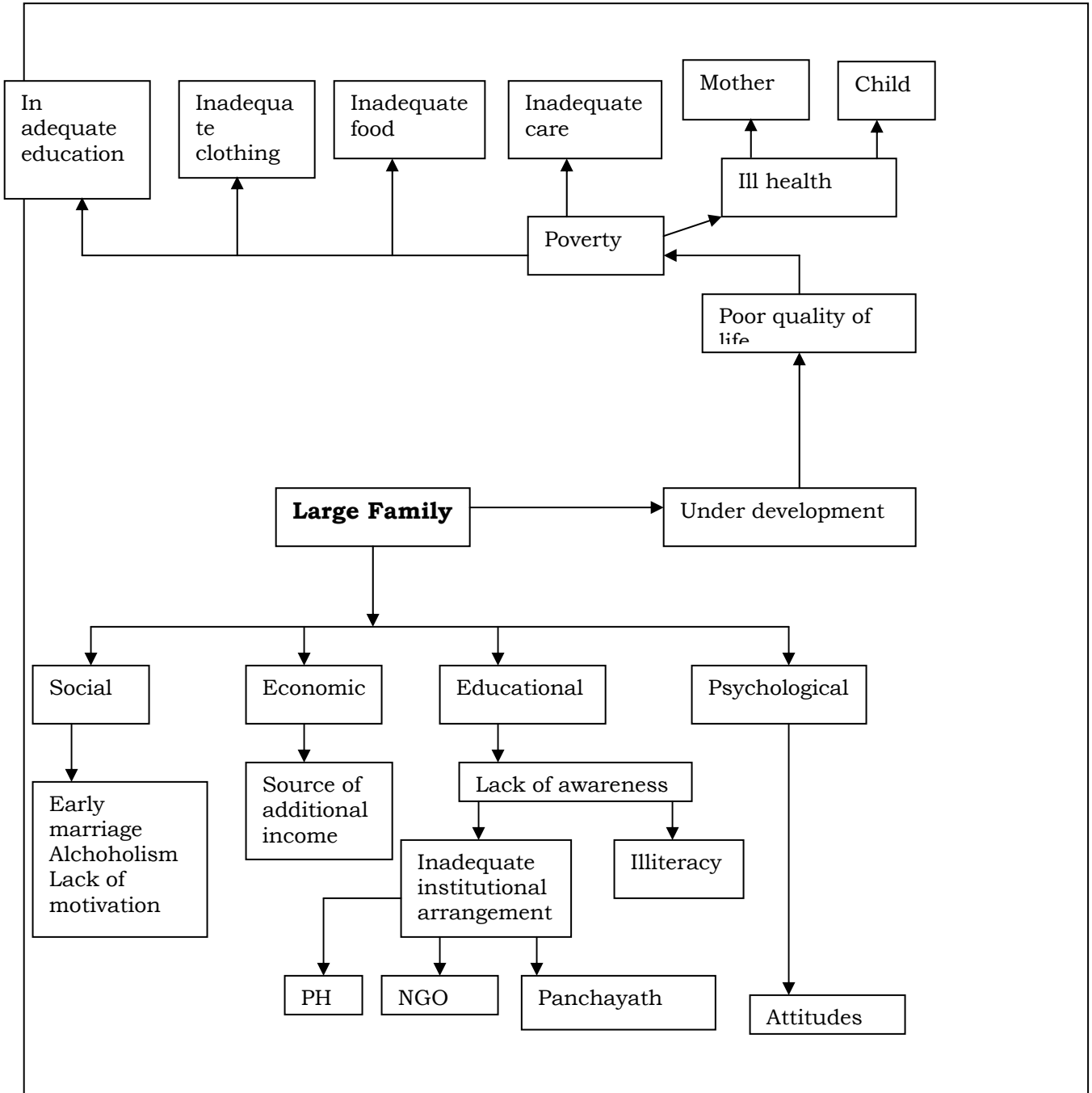
Skin disease

Pyodoma

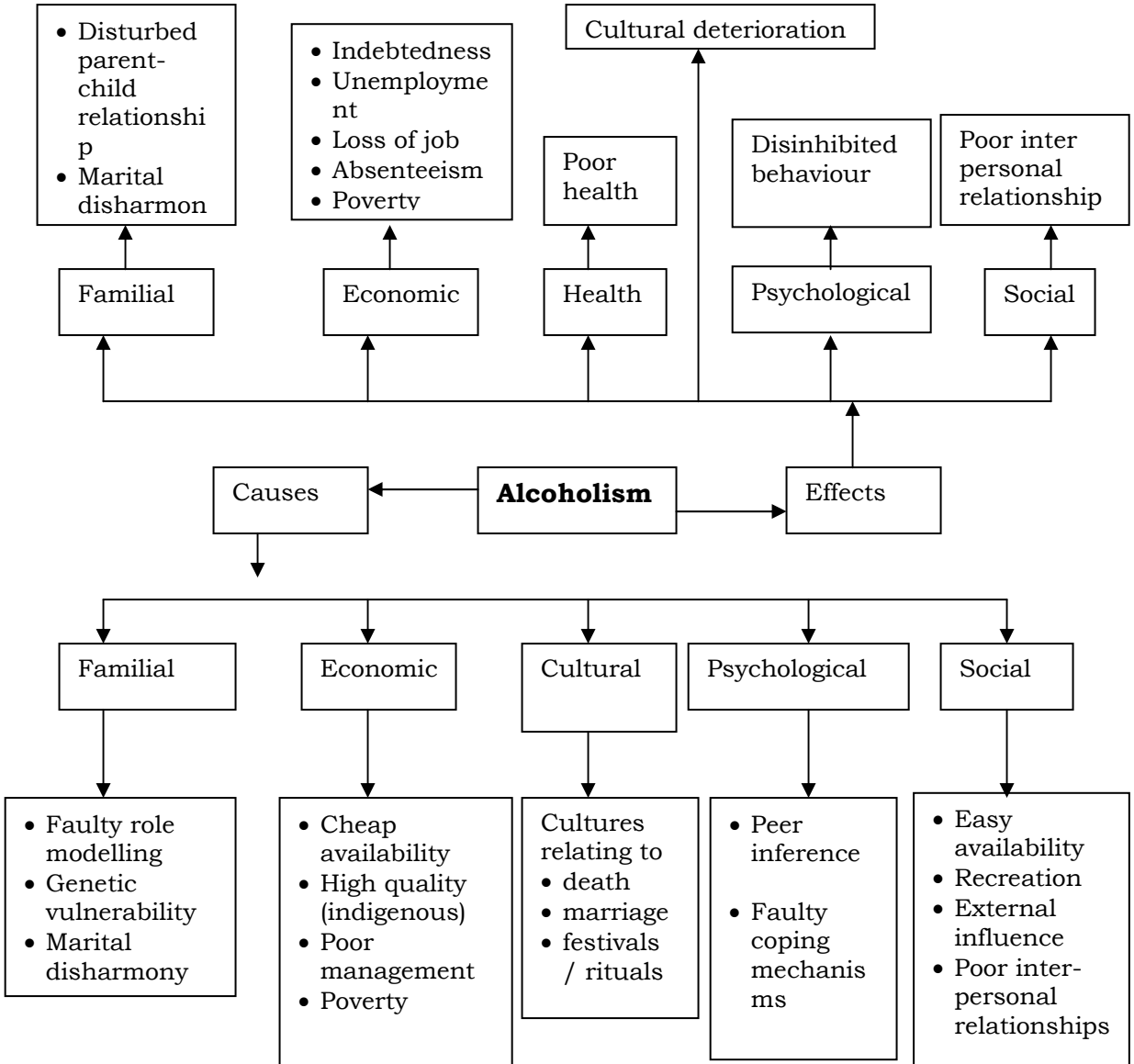
Scabbies

Tenia

34. Problem tree analysis (Site II)



35. Cause-effect analysis of alcoholism (site II)



36. NWFPs Seasonality (Site II)

Item	Chingam	Kanni	Thulam	Vrischikam	Dhanu	Makaram	Kumbam	Meenam	Medam	Edavam	Midhunam	Karkidakam
Then							X	X	X↓			
Manjal				X	X							
Pandam	X	X	X	X	X	X	X	X	X	X	X	X
Kollakkai						X ↑	X↑					
Cheenikkai					X	X ↑	X↑					
Padakizhangu	#	#	#	#	#	#				#	#	#
Nannari		#	#	#								
Karinkurinji	X	X	X									
Orila	X	X	X									
Moovila	X	X	X									
Amalpori	#	#	#	#	#					#	#	#
Thipilli	X	X	X									
Manjakuva				#	#							
Sathavari		X	X	X	X				X	X		
Kattakhiangu	X ↑	X↑	X↑	X ↑	X	X	X	X			X	X
Inth	X									X↑	X ↑	X
Mezhgu							X	X	X↓			
Jathpathri							X	X	X			
Kudampuli	X										X ↑	X ↑
Nelikka				#	#	#						
Uruvanchi					#	#						
Maramanjal	X↓	X↓	X↓	X ↓	X↓	X↓	X↓	X↓	X↓	X↓	X ↓	X↓
Kurumulagu					X	X						
Mango							X	X↑	X↑			
Kalumanja			X	X	X							
Chorkka	X	X	X	X								
Kollarakka	◯											
Kattuingi	◯											
Kavalakizhiungu	X ↑	X↑	X	X	X	X				X	X	X
Vanni	X	X	X	X	X	X				X	X	X

Item	Chingam	Kanni	Thulam	Vrischikam	Dhanu	Makaram	Kumbam	Meenam	Medam	Edavam	Midhunam	Karkidakam
Cheruthain										X	X	X
Neettikuru									X	X		
Nellinja					X	X	X	X				
Vallipazham					X	X						
Kallinchpazham							X	X				
Puvathipazhaam										X	X	X
Kurampzham											X	X
Jackfruit							X	X				
Elam												X
Manginchi											X	X
Echirapazham												
Kottapazham					X							
Manjipazham									X	X		
Thulampazham							X	X				
Vetakotapazham									X	X		
Karalagam	X	X	X	X	X	X	X	X	X	X	X	X
Choorali	X	X	X	X	X	X	X	X	X	X	X	X
Irulanka						X						
Lemon	X	X	X	X	X	X	X	X	X	X	X	X
Kattumalli										X	X	X
Kattujeerkam										X	X	X
Mulangaripazham					X	X						
Thugavali				X	X	X	X					
Payarvalli				X	X	X	X					
Kakkumkkai				X	X	X	X					
Naginchi				X	X	X	X					
Koduvelli						X	X	X				

Karimalapzham						X	X	X				
Cheenari								X	X	X	X	

Codes / Symbols

- Currently not available

Not available (extinct)

high availability (month)

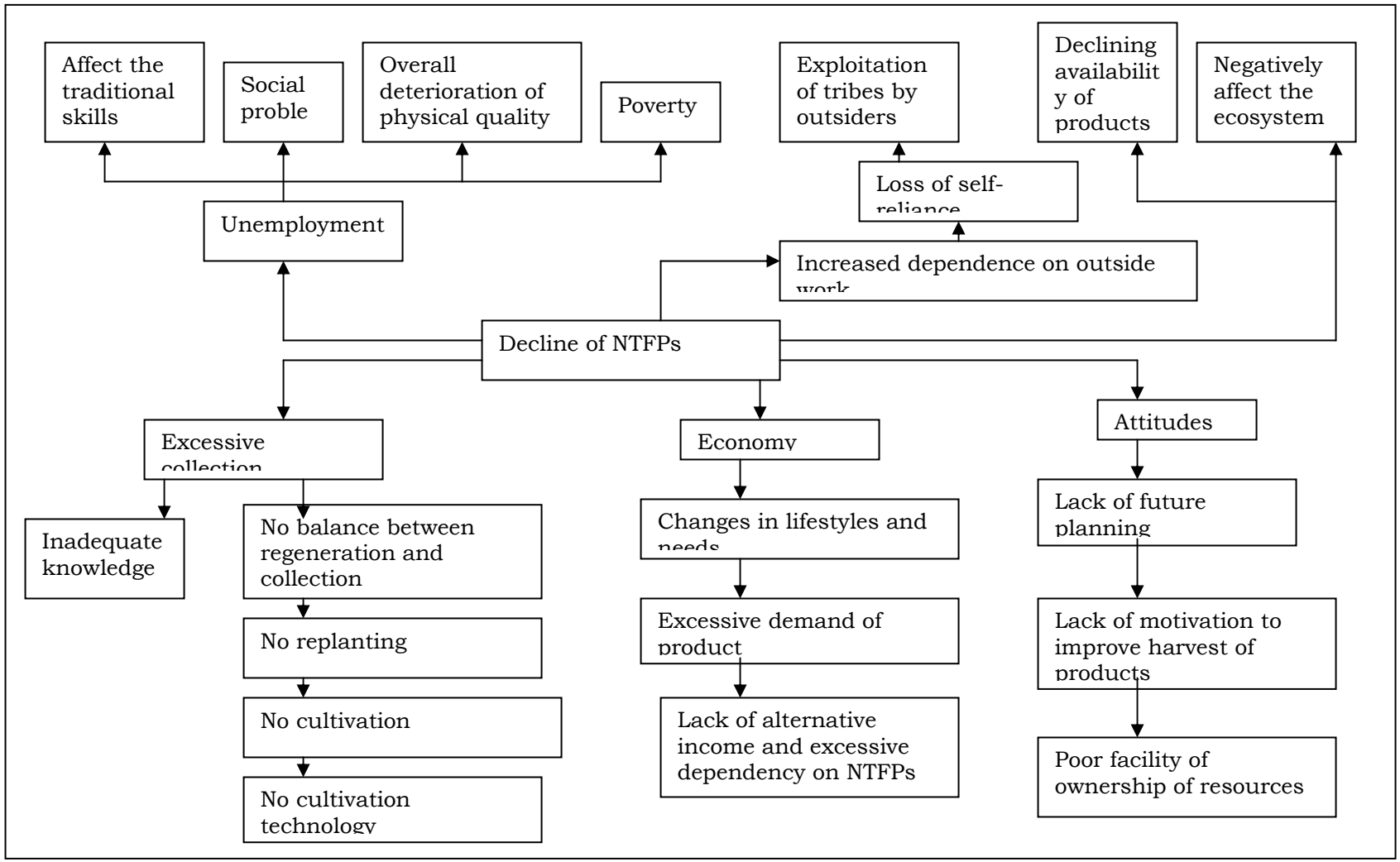
Low availability (months)

37. List of NWFPs collected from Site II

Name	**Scientific Name**
Honey	*Apies sps.*
Kasthoorimanjal	*Curcuma aromatica*
Pandam White / Black)	*Vateria indica / Canarium strictum*
Pollakkai	*Anamirta cocculus*
Cheenikkai	*Acacia concinna*
Padakizhingu	*Cyclea peltata*
Nannari	*Hemidesmes indicus*
Karimkurinji	*Strobilanthes ciliatus*
Orila	*Desmodium velutinum*
Moovila	*Pseudarthria viscida*
Amalpori	*Rauvolfia serpentina*
Thippili	*Piper lomgem*
Manjakuva	*Curcuma aungustifolia*
Sathavari	*Asparagus racemosus*
Inth	*Cycus cirunalis*
Mezhgu (wax)	*Apies sps.*
Jathipathiri	*Myristica dactyloides*
Kodampuli	*Garcinia morella (or Gummi - gutta)*
Nellikkai	*Phyllanthus emblica*
Uruvanchi	*Sapindus laurifolius*
Maramanjal	*Coscinium fenestratum*
Kurumulagu	*Piper argyrophyllum*
Mango	*Mangifera indica*
Chorukka	*Lagenaria vulgaris*
Kollarakka	*Lac sps.*
Kattuinchi	*Zingiber zerumbet*
Kavalakizhanga	
Venni'	
Cheruthain	*Apies sp.*
Neettikuru	
Neellinja	
Vallipazham	
Puvathipazham	
Kurampazham	
Jackfruit	*Artocarpus hetrophyllus*
Name	**Scientific Name**
Elam	*Eletaria cardamomum*
Mangainchi	*Curcuma amada*

Echerapazham	
Kottapazham	*Zizyphus sps.*
Manjipazham	
Nunalpazham	
Vellukottapazham	
Karlagam	*Aristolochia indica*
Churooli	*Mesua ferrea*
Irulankkai	*Xylia xylocarpa*
Lemon	*Citrus sps.*
Kattumalli	
Kattujeerkam	
Mulangaripazham,	
Thugavalli? Vadam	*Sterculi villosa?*
Payarvalli	*Vigna trilobata / Dolichos trilovus*
Kakkumkkai	*Entada Rheedii*
Naginchi	
Koduveli	*Plumbago zeylanica*
Karimalapzham	
Cheenari	

38. Cause-effect analysis of NWFP resources (Site II)



39. WORKSHOP REPORT

Kerala Forest Research Institute and Kerala Forest Department organised a ten day workshop on Participatory Forest Management from 12-01-2001 to 21-01-2001, at Vaniampuzha tribal settlement of Nilambur North division, with the active participation of last semester MSW students and faculty members of Sreesankaracharya University of Sanskrit, Kalady. The workshop was organised in continuation with the community organisation process which have been carried out in the field under the project titled 'Rehabilitation of degraded forest areas', from 2000 April onwards.

The objectives of this workshop were,

A] To understand whether the community consider VSS formation as their need.

If yes, create an environment for VSS formation.

B] To understand the nature of forest dependency of the tribal community.

C] To examine the role of tribal co-operative society in collection, processing, marketing, and selling of NTFP at Vaniampuzha.

D] To understand the socio-economic status of three-tribal colonies at Vaniampuzha.

E] To understand the psycho-social problems of three tribal colonies at Vaniampuzha.

F] To ascertain the level of participation of tribal communities in present and future programs.

The workshop started with a simple inaugural function on the banks of river Chaliyar on 12-01-2001 at 4.30pm. Dr. Mammen Chundamannil, scientist, KFRI, presided over the function and Mr. Haridas, Forester Vaniampuzha Forest Division, welcomed the participants of the workshop. Mr. Ramakrishnan, a resident of Iruttukuthi tribal settlement inaugurated the workshop and welcomed them to three tribal settlements of Vaniampuzha.

On 13-01-2001, Saturday the participants made community visits and started community diagnosis. They started preparation of individual document with case studies. Mr. Jose Antony Areekkal, Lecturer of MSW department made a session on 'Human Resource Management among tribals in the evening hours of the day.

On 14-01-2001, Sunday the participants concentrated their research studies on familial interaction, inter colony interaction, rituals and practices, women and child rearing practices, social problems etc. During evening session Mr. Dileep Kumar, Research Fellow, KFRI presented a paper on Project Planning and Implementation.

On 15-01-2001, the participants conducted a transit walk inside the forest area to examine tribal community's dependence on NTFP. Followed by the transit walk the members drew a resource map of Vaniampuzha Forest Beat with the active participation of the tribal group. Dr Mammen Chundamannil took a session on economic dependency of tribals on forest in the evening hours of the day. The participants prepared an interview guide to conduct socio economic survey at Vaniampuzha on the same day.

On 16-01-2001, the participants conducted a socio-economic survey and ascertained the role of Tribal Co-operative Society at Vaniampuzha. They crosschecked the information about the society that KFRI had already collected and added new information based on their direct interaction with the community. Mr. Subash T.V. the Executive Director of Care and Share International (NGO) presented a paper on 'Economic Side of Project Proposal during evening session'.

On 17-01-2001, the core content of the programme was started with the arrival of Mr. Jacob Mathew PFM Consultant at the Forest Head Quarters. The whole day was taken for Participatory Rural Appraisal session. Selected tribal people of three colonies participated in the PRA session. At noon Dr Anitha, Scientist KFRI took a session on 'Dimensions of Socio-economic Dependency of Tribal People on Forest'. Simultaneously with individual documentation, the group leaders started preparation of group document.

On 18-01-2001, the implementation of PRA techniques was done with the information the participants collected from three colonies. The participants drew Seasonality Diagram, Resource Map, Problem Tree Diagram, Job Matrices Diagram, Forest Resource Diagram etc with the active participation of men and women tribal folk. The two days PRA sessions produced a lot of pictorial representation of data that the participants collected from community and forest. Dr. Sankar, Scientist KFRI also participated in the workshop and introduced a new PRA tool for Wealth Ranking and Community Diagnosis.

On 19-01-2001, the day was totally given for preparation of group document. In the evening all the three group participants presented their group document. They critically evaluated information collected and finalised the group document for the preparation of team document.

On the morning of 20-01-2001 the group leaders started the preparation of the team document and completed the same before noon. In the afternoon the participants together with KFD and KFRI staff submitted the team document before the "Nattukootam" for their close scrutiny of the problems identified and for the participative evaluation. Existing document further corrected new issues identified were added to the team document and finally modified team document i.e. master document, explaining the psycho-social, socio-economic and cultural status of the three tribal settlement prepared.

OUTCOME OF THE WORKSHOP

1. The tribal people considered the formation of Vana Samrakshana Samithi as their own need, for the conservation of forest area and for their own development.

2. Created a congenial environment for the formation of Vana Samrakshana Samithi at Vaniampuzha.

3. A self-explanatory pictorial master document explaining psycho-social, socio-economic and cultural interaction among people and forest at Vaniampuzha prepared.

4. Ensured high level of participation of the community in the workshop activities and a commitment to improve the degraded forest areas at Vaniampuzha.

Lessons learnt: Issues identified in the participatory process

Until the recent past, conservation practices largely ignored the resource dependence and traditional rights of primary stakeholders. Consequence of this is the existing strained relationships between officials and the resultant suffering for primary stakeholders. Community involvement in conservation has had significant positive ecological, social, economic and policy impacts (Kothari *et al*, 1997). There are still a whole lot of issues that need to be well understood and resolved before participatory management as a tool of management is undertaken. In both the sites, the project has experimented with establishing a PFM. The experiences gained from these experiments have been very valuable, especially in the light of the landscape ecological approach. Some important issues identified in PFM based on a landscape approach are discussed below.

Stakeholder identification*:* Site I indicate a multiple stakeholder's community feature, involved with the initiative. Site II depicts a homogeneous entity. However, not all stakeholders have the same interest and involvement in the conservation of a resource and not all are affected equally if the resource is destroyed. The genuine stakeholder should be identified based on certain criteria, viz., intensity of primary and secondary dependence on the resources for survival/basic livelihood; proximity/accessibility; traditional and customary rights to the resource; and ability and willingness to conserve the resource.

Social differences: Social differentiation is common in almost all communities and different sections (including men and women). This is more specific of site I. In case of site II although they are a homogenous group of primary stakeholders among them too differences persist. It is necessary to integrate gender justice into all social programmes and particularly in PFM activities where a large population of the disadvantaged is the beneficiary.

Tenure rights: Absence of tenure translates itself to lack of any stake in conservation and lack of the authority to exclude outsiders from exploiting it. This is a major issue, and even now the understanding will remain tentative if the Forest Department does not share responsibility with the primary stakeholders over the relevant forestland.

Forest-related conflicts: Conflicts identified (specifically site I) are basically, for land, for produce / resource, and for political dominance. This sort of a conflict atmosphere relate mainly to the approach of not involving primary stakeholders and others who care about the landscape in the planning, management and decision-making, and the social and economic dependencies of the local communities (Anitha and Muraleedharan 2002), that conflict with the objectives of the forest conservation.

Erosion of local indigenous knowledge (LIK)*:* The knowledge and practices of primary stakeholders have been largely ignored. However, of late, acknowledgement is made to understand and incorporate the same through the participatory processes. It is necessary to understand that this (LIK) is deep-rooted within the community's social cultural and political environment. It is thus, necessary to build conservation strategies keeping LIK in mind, which alone would have far reaching results.

Costs and benefits: One of the vital aspects of participation is that the benefits gained from conserving a resource go directly to the primary stakeholders, thus, creating a vital link between local populations and local benefits. In most cases, the benefits derived from conservation (eg.

intangible benefits) are not immediately evident. Under such circumstances it is very difficult to convince the community that conservation is necessary, essential and beneficial. In addition, there are also several kinds of costs incurred by communities as a result of their conservation efforts, labour, money etc. put into landscape protection, foregone current use (opportunity costs). Health impacts of temporary reduced access to resources, social impacts of exclusion, increased conflicts within and outside community, man-wildlife conflicts are all indirect costs, whilst primary stakeholders incur these costs, others enjoy the benefits.

***Institutional arrangements*:** Unclear institutional arrangements end up confusing the resource-dependent primary stakeholders. There is a range of institutions involved in conservation and it's generally the top-down approach. They lack co-ordination within and between agencies and also fail to gather support from primary stakeholders who are often marginalised. A clear delineation of the responsibilities and accountability is severely lacking in the management of the same resource.

Political and economic environment: The political and economic environment is non-conducive to participatory management especially so in Site I. Though policy shifts have taken place, the overall economic thrust is on natural resources as raw materials for the market economy. Research has shown that people's participation is vital in sustainable resource management (Palik 1993, Poffenberger 1990, Colfer 1995), the policies have so far been against involving people. A part of this overall economic scenario is the declining availability of livelihood and employment opportunities in rural areas. Participation under such circumstance is not an easy process.

Need of the hour

a. *Workable site specific PFM design* : The focus should be on coming up with a workable economically feasible and socially acceptable location specific design of PFM. As far as site I is concerned, it would be appropriate to continue the regular forestry activities and in site II, an NWFP-based PFM programme should be undertaken, considering the dependency of the primary stakeholders on the natural resources for survival.
b. *Integrating research into the participatory process*: The participatory process has made a beginning for a change from the target-oriented forestry to the process-approach. The paradigm shift in favour of the bottom-up approach enables better transparency, accountability and empowerment of the primary stakeholders. Research can qualitatively improve the PFM programme and it needs to be integrated into the process.

c. *Conflict management needs to be built into the institutional setup*: Given that a conflict cannot operate outside social context, it is necessary to adopt a management strategy where along with the conservation objectives; sustainable livelihood issues are also addressed. Thus, there is a significant need to make conflict management an integral part of the participatory process whereby the conflicts can be understood in a better perspective.

Management option

It is desirable that the primary stakeholders in a democratic system play an active role in the management of national resources. However, an important pre-condition is the primary stakeholders understand the constitutional and national policy requirements along with their

needs. If awareness levels are and concerns for long-term requirements of ecosystems are low, their participation management may not be fruitful. Participatory management models so far tried in several parts of the State are still in an experimental stage and their wide acceptability is doubtful. Under such circumstances, proposals for PFM would lead to unrealistic expectations amongst primary stakeholders. Participation by primary stakeholders should be introduced in a slow and gradual manner. On the other hand, the issues of the genuine needs of the people should also be addressed before it takes the shape of discontentment.

In the foregone socioeconomic assessment and the contentious issues facing PFM in the respective sites, it is evident that any management and rehabilitation strategy/ programme of degraded forests should focus to sustain the basic structure and functions of ecological systems and at the same time cater to the basic needs of the people. In this context, strategies to be adopted for forest management and rehabilitation (degraded forests) should be ecologically and socio-economically sound. Only when the needs of the local community coincides with the preservation need, can forests be effectively protected.

In other words, it is essential to adopt an integrated landscape-livelihood approach (Anitha and Muraleedharan, 2002) to the rehabilitation process. As stated earlier, in a landscape there are several elements like the forests, degraded forest, plantations, village ecosystems, human activity, etc., which have inter-linkages and interactions within and also with those across the landscape. A change in any landscape is inevitable. Changes due to climatic factors are slow and beyond the control of local managers. However, changes due to management decisions and human interactions are quicker and there is a need to manage such changes in a way that does not compromise the long-term sustainability of the resource base and the options available. A sustainable livelihood approach is removing constraints and exploiting opportunities to realize positive livelihood outcomes at the community level.

The theoretical framework of landscape analysis helps to understand and monitor the changes for bringing about sustainable management. The prime focus of landscape analysis is the interactions between the different landscape elements. The nature of the impacts during the interactions, their contributions to change in land, vegetation and water quality are to be assessed. The human element is not a homogeneous component. There is a lot of diversity within the human element. Naturally the needs of different stakeholders vary, so do their resource endowments. An agricultural community outside the forest will have a set of priorities much different from a tribal community. An increase in pressure/dependence on natural resources should be equated with necessary and equivalent changes in formal planning. Such an integrated approach will encompass all the landscape elements. Thus, if sustainable forest resource management is the goal to achieve through the participatory mode, it should consider the basic needs and aspirations of the primary stakeholders and simultaneously deal in an appropriate and timely basis with all sorts of conflicting situations created by large number of users of the natural capital. Rehabilitation of forests have to be approached from landscape perspective, given due consideration to the ecological and social components. All rehabilitation programmes need not be participatory programmes. In some location such as Site I, conventional forestry activities are more efficient and simpler. When stakeholders with high dependence on forests are available (site II), a participatory approach can be very promising.